ON THE INCREASING IMPORTANCE OF INDUSTRY FACTORS:

IMPLICATIONS FOR GLOBAL PORTFOLIO MANAGEMENT

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Abstract: Previous studies that have examined the relative importance of industry and country factors in determining equity returns have generally concluded that country factors dominate industry factors. We present evidence that industry factors have been growing in relative importance and may now even dominate country factors. Furthermore, our evidence suggests that over the most recent five years, diversification across global industries provides greater risk reduction than diversification across countries. Taken together these findings suggest that industry allocation may become a more important consideration for active managers of global equity portfolios and that investors may wish to reconsider home biased equity allocation policies.

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Introduction

Understanding the factors that drive stock returns across countries has long challenged both academics and professional portfolio managers. Numerous studies (see for instance Grinold, Rudd, and Stefek (1989), Beckers, Grinold, Rudd, and Stefek (1992), and Beckers, Connor, and Curds (1996)) have postulated that security prices are determined by a global equity market factor, country specific factors, global and/or local industry factors, and common characteristic factors (for instance size, success, and value). Investment managers thus strive to construct portfolios that aim to maximize the return to risk tradeoff of these underlying factors. Lessard (1974, 1976) suggested that country factors are the dominant driver in security price returns. In his seminal research on the gains from international diversification, Solnik (1974) demonstrated that diversification across countries provides greater risk reduction than diversification across industries. Accepting these conclusions, traditional top down managers have adopted country selection as the critical tactical decision for portfolio construction.

Over recent decades, the decline in trade barriers resulting from the GATT agreements, the emergence of large trading blocks (the EC, NAFTA, and ASEAN), and increased economic policy coordination (in particular for EMU member countries) have fostered increasing economic integration among developed countries and have supported globalization of business enterprise. Thus, the relative importance of country factors may be diminishing as that of global industry factors is increasing. Freiman (1998) presents evidence that the correlation between European markets has on average tripled from the mid 1970s until the end of 1996. He concludes that "active portfolio managers will have increasing difficulty adding value using a top down strategy through country allocation." Indeed the increasing globalization of firms' revenues and operations and the increasing proportion of intra-industry mergers and acquisitions lend support to this thesis.[1] In this context, Brinson (1998) and Weiss (1998) have advocated the notion that global industry factors will constitute an increasingly important dimension of investment strategy.

The scope for active strategies along the industry dimension will be determined by the relative importance of industry factors in explaining security returns as well as by managers' ability to predict the future evolution of these factors. We review alternative measures of the relative importance of industry factors that have been documented in previous research. We then present a factor model of security returns and we describe new findings which suggest that industry factors are economically significant and are growing in importance relative to country factors. These findings imply that over the most recent five years, diversification across industries rather than across countries is a more effective tool for reducing the risk of global equity portfolios, though, clearly it behooves investors to diversify both across countries and across industries. The concluding section reviews the investment implications of these empirical regularities.

Measuring the Importance of Industry Factors

There is a growing literature aimed at quantifying the factor returns embedded in international security prices. Broadly speaking, each of these studies aims to estimate a factor model of security returns across countries. Some authors separate the effects of currency from country by examining return series in excess of the local risk free rate while others leave currency effects embedded within the country returns. Various statistics can then be obtained from the factor returns to review alternative hypotheses about the relative importance of industry and country factors. We review some of these statistics and the information they provide noting that inferences may be sensitive to the treatment of currency effects.

Nearly all authors examine the average R^2 model statistic to measure the extent to which the cross sectional variation of security prices can be explained by industry factors alone and by industry factors once one has accounted for other factors. In the studies we have reviewed the estimated R^2 statistics for a factor model comprised of global industry factors range from 5% (Beckers et. al. (1996)) up to 40% (Roll(1992)). [2] The marginal contribution of industry factors once one accounts for country factors ranges from 4% (Beckers et. al. (1996)) to 15% (Grinold et. al. (1989)). These results suggest that while industry factors alone may have accounted for an important proportion of the cross sectional variation of security returns, once country factors are included in the model, industry factors have added little explanatory power. However, the marginal R^2 statistic should be interpreted with caution because some of these factor model estimation procedures may bias this statistic downward for industries compared to countries. [3]

Another measure of the importance of industry factors examined in the literature focuses on the frequency with which industry factors have been significant contributors to excess returns. Recognizing that factor returns are estimated with some degree of uncertainty, statistical tests are applied at each point in time to assess whether industry factor returns are significantly different from zero. The studies report the proportion of time that one can conclude that an industry factor is different from zero with a reasonable degree of certainty. The values for this particular statistic range from a low of 9% (Beckers et. al. (1996)) to a high of 71% (Grinold et. al. (1989)). With increasing economic integration, one would expect this statistic to rise over time. This thesis is, however, not uniformly supported by the literature. Grinold et. al. (1989) report that thirty two of the thirty six industries they examined exhibited increasing significance over the period 1/86 to 12/88 as compared to the 1/83-12/85 period. On the other hand, Beckers et. al. (1996) report a decline in the average number of months for which industry factors are significant for the period 8/86-3/90 as compared to the 1/83-7/86 period.

A third measure of the importance of industry factors examined in the literature measures the volatility of the factor contribution of industries and of countries. Griffin and Karolyi (1998) and Heston and Rouwenhorst (1994, 1995) examine these statistics using a factor model that controls for differing industrial structure across countries and which we

reestimate in the section that follows. They find that country factors have been more volatile than global industry factors; the ratio of the median volatility of countries to the median volatility of industries ranges from 3.4 to 2.5. Thus, although these studies document significant industry factors, country factors dominate. A broader measure of the relative importance of country versus industry factors is obtained via the "average absolute effect" of each factor from a global perspective. Rouwenhorst (1999) finds that the average country effect is twice as large as that of the average industry effect; moreover he does not uncover any significant change in the relative importance of these effects in the most recent period of time (1993-1998) for European countries and EMU member countries. Urias (1998) computes analogous statistics.[4] However his results can be interpreted as supporting the view that the relative importance of industry factors has risen over time for European countries, and that industry factors are now larger in absolute size than country factors.

Further Evidence on the Increasing Importance of Industry Factors

On balance, the studies we have reviewed suggest that industry factors have been relatively less important than country factors. However, these conclusions are sensitive to the model that is estimated, the countries considered, the industry definitions utilized, and the time period that is analyzed. We estimate a factor model for 21 developed equity markets covering the period December 1985 through November 1999. We present evidence that industry factors have been growing in importance relative to country factors. This finding is not qualitatively inconsistent with some previous research. However, our results suggest that industry factors are now economically more important than country factors. Thus investors may wish to consider both the industry and the country dimension of their global equity strategy.

Data

The data we examined covers the twenty-one countries that comprise the current MSCI World Developed Markets universe. We utilized the Financial Times/Standard & Poors (FT/S&P) thirty-six industry level *national* total return indices to measure the performance of portfolios of securities belonging to the same industry within a country. Since not all industries are represented in every country this constitutes a data set that ranges from a minimum of 380 to a maximum of 425 industry portfolios covering our country universe over the sample period.

Our choice of countries stands in contrast to other recently published studies. Griffin and Karolyi (1998) include several emerging market countries in their global sample. Because these developing countries are less economically integrated with developed countries, their inclusion may distort the estimated relative importance of country factors to industry factors. Rouwenhorst (1999) examines only the countries within Europe. The increasing integration of developed country markets suggests that European regional models may provide imprecise estimates of global industry effects. For instance, because

Europe accounts for only 9% of the World computer software and hardware industry, the European regional factor returns may not provide representative estimates of the factor returns for this industry.

Our choice of industry definition also stands in contrast to Rouwenhorst (1999). The FT/S&P thirty-six industry classification provides a more homogeneous grouping of securities than Rouwenhorst's choice of seven broad industry categories; for instance the "consumer goods and services" industry category he utilizes aggregates the automobile, health and personal care, and computer software industries. In our analysis, these distinct economic activities are treated as separate industries.

Summary statistics for the data we utilize are presented in tables 1 and 2; for ease of exposition we have aggregated the country industry returns to obtain world industry returns on a capitalization weighted basis. Local, weekly total returns are obtained for the period 1986:01:01 through 1999:11:03; we use Wednesday to Wednesday closing prices. We computed and also report local returns in excess of the local risk free rate; the relevant daily one month Eurodeposit rates obtained from DRIFACS are utilized to proxy for the risk free rate.

