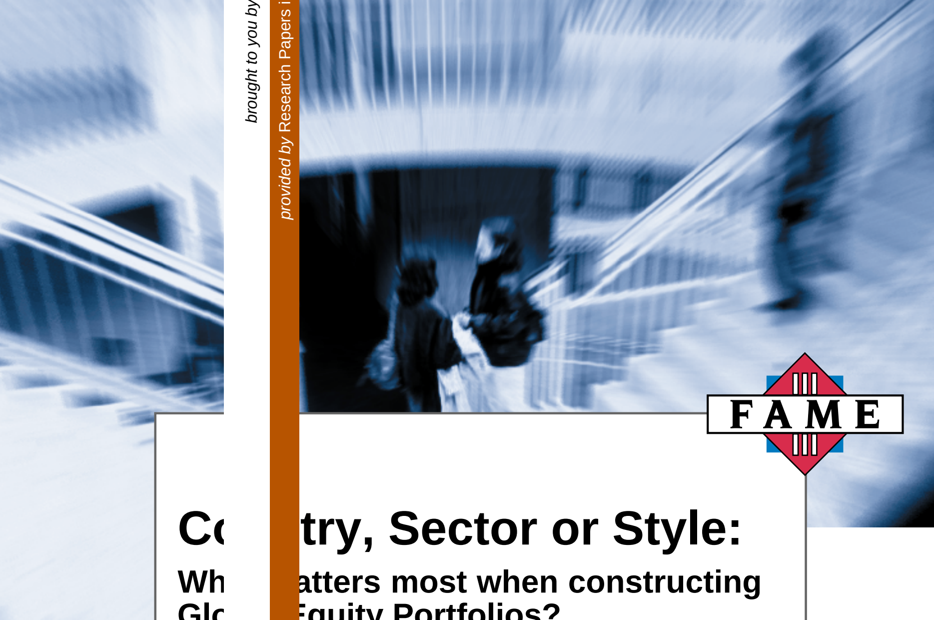


FAME

Co try, Sector or Style:

Wh atters most when constructing Glo Equity Portfolios?

An ical investigation from 1990-2001

Foo MELINK
Lomb r & Cie and Vrije Universiteit

Hél HARASTY
Lomb er & Cie

Pie ILLION
Insea pore) and Academic Advisor
to Lo dier & Cie

Resea r N° 35
Octob

FAME - al Center for Financial Asset Management and Engineering

INTERNATIONAL CENTER FOR
FINANCIAL ASSET MANAGEMENT AND ENGINEERING

RESEARCH PAPER SERIES

The International Center for Financial Asset Management and Engineering (FAME) is a private foundation created in 1996 at the initiative of 21 leading partners of the finance and technology community together with three Universities of the Lake Geneva Region (Universities of Geneva, University of Lausanne and the Graduate Institute of International Studies).

Fame is about *research*, *doctoral training*, and *executive education* with "interfacing" activities such as the FAME lectures, the Research Day/Annual Meeting, and the Research Paper Series.

The *FAME Research Paper Series* includes three types of contributions:

- First, it reports on the research carried out at FAME by students and research fellows.
- Second, it includes research work contributed by Swiss academics and practitioners interested in a wider dissemination of their ideas, in practitioners' circles in particular.
- Finally, prominent international contributions of particular interest to our constituency are included as well on a regular basis.

FAME will strive to promote the research work in finance carried out in the three partner Universities. These papers are distributed with a 'double' identification: the FAME logo and the logo of the corresponding partner institution. With this policy, we want to underline the vital lifeline existing between FAME and the Universities, while simultaneously fostering a wider recognition of the strength of the academic community supporting FAME and enriching the Lemanic region.

Each contribution is preceded by an Executive Summary of two to three pages explaining in non-technical terms the question asked, discussing its relevance and outlining the answer provided. We hope the series will be followed attentively by all academics and practitioners interested in the fields covered by our name.

I am delighted to serve as coordinator of the FAME Research Paper Series. Please contact me if you are interested in submitting a paper or for all suggestions concerning this matter.

Sincerely,

Prof. Martin Hoesli
University of Geneva, HEC
40 bd du Pont d'Arve
1211 Genève 4
Tel: +41 (022) 705 8122
Martin.Hoesli@hec.unige.ch

COUNTRY, SECTOR OR STYLE:
What matters most when constructing Global Equity Portfolios?
An empirical investigation from 1990-2001.

Foort HAMELINK
Hélène HARASTY
Pierre HILLION

October 2001

Country, Sector or Style: What matters most when constructing Global Equity Portfolios?

An empirical investigation from 1990-2001

Foort Hamelink [*], Hélène Harasty [†] and Pierre Hillion [‡]

Abstract

Equity returns are believed to be strongly influenced by country, sector and style effects. A key issue is to be able to disentangle those various effects from one another. In particular, differences between country returns may simply reflect differences in the sector composition of country markets, which makes it clearly difficult to disassociate both effects. Similarly, from 1999-2001 the relative performance of Growth versus Value might be solely due to the striking performance of the Technology and Telecommunication sectors. For global equity portfolio managers, it is crucial to identify which factors offer the highest diversification benefits and return potential. We apply a multi-factor approach to estimate "pure" country, sector and style factor returns. Using data going back to 1990, we identify the major changes that have occurred in developed markets until 2001. Our various indicators clearly point out the growing influence of sector factors. However, country effects remain important and there is no clear-cut evidence that sector factors dominate country factors. Style factors such as Growth, Value and Size also remain significant, even once sector and country effects are deduced. Finally, we show that momentum strategies based on sector returns offer substantial gains, while momentum strategies based on country returns do not. These findings suggest that, while diversification and return benefits from sector strategies have become substantial, managers should continue to monitor carefully country as well as style rewards and risks.

[*]Quantitative Analyst, Lombard Odier & Cie, Geneva, Switzerland, and Associate Professor of Finance, Vrije Universiteit, Department of Finance, Amsterdam, The Netherlands.

[†]Head of Quantitative Research, Lombard Odier & Cie, Geneva, Switzerland.

[‡]Professor of Finance, Insead, and Academic Advisor to Lombard Odier & Cie, Geneva, Switzerland.
The current research will be presented at the Inquire Europe conference on "Investment Styles and Multifactor Models" to be held in Sintra, Portugal, October 28-30, 2001.

The authors thank Diana Bösenbacher and Ariane Bender for helpful research assistance. They also thank Jeroen Jansen and the participants in the Lombard Odier Investment Conference for their useful comments. They are especially grateful to Anne-Valère Amo for her important contribution to this research.

Executive Summary

Evidence of ever-integrating financial markets has led many financial institutions to reconsider their investment process. From fundamental analysis to portfolio construction and management, a clear shift is occurring from country-based to sector-based approaches. Simultaneously, style issues recently raised a large amount of interest, due to the huge divergences between style performances from the late 90's to mid-2001. This topic, which has been a US-only debate since long, is now also under scrutiny among European portfolio managers. Hence, the debate on the portfolio construction process is the following: what matters most, countries, sectors or style? This paper answers this question.

We find that sector effects have become dominant, whatever the manner in which they are identified. However, this is a recent phenomenon, since countries have been more important than sectors for long. The behavior of the technology and the telecommunication sectors only partially explains this trend. Sector effects can therefore be expected to remain at least as important as country effects, even when market volatility returns to lower levels.

However, country effects remain very important, as do Style factors: Value / Growth and Size (expressed through the market capitalisation). It is therefore crucial to take these four categories of factors into account when constructing internationally diversified portfolios. It is important to measure the portfolio exposure to Country and Style, even when the portfolio is constructed along active sector bets. An unwanted under- or over-exposure to one of these factors adds additional and unnecessary risk to the portfolio. In addition, a well-diversified portfolio in terms of sectors may not be diversified in terms of countries or Style factors.

The study is based on five main indicators:

- The identification of pure factors is a key indicator: returns on country (or sector) factors are adjusted to the differences in the sector (or country) and Style composition of country markets. For instance, the pure Swiss factor is adjusted to the fact that a high concentration of financial and pharmaceutical companies influences the returns on the Swiss market heavily. We find that high returns on pure factors are related to large sectors and small countries. In addition, we identify a predominant Growth factor through significant returns, even when the effects of typical Growth sectors (such as TMT) are deduced.

- The statistical significance of the factors, which indicates the homogeneity of the asset class, answers the questions: are sectors more homogeneous than countries? are the behavior of pharmaceutical companies more homogeneous than Swiss stocks? Our results show that sectors have gained in homogeneity in time, while countries have lost some. Growth and Value stocks are also homogeneous, as well as large capitalisation stocks.

- The correlations between the factors, and therefore the potential diversification benefits are key devices as well. We find that correlation between countries tends to increase slightly, while the correlation between sectors is decreasing strongly. Therefore, sector diversification benefits appear more important than country. It should be noted that the increase in country correlations is mainly due to Euro zone countries. Furthermore, our study is solely based on developed countries, and therefore does not take into account the potential strong diversification benefits from emerging markets.

- The potential achievable returns on country and sector strategies is one of the main indicators in our study. We show that a manager, who forecasts future returns on the factors perfectly, achieves much higher returns through sector allocations than country allocations.

- Finally, as we all know how difficult it is to forecast future returns, we evaluate the performance of simple momentum strategies applied to pure country and sector factors. The results of buying (or over-weighting) countries or sectors in an upward trend and selling (or under-weighting) the others, show that momentum strategies based on sector factors, are very rewarding, while they are not for country factors. The out-performance of active sector allocation based on momentum is 4% on average over the past 10 years, while no conclusive result is achieved based on active country allocation.

1 Introduction

Evidence of ever-integrating financial markets has led many financial institutions to reconsider their investment process. From fundamental analysis to portfolio construction and management, a clear shift is occurring from country-based to sector-based approaches. Simultaneously, style issues recently raised a large amount of interest, due to the huge divergences between style performances from the late 90's to mid-2001. This topic, which has been a US-only debate since long, is now also under scrutiny among European portfolio managers. Hence, the debate on the portfolio construction process is the following: what matters most, countries, sectors or style? This paper answers this question.

Actually, it has become increasingly difficult to disentangle country, sector and style effects. Clearly, the strengthening of sector effects is related to the market euphoria engendered by the New Economy. The dramatic and persistent outperformance of the Technology and Telecommunication sectors until March 2000, and the ensuing reversal of fortunes have obviously played a major role in the increase of sector effects. Some consider that differences between country index returns are nowadays mainly driven by differences in their industrial composition. If this is the case, investors should definitely consider abandoning cross-country diversification strategies in favor of cross-industry. This may be particularly true in areas like the Euro-zone, where the adoption of a single currency has eliminated the proportion of return differential that was purely due to exchange rate variations. Hence, a major source of geographical diversification benefits has been erased.

The recent years have also been characterized by a resurgence of exceptionally strong style effects compared to historical standards. The Growth style has outperformed the Value style in the late 90's until March 2000 and then has strongly underperformed it until mid-2001. The shapes of the relative performances of Growth versus Value and the Technology and Telecommunication sectors versus the other sectors are strikingly similar, with a reversal occurring simultaneously in March 2000. Of course, the Technology and Telecommunication sectors are typically "Growth" sectors, showing superior earnings growth expectations and expensive valuations. Hence, the recent period has been characterized by increasing correspondence between style and sector effects, with growth stocks being more and more concentrated in some sectors, or, in other words, each sector becoming gradually more homogenous in terms of style.

For the portfolio manager several issues arise. First, what drives stock returns? Is Novartis primarily a Swiss stock, a pharmaceutical stock, or a growth stock? Have sector effects surpassed country effects? How much style effect is left, once sector effects have been deduced? Second, what is the optimal diversification strategy? Do strategies allocating across sectors offer higher diversification benefits than those allocating across countries? Should investors also diversify across styles, or is style risk already diversified, thus eliminated, once sector risk is?

In order to shed light on these issues, we apply a multi-factor approach and derive several indicators of the relative importance of the country, sector and style effects. A multi-factor model allows us to identify country, sector and style factors driving stock returns. Using data going back to 1990, we are able to capture the major changes that have occurred in developed markets until 2001. We use returns on individual stocks rather than indices, and develop alternative measures of the differences and similarities between country, sector and style factors. In particular, we assign a Value and a Growth attribute to each stock in the universe on the basis of a set of variables that are more likely to reflect the actual styles followed by portfolio managers than the traditional Price-to-Book criteria. We analyze "pure" country, sector and style returns, comparing them over time on the basis of their magnitude and statistical significance. Finally, we compare the profit on momentum strategies based on country and sector factors.

The paper is organized as follows. In Section 2, we introduce the factor estimation methodology, and discuss the data and the selection of factors. In Section 3, we present the main results. Section 4 concludes.

2 The Model and the Factors

2.1 Methodology

2.1.1 The Model

An important methodological issue is to disentangle country factors from sector factors and from style factors. It is crucial to separate these various influences and eliminate the interaction between them. This goal is clearly not reached when country indices are used as proxies for country factors, industry indices for industry factors and style indices for style factors. For instance, if the industrial composition differs across countries, then country indices contain industry effects and industry indices, country effects. The same is true between country and style effects, or between sector and style effects.

To illustrate this point we may take the following example. Returns on a Swiss index may differ from returns on a world index for two reasons. First, returns may differ because the industrial composition of the Swiss index is different from the industrial composition of the world index. On average, if Healthcare stocks outperform the world index and Energy stocks underperform it, the overall effect will be positive for Switzerland because this country index has proportionally more Healthcare and less Energy stocks than the broad index. Second, returns on the Swiss index and the world index may differ because returns on Swiss companies are different from returns on companies belonging to the same industry group but located in a different country.

That is why we apply a multi-factor approach to individual stocks. Country, industry and style effects can be more easily separated by using individual stocks rather than indices, and by estimating simultaneously "pure" factor returns through a regression technique. With this methodology, the Switzerland effect can be interpreted as the outperformance of an industrially diversified Swiss portfolio relative to the world index. By "industrially diversified", we mean that the Swiss portfolio has the same industry composition as the world index. Similarly, the Healthcare effect is the outperformance of a geographically diversified Healthcare portfolio relative to the world index.

In very general terms, multi-factor models specify the return on asset i at time t as the sum of the product of K factor returns and "factor loadings" (equivalently called beta coefficients). The factor loadings are known in advance (the stock market capitalisation, the country or sector belonging of a stock, etc.). The methodology seeks to estimate the returns on these factors. In this study, we examine country and sector factors, as well as the Value, Growth and Size factors.

The model, which is fully described in the Appendix, is specified as follows:

$$R_{i,t} = F_t + \sum_{k=1}^{N^C} D_i^{C_k} F_t^{C_k} + \sum_{k=1}^{N^S} D_i^{S_k} F_t^{S_k} + p_{i,t}^G F_t^G + p_{i,t}^V F_t^V + SZ_{i,t} F_t^{SZ} + \varepsilon_{i,t}, \qquad (1)$$

where $R_{i,t}$ is the return on stock i at time t. N^C and N^S are the number of country and sector factors respectively. $D_i^{C_k}$ ($D_i^{S_k}$) is a dummy variable, set to one if stock i belongs to Country (Sector) k, with $k = 1, \ldots, N^C(N^S)$. $p_{i,t}^G$ and $p_{i,t}^V$ are Salomon Smith Barney's (SSB) Growth and Value probability weights of stock i at time t (see section 2.2.4 for a detailed description of their construction). $SZ_{i,t}$ is the Size exposure of stock i at time t. In the above equation, the unknowns are F_t (the return on the Common factor, which is equivalent to the weighted average of all stock returns), $F_t^{C_k}$ (the returns on the country factors), $F_t^{S_k}$ (the returns on the sector factors), F_t^G and F_t^G (the returns on the Growth and the Value factors), and F_t^{SZ} (the return on the Size factor). Finally, $\varepsilon_{i,t}$ is the stock-specific return, which means the return on stock i at time t regardless of its country, sector or style attribution.

