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Does industrial structure explain the benefits of international diversification?

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Abstract

We examine the influence of industrial structure on the cross-sectional volatility and correlation structure of country index returns for 12 European countries between 1978 and 1992. We find that industrial structure explains very little of the cross-sectional difference in country return volatility, and that the low correlation between country indices is almost completely due to country-specific sources of return variation. Diversification across countries within an industry is a much more effective tool for risk reduction than industry diversification within a country.

Keywords: Exchange rates; International equity markets; Portfolio diversification
JEL classification: G15

1. Introduction

Equity markets of many developed and economically integrated economies move to a large extent independently of one another in terms of returns and volatility. Since Grubel (1968), Levy and Sarnat (1970), and Solnik (1974) first documented the benefits of international diversification, many academics and

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practitioners have commented on the low intercorrelation between international equity markets. [Adler and Dumas (1983) review some of the early papers.] Few papers have attempted to explain the low comovement between markets and the cross-sectional differences in volatility. Lessard (1974) first documented the influence of industry factors on country index returns. In a recent paper, Roll (1992) argues that industrial composition is important for explaining cross-sectional differences in volatility as well as the correlation structure of country index returns. An investment in the Swiss market represents a disproportionate bet on banking stocks, while an investment in the value-weighted market of the Netherlands places a large bet on the energy sector. Because industries are imperfectly correlated, equity markets with different industry composition will also be imperfectly correlated. Part of the benefits of international diversification therefore stem from *industrial* diversification. Differences in industrial structure can also be used to explain why some markets are more volatile: if energy stocks are on average more volatile than banking stocks, one might also expect the Dutch index to be more volatile than the Swiss index.

A second explanation for the low international return correlations is that local monetary and fiscal policies, differences in institutional and legal regimes, and regional economic shocks induce large country-specific variation in returns. This explanation does not require the correlations between industries to be low per se, they could in fact be quite high. Instead, it assumes that the country-specific components of return variation are large enough to dominate any industry effects. In this view, the equity markets of the Netherlands and Switzerland are imperfectly correlated because the banking industry in each country is subject to independent, country-specific shocks, and not because Switzerland has more banks. Lessard (1976), Solnik and de Freitas (1988), Grinold, Rudd, and Stefek (1989), and Drummen and Zimmermann (1992) regress individual stock returns on global, industry, and national factors and conclude that national factors dominate the explained part of stock price variances. Each of these papers, however, also finds a significant role for industry factors. The results of these papers are difficult to interpret because they use the return on industry portfolios to approximate for industry factors and country index returns to approximate for national factors. If industrial composition differs across countries, country indices will be confounded by industry effects, and industry indices will contain country effects.

To accurately distinguish between these two explanations one must separate country effects from industry-driven sources of return variation. Our empirical estimation strategy for decomposing stock returns into industry and country components is closest to Grinold, Rudd, and Stefek (1989) and Beckers, Grinold, Rudd, and Stefek (1992), and in the same spirit as Roll (1992). The third section of the paper outlines this approach after a discussion of the data sample in

Section 2. Using monthly data for the 829 firms that comprise the Morgan Stanley Capital International indices of 12 European countries during 1978–1992, we present evidence in Section 4 that the presence of large country-specific components of return variation, and not industrial structure, is responsible for the low intercorrelations of European equity markets. These country-specific components are also the primary cause of the cross-sectional differences in returns and return volatility across markets. For equally-weighted country indices, less than 1% of these differences can be explained by industry specialization. Our results are in sharp contrast to those studies that have found a significant role for industry effects in stock returns, which is especially surprising since our study covers countries that are geographically concentrated (Europe), economically integrated, but quite different in terms of industrial composition. Section 4 also reconciles our findings with those in Roll (1992). Although we identify large country-specific effects, the remaining puzzle is to determine the source behind these effects. We present evidence that only a small portion of country-specific return variation is associated with exchange rate fluctuations. Section 5 summarizes our main findings and presents some directions for future research.