Our empirical analysis is conducted on weekly local excess returns. Thus, our results can be viewed as currency hedged from any (developed market) investor's perspective. As demonstrated in Singer and Karnosky (1995) this follows from the arbitrage relationship that interest differentials equal the forward discount. We abstract from considerations of "optimal" currency hedge ratios.

Methodology

We utilize a factor model that focuses on the industry and the country characteristics of asset returns. More formally, define $R_i(t)$ to be the excess return on security *i* at time *t*, $A(t)$ to be a global factor return common to all securities determined at time *t*, $RS_j(t)$ to be the factor return on industry (sector) *j* at time *t*, $RC_k(t)$ to be the factor return on country *k* at time *t*, and $LS_{i,j}(t)$ and $LC_{i,k}(t)$ to be the factor loadings on the respective factor returns for asset *i* at time *t*, then:

$$(1) \quad R_i(t) = A(t) + LS_{i,j}(t) \cdot RS_j(t) + LC_{i,k}(t) \cdot RC_k(t) + \varepsilon_i(t)$$

Note that the above formulation abstracts from other common charateristic factors of security returns as for instance, size and value, (see Grinold, Rudd, and Stefek (1989)) or macro-economic factors (see Chen, Roll, and Ross (1986)). As in Heston and Rouwenhorst (1995) and Griffin and Karolyi (1998), we postulate that factor loadings are fixed over time with values of zero or one; furthermore, the return on security *i* is affected by the global factor, the industry and country factor to which the stock belongs, and an idiosyncratic disturbance. Thus, consider the return for security *i* that belongs to industry *j* in country *k*, equation *(1)* can then be rewritten as:

(2) $$R_i(t) = A(t) + RS_j(t) + RC_k(t) + \varepsilon_i(t)$$

The above model provides a tractable but somewhat restricted representation of economic reality. Most notably we assumed that industry effects are global in nature while there may be strong regional effects due to differences in capital-labor ratios across countries. Furthermore, securities in the same country have similar exposures to domestic and global factors; thus, Ford and Winn-Dixie Stores are affected by the US and the global factor in the same fashion; this is somewhat unrealistic given the different exposure of each company to non US factors as reflected, for instance, in each company's proportion of foreign sales to total sales.[5] Finally, we abstract from any company style factors; however, casual observation suggests that the recent performance of some of these factors, as for instance "size", have been rather unstable. The results of our empirical analysis are thus conditioned on the extent to which our estimates of the country and industry factors are independent of company characteristic factors and the extent to which our simplifying assumptions provide a sufficiently close representation of economic phenomena.

The framework outlined in equation *(2)* above enables us to determine the relative importance of country and industry factors in driving security returns. Excess returns on securities are "observable"; we need to estimate the "unobservable" factor returns for the purposes of inference. This can be obtained via cross sectional regressions with indicator variables proxying for the factor loadings. More specifically, define $S_j(t)$ to be a dummy variable defined as one if security *i* belongs to industry *j* and zero otherwise (with *j = 1,2…36*), $C_k(t)$ to be a dummy variable defined as one if security *i* belongs to country *k* and zero otherwise (with *k = 1,2, ... 21*), then the following model can be fitted:

(3) $$R_i(t) = A(t) + \beta_j(t) \cdot S_j(t) + \gamma_k(t) \cdot C_k(t) + \varepsilon_i(t)$$

Fitting equation (3) across securities at a given point in time T will yield estimates of $\beta_j(T)$ for *j = 1, 2,...36* and $\gamma_k(T)$ for *k = 1, 2,…21*, and these can be interpreted as the empirical estimates of the industry factor returns $RS_j(T)$ and the country factor returns $RC_k(t)$. This cross sectional regression can then be estimated over time to obtain a time series of $\hat{R}S_j(t)$ and $\hat{R}C_k(t)$.

Estimating equation *(3)* via ordinary least squares is not possible as the design matrix exhibits perfect multicollinearity. We thus impose the additional restriction that:

(3a) $$\sum_j W_j(t-1) \cdot \beta_j(t) = 0$$

(3b) $$\sum_k V_k(t-1) \cdot \gamma_k(t) = 0$$

Where $W_j(t)$ and $V_k(t)$ represent the capitalization weights (in our world portfolio of 21 developed countries) of industry *j* and country *k* at time *t*. Imposing these restrictions and estimating the equation via weighted least squares (where the weights on the observations equal the capitalization weights) will ensure that $A(t)$ equals the capitalization weighted return on the world portfolio. In practice, the model is estimated with 35 industry dummies and 20 country dummies and the remaining parameter estimates are obtained via the appropriate matrix algebra transformations. [6]

The resulting model estimates of $\beta_j(t)$ and $\gamma_k(t)$, which are often referred to as the "pure" industry and "pure" country returns have useful investment interpretations. The industry return $\hat{A}(t)+\hat{\beta}_j(t)$ represents the return on a *geographically* diversified portfolio in industry *j*. Namely the geographical composition of $\hat{\beta}_j(t)$ equals that of the world portfolio. Similarly, $\hat{A}(t)+\hat{\gamma}_k(t)$ equals the return on country *k* with the same industry composition as that of the world portfolio. As Heston and Rouwenhorst (1995) argue, the $\beta_m(t)$ can be interpreted as the return in excess of benchmark at time *t* from a tilt in global industry *m* with neutral country exposure, and simlarly $\gamma_n(t)$ can be interpreted as the return in excess of benchmark at time *t* from a tilt in country *n* with neutral industry exposure. It follows that this framework is particularly useful for portfolio return attribution. Thus consider the capitalization weighted return for country *k* at time *t*:

$$(4) \qquad R_k(t) = \hat{A}(t) + \sum_j Z_{k,j}(t-1)\cdot\hat{\beta}_j(t) + \hat{\gamma}_k(t)$$

where $Z_{k,j}(t)$ equals the capitalization weight of industry *j* in country *k* at time *t*, and thus $\sum_j Z_{k,j}(t) = 1.0$. Interpreting equation (4), the return in country k in excess of the world index, $\hat{A}(t)$, is determined by $\hat{\gamma}_k(t)$, the extent to which companies in country *k* outperformed their industry peers in the rest of the world, and by the Z's which measure the extent to which the industry composition of country *k* differs from that of the world index. We thus note that several highly successful companies located in one country may generate a high country specific return. Consider for instance Nokia and UPM-Kymmene; it is in fact difficult to ascertain quantitatively whether their success is "idiosyncratic" or rather reflects a "structural" Finnish factor.

Before proceeding to review our results, we note that our estimates of the $\beta_j(t)$ and $\gamma_k(t)$ are obtained from industry level return series within our 21 country universe. Griffin and Karolyi (1998) demonstrate that the point estimates from this estimation are equal to those obtained from individual security returns. Some intuition for this result can be obtained by noting that the Heston and Rouwenhorst (1994) framework aims to explain how much of the cross sectional dispersion of "individual" security returns is accounted for by differences in the dispersion of returns for "groups" of securities (countries and industries). Our regression estimates provide a measure of the mean

difference of returns for two alternative "groupings" of securities - country and industry based groupings. These mean differences can be obtained either from an average of the mean of the "individuals" or from the means of the groups; the approaches are computationally equivalent.

Empirical Results

In table 3 we present summary statistics for cross sectional estimates of the factor returns (the $\hat{A}$, $\hat{\beta}$'s, $\hat{\gamma}$'s) for the period 1986:01:01- 1999:11:03. We also present summary statistics for three subperiods. We review the results of the factor model estimation with a view to examining recent financial market trends and in particular with a view to quantifying the relative importance of industry and country factors in determining investment performance.

The mean return estimates can be utilized to understand the relative performance of various markets. Thus the recent underperformance of Japan relative to the world index is largely attributable to a country wide factor rather than an industry structure that differs from that of the rest of the world; similarly, the recent underperformance of the Australian market is largely attributable to its large exposure to basic goods.