In order to estimate the above model and ensure that a world portfolio has zero exposure to each factor, we need to impose some additional restrictions on the parameters. They are fully described in the Appendix and may be summarized in the following way: the weighted average of the returns of each factor category (countries, sectors, Value/Growth and Size) should equal zero. With these constraints, a portfolio replicating a world index has zero exposure to each factor. Hence, by construction, the Common factor equals the world index return. The substitution of the constraints in equation (1) allows us to work on an unconstrained regression. It may occur that only very few stocks are found in a given country or sector. In order to obtain country and sector factors that are representative of a substantial group of stocks, we decide to remove country or sector dummies when the set comprises less than five stocks. In this case, the corresponding stock returns only contribute to the estimation of the Common factor.

2.1.2 Correlation issues

In the selection of the *a priori* factors to be considered in the model, it is important to choose carefully the correlation structure on the risk factors. Two main approaches can be found in the literature, and this is also how commercial risk models differentiate.

The first approach is to estimate the factor returns in stages. At each stage, the returns on one factor category are estimated using regression residuals of the previous stage. For example, we may begin calculating the Common factor. The error terms of this first regression could then be used to estimate the country factor returns. The error terms of this second regression could then be used to estimate the sector factor returns, etc.

$$(1)\ R_{i,t} = F_t + \varepsilon^1_{i,t}, \quad (2)\ \varepsilon^1_{i,t} = \sum_{k=1}^{N^C} D_i^{C_k} F_t^{C_k} + \varepsilon^2_{i,t}, \quad (3)\ \varepsilon^2_{i,t} = \sum_{k=1}^{N^S} D_i^{S_k} F_t^{S_k} + \varepsilon^3_{i,t}, \quad \ldots$$

The advantage of this approach is that we set zero-correlations between factor categories. However, the main drawback, which is the reason why we have not adopted this methodology, is the lack of economic foundation to justify in which order the various factors should be estimated. For instance, why should country factors be estimated before sector factors? In the case of strongly correlated factors, such as Technology and Growth, the factor returns obtained from the regressions may significantly differ. For example, if sector factors are estimated first, and the Growth factor second, the latter should be weaker than if it were estimated first. Unless there is a good reason for estimating a particular factor prior to another, it is less arbitrary to consider all factors at the same level of importance.

This brings us to introduce the second approach, which is used in this paper. The idea is to estimate all factor returns at once, leading to a large variance-covariance matrix of factors for which there is no reason to find off-diagonal elements equal to zero. In particular, we expect strong correlations between the Growth factor and factors such as Technology or Telecommunications.

2.1.3 Weighting schemes of the cross-sectional regressions

The cross-sectional regressions may be run to get the factor returns by using either a value-weighted OLS regression method or an equal-weighted OLS. The two approaches are found in the literature and we believe that a preference for one or another depends on the practical use. On one hand, analysis based on value-weighted regressions is probably more accurate for a portfolio manager aiming at a low tracking error against a capitalisation-weighted benchmark. This portfolio manager will indeed have factor bets through large capitalisation stocks, in order to keep his tracking error under control. On the other hand, a portfolio manager whose strategy is to invest in a limited number of stocks without being concerned by their capitalisation, should focus on the equal-weighted model. Such a manager will actually bet on factors through his stocks of strong conviction whatever their benchmark weights. Consequently, his tracking error is likely to be substantial. In this study, we primarily focus on the value-weighted (VW) regression technique for the unhedged sample, but we present some results for the equal-weighted (EW) regressions and the hedged sample for comparative purposes.

2.2 The Factors

2.2.1 Data

In this study, we focus on the constituents of the SSB World Primary Market Index (PMI). We choose this index rather than the MSCI World Index, for several reasons. To begin with, the SSB data is available back to 1990, while no compiled data is available in agreement with MSCI's new industry classification before 1995. Furthermore, an *ex post* reclassification according to a new classification system may induce an additional bias. The other reason the SSB data is preferred, is the availability of the unique SSB Value/Growth classification on a historical basis (for details see section 2.2.4). However, we believe our global results should be little affected by the choice of one world index rather than another.[1]

The SSB World PMI is a sub-index of the SSB World Broad Market Index (BMI), which consists of 23 developed market country indices. Each BMI country index comprises companies with an investable market capitalisation (defined as a float-adjusted market capitalisation) greater than USD 100 million. For each country, the largest companies are assigned to the PMI until 80% of the BMI investable market value is reached. It is thus composed of medium to large capitalisations. As of August 30, 2001, the World PMI included 1036 stocks.

It is important to avoid a survival bias and estimate historical returns on factors using the historical composition of the universe rather than the current one. We collect price data as of month t for all the stocks that were in the universe at month $t-1$. The data consists of the price level at the end of month t and at end of month $t-1$. The prices are in local currency and in US dollars. Two series of returns are derived, one characterizing an investor who hedges his foreign investment, not the other who therefore risks an unexpected currency movement. We refer to these two series of returns as the "Hedged" and "Unhedged" samples. Unhedged returns are defined as $ln[P^{\$}_{i,t}/P^{\$}_{i,t-1}]$, where $P^{\$}_{i,t}$ is the adjusted price of stock i in US dollars at time t. Hedged returns are obtained from local prices together with the interest rate differential. Denoting r^* the short-term (3-month) interest rate of the foreign country, and r the domestic or reference (here, the US) short term rate, the hedged returns may be expressed as: $ln[P^{Loc}_{i,t}/P^{Loc}_{i,t-1}] + ln[(1+r)/(1+r^*)]$, where $P^{Loc}_{i,t}$ is the adjusted price of stock i in local currency at time t. It should be noted that the methodology described above does not constitute a "perfect hedge", as between $t-1$ and t the stock price may have moved in such a way that the forward sale of foreign currency is either insufficient (if the price has increased) or too important (the price has gone down and the proceeds from the sale of the stock are insufficient to buy a predetermined amount of reference currency). However, we choose this hedging approach because it corresponds to what is feasible to a typical portfolio manager.

It is clear that in the case of unhedged returns, currency movements will affect the country factors. However, looking at unhedged returns may be more relevant, owing to the many portfolio managers who do not hedge for whatever reasons (the cost of hedging, the believed mean-reverting pattern of currencies, the natural hedge provided by multinationals and other large firms, etc.). It should be emphasized that this is incorrect from a theoretical point of view (see Solnik, 1974, for instance), because additional risk is added to the portfolio without any corresponding risk premium.[2]

[1] Estimations performed on the FTSE Multinationals index produce very similar results, which are available from the authors upon request.

[2] This is true unconditionally but not conditionally. Conditionally, there is evidence that foreign exchange rate risk is time-varying and priced, suggesting that investors are rewarded for this risk (see for instance De Santis *et al.*, 1999).

2.2.2 Country and Sector Factors

For each stock, we also collect data related to the domicile country, as well as to its sector. This again is done each month based on the stock belonging to the universe as of the previous month. Although we do not expect many firms to change country or sector over time very often, this careful data checking procedure should eliminate any potential survival bias.

2.2.3 Size Factor

Given the large literature documenting the various effects of the Size factor, we also construct a size indicator. Different approaches have been taken previously (Fama and MacBeth, 1973, took the logarithm of the market capitalisation, other research calculated the exposure to the returns on the $x\%$ largest stocks minus the returns on the $x\%$ smallest stocks, etc.). We are taking here a slightly different approach. As shown in detail in the Appendix, the Size exposure of each stock is obtained from the transformation of its index weighting in such a way that, at each period: a) the index has a zero exposure to the Size factor, and b) the largest constituent has an exposure of 1. The latter restriction ensures an economic interpretation of the magnitude of the Size factor.[3]

2.2.4 Value/Growth Factor

An important issue is the assignment of a given stock to either the "Value" or the "Growth" category. Since the seminal study of Fama and French (1992), a Value stock is often defined as a stock the issuing firm of which has a large Book-to-Price (B/P). Fama and French found that, for the US market, the stocks belonging to the deciles characterized by the lowest and the highest Book Value to Market Value (BV/MV) had respectively an average annualized return of 5.8% and 22.4%. They concluded that the market tends to reward the BV/MV ratio, such that the equilibrium expected returns increase when the ratio increases. This finding has had a huge impact on equity style investing. Although this outcome initially only defined the Value style, it has led to the wide acceptance that high Book-to-Price stocks are Value stocks and that low Book-to-Price stocks are Growth stocks.

Several index providers have developed a Value/Growth classification based on this single measure (S&P/Barra for the US, MSCI for international or country style indices). The lowest Book-to-Price stocks are considered as Growth stocks, and the highest, as Value stocks. MSCI, for instance, ranks the constituents of each country standard index by the latest reported B/P, and then splits the universe in two groupings. The stocks with the smallest B/P are assigned to the Growth index until one half of the total index market value is reached. The remaining stocks, characterized by a larger B/P, are then assigned to the Value index. These style indices are rebalanced twice a year to reflect any change in

[3]The Size effect is likely to be downward biased as our sample, the SSB PMI World Index, only includes medium to large capitalisation stocks.

the B/P structure. International Value/Growth indices are calculated using each country Value and Growth constituents.

Classifications based exclusively on the Book-to-Price attribute are little satisfactory, both from a theoretical and a practical point of view. First of all, Growth style is thought of as just the opposite of Value style, Value investing being defined as buying cheap stocks, and cheapness being measured by the Book-to-Price ratio. This implies that Growth managers are "buyers of expensive stocks", regardless of the true growth prospects of the issuing firm. The univariate Book-to-Price methodology fails to identify what Growth style really is, namely buying stocks of companies the earnings of which are growing faster than the average. Second, every stock is assumed to be either a pure Growth stock or a pure Value stock. Realistically, some stocks may be neither Growth nor Value (expensive without superior earnings growth). Other stocks may be a mixture of both styles (cheap stocks with superior earnings growth). Third, in the ranked universe, the last Value stocks have almost the same Book-to-Price as the first Growth stocks, but the former are considered pure Value stocks and the latter, pure Growth stocks. Finally, since firms belonging to the same industry tend to have similar book values, both Value and Growth indices incline to be composed of a few industries only.

A more satisfying way of defining style is to focus on the different criteria shared by investors following the same investment style. For instance, if investors consider that high Book-to-Price is the fundamental characteristic of a Value stock, then this ratio should be used to measure its "amount" of Value style. Similarly, if investors consider that high earnings per share (EPS) growth is the fundamental characteristic of a Growth stock, then this rate should be used to measure its "amount" of Growth style. With such an approach, Value and Growth styles are defined separately, thus allowing a stock to be pure Growth or Value, none of them, or a mixture. For the US market, the Frank Russell Style Indices, the Wilshire Associates Style Indices and the Prudential Securities Equity Style Indices are constructed on the basis of such a multivariate methodology. Global Style indices based on such an approach are only provided by SSB.

In this paper, we use the Growth and Value characterization developed by Salomon Smith Barney. The SSB methodology can be summarized as follows. First, variables defining and characterizing the two styles are identified. A set of 10 Growth variables that measure the company growth (for instance, the five-year historical Earnings per Share Growth) is chosen. Similarly, a set of 5 Value variables that measure the relationship between intrinsic and market value (for instance, the Earnings per share to Price per Share) is selected. These variables are standardized by region. Cluster analysis is then applied to determine which variables contribute effectively and significantly to the differentiation between Growth and non-Growth, or between Value and non-Value stocks. A total of 3 Growth and 4 Value variables have been retained. For each stock of a given SSB Country PMI Index, Growth and Value scores are derived from the level of these variables. Finally, Value and Growth probability weights are deduced from these scores and assigned to each stock. These probabilities are constructed in order to ensure that i) each SSB Country Style Index represents exactly 50% of the total float-adjusted market capitalisation of the corresponding SSB Country PMI Index, and, ii), for each stock, the sum of the Growth and Value probability weights equals one. These probability weights are revised once a year based on the information available, at the end of March, for company reported data, and at the end of May, for price data. They become effective on the 1^{st} July, and are then held constant during the subsequent year.

In our study, the SSB Growth and Value probability weights are the factor loadings labeled $p^G_{i,t}$ and $p^V_{i,t}$ in equation (1). As shown in the Appendix, it results from SSB methodology that, in our value-weighted model, "pure" Value returns are the exact opposite of "pure" Growth returns as estimated by our value-weighted regression technique. Hence, in the subsequent parts of the paper, we shall drop the "Value" label and focus exclusively on the Growth factor, keeping in mind the simple relation between both factors under the value-weighted scheme. However, the relation between the Growth and the Value factors is more complex in the case of an equal-weighted regression technique (see section 2.2.6 for a description of the different regression techniques).

3 Results

3.1 The pure factors

Returns on pure factors are shown as cumulated log-returns in Figures 1 to 7.

Figure 1 shows the cumulated log-returns on the Common Factor for the four different samples (hedged/unhedged, EW/VW). All return series are calculated from a US investor's viewpoint. The difference between the cumulated EW and VW returns is due to the outperformance of large stocks relative to small stocks since 1998. The difference between the cumulated hedged and unhedged returns is very small, which is not surprising as the US represent the largest capitalisation in the sample.

Figure 2 reports the cumulated returns on the Size (Panel A) and the Growth (Panel B) factors, both for the EW and the VW samples. It should be emphasized here that the returns are pure factor returns, net of all other factor returns. The figure shows how small the return on the pure Growth factor was prior to 1999, while the pure Size factor has revealed a steady positive trend from 1995 to 1999.[4] Since many large firms are Growth firms, the results may be misleading if Size is not disassociated from Growth. For instance, it is often claimed that Growth performed well in the second half of the 90's. We believe it was rather a Size effect until 1999. Another important outcome is that the strong Growth effect that emerged in 1999 is not only due to extraordinarily strong Sector effects concentrated in a few Growth-oriented sectors like Technology and Telecommunications.

[4] We also applied this methodology to a sub-sample composed of the European stocks making up the SSB World PMI index. One of the most striking differences is the behaviour of the pure Size factor in Europe, which followed a strong negative trend over the same 1990-2001 period. This result does not only contrast sharply with the Size pattern of the full SSB World PMI index (Figure 7), but it also belies the Size effect measured "conventionally". Indeed, the most common way to measure the Size effect is to simply plot the performance of large versus small capitalisation stocks, which tends to show the outperformance of Size. Our multi-factor decomposition reveals the "pure" performance contribution of each factor separately (Country, Sector, Size and Value/Growth), whereas the outperformance of a set of large capitalisation stocks might be only due to a specific Country, Sector or Value/Growth concentration. Hence, in the case of Europe, the outperformance of large over small European stocks is not due to their size but rather to their country, sector or Value/Growth composition.

Indeed, a strong Growth effect remains once sector effects are isolated.

In Figure 3, we represent the country factor returns of the G5. The shape of the cumulated returns on Japan is striking. While Figure 3 pertains to the unhedged VW sample, Figure 4 shows the Japan factor for the 4 different samples. The pattern of the two unhedged samples clearly shows the strong yen appreciation of 1998. It is a nice illustration of how different the results are, according to the weighting scheme (EW or VW) and the hedging assumption. In Figure 5, we show the results for several other major European countries and we find that differences between country factors are striking even within Europe.

Figure 6 represents the cumulated returns on sector factors. The returns on the Technology and Telecommunication sectors are clearly recognizable. It should be remembered that sector and Growth factors are estimated simultaneously. Hence, the correlation between sectors and Growth is not zero. In order to better understand the relation between highly correlated factors, we also show in Figure 7 three factors for which the *a priori* correlation is high: Telecommunications, Technology and Growth. These three factors show their peak in March 2000. The graph also indicates that prior to 1996 the correlation between them was far less important.

Figure 1: Cumulated log-returns on the Common factor for the various samples.