2. Data description

The sample includes monthly total returns for all firms in the Morgan Stanley Capital International (MSCI) indices of 12 European countries from 1978 to 1992. The composition of the MSCI indices changes over time because of mergers, delistings, and bankruptcies. Occasionally, a firm will be dropped from the index but remain listed on the local stock exchange. If this occurs, the firm is kept in the sample as long as return information is available. A second adjustment is made for (classes of) shares with ownership restricted to local shareholders. We include only those shares or classes of shares that can be held by international investors. The final sample consists of 829 firms with a partial or complete return history over the sample period. Firms are assigned to one of seven broad industry categories, based on industry classifications obtained from the Financial Times (FT) Actuaries/Goldman Sachs:[1]

[1]Roll (1992) uses the same broad industry categories, and provides a detailed description of the components of these groupings. MSCI employs broad industry grouping and detailed industry assignments that are somewhat different from FT Actuaries. For some MSCI firms FT Actuaries/ Goldman Sachs did not provide an industry classification. In this case, we used the detailed industry assignment of MSCI as the basis for assigning that firm to one of the seven FT Actuaries broad industry categories. We had to drop one firm because we did not have an industry assignment for that firm.

Finance, Insurance, and Real Estate
Energy
Utilities
Transportation and Storage
Consumer Goods and Services
Capital Goods
Basic Industries

Table 1 shows that the industrial composition of country indices, as well as the geographical distribution of industries is not uniform. Panel A shows that most firms belong to one of four sectors: finance, basic industries, consumer goods and services, and capital goods. The number of firms in energy, utilities, and transportation is relatively small. Not all countries have firms in the energy sector. Utilities are publicly-traded companies in some countries but government-owned in others, which precludes them from appearing in the sample. Utility stocks tend to be concentrated in the U.K., whereas many transportation stocks can be found in the smaller markets of Denmark and Norway. More than a quarter of the firms in Switzerland are in the finance sector, whereas fewer than 10% of the Swedish firms are. A different picture emerges if we look at the market capitalization of the local markets and industry sectors. Panel B of Table 1 gives the average weight measured as the percentage of the total capitalization of the 12 markets in our sample, which we will refer to as the 'European' market. Italy has more than twice the number of firms of the Netherlands, but its contribution is smaller in terms of market capitalization. Energy stocks which make up less than 3% of the total number of firms in the sample, account for 12.50% of the market capitalization. The single Energy stock in the Netherlands (Royal Dutch Shell) accounts for over half of the Dutch market capitalization, over 25% of the energy industry, and 3.56% of the total European market capitalization. Firms in the financial industry tend to be larger than firms in basic industries or the transportation sector; German companies are on average larger than French firms.

Table 2 summarizes the performance of the 12 countries and seven industries during the period 1978–1992. All returns are measured monthly in a common currency (the Deutschmark) and expressed as percent per month.[2] The top panel shows that there are substantial differences across markets both in terms of

[2] Total returns in local currency are obtained from ARCAS–Wessels Roll Ross. ARCAS computes monthly total returns from end-of-month stock prices taken from the largest exchange in the country to which the firm is assigned by Morgan Stanley. The return calculation assumes immediate reinvestment of dividends. We convert these local currency returns to DM returns using end-of-month exchange rates taken from the *Financial Times*: $R_{t+1}^{DM} = (1 + R_{t+1}^{LC})(S_{t+1}/S_t) - 1$, where R_{t+1}^{DM} and R_{t+1}^{LC} are the DM and local currency returns between time t and $t + 1$, and S_t is the DM price of one unit of local currency at time t.

Table 1
Industry composition by countries

Industry composition of the Morgan Stanley Capital International country indices 1978–1992. Panel A gives for each country by industry the number of firms included in the sample. Panel B gives the average market capitalization of the countries by industry expressed as a percentage of the European value-weighted market.