Mean factor return estimates, or more precisely the time series of factor returns can be utilized to measure the opportunities for outperforming the world index with systematic industry or country based tilts. Rouwenhorst (1999) proposes the mean absolute deviation (MAD) as a measure of the relative importance of industry and country factors. One can think of the MADs as the capitalization weighted returns of perfect foresight strategies that are exclusively based on either industry or on country tilts. In a sense, this statistic captures how "mad" an investor can be for having missed out on being on the right side of the market. More formally, the industry MAD is defined as:

$$(5) \qquad MAD(t) = \sum_j W_j(t-1) \cdot |\hat{\beta}_j(t)|$$

and analogously for countries. In figure 1 we plot a 52 week moving average of the industry and country MADs. Rouwenhorst (1999) finds that country based tilts (denominated in German Marks and as captured by the MAD measure) have always dominated industry based tilts in Europe for the period 1978-1998. Our results are significantly different. We find that since early 1997, the return opportunities from industry tilts have dominated those emanating from country tilts; since that time they have grown increasingly larger as is reflected in the dark line in figure 2 where we have ploted the ratio of industry effects to country effects over time.

The risk profile of our factor returns is also markedly different from that reported by Rouwenhorst (1999). He finds that the standard deviation of most country factors (the $\hat{\gamma}$'s) are larger than even the most volatile industry factor. We find that in several instances industry factors are more volatile than country factors. Thus, for instance, the oil industry factor returns are more volatile (12.5% annualized standard deviation for the

period 12/31/85-11/03/99) than the Dutch country factor returns (11.9% annualized standard deviation for the period 12/31/85-11/03/99).

It is important to note that the difference in our results most probably does *not* originate from the differing industry granularity of the data. In particular, for instance, the "energy sector" in Rouwenhort's analysis is comprised of our oil and non-oil energy industries. Table 4 provides the correlation of the factor returns across industries. Broadly speaking, and not surprisingly, industry factor returns belonging to the same sector are more highly correlated among themselves than across sectors. In the particular case of the energy sector, the component industries exhibit high volatility of returns (12.5% and 21.2% for the 12/31/95-11/03/99 period – table 3) and a high correlation in returns (0.55 for the 12/31/85-11/03/99 period – table 4).

To further explore the impact of the industry granularity on our results, we examined a factor model of 21 countries and 21 industries. Industries were grouped on the basis of economic fundamentals rather than the historical correlation matrix; thus for instance the auto parts industry was grouped with auto components and consumer durables, and the computer and office equipment industry was grouped with software. In figure 2 we plot the ratio of the resulting industry MAD to the country MAD; clearly, industry granularity does not affect the result that industry factors have grown increasingly important relative to country factors.[7]

Factor model estimates can also be utilized to draw inferences about the relative merits of international diversification strategies across industries and across countries. Figure 3 provides a time series plot of the capitalization weighted correlations of country factor returns using a rolling 52 week window of data. [8] The graph confirms the findings of Beckers, Connor, and Curds (1996) and Solnik and Roulet (1999); namely increasing economic integration has been associated with a rise in the correlation of country factor returns.[9] This would suggest that the gains from diversifying across countries are likely to be diminishing. A similar plot for the capitalization weighted correlation of the industry factor returns (figure 3) shows that these have been relatively stable over the recent decade. By 1999:11:03, the capitalization weighted correlation of country factor returns equaled that of industries using the most recent 52 week window of data.

Heston and Rouwenhorst (1995) illustrate how their factor model can be exploited to re-examine Solnik's (1974) insight into the gains from international diversification. Assume that the average security has an annualized variance of $(28.8)^2$.[10] An equally weighted portfolio of n such securities will have a variance of $(28.8)^2/n$ plus $(n-1)/n$ multiplied by the average covariance of these securities. As n increases in size, the variance of the portfolio is primarily determined by the average covariance of the securities. Thus, the ratio of the average covariance of the securities to the average security variance provides the "limits" from the gains of diversification. The average covariance for a large group of stocks is equal to the variance of an equally weighted index; a capitalization weighted index covering a large number of securities can provide a close approximation to the equally weighted index. The world index thus provides a benchmark for alternative diversification strategies.

As discussed in our review of the factor model, the sum of $\hat{A}(t)$ and $\hat{\gamma}_k(t)$ can be viewed as the returns from a strategy that is diversified across industries. Similarly the sum of $\hat{A}(t)$ and $\hat{\beta}_j(t)$ can be viewed as the returns from a strategy that is diversified across countries. Following Heston and Rouwenhorst (1994) we compute the capitalization weighted volatility of these factor returns for our universe of securities for the period 12/31/85-12/31/94; these parameter estimates can then be utilized to obtain the previously documented empirical regularity that diversification across countries dominates diversification across industries as illustrated in figure 4a.[11] However, as suggested by the results we have presented, a marked structural change in the importance of country and industry factors has been exhibited in relative asset returns over the past several years. The volatility estimates using the last five years of data (11/03/94-11/03/99), suggest, as illustrated in figure 4b, that the gains from diversifying across industries are slightly superior to those from diversifying across countries. In figure 4c we show that volatility estimates obtained using a 52 week history (11/11/98-11/03/99) imply that the gains from diversifying across industries are now larger than the gains from diversifying across countries. Clearly, however it is beneficial to diversify across both factors.

An alternative way of examining the gains from diversifying across industries and across countries considers exploiting the factor structure of equity returns. The model we have estimated suggests that both the volatility *and* the return of securities vary by country and by industry. Portfolios that aim to maximize the Sharpe ratio will thus reflect the return to risk tradeoffs of alternative strategies. Table 5 reports the maximal historical Sharpe ratios that are obtained from three different strategies that take positions in (1) industries only, (2) countries only, and (3) industries and countries. The optimizations are conducted utilizing the historical variance-covariance matrix estimated over the full sample period (1/1/86-11/03/99) and the historical mean returns for the full sample period as reported in table 3. We allow short sales. Since we recognize that the results of such portfolio construction exercises are driven by the mean return vector, we also examine the Sharpe ratio portfolios under the agnostic assumption that the mean country and industry factor return vectors are zero; in some sense, this second experiment is analogous to that performed in figure 4 but it allows short sales and is independent of the weighing scheme which Heston and Rouwenhorst (1994) utilize or that we utilize. The Sharpe ratios of the industry factor portfolios dominate those of the country factor portfolios, and diversification across industries and across countries is clearly most optimal. Thus, our results suggest that industries provide interesting risk and return tradeoffs for the global investor.

Conclusions

We have reviewed and extended the empirical evidence relating to the economic importance of global industry factors and their growing importance relative to country factors in determining security returns across countries. Past studies generally demonstrated that both country and industry factors have been significant determinants of equity security returns and that country factors have been relatively larger in magnitude. Previous evidence with regards to the growing relative importance of industry factors appears mixed. However, our results suggest that industry factors have become an increasingly important component of security returns. More importantly, diversification across industries now provides greater risk reduction benefits than diversification across countries. Given the increasing geographical integration of markets we expect these phenomena to persist and even strengthen.

Several implications for passive and active portfolio management may be drawn from our analysis. First, unintended industry exposures that result from equity benchmarks that are biased towards the home market may result in increasingly inefficient global asset allocations. Consider for instance the UK market. It has a small exposure to the information technology industry (about 1.5%) as compared to the World market (about 11.3%). A home biased UK portfolio would explicitly tilt the portfolio away from the global allocation to the information technology industry. The empirical evidence that we have presented suggests that such a tilt would materially impact the return to risk for this investor. Second, active global equity investment management will increasingly need to balance the return to risk tradeoffs of global industry allocations in addition to country allocations. [12] Finally, in this context, stock selection opportunities may increasingly reside in relative comparisons of stocks across countries but within common global industries. This will be explored in our next paper.

ENDNOTES

1. The increased globalization of firms' activities is reflected, in part, by the increasing importance of foreign sales as a percentage of total sales; this ratio has risen from 24% in 1988 to 31% in 1998 for the constituents of the Morgan Stanley Capital International World index. Intra-sector mergers and acquisitions as a percentage of total cross-border mergers and acquisitions have risen from 51% for the period 1989-1993 to 64% for the period 1994-1999Q1.

2. The estimate obtained by Roll is probably biased upwards as he is unable to separate the world equity factor from the world industry factors.