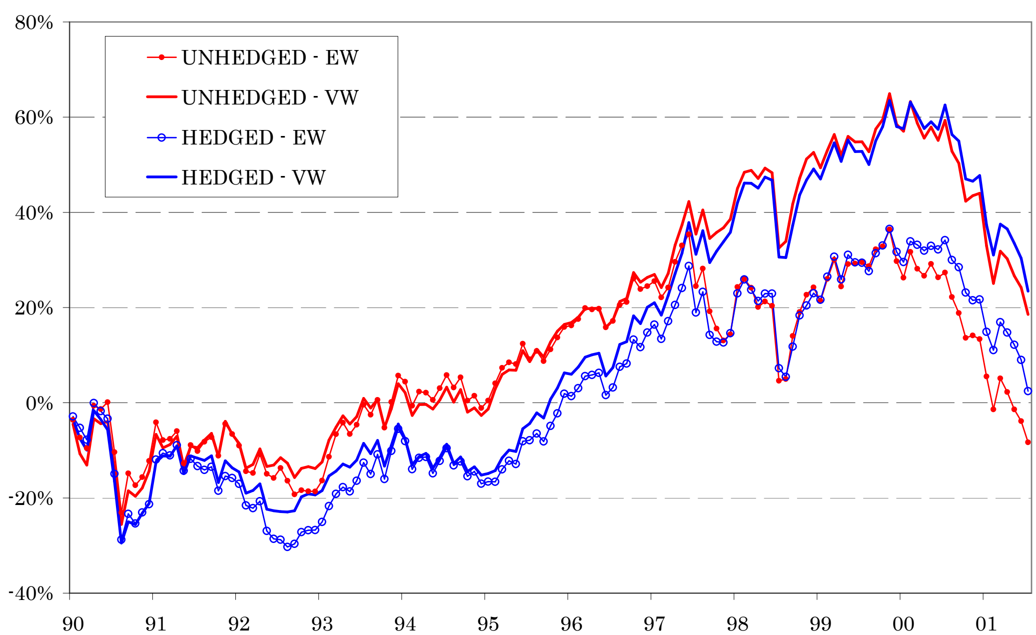
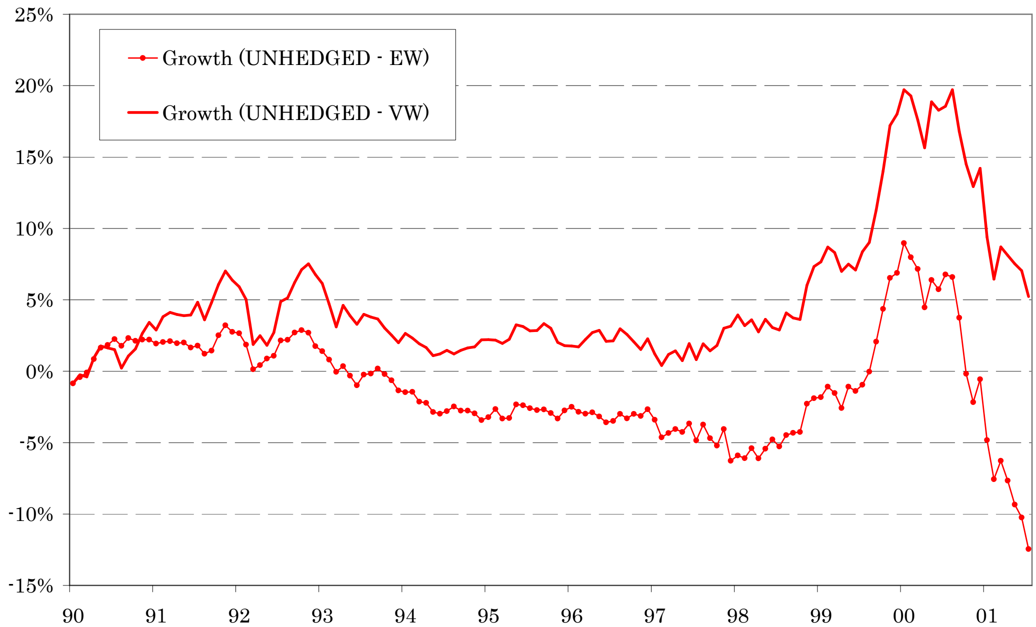


Figure 2: Cumulated log-returns on the Growth and the Size factors for the unhedged sample.

Panel A: Growth factor



Panel B: Size factor

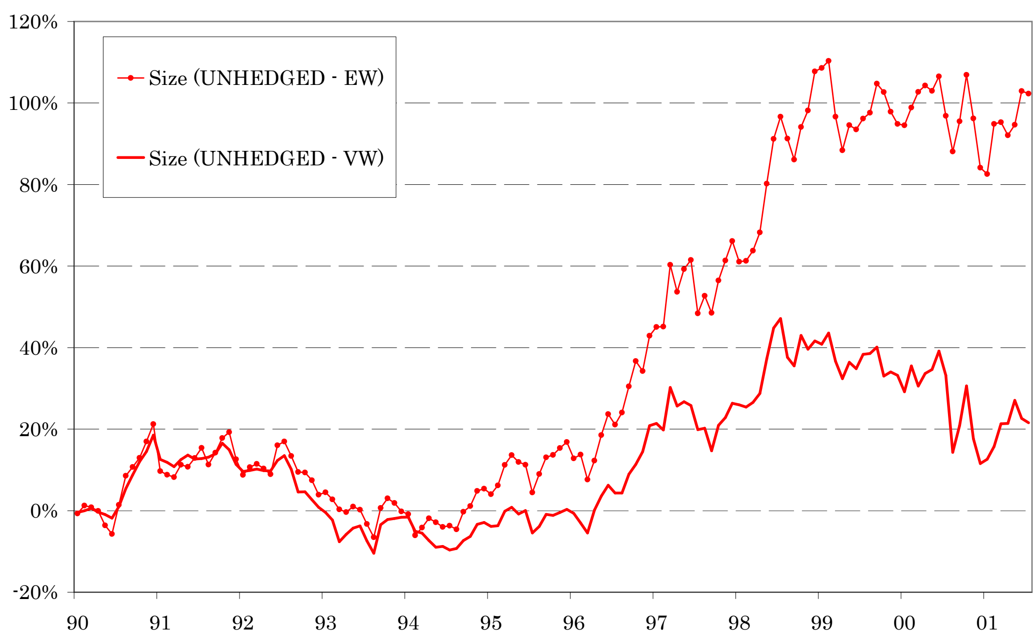


Figure 3: Cumulated log-returns on country factors for the G5 (Unhedged - VW sample).

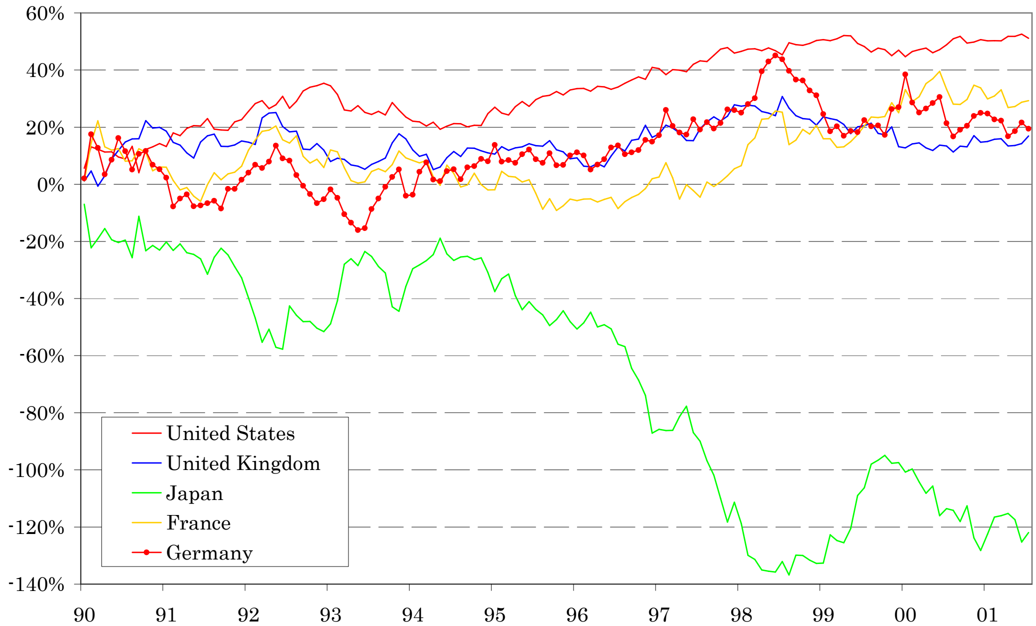


Figure 4: Cumulated log-returns on the Japan factor for the various samples.

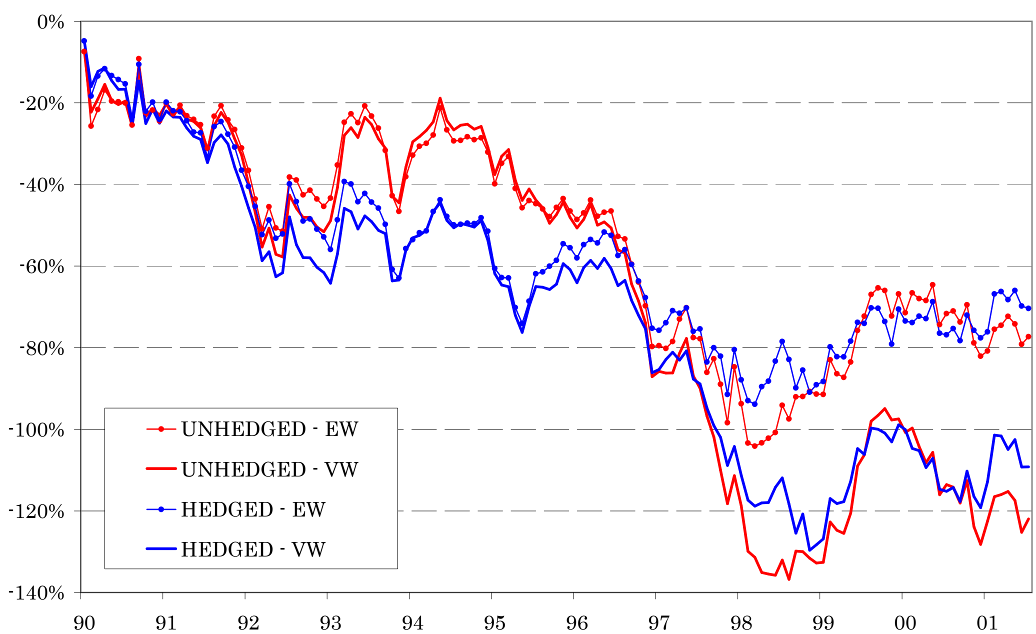


Figure 5: Cumulated log-returns on various European country factors (Unhedged - VW sample).

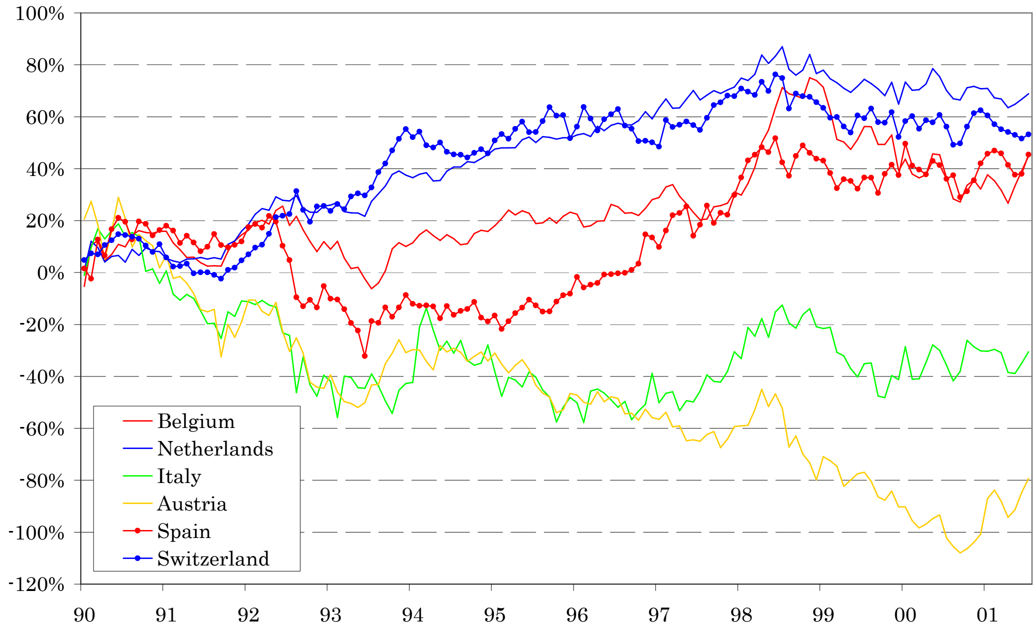


Figure 6: Cumulated log-returns on sector factors (Unhedged - VW sample).

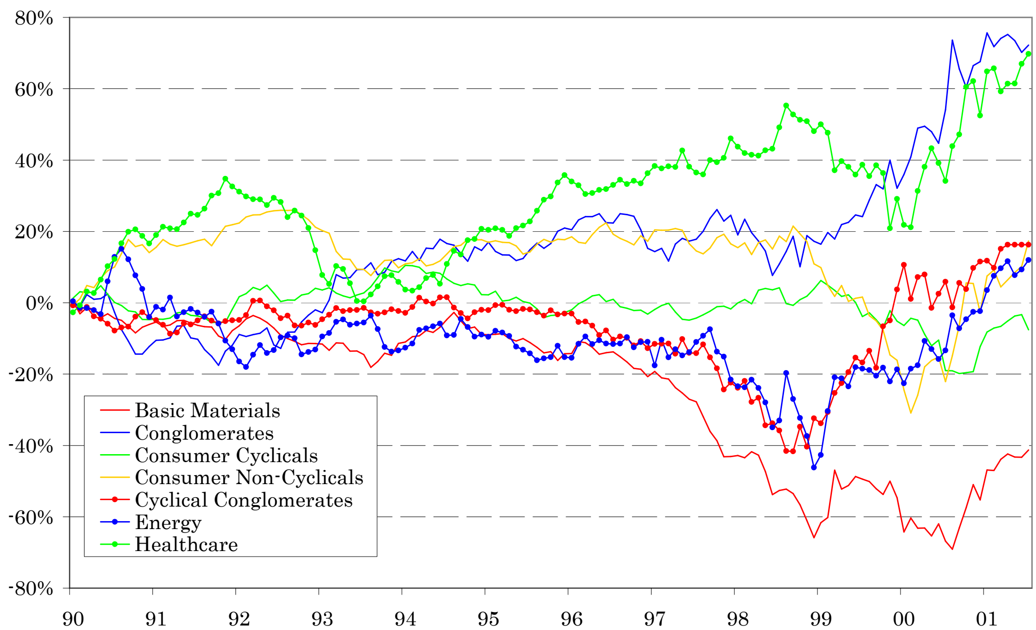


Figure 6 (continued):