	Industry							
Country	F	E	U	T	Co	Ca	B	Total
A: Number of firms by country and industry								
Austria	7	1	1	1	3	2	9	24
Belgium	9	1	8	1	3	–	16	38
Denmark	10	–	1	5	14	3	2	35
France	29	4	2	1	46	17	16	115
Germany	18	1	3	3	22	17	27	91
Italy	26	3	5	2	19	11	19	85
Netherlands	7	1	–	3	10	4	7	32
Norway	9	1	–	5	10	9	6	40
Spain	12	2	9	2	11	2	14	52
Sweden	5	–	–	–	13	11	26	55
Switzerland	19	–	–	3	31	11	9	73
United Kingdom	38	9	18	4	49	36	35	189
Europe	189	23	47	30	231	123	186	829
B: Average weights in the European value-weighted market								
Austria	0.13	0.02	0.01	0.01	0.08	0.03	0.10	0.38
Belgium	0.69	0.61	0.74	0.02	0.14	–	0.51	2.71
Denmark	0.30	–	0.01	0.13	0.43	0.07	0.01	0.95
France	1.86	1.34	0.42	0.03	3.77	1.39	1.30	10.11
Germany	5.58	0.10	0.92	0.26	3.89	3.05	5.37	19.17
Italy	2.65	0.07	0.39	0.03	1.18	0.44	0.46	5.23
Netherlands	0.74	3.56	–	0.17	1.39	0.71	0.37	6.94
Norway	0.14	0.36	–	0.04	0.12	0.12	0.05	0.83
Spain	1.47	0.18	1.85	0.03	0.25	0.01	0.22	4.02
Sweden	0.28	–	–	–	0.83	0.72	0.64	2.47
Switzerland	3.98	–	–	0.16	2.84	0.35	1.08	8.41
United Kingdom	9.06	6.26	2.40	0.43	12.04	4.65	3.96	38.79
Europe	26.87	12.50	6.75	1.30	26.97	11.53	14.07	100.00

F = Finance, Insurance, and Real Estate, E = Energy, U = Utilities, T = Transportation and Storage, Co = Consumer Goods and Services, Ca = Capital Goods, B = Basic Industries.

average returns and the volatility of these returns. Austria, Norway, and Switzerland were among the poor-performing countries, while France, Italy, and Sweden were the highest performers, despite the depreciation of their currencies against the Deutschmark (DM). Measured by standard deviation of returns, the

Table 2

Summary statistics (monthly data 1978–1992)

Panel A summarizes the mean and the standard deviation of the monthly equally-weighted (EW) and value-weighted (VW) country index returns. Panel B contains the summary statistics for the monthly returns on equally- and value-weighted industry portfolios. All returns are measured in Deutschmarks and expressed in percent per month. The currency return is the proportional change in the exchange rate measured in DM per unit of local currency. The correlations above the diagonal refer to value-weighted index returns, those below the diagonal are between the equally-weighted index returns.