3. Factor models are often estimated in a sequential fashion. Namely, regressions of equity returns onto country market returns are fitted and the residuals from this first pass regression are then fitted to industry index returns. Alternatively, the first pass regression is utilized to obtain a factor loading on the country market return and the second pass regression imposes factor loadings obtained from observable variables. The limitations of this approach may be appreciated when one considers Nokia which represents 70% of the market capitalization of the Finish market. Clearly, the residuals of the first pass regression for this security will be relatively small and thus it will appear that the electronics and instrumentation industry return accounts for a relative small proportion of Nokia's volatility. If one were to reverse the order of the two pass regressions, thus regressing Nokia's return on its industry returns first, it is quite likely that the variance decomposition would ascribe greater explanatory power to the industry return.

4. Urias (1998) postulates that the return on a security i is determined by either the country or the industry to which it belongs. He utilizes observable country and index returns that are scaled to have the same variance; the estimated factor loadings thus measure the relative importance of the country and industry factors. He computes the capitalization weighted sum of the factor loadings and finds that the weighted industry beta has risen over time and has recently exceeded the weighted country beta. This result holds for the 16 European countries examined as well as for the subset of EMU member countries.

5. Marsh and Pfleiderer (1997) utilize a framework that is similar to that represented by equation (1), and they provide evidence suggesting that factor loadings differ across industries.

6. A technical appendix outlining the appropriate matrix manipulations is available on request from the authors.

7. The factor model we have presented allows for a convenient exploration of alternative groupings of countries and industries; factor returns for groups of industries can be estimated by weighted least squares imposing constraints on the relevant dummy variables.

8. The data utilized for this analysis consists of the sum of the country factor returns with the world return. The weighing matrix for the estimated correlations is obtained from the cross product of the capitalization; the cross products are then rescaled so that the sum of the weights adds to one. An equal weighted scheme yields similar results.

9. Beckers, Connor, and Curds (1996) estimate various measures of relative variability that formally test the increasing integration of markets. In brief, these measures quantify the extent to which the cross sectional dispersion of returns is accounted for 1by industry and by country factors. We have estimated these measures and our results are similar to theirs though with higher statistical significance. These results are available on request from the authors.

10. This estimate was obtained from the capitalization weighted volatility of the constituents of the FT World Index (covering the 21 countries in our universe) at 10/31/99. The volatility for each security was obtained from the most recent 60 months of data (where available). This estimate is however relatively unimportant for the presentation of figures 4a, 4b, 4c as it serves to scale the gains from alternative diversification strategies.

11. Heston and Rouwenhorst (1994) weigh the volatilities by the number of securities in each country. We utilize the capitalization weights to maintain broad consistency with the results we have presented.

12. Cavaglia et. al. (1995) present evidence that suggests that industry returns across countries are predictable. Active asset allocation strategies can be developed to exploit this anomaly.

REFERENCES

Beckers, Stan, Richard Grinold, Andrew Rudd, and Dan Stefek. 1992. "The Relative Importance of Common Factors across the European Equity Markets." *Journal of Banking and Finance*, Vol. 16, no. 1 (February): 75-95.

Beckers, Stan, Gregory Connor, and Ross Curds. 1996. "National versus Global Influences on Equity Returns." *Financial Analysts Journal*. Vol. 52, no. 2 (March/April): 31-39.

Brinson, Gary. 1998. "Investment Management in the 21st Century". *The Future of Investment Management.*

Cavaglia, Stefano, Dimitris Melas, and Osamu Miyashita. 1994. "Efficiency Across Frontiers". *Risk*. Vol. 7, no. 10 (October 1994): 56-61.

Cavaglia, Stefano, Dimitris Melas, George Tsouderos, and Keith Cuthbertson. 1995. "Industrial Action". *Risk*. Vol. 8, no. 5 (May 1995): 32-36.

Cavaglia, Stefano, Dimitris Melas, and George Tsouderos. 2000. "Cross-Industry and Cross-Country International Equity Diversification". *The Journal of Investing*. Vol. 9, no. 1 (Spring 2000): 65-71.

Chen, Nai-fu, Richard Roll, and Steven Ross. 1986. "Economic Forces and the Stock Market" *Journal of Business*. Vol. 59, no. 3 (July 1986): 386-404.

Drummen, Martin and Heinz Zimmermann. 1992. "The Structure of European Stock Returns." *Financial Analysts Journal.* Vol. 48, no. 4 (July/August): 15-26.

Freiman, Eckhard. 1998. "Economic Integration and Country Allocation in Europe." *Financial Analysts Journal*. Vol. 54, no. 5 (September/October): 32-41.

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

Griffin, John M. and G. Andrew Karolyi. 1998. "Another Look at the Role of the Industrial Structure of Markets for International Diversification Strategies." *Journal of Financial Economics*, Vol. 50, no. 3 (December): 351-373.

Heston, Steven L. and K. Geert Rouwenhorst. 1994. "Does Industrial Structure Explain the Benefits of Industrial Diversification?" *Journal of Financial Economics*, Vol. 36, no. 1 (August): 3 –27.

Heston, Steven L. and K. Geert Rouwenhorst. 1995. “Industry and Country Effects in International Stock Returns.” *Journal of Portfolio Management*, Vol. 21, no. 3 (Spring): 53-58.

King, Benjamin. 1966. “Market and Industry Factors in Stock Price Behavior” *Journal of Business*. Vol. 44 (January): 139-190.

Lessard, Donald. 1976. “World, Country, and Industry Relationships in Equity Returns: Implications for Risk Reduction through International Diversification.” *Financial Analysts Journal*. Vol. 32, no. 1 (January/February): 32-38.

Lessard, Donald. 1974. “World, National, and Industry Factors in Equity Returns”. *Journal of Finance*. Vol. 29, no. 3 (May): 379-391.

Lin, Weling. 1999. “Risk Contributors: Country versus Industry.” *Frank Russell Research Commentary*.

Marsh, Terry and Paul Pfleiderer.1997. “The Role of Country and Industry Effects in Explaining Global Stock Returns.” *Working Paper*.

Roll, Richard. 1992. “Industrial Structure and the Comparative Behavior of International Stock Market Indices” *Journal of Finance*. Vol. 47, no. 1 (March): 3-42.

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

Singer, Brian and Denis Karnosky, 1995. “The General Framework for Global Investment Management and Performance Attribution.” *Journal of Portfolio Management*, Vol. 21 no.2 (Winter): 84-92.

Solnik, Bruno. 1974. “Why not Diversify Internationally Rather than Domestically.” Financial Analyst Journal, Vol. 30: 48-54.

Solnik, Bruno and Jacques Roulet, 1999. “Dispersion as Cross-Sectional Correlation: Are Stock Markets Becoming Increasingly Correlated?” *Working Paper*.

Urias, Michael, Yazid Sharaiha, and Robert Hendricks. 1998. “European Investing after EMU: Industry and National Effects in Equity Returns.” *Morgan Stanley Dean Witter Global Equity Derivative Markets.* (June): 17-42.

Weiss, Andrew. 1998. “Global Industry Rotation: New Look at an Old Idea.” *Financial Analysts Journal*, Vol. 54, no. 3 (May/June): 6-8.