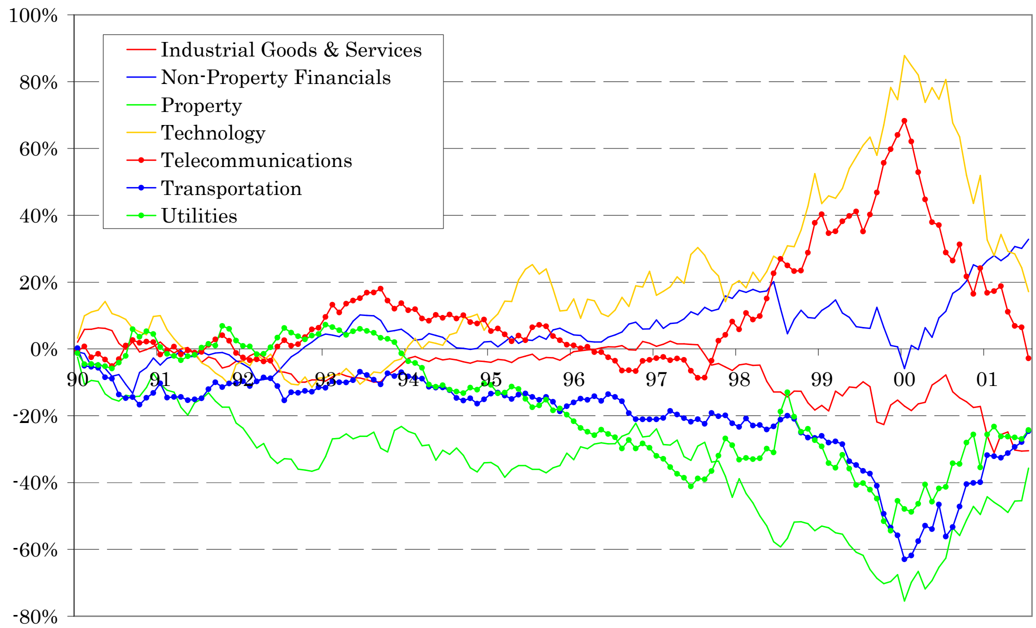
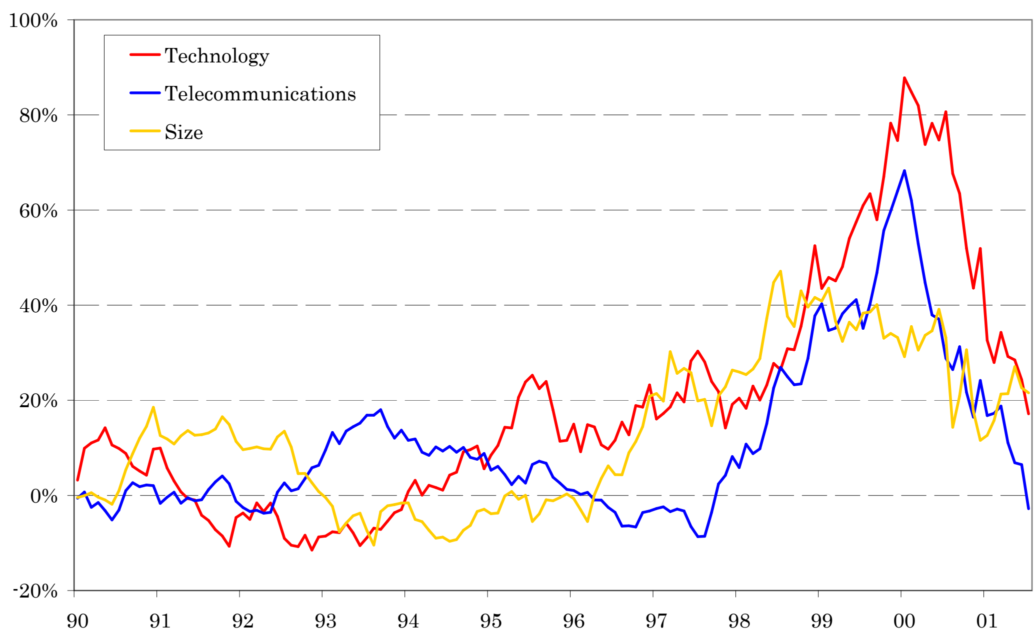


Figure 7: Cumulated log-returns on three highly correlated factors (Unhedged - VW sample).



3.2 Homogeneity of country, sector and style factors

It is also important to investigate the significance of each factor in the cross-sectional regressions. Two factors may have similar behaviors over time, while one is highly significant in each cross-sectional regression, and not the other. We maintain that the cross-sectional t-statistic is an indicator of the homogeneity of each factor. A high cross-sectional significance indicates a fairly good homogeneity of a given factor. For instance, if the Healthcare factor is constantly significant over time, while the Switzerland factor is not, we can infer that the behavior of Healthcare stocks is more homogenous than the Swiss stocks. We therefore calculate the factor t-statistics for each monthly cross-sectional regression, which are independent of the sign or the magnitude of factor returns.

We report in Table 1 the average t-statistic of each factor, and show if its average value over time is significantly larger than the critical value of 1.96. Several interesting results emerge from the table. The results are overall very similar for the hedged and the unhedged samples, even for the country factors. Large countries are generally significant, while small countries are not. Most sectors are highly significant for the VW samples (9 out of 14), but are less significant for the EW samples (5 out of 14). Size and Growth are highly significant for the VW samples and insignificant for the EW.

In order to visualize how factor significance evolves over time, we represent the 12-month moving average of the t-statistics in Figure 8. The top graph shows the results of the EW sample and the bottom, the VW, both based on unhedged returns. Here we discover several important differences between factor categories.

The significance of country factors has been falling since 1991, while the opposite has occurred (although to a lesser extent) for sector factors. This is true for both the equal-weighted and the value-weighted regressions. The average t-statistic of the Country factor was very high at the beginning of the 90's, well above the Sector factor. At the end of the decade, the Country factor was hardly significant (slightly below 2), while the significance of the Sector factor rose above 2.5. Hence, we can conclude that sectors clearly became more homogeneous than countries. The Growth factor was distinctly significant in the late 90's, but this is far from true for the whole decade. It seems that the behavior of Growth stocks lost homogeneity especially in the mid-90's. The Size factor has been significant since 1991 for the VW sample. For the EW sample, this factor was only marginally significant during 1997 (although Figure 2/Panel B shows that this factor is large in magnitude). In 2001, Size was only significant for the VW sample.

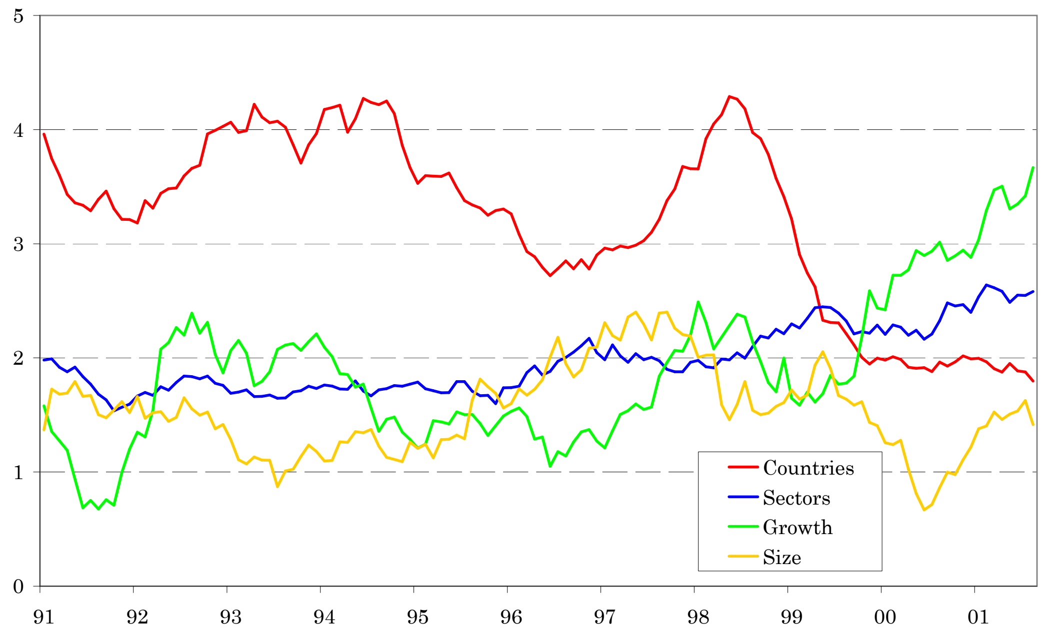
Table 1: Cross-sectional t-statistics of factor returns.

	Unhedged		Hedged	
	EW	VW	EW	VW
Common Factor	7.01**	18.39**	6.44**	17.52**
Japan	10.06**	11.29**	9.07**	9.83**
United States	6.82**	8.37**	5.93**	7.02**
Greece	6.18**	1.36	5.50**	1.18
Italy	4.46**	3.29**	4.07**	3.11**
United Kingdom	3.23**	4.26**	3.13**	4.25**
Hong Kong	3.23**	3.29**	3.21**	3.27**
Canada	3.15**	2.13*	2.67**	1.86
Singapore	3.03**	1.74	2.83**	1.63
France	2.93**	2.98**	2.94**	3.16**
Sweden	2.70**	2.11	2.55**	2.13*
Germany	2.47**	3.53**	2.37**	3.34**
Australia	2.44**	2.31**	2.06	1.84
Norway	2.37**	0.96	2.27**	0.88
Austria	2.22*	0.93	2.09	0.92
Belgium	2.11	1.23	1.93	1.16
Denmark	2.01	1.17	1.87	1.15
Spain	1.94	2.13*	1.76	1.95
Switzerland	1.66	2.77**	1.46	2.53**
New Zealand	1.48	0.76	1.31	0.70
Portugal	1.41	0.88	1.24	0.74
Netherlands	1.30	1.83	1.22	1.85
Ireland	1.06	0.80	1.01	0.81
Technology	3.72**	5.59**	3.73**	5.59**
Non-Property Financials	3.02**	4.77**	3.02**	4.77**
Energy	2.78**	3.80**	2.78**	3.80**
Utilities	2.46**	2.73**	2.46**	2.73**
Basic Materials	2.46**	2.56**	2.46**	2.56**
Consumer Non-Cyclicals	2.09	3.29**	2.10	3.30**
Healthcare	1.96	4.21**	1.96	4.21**
Telecommunications	1.93	2.48**	1.93	2.48**
Consumer Cyclicals	1.62	2.70**	1.62	2.70**
Industrial Goods & Services	1.67	1.79	1.67	1.79
Property	1.28	1.14	1.28	1.14
Transportation	1.23	1.26	1.23	1.26
Conglomerates	0.90	2.04	0.90	2.04
Cyclical Conglomerates	0.80	1.42	0.80	1.42
Growth	1.98	2.83**	1.98	2.83**
Size	1.50	2.97**	1.50	2.97**

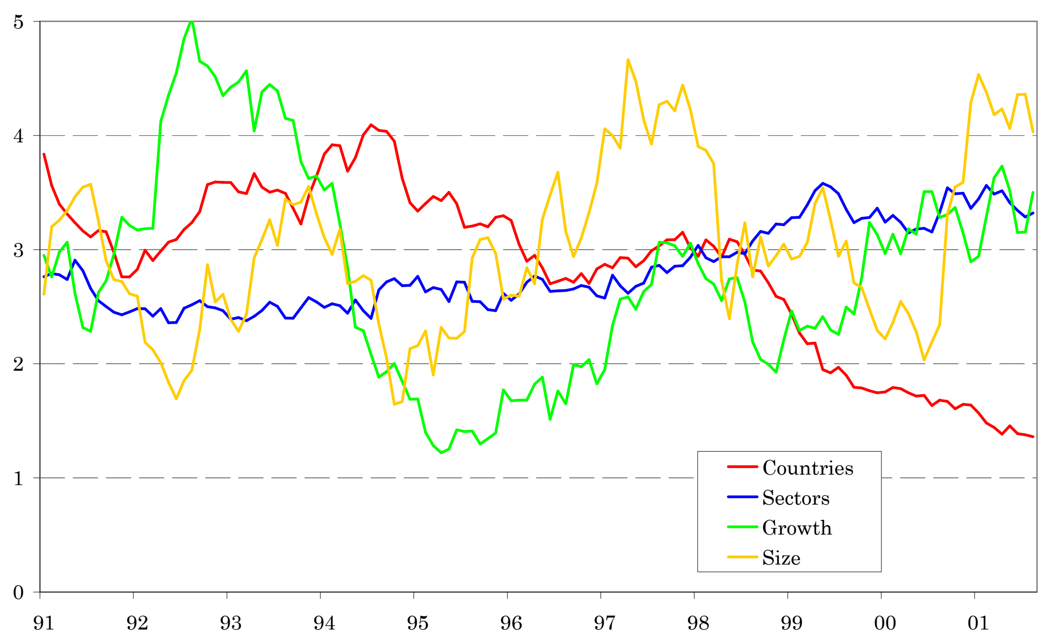
Note: ** (*) indicates if the sample mean t is above the distribution mean 1.96 at 5% (10%) level.

Figure 8: Average absolute t-statistics of countries, sectors, Growth and Size over time (12-month moving average) for the EW and the VW samples.

Panel A: Unhedged - EW



Panel B: Unhedged - VW



3.3 Benefits from country, sector and style diversification

Diversification benefits arise from low correlation among asset classes. In particular, the benefits of international diversification arising from low correlations among Equity markets are well documented. Nevertheless, the main sources driving correlations remain controversial among both academics and practitioners. Low correlations may be due to differences in economic conditions across national borders, like variations in regulatory environment, economic policies and growth rates. If this is the case, cross-country diversification strategies should produce significant benefits.

On the contrary, low correlations among Equity markets may be explained by the specific industrial composition of each country. For instance, an investment in the Swiss market actually implies a high exposure to the banking sector, while an investment in the Dutch market, to the energy sector. Equity markets are maybe imperfectly correlated only because industries are. If this is the case, allocation strategies across sectors could offer higher diversification benefits than across countries.

In this subsection, we report various dispersion and correlation measures among country and sector factors, as well as indicators of their magnitude in international strategies.

To begin with, we calculate the monthly cumulative cross-sectional dispersion among pure country and pure sector returns in order to identify turbulent periods (for a review of cross-sectional dispersion, see Solnik and Roulet, 1999). Hence, for each month, we get the cumulative cross-sectional dispersion of country and sector returns and then we sort them by decreasing order. Figure 9 indicates the 20 highest cumulative variances. The first bar shows that in September 2000, sector returns were twice as volatile as country returns. In February 2001, sectors were even 3 times more volatile than countries. Most of the time, however, the dispersion of country returns is much higher than sector returns (16 months out of 20). This suggests higher diversification benefits from cross-country allocation in times of high volatility. This also holds for the overall period: the dispersion of country returns is on average 0.25% per month, while it is as low as 0.10% for sector returns.

Table 2 reports the full correlation matrix among pure sector returns (Panel A) and among pure country returns (Panel B). It should be realized that there are non-zero correlations between country and sector factors, although we do not report them.[5] Correlations are generally low or even negative, both among country and sector returns. Pure factors appear to be very little correlated, as opposed to factors including the Common factor (which is not a surprise). The correlations among country (or sector) factors increased by the Common factor are strongly influenced by the Common factor itself. Therefore, we believe here that the correlation among pure factors is the only measure that really matters when performance is measured against a benchmark, and for an active investor who wants to make bets on either country or sector factors. Nevertheless, for comparison purposes, we also report factor results including the Common factor. As correlations among pure country and sector factors are very low, the diversification impact (both along countries and sectors) should be high.

[5] Full results are available from the authors upon request.

Figure 9: The 20 highest cumulative cross-sectional dispersions of country and sector factors from 1990 to 2001.