A: By country

Country		EW return		VW return		Currency return		Correlation matrix												
		Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	A	B	D	F	G	I	Ne	No	Sp	Swe	Swi	UK	Eur
Austria	(A)	0.795	6.560	0.684	6.446	0.017	0.777		0.343	0.096	0.333	0.536	0.234	0.307	0.292	0.285	0.274	0.408	0.287	0.461
Belgium	(B)	1.320	5.276	1.153	5.062	−0.149	0.827	0.386		0.337	0.529	0.524	0.371	0.575	0.507	0.398	0.411	0.553	0.471	0.666
Denmark	(D)	1.131	5.400	1.035	5.356	−0.182	1.287	0.158	0.391		0.259	0.330	0.341	0.411	0.333	0.327	0.374	0.374	0.392	0.480
France	(F)	1.499	6.499	1.386	6.480	−0.228	1.060	0.347	0.571	0.296		0.503	0.390	0.475	0.449	0.346	0.306	0.450	0.416	0.645
Germany	(G)	0.922	4.735	0.884	5.361			0.553	0.621	0.398	0.532		0.362	0.546	0.362	0.337	0.405	0.648	0.391	0.719
Italy	(I)	1.504	7.723	1.506	7.992	−0.427	1.595	0.286	0.383	0.327	0.417	0.431		0.388	0.241	0.425	0.416	0.327	0.371	0.550
Netherlands	(Ne)	1.218	5.553	1.359	4.902	−0.019	0.421	0.319	0.597	0.390	0.485	0.603	0.331		0.567	0.378	0.471	0.621	0.650	0.787
Norway	(No)	0.787	7.844	1.143	8.322	−0.294	1.799	0.338	0.477	0.445	0.392	0.444	0.412	0.463		0.288	0.416	0.467	0.501	0.585
Spain	(Sp)	1.241	8.293	1.092	6.808	−0.321	1.932	0.295	0.445	0.352	0.385	0.411	0.396	0.441	0.412		0.491	0.351	0.439	0.558
Sweden	(Swe)	1.616	7.461	1.365	7.074	−0.353	2.122	0.247	0.397	0.322	0.330	0.382	0.386	0.477	0.476	0.445		0.476	0.472	0.602
Switzerland	(Swi)	0.739	4.937	0.931	4.732	0.041	1.636	0.454	0.640	0.408	0.479	0.693	0.382	0.675	0.497	0.444	0.495		0.517	0.735
United Kingdom	(UK)	1.434	6.384	1.356	6.015	−0.238	2.687	0.313	0.507	0.387	0.423	0.471	0.401	0.507	0.507	0.491	0.479	0.570		0.878
Europe	(Eur)	1.234	4.524	1.105	4.412			0.501	0.743	0.523	0.744	0.760	0.645	0.711	0.652	0.639	0.618	0.771	0.811	

B: By industry sector

Industry		EW return		VW return		Correlation matrix							
		Mean	Std. dev.	Mean	Std. dev.	F	E	U	T	Co	Ca	B	Eur
Finance	(F)	1.168	4.418	1.063	4.642		0.557	0.674	0.765	0.905	0.867	0.887	0.947
Energy	(E)	1.479	5.931	1.419	6.300	0.636		0.428	0.493	0.592	0.568	0.555	0.713
Utilities	(U)	1.353	3.901	0.995	4.420	0.730	0.456		0.614	0.676	0.649	0.666	0.719
Transport	(T)	1.093	5.104	0.844	5.397	0.808	0.535	0.621		0.775	0.788	0.816	0.804
Consumer	(Co)	1.407	4.503	1.297	4.603	0.935	0.660	0.700	0.798		0.913	0.909	0.963
Capital	(Ca)	0.974	5.220	0.864	5.104	0.915	0.647	0.711	0.819	0.936		0.905	0.934
Basic	(T)	1.183	5.101	0.943	4.777	0.920	0.639	0.730	0.836	0.930	0.941		0.937
Europe	(Eur)	1.234	4.524	1.105	4.412	0.968	0.684	0.751	0.846	0.978	0.968	0.975	

Norwegian and Italian markets were almost twice as volatile as the Swiss market. The bottom panel of Table 2 shows that industry performance was more uniform than country performance. Since our industry categories are broad enough to define only seven industries (versus 12 countries), the average industry is larger than the average country in our sample. In this sense, one would expect industries to be more diversified across countries than countries are diversified across industries, consistent with the pattern that the volatility of industries is generally more uniform than the volatility of countries. The top panel of Table 2 also shows that most of the cross-country correlations measured in a common currency are well below unity, despite the fact that local markets are often reasonably well-diversified portfolios. The average correlation between the value-weighted country indices is only 0.407. Equally-weighted correlations are on average slightly higher at 0.434.

The variation of returns and volatility across markets and industries, and the low correlation among country index returns, motivate the two questions we attempt to answer in this paper. First, is there a relationship between the relative performance of countries (in terms of average returns or return volatility) and their industrial structure? And second, are the benefits of international diversification primarily due to industrial diversification? Roll (1992) argues that the low return correlations across countries can in part be explained by the fact that global industry factors, which he estimates from country index returns, are often strongly negatively correlated. This result is somewhat surprising since individual securities, let alone internationally diversified portfolios, are on average positively correlated. Our sample of individual stock returns and industry assignments allows a direct construction of industry portfolio returns. The correlation matrix of the European industry portfolios is given in the bottom panel of Table 2, and confirms that the correlations between industry returns are all positive and in fact substantially higher than most country correlations. The average of the value-weighted industry correlations is 0.714, and the average for equally-weighted industry indices is 0.757.