Table 1:

COUNTRY RETURNS

(12/31/85-11/03/99)

Country	total returns (local) mean	total returns (local) standard deviation	excess returns (local) mean	excess returns (local) standard deviation	minimum number of companies	maximum number of companies	average market capitalization
Australia	13.3	18.3	3.3	18.3	68	96	1.4%
Austria	6.3	20.5	0.5	20.6	12	27	0.1%
Belgium	16.1	15.9	8.7	16.0	21	65	0.7%
Canada	10.4	14.1	2.8	14.1	98	135	2.1%
Denmark	12.0	15.1	3.7	15.2	30	39	0.3%
Finland	25.6	25.7	16.3	25.8	0	29	0.2%
France	16.2	19.7	8.3	19.8	70	131	3.1%
Germany	9.8	19.2	3.9	19.3	51	102	3.7%
Hong Kong	17.5	28.6	10.7	28.6	43	69	1.4%
Ireland	18.9	21.6	9.3	21.6	11	19	0.2%
Italy	12.0	24.2	1.5	24.3	52	102	1.6%
Japan	4.1	20.5	0.6	20.6	441	485	28.3%
Netherlands	16.9	16.6	10.5	16.6	19	43	1.8%
New Zealand	6.6	20.3	-4.0	20.4	13	31	0.2%
Norway	9.2	23.0	0.0	23.1	22	41	0.1%
Singapore	12.0	28.8	8.0	28.8	24	48	0.3%
Spain	20.9	21.4	9.1	21.5	29	55	1.0%
Sweden	22.0	22.3	11.9	22.4	25	50	0.8%
Switzerland	12.6	18.1	7.8	18.1	28	68	2.0%
United Kingdom	15.9	15.8	6.1	15.8	195	354	10.1%
United States	17.4	15.3	10.6	15.3	503	656	40.9%

Notes:

1) Mean returns represent the annual geometric rate of return over the estimation period.
2) The standard deviation of returns is stated on an annualized basis and is computed from the weekly standard deviations of the logarithmic returns mutiplied by the square root of 52.0.
3) The average market capitalization is a time weighted capitalization measure over the sample.

Table 2:

Global Industry Returns
(12/31/85-11/03/99)

	total returns (local) mean	total returns (local) standard deviation	excess returns (local) mean	excess returns (local) standard deviation	minimum number of companies	maximum number of companies	average market capitalization
Commercial Banks	10.3	19.7	4.7	19.7	124	185	12.4%
Financial Instit	11.5	23.7	5.6	23.7	70	100	3.7%
Insurance Life	15.8	16.9	7.8	17.0	19	30	0.7%
Insurance Prop	11.9	16.1	5.2	16.1	66	89	3.7%
Real Estate	7.4	21.3	1.1	21.3	53	72	1.3%
Diversified Hold	13.1	16.2	5.3	16.3	24	75	1.8%
Oil	15.0	14.6	7.8	14.6	57	71	5.8%
Non-Oil Energy	9.2	25.0	2.7	25.0	13	20	0.5%
Utilities	15.5	12.7	8.8	12.7	118	158	10.4%
Transport/Store	6.3	15.8	1.0	15.8	74	98	2.8%
Automobiles	9.9	17.8	4.5	17.8	25	31	3.0%
House Dur/Applia	7.6	21.8	3.2	21.8	25	30	1.3%
Div.Cons G./Srv.	12.2	18.1	5.4	18.1	9	26	0.6%
Textiles/Apparel	6.7	17.6	1.1	17.6	21	48	0.5%
Beverage/Tobacco	16.2	15.1	8.9	15.1	45	71	3.5%
Health/Pers Care	18.5	15.6	11.8	15.6	77	96	7.2%
Food/Grocery Pro	14.7	12.8	8.1	12.9	80	116	3.7%
Entert/Leis/Toys	10.1	14.8	4.0	14.8	56	74	2.1%
Media	14.5	15.3	7.6	15.3	54	73	2.3%
BusSrvs/CompSoft	23.3	21.4	16.5	21.5	21	61	1.4%
Retail Trade	14.8	14.7	8.0	14.7	100	115	4.6%
Wholesale Trade	5.8	20.9	1.3	21.0	26	35	1.0%
Arospace/Defence	10.0	17.4	3.5	17.4	11	30	0.8%
Comp/Comm/Office	13.1	20.8	6.7	20.8	42	68	3.6%
Electrical Equip	15.6	16.1	9.4	16.2	32	50	2.7%
Electronics/Inst	14.2	22.1	8.6	22.1	53	73	3.0%
Machine&EngiSrvs	7.6	16.3	1.8	16.3	66	94	1.7%
Auto Components	8.3	16.0	2.8	16.0	38	56	1.0%
Diversified Inds	12.1	15.3	5.0	15.4	31	48	1.4%
HeavyEngin/Shipb	3.6	23.9	-0.6	23.9	15	24	0.6%
Constr/Build Mat	6.0	17.1	0.3	17.1	84	131	2.4%
Chemicals	10.4	15.2	4.4	15.2	80	120	3.9%
Mining/Metal/Min	6.8	17.7	0.8	17.7	64	92	2.4%
PreciousMeta/Min	2.9	23.6	-3.7	23.7	19	29	0.4%
Forestry/PaperPr	9.9	17.6	3.3	17.6	50	67	1.4%
Fabric MetalProd	6.1	17.8	0.5	17.6	11	35	0.4%

TABLE 3:

PURE FACTOR RETURNS

	MEAN RETURNS				VOLATILITY OF RETURNS			
	12/31/85	12/31/85	12/26/90	12/27/95	12/31/85	12/31/85	12/26/90	12/27/95
	11/03/99	12/26/90	12/27/95	11/03/99	11/03/99	12/26/90	12/27/95	11/03/99
World	6.6	2.7	4.8	14.3	13.5	15.6	10.3	14.3
Commercial Banks	0.3	-1.5	3.6	-1.7	10.6	12.8	8.8	9.3
Financial Instit	1.1	-3.5	3.3	4.5	12.0	13.7	9.6	12.6
Insurance Life	-0.4	-3.0	-1.1	4.0	8.5	8.9	8.0	8.5
Insurance Prop	-0.7	-1.0	0.2	-1.4	6.8	6.9	5.7	7.9
Real Estate	-4.1	-3.0	-1.4	-9.0	10.4	13.0	7.5	9.9
Diversified Hold	-2.1	-2.2	1.1	-6.0	6.8	5.9	5.2	9.3
Oil	-1.3	4.7	-3.4	-5.8	12.5	12.9	9.5	15.0
Non-Oil Energy	-5.6	-0.3	-7.8	-9.3	21.2	17.3	16.2	29.6
Utilities	0.2	0.3	-1.4	2.4	8.5	10.0	6.3	8.8
Transport/Store	-3.7	-1.9	-1.4	-8.8	7.3	9.4	5.1	6.7
Automobiles	0.8	-3.7	3.7	3.2	10.7	11.0	9.8	11.5
House Dur/Applia	-0.1	-4.3	0.7	4.3	16.3	21.5	11.7	13.5
Div.Cons G./Srv.	-4.3	1.4	-0.4	-15.5	10.3	8.5	8.3	13.9
Textiles/Apparel	-3.5	-0.4	-3.5	-7.4	9.9	8.5	7.5	13.7
Beverage/Tobacco	0.6	11.6	-0.4	-10.8	9.3	7.6	8.2	12.0
Health/Pers Care	2.5	4.1	1.6	1.6	8.4	7.1	9.0	9.0
Food/Grocery Pro	-0.5	5.4	-2.8	-4.8	7.5	6.3	6.3	9.8
Entert/Leis/Toys	-2.6	-1.0	-1.1	-6.3	7.6	7.7	6.2	9.0
Media	-0.4	-1.6	-0.2	0.8	6.7	7.1	4.9	8.1
BusSrvs/CompSoft	7.7	-1.8	12.2	15.2	13.6	12.5	13.0	15.4
Retail Trade	0.9	2.0	-2.2	3.6	7.0	6.8	6.2	8.1
Wholesale Trade	-1.6	1.1	-2.5	-3.7	11.2	13.9	7.9	10.8
Arospace/Defence	-6.1	-6.4	4.7	-18.2	12.1	8.4	9.7	17.4
Comp/Comm/Office	-0.2	-9.2	-3.5	17.6	13.1	10.5	10.8	17.6
Electrical Equip	1.8	-1.2	0.5	7.5	7.3	7.5	6.3	8.2
Electronics/Inst	3.3	-6.2	5.7	13.7	15.8	16.9	11.7	18.7
Machine&EngiSrvs	-3.3	2.4	-2.9	-10.7	8.5	8.8	6.3	10.4
Auto Components	-1.2	-0.8	1.9	-5.6	8.0	8.4	6.6	9.2
Diversified Inds	-2.5	-2.6	0.7	-6.5	7.4	7.9	5.9	8.4
HeavyEngin/Shipb	-2.6	7.1	0.0	-16.7	15.0	20.1	9.2	13.1
Constr/Build Mat	-3.5	5.1	-4.9	-11.8	9.0	10.3	6.4	9.9
Chemicals	-2.0	-1.9	1.8	-7.0	7.0	6.9	5.2	8.9
Mining/Metal/Min	-3.2	5.1	-2.1	-14.2	11.1	13.1	7.6	11.9
PreciousMeta/Min	-9.3	-4.3	-0.1	-25.5	22.2	21.2	18.8	26.8
Forestry/PaperPr	-3.8	3.0	-3.5	-12.2	10.9	8.9	8.8	14.9
Fabric MetalProd	-4.1	1.2	-1.9	-13.1	10.2	9.7	8.1	12.7
Australia	-2.2	-7.8	3.6	-2.0	15.1	19.1	12.0	12.8
Austria	-4.8	1.7	-13.0	-1.8	19.5	24.9	16.8	14.1
Belgium	1.5	-0.7	0.1	6.3	13.9	16.8	11.0	13.1
Canada	-3.4	-8.6	-1.6	1.4	9.9	11.2	9.5	8.3
Denmark	-4.2	-3.6	-9.6	2.3	15.2	16.1	14.6	14.8
Finland	8.4	-11.6	4.7	32.7	22.1	17.4	25.3	20.7
France	1.5	-1.0	-3.8	12.6	14.9	18.8	12.5	11.7
Germany	-2.1	-6.7	-4.4	7.3	14.4	17.4	12.9	11.4
Hong Kong	5.4	7.4	18.1	-11.3	24.7	26.4	23.1	24.2
Ireland	3.0	-0.4	2.1	8.9	17.8	19.7	16.3	17.0
Italy	-4.4	-8.6	-7.1	5.1	21.5	22.5	22.3	18.9
Japan	-5.1	4.3	-8.1	-12.5	14.1	12.2	14.0	16.4
Netherlands	3.6	-5.8	6.6	13.0	11.9	12.3	9.5	13.9
New Zealand	-10.0	-20.1	4.5	-13.7	19.4	23.5	16.3	16.9
Norway	-4.7	-7.2	-4.3	-2.0	19.4	21.9	19.2	16.0
Singapore	1.9	9.2	8.6	-14.1	24.0	25.1	18.0	28.9
Spain	2.1	-0.8	-4.0	14.7	17.9	21.2	15.7	15.7
Sweden	5.1	1.9	5.4	8.8	17.4	19.8	17.2	13.9
Switzerland	0.2	-11.7	7.8	7.2	14.1	16.5	12.1	12.8
United Kingdom	-0.7	-3.1	2.9	-2.0	11.3	13.3	10.5	9.4
United States	3.2	0.7	6.3	2.7	7.8	9.3	7.5	5.7
Cap-Weighted Industry					9.7	10.3	7.8	10.9
Cap-Weighted Country					11.6	12.2	11.1	9.8