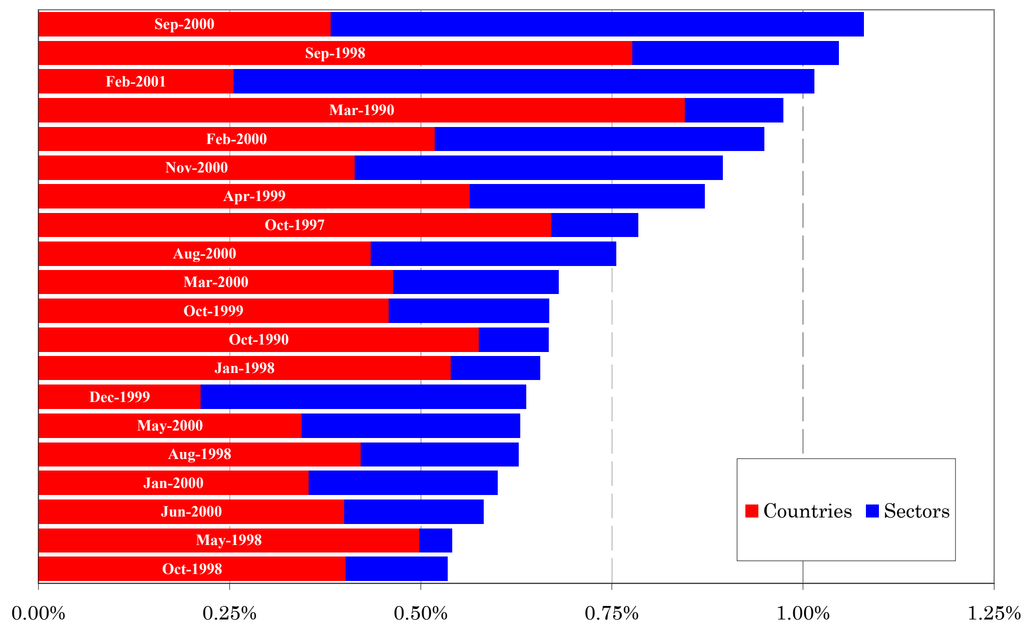


Table 2: Correlations among pure factors (Unhedged - VW sample).

Panel A: Sector factors

	Basic Materials	Conglomerates	Consumer Cyclicals	Consumer Non-Cyclicals	Cyclical Conglomerates	Energy	Healthcare	Industrial Goods & Services	Non-Property Financials	Property	Technology	Telecommunications	Transportation	Utilities
Basic Materials	1													
Conglomerates	0.02	1												
Consumer Cyclicals	0.16	0.03	1											
Consumer Non-Cyclicals	0.19	-0.08	0.00	1										
Cyclical Conglomerates	0.08	-0.11	-0.02	-0.15	1									
Energy	0.26	0.19	-0.27	0.05	-0.09	1								
Healthcare	-0.01	-0.02	-0.25	0.65	-0.22	0.13	1							
Industrial Goods & Services	0.23	-0.07	0.02	-0.18	0.22	-0.08	-0.33	1						
Non-Property Financials	0.10	-0.03	-0.05	0.05	-0.16	-0.06	0.02	-0.30	1					
Property	0.22	0.23	-0.10	0.10	-0.13	0.15	0.11	-0.03	0.27	1				
Technology	-0.32	-0.08	-0.02	-0.62	0.16	-0.29	-0.52	0.36	-0.49	-0.28	1			
Telecommunications	-0.33	-0.20	0.15	-0.29	0.16	-0.27	-0.31	-0.14	-0.24	-0.33	0.28	1		
Transportation	0.40	0.01	0.27	0.49	-0.10	0.06	0.29	-0.05	0.17	0.23	-0.47	-0.25	1	
Utilities	0.00	0.03	-0.16	0.49	-0.18	0.23	0.45	-0.28	0.02	0.17	-0.53	-0.08	0.34	1

Panel B: Country factors

	Australia	Austria	Belgium	Canada	Denmark	France	Germany	Greece	Hong Kong	Ireland	Italy	Japan	Netherlands	New Zealand	Norway	Portugal	Singapore	Spain	Sweden	Switzerland	United Kingdom	United States
Australia	1																					
Austria	0.03	1																				
Belgium	0.18	0.36	1																			
Canada	0.32	0.02	-0.01	1																		
Denmark	0.08	0.31	0.40	0.09	1																	
France	0.04	0.35	0.49	-0.01	0.26	1																
Germany	0.09	0.53	0.49	0.06	0.43	0.58	1															
Greece	0.01	0.34	0.34	-0.38	0.12	0.32	0.23	1														
Hong Kong	0.24	0.24	-0.01	0.31	0.08	0.09	0.20	-0.17	1													
Ireland	0.08	0.19	0.4	0.01	0.34	0.12	0.18	-0.04	-0.01	1												
Italy	0.09	0.23	0.31	0.05	0.3	0.30	0.34	0.28	0.05	0.13	1											
Japan	-0.03	-0.15	-0.26	-0.39	-0.21	-0.24	-0.35	0.05	-0.19	-0.14	-0.02	1										
Netherlands	0.14	0.45	0.65	0.06	0.34	0.50	0.60	0.25	0.14	0.26	0.26	-0.31	1									
New Zealand	0.45	0.23	0.27	0.30	0.12	0.19	0.13	-0.01	0.15	-0.04	0.16	-0.07	0.3	1								
Norway	0.22	0.28	0.23	0.25	0.31	0.25	0.23	0.19	0.12	0.14	0.14	-0.22	0.17	0.44	1							
Portugal	0.26	0.49	0.66	0.17	0.33	0.58	0.44	0.38	0.07	0.09	0.58	0.06	0.64	0.55	0.59	1						
Singapore	0.19	0.12	-0.04	0.13	-0.07	-0.04	0.09	-0.39	0.63	0.00	0.04	-0.04	0.03	0.23	0.06	-0.05	1					
Spain	0.07	0.28	0.23	-0.05	0.21	0.36	0.29	0.49	0.16	0.19	0.38	-0.03	0.19	0.19	0.27	0.68	0.1	1				
Sweden	0.14	0.05	-0.04	-0.04	0.09	0.27	0.28	0.09	0.09	-0.11	0.13	-0.01	0.15	0.05	0.18	0.51	0.09	0.36	1			
Switzerland	-0.02	0.35	0.34	-0.08	0.32	0.34	0.31	0.28	0.08	0.11	-0.01	-0.1	0.46	0.32	0.21	0.62	-0.01	0.13	0.18	1		
UK	0.16	0.28	0.31	-0.07	0.28	0.24	0.25	0.14	0.06	0.29	-0.01	-0.25	0.39	0.19	0.18	0.05	-0.05	0.09	-0.05	0.31	1	
US	-0.02	-0.11	-0.03	0.39	-0.08	-0.12	-0.08	-0.18	0.08	-0.05	-0.21	-0.74	0.02	0.02	0.11	-0.4	-0.04	-0.24	-0.25	-0.16	-0.07	1

We report in Figure 10 the average correlation among country and sector factors over time. At each point in time, the correlations are measured over the previous 36 months and then averaged among factors of each category. Panel A shows correlations among factors increased by the Common factor, while Panel B reports correlations among pure factors. Our results are very comparable to previous research on the topic (see for instance Cavaglia, 2000).

Panel A reveals that country correlations were below 50% until the 1998 crisis. They increased over roughly 55% in summer 1998 and have remained at this level until mid-2001. Sector correlations have shown a clear decreasing trend over the whole period, but have remained above country correlations until the end of 1999. In mid-2001, sector correlations were around 40%, while country correlations, close to 55%. The usual interpretation is that, although diversifying along sectors is becoming more and more beneficial (because of decreasing correlations), country factors still offer high diversification benefits (because the average correlation is still relatively low). Another important finding is that, while correlations among country returns tend to increase sharply during market corrections, as in summer 1998, correlations among sectors appear to be more resilient to such shocks, since they increase only marginally. Thus, diversification along sectors seems to be more robust than along countries when the global investor needs it most, e.g. during correction periods.[6]

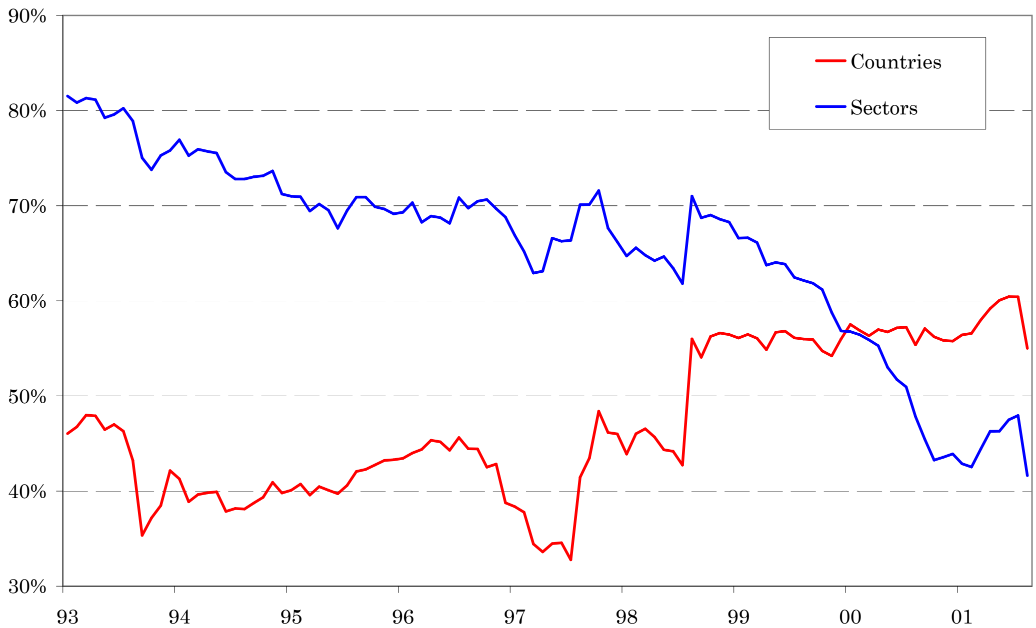
Panel B of Figure 10 offers an alternative way of analyzing potential diversification benefits through the average correlation among pure country and sector returns. The average correlation between pure sector returns is very stable between −5% and +2%, while it is between 7% and 17% among pure country returns. Given these results, sector factors seem to offer slightly higher diversification benefits.

In order to better assess the importance of the Growth factor for diversification purposes, we show in Figure 11 its correlations with all the other factors. Unsurprisingly, the strongest correlations are with Technology (45%), followed by the Common factor (almost 40%) and the Telecommunications (almost 30%). Strong negative correlations are with Transportation (−50%) and Consumer non-Cyclicals (−47%).

[6]This finding seems to be in contradiction to Figure 9, which shows that cross-sectional dispersion among country returns increased dramatically in August 1998. Actually, covariances between country returns increased even more, producing higher country correlations despite higher variances.

Figure 10: Average correlation among country and sector factors (36-month rolling), (Unhedged - VW sample).

Panel A: Factors including the Common factor



Panel B: Pure factors

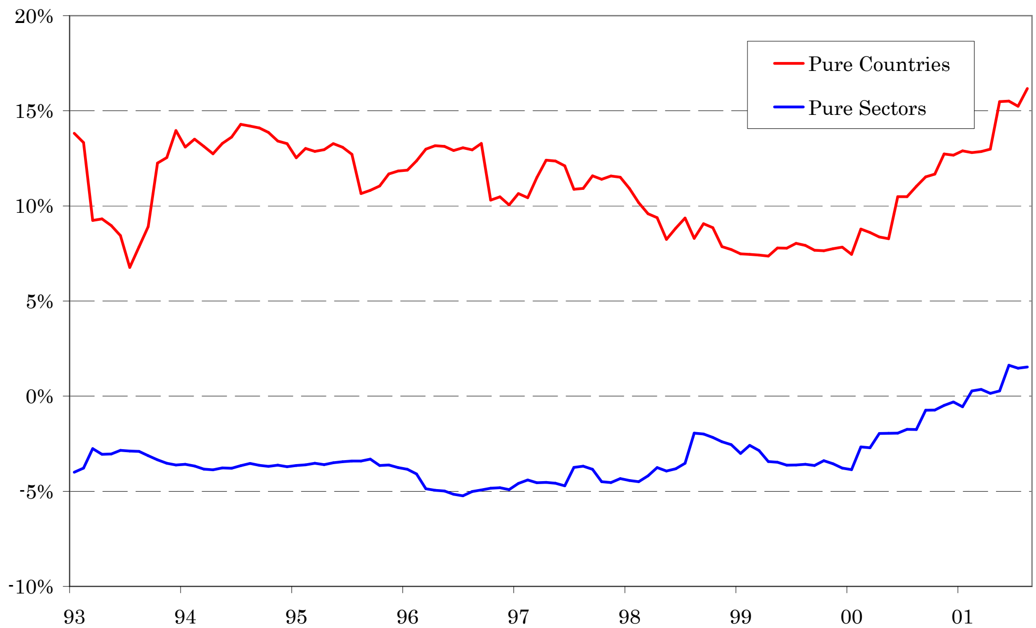
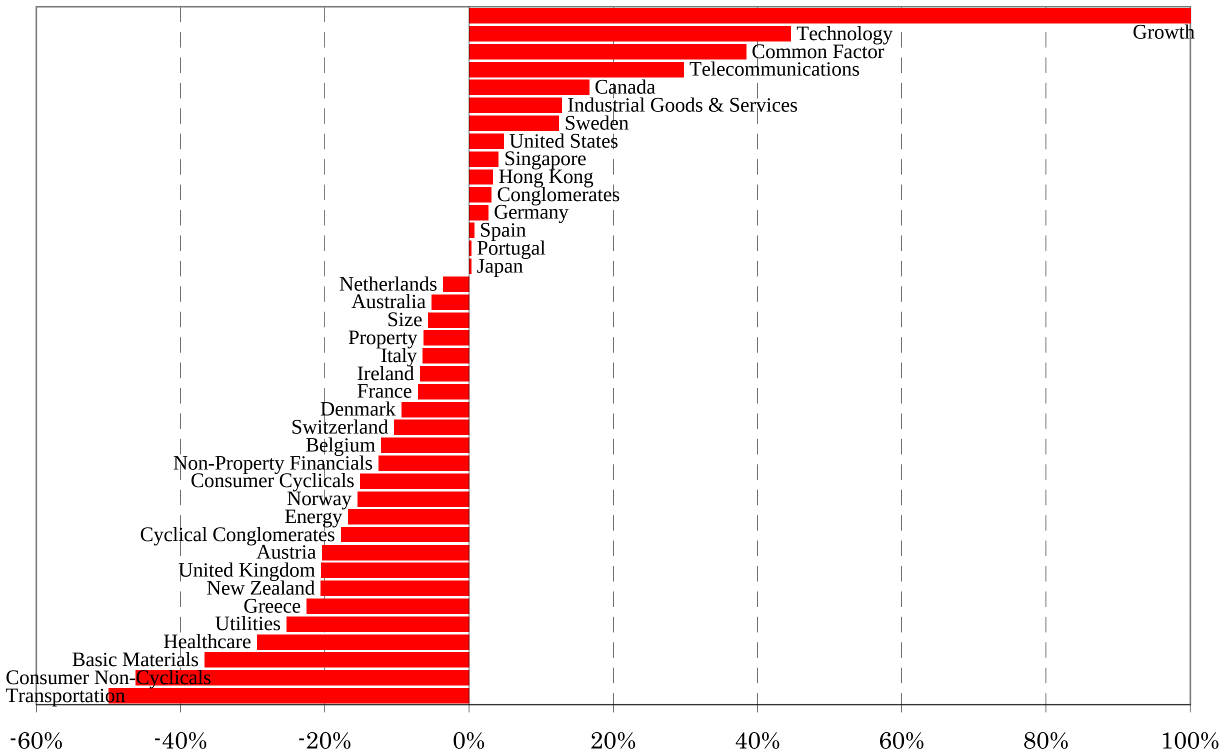


Figure 11: Correlations between the Growth factor and all the other factors (Unhedged - VW sample).



3.4 The magnitude of country, sector and style effects

Another measure of potential benefits from cross-country and cross-industry strategies has been proposed by Rouwenhorst (1999). He suggested to use the Mean Absolute Deviation (MAD) indicator, defined as the weighted average of the absolute deviations from the mean return at a given date t. This indicator provides a measure of the opportunities of outperforming an index through active country or industry exposures. The country (respectively the industry) MAD can thus be considered as the gains from a perfect foresight strategy based exclusively on country (respectively industry) bets. The strategy would be to hold a long position in rising factors and a short position in declining factors, in proportion to their weight. Their contribution can be either equal-weighted or capitalisation-weighted.