Notes:
All of the summary statistics are stated on an annualised basis as in tables 1 and 2.

TABLE 4: PURE FACTOR CORRELATIONS
1985-1999

		WOL	I01	I02	I03	I04	I05	I06	I07	I08	I09	I10	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20	I21	I22	I23	I24	I25	I26	I27	I28	I29	I30	I31	I32	I33	I34	I35	I36
World	WOL	1.00																																				
Commercial Banks	I01	0.20	1.00																																			
Financial Instit	I02	0.53	0.36	1.00																																		
Insurance Life	I03	0.02	0.02	0.11	1.00																																	
Insurance Prop	I04	0.19	0.33	0.33	0.38	1.00																																
Real Estate	I05	0.15	0.04	0.22	0.04	0.18	1.00																															
Diversified Hold	I06	0.01	-0.10	0.03	0.11	0.07	0.16	1.00																														
Oil	I07	-0.35	-0.14	-0.32	-0.19	-0.27	0.00	-0.11	1.00																													
Non-Oil Energy	I08	-0.03	-0.08	-0.13	-0.13	-0.17	0.06	-0.05	0.55	1.00																												
Utilities	I09	-0.38	-0.22	-0.12	0.09	-0.01	0.07	0.03	0.12	-0.11	1.00																											
Transport/Store	I10	-0.04	-0.19	-0.03	0.10	0.07	0.22	0.12	-0.01	0.04	0.10	1.00																										
Automobiles	I11	0.04	-0.28	-0.06	-0.01	-0.11	-0.14	0.08	-0.11	0.00	-0.22	-0.06	1.00																									
House Dur/Applia	I12	0.01	-0.33	-0.18	-0.04	-0.20	-0.24	0.03	-0.07	0.05	-0.28	-0.21	0.52	1.00																								
Div.Cons G./Srv.	I13	-0.02	-0.06	-0.06	-0.08	-0.02	0.15	0.10	0.16	0.11	0.08	0.10	-0.01	0.01	1.00																							
Textiles/Apparel	I14	-0.01	-0.13	-0.12	0.01	-0.11	-0.05	0.08	0.02	0.02	-0.13	0.17	0.06	0.03	0.15	1.00																						
Beverage/Tobacco	I15	-0.17	-0.12	-0.18	-0.02	-0.10	0.04	0.07	0.02	-0.11	0.14	0.07	-0.14	-0.11	0.11	0.11	1.00																					
Health/Pers Care	I16	-0.07	-0.19	-0.11	-0.02	-0.12	-0.11	-0.06	-0.14	-0.19	-0.07	-0.12	-0.14	0.01	-0.12	0.00	0.26	1.00																				
Food/Grocery Pro	I17	-0.36	-0.19	-0.33	0.03	-0.11	0.01	0.01	0.09	-0.10	0.17	0.05	-0.17	-0.07	0.10	0.16	0.50	0.34	1.00																			
Entert/Leis/Toys	I18	-0.15	-0.30	-0.22	-0.01	-0.16	-0.06	0.08	-0.11	-0.10	-0.11	-0.01	0.24	0.33	0.02	0.16	0.07	0.05	0.13	1.00																		
Media	I19	-0.02	-0.23	-0.08	0.13	-0.08	-0.04	0.05	-0.16	-0.06	0.01	0.02	0.14	0.18	-0.02	0.07	-0.03	0.04	0.06	0.29	1.00																	
BusSrvs/CompSoft	I20	0.15	-0.12	-0.04	-0.06	-0.14	-0.15	-0.07	-0.21	-0.06	-0.25	-0.10	0.05	0.13	-0.14	0.00	-0.22	0.06	-0.17	0.13	0.10	1.00																
Retail Trade	I21	-0.09	-0.21	-0.18	0.08	-0.05	-0.05	0.05	-0.16	-0.14	-0.04	0.08	0.01	0.06	-0.06	0.18	0.11	0.20	0.22	0.16	0.15	0.12	1.00															
Wholesale Trade	I22	0.07	-0.11	-0.02	0.01	-0.04	0.00	0.02	-0.01	-0.01	-0.01	0.12	-0.04	-0.12	-0.01	0.04	-0.02	-0.06	-0.01	0.00	0.01	-0.07	0.00	1.00														
Arospace/Defence	I23	-0.17	-0.13	-0.16	-0.01	-0.11	0.08	0.05	0.15	0.13	0.01	0.08	0.05	0.00	0.15	0.10	0.08	-0.10	0.13	0.08	-0.01	-0.10	0.00	0.06	1.00													
Comp/Comm/Office	I24	0.18	-0.17	-0.06	-0.16	-0.17	-0.20	-0.10	-0.25	-0.04	-0.31	-0.20	0.21	0.30	-0.17	-0.05	-0.32	-0.09	-0.33	0.09	0.06	0.46	-0.08	-0.05	-0.11	1.00												
Electrical Equip	I25	0.07	-0.19	-0.11	-0.07	-0.12	-0.18	-0.10	-0.15	-0.05	-0.20	-0.09	0.22	0.28	-0.02	0.00	-0.10	0.01	0.01	0.14	0.05	0.12	0.00	-0.05	0.01	0.20	1.00											
Electronics/Inst	I26	0.10	-0.34	-0.17	-0.14	-0.20	-0.24	-0.04	-0.14	0.00	-0.30	-0.24	0.35	0.63	-0.06	-0.05	-0.26	-0.11	-0.30	0.20	0.05	0.35	-0.06	-0.02	-0.02	0.61	0.28	1.00										
Machine&EngiSrvs	I27	0.02	-0.23	-0.21	-0.04	-0.15	-0.11	0.09	-0.06	0.15	-0.26	0.15	0.33	0.32	0.07	0.23	-0.05	-0.17	-0.09	0.25	0.10	0.08	0.03	0.11	0.16	0.12	0.14	0.22	1.00									
Auto Components	I28	-0.04	-0.29	-0.20	0.00	-0.21	-0.06	0.09	-0.02	0.06	-0.23	0.18	0.38	0.27	0.10	0.28	-0.01	-0.13	0.02	0.32	0.12	0.04	0.07	0.06	0.16	0.09	0.11	0.17	0.48	1.00								
Diversified Inds	I29	-0.03	-0.16	-0.13	0.01	-0.11	0.04	0.08	0.03	0.09	-0.08	0.18	0.10	0.09	0.07	0.15	0.04	-0.19	0.05	0.16	0.09	-0.04	0.01	-0.03	0.28	-0.04	0.10	0.03	0.25	0.32	1.00							
HeavyEngin/Shipb	I30	0.08	-0.26	0.01	0.02	-0.02	0.06	0.11	-0.01	0.08	0.02	0.24	0.04	-0.04	0.04	0.01	0.00	-0.12	-0.03	-0.06	-0.01	-0.07	-0.06	0.21	0.09	-0.07	0.00	0.03	0.21	0.13	0.06	1.00						
Constr/Build Mat	I31	-0.03	-0.18	-0.05	-0.03	-0.01	0.28	0.16	0.04	0.07	0.00	0.34	-0.07	-0.19	0.10	0.14	0.11	-0.07	0.09	0.05	-0.08	-0.16	0.04	0.19	0.16	-0.20	0.00	-0.21	0.21	0.11	0.23	0.25	1.00					
Chemicals	I32	0.02	-0.24	-0.17	-0.09	-0.21	-0.02	0.05	0.13	0.17	-0.19	0.25	0.16	0.09	0.21	0.26	0.05	-0.12	0.08	0.10	0.03	-0.11	0.01	0.11	0.18	-0.11	0.08	0.00	0.42	0.36	0.32	0.26	0.26	1.00				
Mining/Metal/Min	I33	-0.01	-0.19	-0.16	-0.12	-0.18	0.03	0.06	0.19	0.20	-0.11	0.24	0.09	-0.04	0.15	0.14	-0.03	-0.24	-0.09	-0.04	-0.07	-0.11	-0.15	0.15	0.16	-0.09	0.00	0.03	0.33	0.23	0.19	0.51	0.28	0.45	1.00			
PreciousMeta/Min	I34	-0.22	-0.07	-0.21	-0.11	-0.10	0.04	0.01	0.31	0.20	0.05	0.05	-0.07	-0.08	0.17	0.09	0.04	-0.12	0.05	-0.02	-0.06	-0.14	-0.15	0.07	0.18	-0.15	-0.04	-0.07	0.10	0.11	0.10	0.05	0.07	0.20	0.37	1.00		
Forestry/PaperPr	I35	0.00	-0.08	-0.17	-0.02	-0.02	0.03	0.05	0.04	0.09	-0.15	0.17	0.06	0.05	0.18	0.18	0.00	-0.21	0.01	0.11	0.01	-0.08	0.02	0.13	0.20	-0.03	0.03	0.05	0.28	0.22	0.25	0.16	0.21	0.43	0.38	0.18	1.00	
Fabric MetalProd	I36	0.04	-0.19	-0.09	-0.02	-0.12	0.02	0.11	0.11	0.15	-0.15	0.11	0.14	0.15	0.15	0.29	0.08	-0.07	0.08	0.20	0.03	-0.03	0.06	0.06	0.16	-0.10	0.10	0.02	0.31	0.35	0.22	0.11	0.21	0.27	0.23	0.06	0.28	1.00

TABLE 5:

MAXIMAL SHARPE RATIO PORTFOLIOS
(01/01/86-11/03/99)

	HISTORICAL MEANS HISTORICAL RISK MATRIX	NULL MEAN VECTOR (*) HISTORICAL RISK MATRIX
(1) INDUSTRY FACTOR PORTFOLIO	1.41	0.67
(2) COUNTRY FACTOR PORTFOLIO	1.28	0.58
(3) INDUSTRY & COUNTRY FACTOR PORTFOLIO	1.84	0.75

Notes:
The Sharpe ratios are stated on an annualized basis
(*) Country and industry factor expected returns are set to zero;
The World expected return is set to its historical mean.

Figure 1: Capitalization Weighted Pure Factor MADS
(52 Week Moving Average)

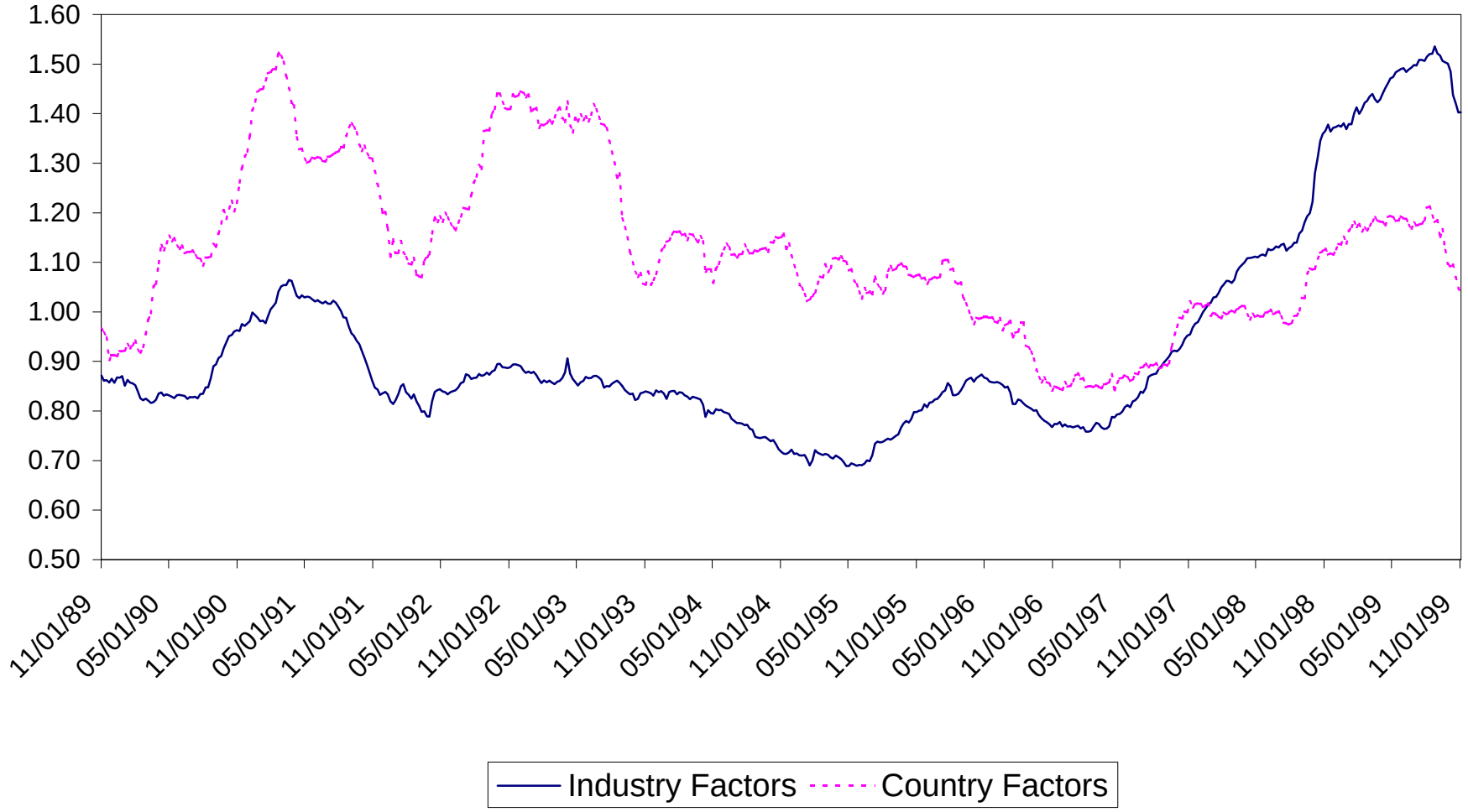

Figure 2: Ratio of Capitalization Weighted Pure Factor MADS (52 Week Moving Average)