For example, we consider a universe comprising only 2 countries (the US and Switzerland) and 2 sectors (Technology and Healthcare), where each factor is equal-weighted within each category. If pure country returns happen to be +1% and −1% (for the US and Switzerland respectively) over a given month, then the perfect foresight strategy return is 1% (reflecting a long position in the US and a short position in Switzerland). The country MAD equals 1%. Now, if pure sector returns are +10% and −10% (for the Technology and Healthcare sectors respectively), then the perfect foresight strategy return is 10%.

The sector MAD equals 10%. In this case, the impact of sector factors is much stronger than country factors. Since the MAD is generally a quite volatile indicator, some previous research applied a smoothing by taking a 52-week moving average (Cavaglia *et al.*, 2000), or a 48-month moving average (Baca *et al.*, 2000, used the variance instead of the absolute mean).

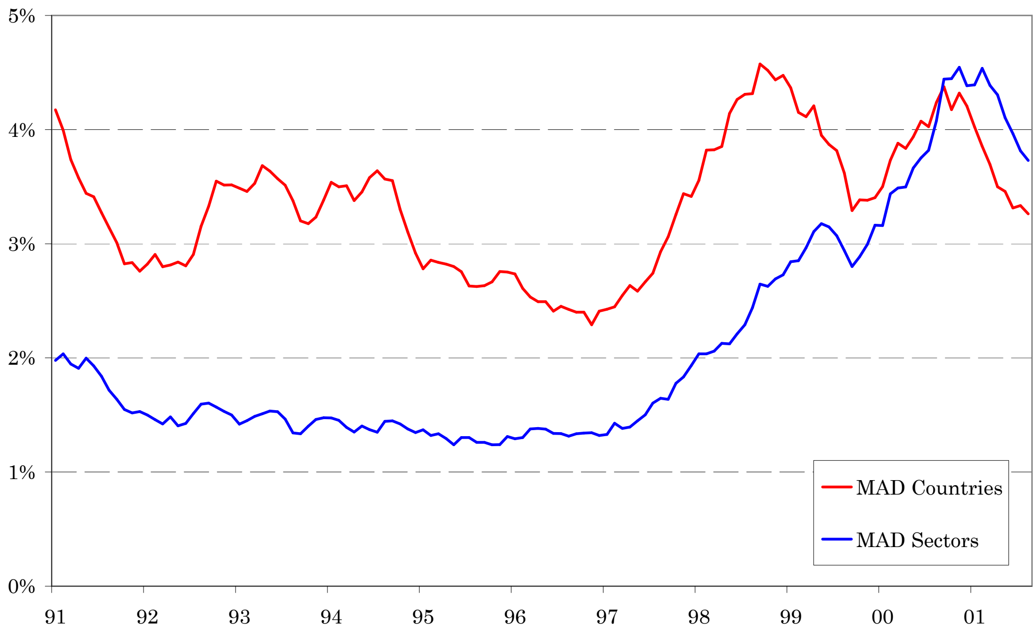
Figure 12 shows the MAD 12-month moving average over the whole period. Panel A shows the equal-weighted MAD and panel B, the value-weighted MAD. Our results are akin to previous findings: from 1991 to the late 90's, the country MAD has been above the sector MAD. However, the sector MAD has increased dramatically between 1997 and the end of 2000. The equal-weighted MAD caught up with the level of the country MAD at the end of 2000, while the value-weighted MAD has largely exceeded the country MAD over this period. Between mid-2000 and mid-2001, all MADs have been following a comparable slightly decreasing trend. This sheds doubt on all definitive conclusions on a persistent downward trend for country effects as opposed to a persistent upward trend for sector effects. However, a general conclusion is that, while country factors have not lost much in magnitude, sector factors have undoubtedly gained importance between 1998 and 2000.

In Figure 13, we represent the importance of weighted average absolute returns on the Common Factor, the pure Country, Sector and Growth + Value factors, as well as the average absolute stock-specific returns, as a percentage of the whole.[7] Again, Panel A shows equal-weighted returns and Panel B, value-weighted returns. The Growth factor has clearly gained importance over time. For both weighting schemes, it was at least as important as the average absolute country or sector returns by mid-2001. The decrease of the Country contribution is obvious in both panels but is much more important when returns are value-weighted. The average absolute stock-specific returns accounted for more than 30% of the total over the whole period, suggesting the large potential added-value of stock picking.

[7]Here the Growth factor is actually multiplied by 2 in order to reintegrate the Value factor into the return decomposition. This decomposition is directly derived from equation (1), which explicitly takes the Value factor into account. The Appendix shows that the Value factor is the exact opposite of the Growth factor in the case of the VW sample.

Figure 12: Mean Absolute Deviation (MAD) indicator for country and sector factors (12-month moving average), (Unhedged sample).

Panel A: EW sample



Panel B: VW sample

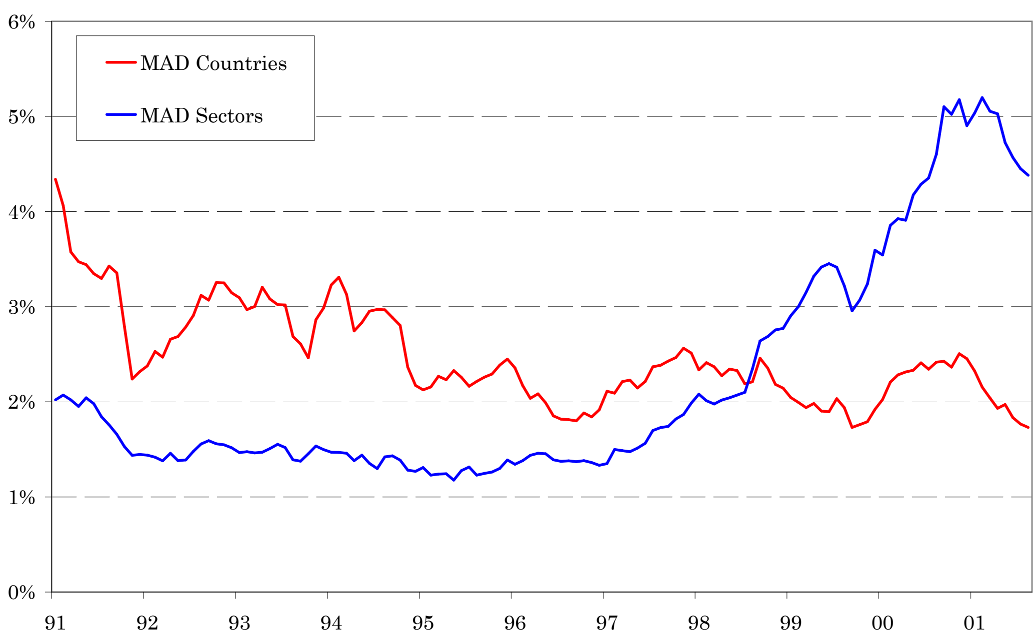
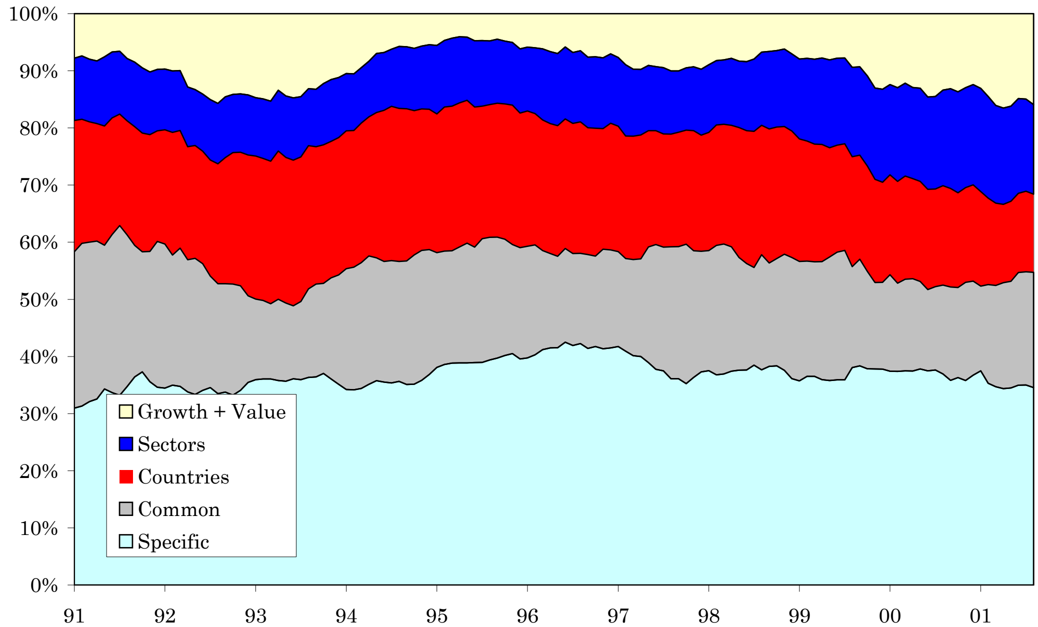
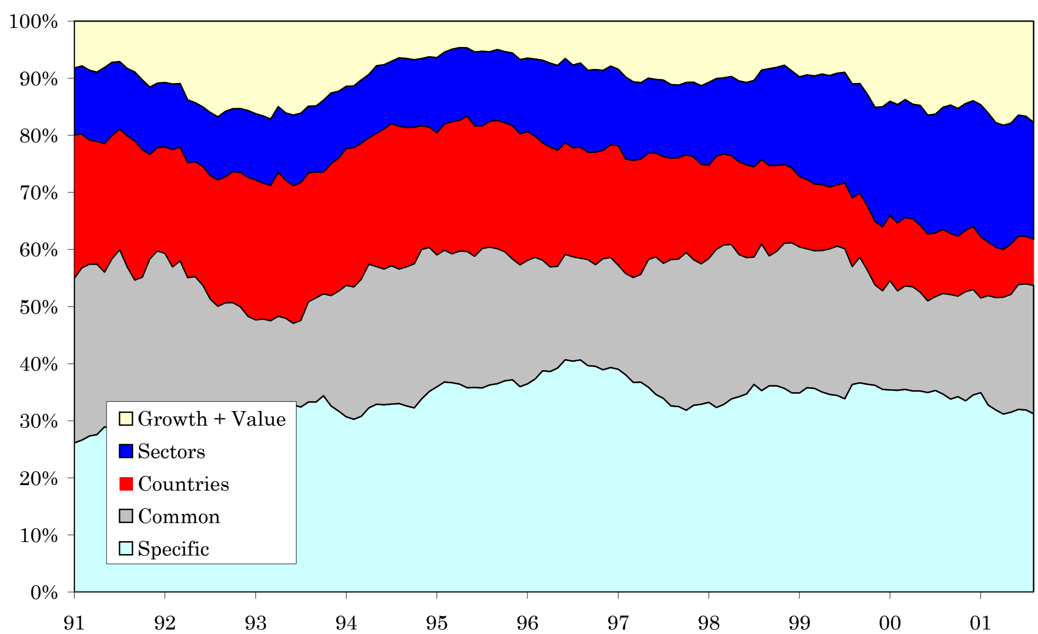


Figure 13: Average absolute stock-specific returns and average absolute returns on the Common, Country, Sector and Growth + Value factors, as a percentage of the whole (12-month moving average), (Unhedged sample).

Panel A: EW sample



Panel B: VW sample



3.5 Factor Returns and Momentum

Risk control is an important issue for portfolio managers, and it is essential to assess which strategy - country, sector or style allocation - provides the greatest diversification benefits. However, it is also vital to compare strategies on the basis of the return enhancement they are likely to offer. Several issues arise here. We already showed in section 3.2 that, in terms of MAD, the potential overperformance of sector strategies became similar to country strategies, assuming that portfolio managers are perfectly able to forecast country and sector returns. However, we all know how difficult this forecasting exercise is in reality. In this section, we investigate the predictability of factor returns using a simple momentum-based approach. It should be realized that the momentum strategy presented and tested here is only an illustration among many other forecasting techniques. Nevertheless, we believe that it is interesting to apply such strategies to country and sector factors and compare the results.

Momentum is now extensively documented by research. A recent study by Moskowitz and Grinblatt (1999) confirms the existence of momentum in individual stock returns, but shows that this effect is only due to an industry momentum effect. Indeed, once the industry momentum is removed, there is no evidence of any momentum effect left on the stock level. The framework developed by these authors is the most common. The idea is to compare over m months the performance of stocks selected among the best or the worst over the past n months.

The momentum indicator we use here is well known among technical traders and is based on the following rule. A BUY signal is given when the price moves above the maximum of the past n months. A SELL signal is given when the price moves below the minimum of the past n months. In our case, the "prices" are replaced by the cumulated factor returns. At the beginning of each month, we construct this indicator for each factor. We then build a portfolio, which is 50% short in factors with a SELL signal and 50% long in factors with a BUY signal. The return on this portfolio is calculated each month, then averaged over the whole period and finally annualized. The results of our momentum strategy are shown in Table 3 for all the different samples. There are clear-cut features that country factors do not generate any significant profits over time, while sector-based strategies are significantly profitable for most n values. For $n = 4$ for instance, the annual outperformance of the sector portfolio is between 4.8% and 5.1%, with a t-statistic above 3.2, which means that the return gain is significantly different from zero.

It should be noted that the above momentum strategy is based on pure factors and may not be easily replicated in practice. Therefore, we suggest the following strategy based on realized stock returns, instead of constructing pure factor mimicking portfolios.

Table 3: Momentum strategy - Annualized performance of a portfolio 50% short in country (sector) factors with a SELL signal, and 50% long in country (sector) factors with a BUY signal.

	Unhedged				Hedged			
	EW		VW		EW		VW	
n	Mean	t-stat	Mean	t-stat	Mean	t-stat	Mean	t-stat
				Country Factors				
2	-0.002	-0.210	-0.011	-0.966	-0.005	-0.436	-0.009	-0.704
3	0.001	0.077	-0.006	-0.469	-0.007	-0.636	-0.006	-0.550
4	-0.006	-0.461	-0.002	-0.183	-0.017	-1.513	-0.010	-0.818
5	-0.005	-0.407	-0.011	-0.627	-0.011	-0.886	-0.010	-0.678
6	-0.013	-0.891	-0.011	-0.782	-0.014	-1.088	-0.007	-0.585
7	-0.006	-0.433	-0.025	-1.774	-0.012	-0.918	-0.012	-0.959
8	0.000	0.034	-0.021	-1.267	-0.015	-1.203	-0.019	-1.341
9	0.006	0.477	-0.012	-0.934	-0.011	-0.860	-0.012	-1.116
10	0.005	0.373	-0.011	-0.857	-0.014	-1.140	-0.005	-0.431
11	0.001	0.080	-0.005	-0.394	-0.008	-0.658	-0.002	-0.227
12	0.006	0.422	0.001	0.127	-0.007	-0.531	-0.002	-0.187
				Sector Factors				
2	0.039	3.201	0.034	2.770	0.039	3.221	0.034	2.767
3	0.050	3.914	0.042	2.993	0.050	3.945	0.042	3.016
4	0.048	3.612	0.049	3.246	0.049	3.676	0.051	3.332
5	0.047	3.282	0.048	2.873	0.046	3.247	0.048	2.899
6	0.038	2.847	0.042	2.614	0.039	2.872	0.042	2.585
7	0.035	2.564	0.036	2.218	0.035	2.624	0.036	2.208
8	0.032	2.365	0.033	1.973	0.033	2.438	0.033	1.974
9	0.033	2.429	0.033	2.033	0.032	2.410	0.033	2.020
10	0.028	2.060	0.026	1.641	0.027	2.026	0.026	1.625
11	0.024	1.951	0.033	2.089	0.024	1.979	0.033	2.072
12	0.030	2.520	0.028	1.889	0.029	2.438	0.028	1.889

At each period, we build a minimum variance portfolio where stock weights are such that the exposure to the Common, the country and the style factors is zero, whereas the exposure to the sector factors is either positive (if the trend of the pure sector momentum indicator is upward) or negative (if the trend is downward). Formally, the optimisation problem to be solved at each time t:

$$\min_{w_{i,t}} \quad \sum_{i=1}^{N_t} w_{i,t}^2 \hat{\sigma}_{i,t}, \tag{2}$$

$$\text{subject to} \quad \sum_{i=1}^{N_t} w_{i,t} D_i^{Factor_k} = 0 \qquad \forall\ Factor \neq S, \tag{3}$$

$$\sum_{i=1}^{N_t} w_{i,t} D_i^{S_k} = \gamma_{k,t} m_{k,t}, \tag{4}$$

$$-0.05 \leq w_{i,t} \leq 0.05, \tag{5}$$

$$\sum_{i=1}^{N_t} w_{i,t} = 0, \tag{6}$$

where $\hat{\sigma}_{i,t}$ is the specific variance, that is the variance estimate specific to stock i at time t, calculated from the sequence of stock-specific returns, $\varepsilon_{i,\tau}, \tau \in [0, ..., t]$. $m_{k,t}$ is the momentum indicator of Sector k at time t, which equals +1 if the trend is upward and −1 if the trend is downward. Finally, $\gamma_{k,t}$ is a constant, indicating to which extent, Sector k may be over- or under-weighted.