Figure 3: Capitalization Weighted Factor Correlations (52 Week Moving Average)

Figure 4A: International Diversification Strategies 12/31/85-12/31/94

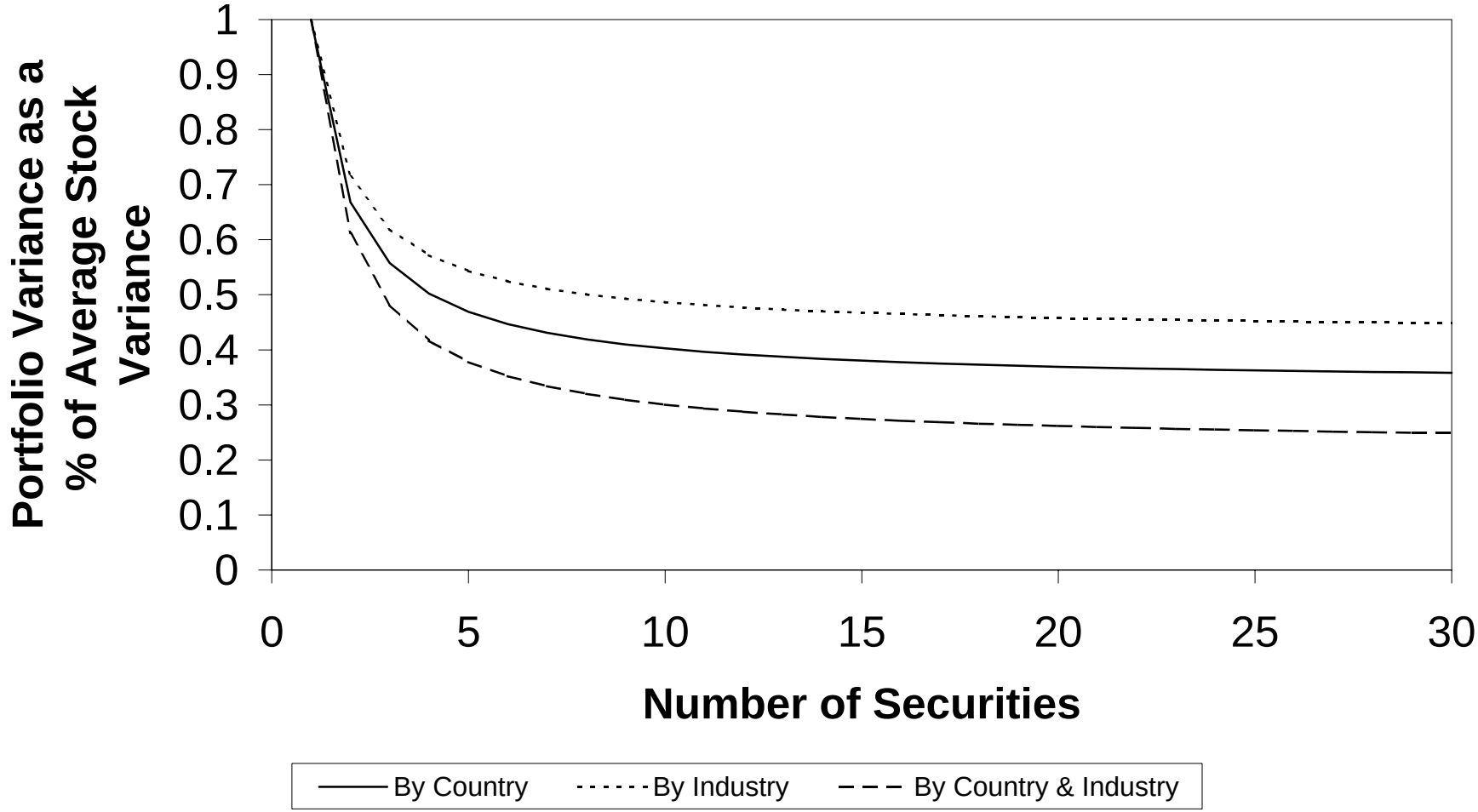

Figure 4B: International Diversification Strategies 12/31/94-11/03/99

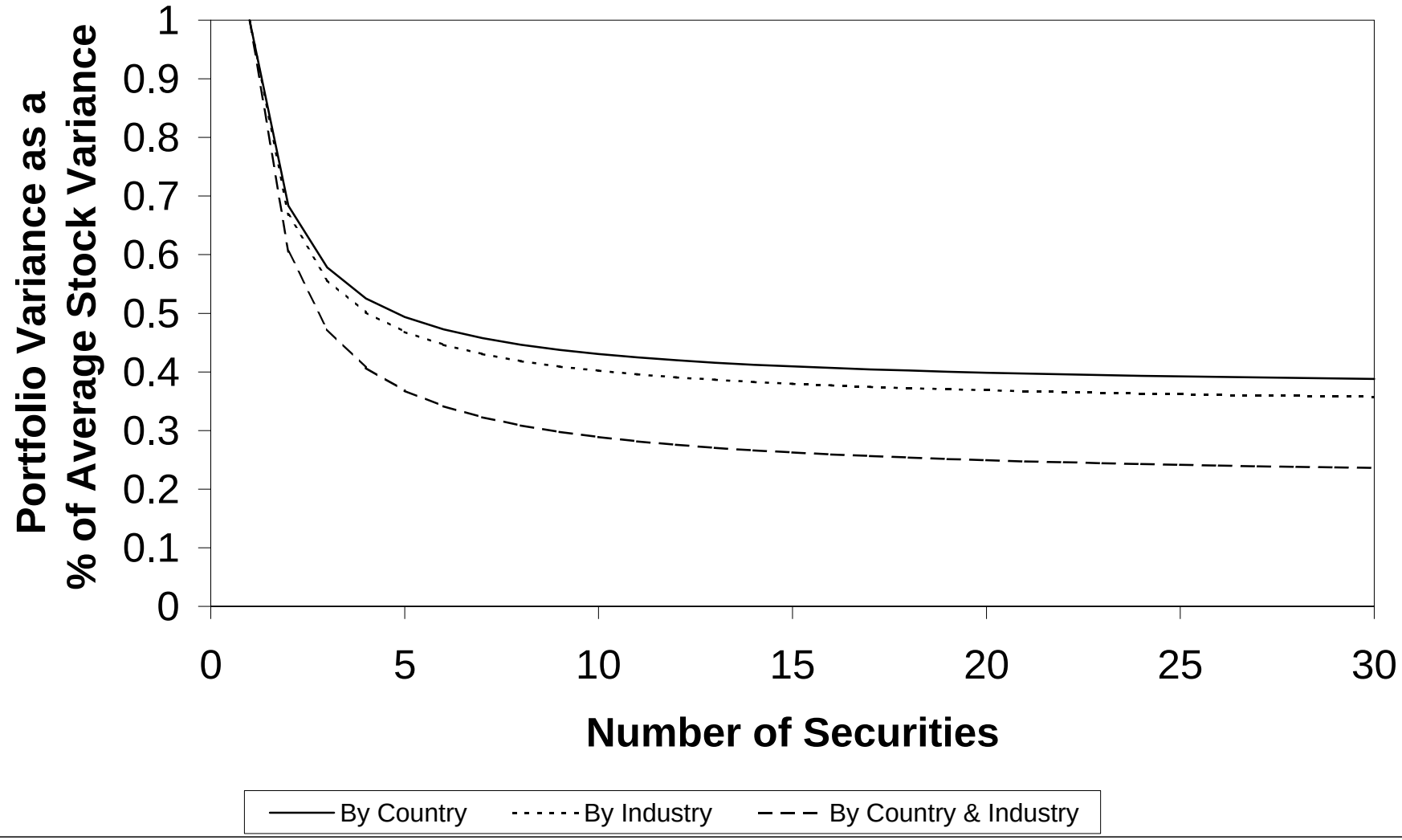

Figure 4C: International Diversification Strategies 11/03/98-11/03/99