In other words, the optimisation consists in choosing stocks characterized by a low specific variance, such that the exposure to sectors is positive (respectively, negative) when the pure factors are in an upward (respectively, downward) trend. The exposure to all other factors, which are not predictable in terms of future returns, is zero.

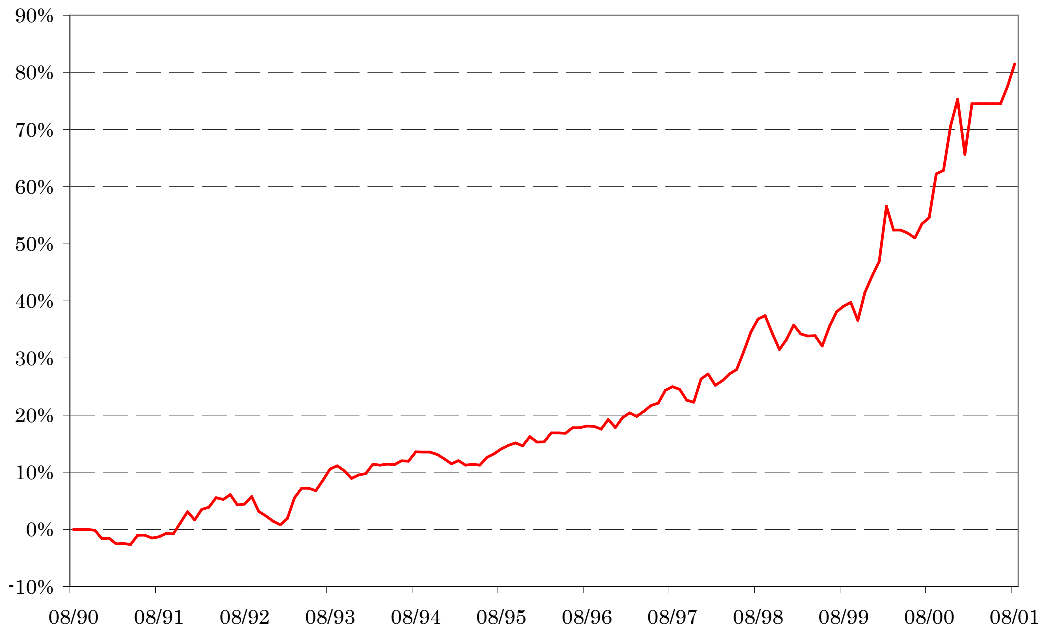
However, in practice, the above constraints often lead to unfeasible problems (for instance, this is the case when many more sectors follow a downward trend rather than an upward trend). Therefore, we have to modify the sector constraint (4), such that each sector is either over- or under-weighted between 10% and 30%. Formally, we have:

$$\min\{0.1\ m_{k,t},\ 0.3\ m_{k,t}\} \leq \sum_{i=1}^{N_t} w_{i,t} D_i^{S_k} \leq \max\{0.1\ m_{k,t},\ 0.3\ m_{k,t}\}. \tag{7}$$

This optimisation is carried out at each time t and is solely based on observations available up to then (the strategy is therefore easily replicable). The problem was no solvable for a few months only (4 out of 139), in which case no active position was taken. The resultant cumulated log-returns are shown in Figure 14 (the momentum indicator is based on $n = 4$ months). They can be either interpreted as absolute returns on a long-short portfolio, or excess returns on a portfolio tracking the SSB World PMI index.

This simple momentum strategy shows that sector-based returns would have been predictable over time (in our case, from 1990 to 2001). Of course, the momentum indicator on pure sector factors may "not work" in future. However, it is striking to find out that sector-based strategies are performing much better than country. We believe that factor predictability is a crucial element when the importance of country or sector factors is investigated. Our strategy captures sector trends, while it does not reveal any clear country pattern. Country risk may therefore be considered as an unpredictable risk that should be hedged against. On the contrary, gains may be sought through active exposure to predictable sector risk. However, other quantitative strategies may yield superior results, or a manager may have superior return forecasting skills.

Figure 14: Cumulated log-returns on a mock portfolio built through the momentum strategy applied to pure sector factors (Unhedged - VW sample, $n = 4$ months).



4 Conclusion

We show empirical evidence of the importance of country, sector and style factors for the construction of global equity portfolios. Our initial questions were clear: should a portfolio manager structure his portfolio along countries, sectors or style? Are sector-based strategies definitely superior to country-based or style-based strategies? Our various indicators point out a more moderate conclusion: undoubtedly, diversification benefits and return potentials of sector-based approaches have dramatically increased in the late 90's, and were comparable to country-based approaches in the first half of 2001. Nevertheless, country factors remain influential, and there is no sign that this importance is being severely altered. Another important finding is that style effects remain substantial even once country and sector effects are deduced. The dramatic divergence between the performance of Growth and Value styles from 1999-2001 cannot be explained by sector effects only. There is visibly an independent Value/Growth effect. The same is true for the Size factor.

When the pattern and the significance of pure factor returns are investigated, we find clear evidence of i) the statistical significance of the four factor categories, Country, Sector, Growth/Value and Size, ii) an increasing significance of sector factors and a decreasing significance of country factors. Evidently, sectors are becoming more and more homogenous, while the opposite is true for countries. When we compute correlations among country and sector factors increased by the Common factor, we identify a significant reduction among sector factors over time, while country correlations remain stable. Nevertheless, correlations among pure country and sector factors are both very low and stable over time. Correlations among pure sector factors are slightly lower. The Mean Absolute Deviation (MAD) indicator points out a dramatic rise of the sector effect but also a clear resilience of the country effect. Finally, we show that sector returns are momentum-driven, while country returns are not. This has important implications in terms of active allocation policies. Potential gains from sector allocation are clearly superior to those from country allocation.

Given these essential findings, it is obvious that the milieu of asset management should not solely be organized along sectors. Country effects may be losing importance but it is definitely too early to abandon cross-country allocations in favor of cross-sector. Style effects also deserve careful monitoring, as they play a major and independent role. The current focus on the "Sector versus Country" debate should not prompt portfolio managers to put them aside, since this may significantly alter portfolio efficiency. A multidimensional approach is the only appropriate approach. All four factors, Country, Sector, Growth/Value and Size, represent significant risk factors that should be explicitly taken into account, monitored and managed in global equity portfolios.

A Appendix

The purpose of this appendix is to present our multi-factor model as well as to justify the constraints it is subject to.

A.1 Notations

Factor returns are estimated through independent cross-sectional regressions of stock returns on their exposures to 5 factor categories. We shall use the following notations:

- N_t denotes the total number of index constituents at time t, $t = 1, \ldots, T$;
- $P_{i,t}$ is the adjusted price of stock i at time t (in US dollars for the unhedged sample, $P_{i,t}^{\$}$, and in local currency for the hedged sample, $P_{i,t}^{Loc}$);
- $R_{i,t}$ is the return on stock i at time t, defined as $ln[P_{i,t}^{\$}/P_{i,t-1}^{\$}]$ for the unhedged sample, and $ln[P_{i,t}^{Loc}/P_{i,t-1}^{Loc}] + ln[(1+r)/(1+r^*)]$[1] for the hedged sample;
- Let $MC_{i,t}$ be the SSB index market capitalisation of stock i and TMC_t, the SSB PMI index total market capitalisation at time t;
- $w_{i,t}$ is the weight of stock i at time t such that $\sum_{i=1}^{N_t} w_{i,t} = 1$. $w_{i,t}$ will be defined according to the different weighting schemes applied to the cross-sectional regressions. Indeed, $w_{i,t}$ is the SSB index weighting of stock i at time t ($MC_{i,t}/TMC_t$) if a value-weighted scheme is used, while it is equal to $1/N_t$ if an equal-weighted scheme is applied;
- N^C and N^S are the number of country and sector factors respectively;
- Stock exposures to each factor at time t are given by:
  - $D_i^{C_k}$ a dummy variable, set to one if stock i belongs to country k, $k = 1, \ldots, N^C$;
  - $D_i^{S_k}$ a dummy variable, set to one if stock i belongs to sector k, $k = 1, \ldots, N^S$;
  - $p_{i,t}^G$ the SSB Growth probability weight of stock i;
  - $p_{i,t}^V$ the SSB Value probability weight of stock i;
  - $SZ_{i,t}$ the Size exposure of stock i.
- At each time t, the cross-sectional regression provides an estimation of the following parameters:
  - the Common factor return, denoted F_t;
  - the return on the k^{th} country factor, denoted $F_t^{C_k}$, $k = 1, \ldots, N^C$;
  - the return on the k^{th} sector factor, denoted $F_t^{S_k}$, $k = 1, \ldots, N^S$;
  - the returns on the Growth and the Value factors, denoted F_t^G and F_t^V respectively;
  - the Size factor return, denoted F_t^{SZ};
  - the stock-specific return, denoted $\varepsilon_{i,t}$.

[1] As a reminder, r^* is the short-term interest rate of the foreign country, and r, the domestic/reference short-term rate (in our case, the US 3-month interest rate).

A.2 Construction of the multi-factor model

The full regression equation at time t is:

$$R_{i,t} = F_t + \sum_{k=1}^{N^C} D_i^{C_k} F_t^{C_k} + \sum_{k=1}^{N^S} D_i^{S_k} F_t^{S_k} + p_{i,t}^G F_t^G + p_{i,t}^V F_t^V + SZ_{i,t} F_t^{SZ} + \varepsilon_{i,t}. \tag{1}$$

The index return at time t is defined as the weighted average of constituent returns:

$$\sum_{i=1}^{N_t} w_{i,t} R_{i,t}$$

which, through equation (1), is equal to:

$$\begin{aligned}\sum_{i=1}^{N_t} w_{i,t} R_{i,t} \quad = \quad & F_t + \sum_{k=1}^{N^C} \left(\sum_{i=1}^{N_t} w_{i,t} D_i^{C_k} \right) F_t^{C_k} + \sum_{k=1}^{N^S} \left(\sum_{i=1}^{N_t} w_{i,t} D_i^{S_k} \right) F_t^{S_k} \\ & + \sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G F_t^G + \sum_{i=1}^{N_t} w_{i,t} p_{i,t}^V F_t^V + \sum_{i=1}^{N_t} w_{i,t} SZ_{i,t} F_t^{SZ} + \sum_{i=1}^{N_t} w_{i,t} \epsilon_{i,t}.\end{aligned}$$

We have to set the following constraints in order to identify the Common factor with the index return, which ensures that the world portfolio has zero exposure to each factor:

$$\sum_{k=1}^{N^C} \left(\sum_{i=1}^{N_t} w_{i,t} D_i^{C_k} \right) F_t^{C_k} = 0, \tag{2}$$

$$\sum_{k=1}^{N^S} \left(\sum_{i=1}^{N_t} w_{i,t} D_i^{S_k} \right) F_t^{S_k} = 0, \tag{3}$$

$$\sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G F_t^G + \sum_{i=1}^{N_t} w_{i,t} p_{i,t}^V F_t^V = 0, \tag{4}$$

$$\sum_{i=1}^{N_t} w_{i,t} SZ_{i,t} F_t^{SZ} = 0. \tag{5}$$

The next step consists in simplifying these constraints and substituting them into the main equation (1).

In constraints (2) and (3), $\sum_{i=1}^{N_t} w_{i,t} D_i^{C_k}$ simply represents the relative weight of Country k in the universe at time t and $\sum_{i=1}^{N_t} w_{i,t} D_i^{S_k}$, the relative weight of Sector k. Setting the relative weight of the country and sector factors to

$$W_{C_k,t} \equiv \sum_{i=1}^{N_t} w_{i,t} D_i^{C_k} \quad \text{and} \quad W_{S_k,t} \equiv \sum_{i=1}^{N_t} w_{i,t} D_i^{S_k}$$

respectively, both constraints reduce to

$$\sum_{k=1}^{N^C} W_{C_k,t} F_t^{C_k} = 0 \quad \text{and} \quad \sum_{k=1}^{N^S} W_{S_k,t} F_t^{S_k} = 0.$$

Isolating the first factor return of each category ($k = 1$) in the previous equation and substituting them into expressions $\sum_{k=1}^{N^C} D_i^{C_k} F_t^{C_k}$ and $\sum_{k=1}^{N^S} D_i^{S_k} F_t^{S_k}$, lead to:

$$\sum_{k=2}^{N^C} \left(D_i^{C_k} - \frac{W_{C_k,t}}{W_{C_1,t}} D_i^{C_1} \right) F_t^{C_k} \quad \text{and} \quad \sum_{k=2}^{N^S} \left(D_i^{S_k} - \frac{W_{S_k,t}}{W_{S_1,t}} D_i^{S_1} \right) F_t^{S_k}. \tag{6}$$

Concerning the SSB probability weights, we have $p_{i,t}^V = 1 - p_{i,t}^G$ by construction.[2] Therefore, constraint (4) may be rewritten as:

$$F_t^V = - \frac{\sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G}{1 - \sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G} F_t^G. \tag{7}$$

Finally, in order to satisfy constraint (5), the size exposure $SZ_{i,t}$ has to be defined through the stock weights, $w_{i,t}$, according to the following standardization rule:

$$SZ_{i,t} = \frac{\frac{MC_{i,t}}{TMC_t} - \mu_t}{a_t}, \tag{8}$$

where $\mu_t = \sum_{i=1}^{N_t} w_{i,t} \frac{MC_{i,t}}{TMC_t}$ and a_t is chosen such that $\max_i \{SZ_{i,t}\} = 1$. In other words, μ_t is the weighted average of stock index weights at time t, and a_t is a scaling factor (ensuring an economic interpretation of the magnitude of the Size factor).

At this stage, we can introduce constraints (6) and (7) into equation (1), allowing us to work on an unconstrained model:

$$\begin{aligned} R_{i,t} &= F_t + \sum_{k=2}^{N^C} \left(D_i^{C_k} - \frac{W_{C_k,t}}{W_{C_1,t}} D_i^{C_1} \right) F_t^{C_k} + \sum_{k=2}^{N^S} \left(D_i^{S_k} - \frac{W_{S_k,t}}{W_{S_1,t}} D_i^{S_1} \right) F_t^{S_k} \\ &+ \frac{p_{i,t}^G - \sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G}{1 - \sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G} F_t^G + SZ_{i,t} F_t^{SZ} + \varepsilon_{i,t}. \end{aligned} \tag{9}$$

A.2.1 Value-weighted scheme

If the $(w_{i,t})_{i=1,\ldots,N_t}$ turn out to be the SSB stock weights, then $\sum_{i=1}^{N_t} w_{i,t} p_{i,t}^G = 0.5$[3] and constraint (7) reduces to

$$F_t^V = -F_t^G.$$

As far as the Size factor is concerned, $\mu_t = \sum_{i=1}^{N_t} \left(\frac{MC_{i,t}}{TMC_t} \right)^2$ and

$$SZ_{i,t} = \frac{\frac{MC_{i,t}}{TMC_t} - \sum_{i=1}^{N_t} \left(\frac{MC_{i,t}}{TMC_t} \right)^2}{a_t}.$$

[2]For a full description of SSB methodology, see Salomon Smith Barney (2000), pp. 68-71.

[3]The SSB probability weights are scaled so that each SSB Country Style Index covers exactly 50% of the total investable market capitalisation of the corresponding SSB Country PMI Index.

The multi-factor model (9) becomes then:

$$\begin{aligned} R_{i,t} &= F_t + \sum_{k=2}^{N^C} \left(D_i^{C_k} - \frac{W_{C_k,t}}{W_{C_1,t}} D_i^{C_1} \right) F_t^{C_k} + \sum_{k=2}^{N^S} \left(D_i^{S_k} - \frac{W_{S_k,t}}{W_{S_1,t}} D_i^{S_1} \right) F_t^{S_k} \\ &+ (2p_{i,t}^G - 1) F_t^G + SZ_{i,t} F_t^{SZ} + \varepsilon_{i,t}. \end{aligned} \tag{10}$$

A.2.2 Equal-weighted scheme

If the stocks are equal-weighted $w_{i,t} = \frac{1}{N_t}$, then constraint (7) reduces to

$$F_t^V = -\frac{P_t^G}{N_t - P_t^G} \quad F_t^G,$$

where $P_t^G = \sum_{i=1}^{N_t} p_{i,t}^G$. The Size factor is then defined as:

$$SZ_{i,t} = \frac{\dfrac{MC_{i,t}}{TMC_t} - \dfrac{1}{N_t}}{a_t},$$

where $\frac{1}{N_t} = \mu_t$.

The multi-factor model (9) becomes then:

$$\begin{aligned} R_{i,t} &= F_t + \sum_{k=2}^{N^C} \left(D_i^{C_k} - \frac{W_{C_k,t}}{W_{C_1,t}} D_i^{C_1} \right) F_t^{C_k} + \sum_{k=2}^{N^S} \left(D_i^{S_k} - \frac{W_{S_k,t}}{W_{S_1,t}} D_i^{S_1} \right) F_t^{S_k} \\ &+ \left(\frac{N_t p_{i,t}^G - P_t^G}{N_t - P_t^G} \right) F_t^G + SZ_{i,t} F_t^{SZ} + \varepsilon_{i,t}. \end{aligned} \tag{11}$$

References

Baca, Sean P., Brian L. Garbe, and Richard A. Weiss, 2000, The Rise of Sector Effects in Major Equity Markets, *Financial Analysts Journal*, September/October, 34-40.

Beckers, Stan, Gregory Connor, and Ross Curds, 1996, National versus Global Influences on Equity Returns, *Financial Analysts Journal*, March/April, 31-38.

Cavaglia, Stefano, Christopher Brightman, and Michael Aked, 2000, The Increasing Importance of Industry Factors, *Financial Analysts Journal*, September/October, 41-53.

Cavaglia, Stefano M.F.G., Dimitris Melas, and George Tsouderos, 2000, Cross-Industry and Cross-Country International Equity Diversification, *Journal of Investing*, Volume 9, Number 1, 65-72.

Connor, Gregory, 1995, The Three Types of Factor Models: A Comparison of Their Explanatory Power, *Financial Analysts Journal*, May/June, 42-46.

De Santis, G., B. Gerard and P. Hillion, 1999, Portfolio Choice and Currency Risk Inside and Outside the EMU, *Swedish Economic Policy Review*, 6, 87-116.

Dumas, B. and B. Solnik, 1995, The World Price of Foreign Exchange Rate Risk, *Journal of Finance*, 50, 445-479.

Fama, Eugene F., and Kenneth R. French, 1992, The Cross-Section of Expected Stock Returns, *Journal of Finance*, Vol. 47, June, No. 2, 427-465.

Fama, Eugene F., and Kenneth R. French, 1998, Value versus Growth: The International Evidence, *Journal of Finance*, vol. 53, December, 1975-1999.

Fama, Eugene F., and J. MacBeth, 1973, Risk, Return, and Equilibrium: Empirical Tests, *Journal of Political Economy*, Vol. 81, 607-636.

Griffin, John M., and G. Andrew Karolyi, 1998, Another look at the role of industrial structure of markets for international diversification strategies, *Journal of Financial Economics*, 351-373.

Grinold, Richard, Andrew Rudd, and Dan Stefek, 1989, Global Factors: Fact of Fiction? *Journal of Portfolio Management*, vol. 16, no. 1 Fall, 79-89.

Heston, Steven L., and K. Geert Rouwenhorst, 1994, Does Industrial Structure Explain the Benefits of International Diversification? *Journal of Financial Economics*, 3-27.

Heston, Steven L., and K. Geert Rouwenhorst, 1995, Industry and Country Effects in International Stock Returns, *Journal of Portfolio Management*, 53-58.

Moskowitz, Tobias J., and Mark Grinblatt, 1999, Do industries explain momentum? *Journal of Finance* 54, 1249-1290.

Rouwenhorst, K. Geert, 1999, European Equity Markets and the EMU, *Financial Analysts Journal*, Vol. 55, no. 3, May/June: 57-64.

Salomon Smith Barney, 2000, Equity Style Investing and the Salomon Smith Barney World Equity Style Indices, *Quantitative Equity Research - Equity Index*, January.

Solnik, Bruno, 1974, Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, vol. 30, no. 4, 48-54.

Solnik, Bruno, and Jacques Roulet, 1999, Dispersion as Cross-Sectional Correlation: Are Stock Markets Becoming Increasingly Correlated? *Financial Analyst Journal*, Vol.56, no. 1, 2000, 54-61.

RESEARCH PAPER SERIES

Extra copies of research papers will be available to the public upon request. In order to obtain copies of past or future works, please contact our office at the location below. As well, please note that these works will be available on our website, ***www.fame.ch***, under the heading "Research" in PDF format for your consultation. We thank you for your continuing support and interest in FAME and look forward to serving you in the future.

N° 34: Variable Selection for Portfolio Choice
Yacine AÏT-SAHALIA, Princeton University & NBER, and Michael W. BRANDT, Wharton School, University of Pennsylvania & NBER, *February 2001*
(Please note: The complete paper is available from the Journal of Finance 56, 1297-1351.)

N° 33: The Characteristics of Individual Analysts' Forecast in Europe
Guido BOLLIGER, University of Neuchâtel and FAME, *July 2001*

N° 32: Portfolio Diversification: Alive and Well in Euroland
Kpaté ADJAOUTE, HSBC Republic Bank (Suisse), SA and Jean-Pierre DANTHINE, University of Lausanne, CEPR and FAME, *July 2001*

N° 31: EMU and Portfolio Diversification Opportunities
Kpate ADJAOUTÉ, Morgan Stanley Capital International, Geneva and Jean-Pierre DANTHINE, University of Lausanne, CEPR and FAME, *April 2000*

N° 30: Serial and Parallel Krylov Methods for Implicit Finite Difference Schemes Arising in Multivariate Option Pricing
Manfred GILLI, University of Geneva, Evis KËLLEZI, University of Geneva and FAME, Giorgio PAULETTO, University of Geneva, *March 2001*

N° 29: Liquidation Risk
Alexandre ZIEGLER, HEC-University of Lausanne, Darrell DUFFIE, The Graduate School of Business, Stanford University; *April 2001*

N° 28: Defaultable Security Valuation and Model Risk
Aydin AKGUN, University of Lausanne and FAME; *March 2001*

N° 27: On Swiss Timing and Selectivity: in the Quest of Alpha
François-Serge LHABITANT, HEC-University of Lausanne and Thunderbird, The American Graduate School of International Management; *March 2001*

N° 26: Hedging Housing Risk
Peter ENGLUND, Stockholm School of Economics, Min HWANG and John M. QUIGLEY, University of California, Berkeley; *December 2000*

N° 25: An Incentive Problem in the Dynamic Theory of Banking
Ernst-Ludwig VON THADDEN, DEEP, University of Lausanne and CEPR; *December 2000*

N° 24: Assessing Market Risk for Hedge Funds and Hedge Funds Portfolios
François-Serge LHABITANT, Union Bancaire Privée and Thunderbird, the American Graduate School of International Management; *March 2001*

N° 23: On the Informational Content of Changing Risk for Dynamic Asset Allocation
Giovanni BARONE-ADESI, Patrick GAGLIARDINI and Fabio TROJANI, Università della Svizzera Italiana; *March 2000*

N° 22: The Long-run Performance of Seasoned Equity Offerings with Rights: Evidence From the Swiss Market
Michel DUBOIS and Pierre JEANNERET, University of Neuchatel; *January 2000*

N° 21: Optimal International Diversification: Theory and Practice from a Swiss Investor's Perspective
Foort HAMELINK, Tilburg University and Lombard Odier & Cie; *December 2000*

N° 20: A Heuristic Approach to Portfolio Optimization
Evis KËLLEZI; University of Geneva and FAME, Manfred GILLI, University of Geneva, *October 2000*

N° 19: Banking, Commerce, and Antitrust
Stefan Arping; University of Lausanne; *August 2000*

N° 18: Extreme Value Theory for Tail-Related Risk Measures
Evis KËLLEZI; University of Geneva and FAME, Manfred GILLI, University of Geneva; *October 2000*

N° 17: International CAPM with Regime Switching GARCH Parameters
Lorenzo CAPIELLO, The Graduate Institute of International Studies; Tom A. FEARNLEY, The Graduate Institute of International Studies and FAME; *July 2000*

N° 16: Prospect Theory and Asset Prices
Nicholas BARBERIS, University of Chicago; Ming HUANG, Stanford University; Tano SANTOS, University of Chicago; *September 2000*

N° 15: Evolution of Market Uncertainty around Earnings Announcements
Dušan ISAKOV, University of Geneva and FAME; Christophe PÉRIGNON, HEC-University of Geneva and FAME; *June 2000*

N° 14: Credit Spread Specification and the Pricing of Spread Options
Nicolas MOUGEOT, IBFM-University of Lausanne and FAME, *May 2000*

N° 13: European Financial Markets After EMU: A First Assessment
Jean-Pierre DANTHINE, Ernst-Ludwig VON THADDEN, DEEP, Université de Lausanne and CEPR and Francesco GIAVAZZI, Università Bocconi, Milan, and CEPR; *March 2000*

N° 12: Do fixed income securities also show asymmetric effects in conditional second moments?
Lorenzo CAPIELLO, The Graduate Institute of International Studies; *January 2000*

N° 11: Dynamic Consumption and Portfolio Choice with Stochastic Volatility in Incomplete Markets
George CHACKO, Harvard University; Luis VICEIRA, Harvard University; *September 1999*

N° 10: Assessing Asset Pricing Anomalies
Michael J. BRENNAN, University of California, Los Angeles; Yihong XIA, University of Pennsylvania; *July 1999*

N° 9: Recovery Risk in Stock Returns
Aydin AKGUN, University of Lausanne & FAME; Rajna GIBSON, University of Lausanne; *July 1999*

N° 8: Option pricing and replication with transaction costs and dividends
Stylianos PERRAKIS, University of Ottawa; Jean LEFOLL, University of Geneva; *July1999*

N° 7: Optimal catastrophe insurance with multiple catastrophes
Henri LOUBERGÉ, University of Geneva; Harris SCHLESINGER, University of Alabama; *September 1999*

N° 6: Systematic patterns before and after large price changes: Evidence from high frequency data from the Paris Bourse
Foort HAMELINK, Tilburg University; *May 1999*

N° 5: Who Should Buy Long-Term Bonds?
John CAMPBELL, Harvard University; Luis VICEIRA, Harvard Business School; *October 1998*

N° 4: Capital Asset Pricing Model and Changes in Volatility
André Oliveira SANTOS, Graduate Institute of International Studies, Geneva; *September 1998*

N° 3: Real Options as a Tool in the Decision to Relocate: An Application to the Banking Industry
Pascal BOTTERON, HEC-University of Lausanne; *January 2000*

N° 2: Application of simple technical trading rules to Swiss stock prices: Is it profitable ?
Dušan ISAKOV, HEC-Université de Genève; Marc HOLLISTEIN, Banque Cantonale de Genève; *January 1999*

N° 1: Enhancing portfolio performance using option strategies: why beating the market is easy.
François-Serge LHABITANT, HEC-University of Lausanne; *December 1998*

International Center FAME - Partner Institutions

The University of Geneva

The University of Geneva, originally known as the Academy of Geneva, was founded in 1559 by Jean Calvin and Theodore de Beze. In 1873, The Academy of Geneva became the University of Geneva with the creation of a medical school. The Faculty of Economic and Social Sciences was created in 1915. The university is now composed of seven faculties of science; medicine; arts; law; economic and social sciences; psychology; education, and theology. It also includes a school of translation and interpretation; an institute of architecture; seven interdisciplinary centers and six associated institutes.

More than 13'000 students, the majority being foreigners, are enrolled in the various programs from the licence to high-level doctorates. A staff of more than 2'500 persons (professors, lecturers and assistants) is dedicated to the transmission and advancement of scientific knowledge through teaching as well as fundamental and applied research. The University of Geneva has been able to preserve the ancient European tradition of an academic community located in the heart of the city. This favors not only interaction between students, but also their integration in the population and in their participation of the particularly rich artistic and cultural life. ***http://www.unige.ch***

The University of Lausanne

Founded as an academy in 1537, the University of Lausanne (UNIL) is a modern institution of higher education and advanced research. Together with the neighboring Federal Polytechnic Institute of Lausanne, it comprises vast facilities and extends its influence beyond the city and the canton into regional, national, and international spheres.

Lausanne is a comprehensive university composed of seven Schools and Faculties: religious studies; law; arts; social and political sciences; business; science and medicine. With its 9'000 students, it is a medium-sized institution able to foster contact between students and professors as well as to encourage interdisciplinary work. The five humanities faculties and the science faculty are situated on the shores of Lake Leman in the Dorigny plains, a magnificent area of forest and fields that may have inspired the landscape depicted in Brueghel the Elder's masterpiece, the Harvesters. The institutes and various centers of the School of Medicine are grouped around the hospitals in the center of Lausanne. The Institute of Biochemistry is located in Epalinges, in the northern hills overlooking the city. ***http://www.unil.ch***

The Graduate Institute of International Studies

The Graduate Institute of International Studies is a teaching and research institution devoted to the study of international relations at the graduate level. It was founded in 1927 by Professor William Rappard to contribute through scholarships to the experience of international co-operation which the establishment of the League of Nations in Geneva represented at that time. The Institute is a self-governing foundation closely connected with, but independent of, the University of Geneva.

The Institute attempts to be both international and pluridisciplinary. The subjects in its curriculum, the composition of its teaching staff and the diversity of origin of its student body, confer upon it its international character. Professors teaching at the Institute come from all regions of the world, and the approximately 650 students arrive from some 60 different countries. Its international character is further emphasized by the use of both English and French as working languages. Its pluralistic approach - which draws upon the methods of economics, history, law, and political science -reflects its aim to provide a broad approach and in-depth understanding of international relations in general. ***http://heiwww.unige.ch***

UNIVERSITÉ DE GENÈVE

HEI

UNIVERSITE DE LAUSANNE

FAME

INTERNATIONAL CENTER FOR
FINANCIAL ASSET MANAGEMENT AND ENGINEERING

40, Bd. du Pont d'Arve
PO Box, 1211 Geneva 4
Switzerland
Tel (++4122) 312 09 61
Fax (++4122) 312 10 26
http: //www.fame.ch
E-mail: admin@fame.ch

UNIVERSITÉ DE GENÈVE

THE GRADUATE INSTITUTE OF
INTERNATIONAL STUDIES

UNIVERSITÉ DE LAUSANNE