3. Decomposition of returns in industry and country components

In order to separate country performance from industry performance, we postulate the following model for the return on the ith security that belongs to industry j and country k:

$$R_{it} = \alpha_t + \beta_{jt} + \gamma_{kt} + e_{it}\,, \tag{1}$$

where α_t is a base level of return in period t, β_{jt} is the industry effect, γ_{kt} the country effect, and e_{it} is a firm-specific disturbance. Formulation (1) allows separate influences of industry and country effects, but rules out any interaction between these effects. We assume that the firm-specific disturbances have a zero mean and finite variance for returns in all countries and industries, and are uncorrelated across firms. We have data on securities for 12 European countries, distributed over seven industry categories. Defining an industry dummy I_{ij} that is to equal one if security i belongs to industry j and zero otherwise, and a country dummy C_{ik} that is equal to one if security i belongs to country k and zero otherwise, for each period t we can rewrite (1) as

$$R_i = \alpha + \beta_1 I_{i1} + \beta_2 I_{i2} + \cdots + \beta_7 I_{i7} + \gamma_1 C_{i1} + \gamma_2 C_{i2} + \cdots + \gamma_{12} C_{i12} + e_i \,. \tag{2}$$

It is not possible to estimate (2) directly by cross-sectional regression, because of perfect multicollinearity between the regressors. The seven industry dummies as well as the 12 country dummies add up to the unit vector across firms. Conceptually, the problem is that there is not a unique way of identifying country and industry effects. Since every firm is in one country and in one industry, we can only measure cross-sectional *differences* between industries and cross-sectional *differences* between countries. Industry and country effects can only be measured relative to some benchmark. One possibility would be to choose the capital goods sector (industry 5) in Germany (country 6) as a base, and estimate (2) under the restriction that β_5 and γ_6 are zero. In this case, β_j will measure the industry effect of sector j relative to the capital goods industry and γ_k will measure the country effect of country k relative to Germany. Rather than choosing an arbitrary country and industry as a benchmark, it is more natural to ask how each industry or country differs from the average firm in our sample, which is equivalent to measuring industry and country effects relative to the European equally-weighted market. To implement this definition, we impose the restrictions that for each period t,

$$\sum_{j=1}^{7} n_j \beta_j = 0 \,, \tag{3a}$$

$$\sum_{k=1}^{12} m_k \gamma_k = 0 \,, \tag{3b}$$

where n_j and m_k denote the number of assets in industry j and country k, respectively.[3]

[3] This choice simplifies the interpretation of the coefficients, but does not affect the statistical properties of the model. The residuals in (2) are identical if a constant is added to α and the same constant is subtracted from every β. Similarly, the fit is unchanged if a constant is added to α and the same constant is subtracted from every γ. Consequently, this indeterminacy in (2) does not affect cross-sectional differences in the β's or cross-sectional differences in the γ's. Since cross-sectional differences are not affected, the indeterminacy is completely resolved by specifying the average β and the average γ in *any one* portfolio. We thank John Long for suggesting this point. [See also Suits (1984) and Kennedy (1986) for a discussion.]

In ordinary least-squares estimation of a regression the estimated disturbances are, by construction, orthogonal to all industry and country dummies. This means that the average residual is zero in every country and in every industry. Adding these disturbances over all countries or over all industries, we find that the estimated disturbance for the aggregate European index is also zero. Since the sum of industry and country effects is zero for the European index (by definition), the least-squares estimate of α is equal to the return on the European equally-weighted market. The pure industry return $\hat{\alpha} + \hat{\beta}_j$ is the least-squares estimate of the return on a geographically-diversified portfolio of firms in the jth industry. In this context, a geographically-diversified portfolio is a portfolio that has the same country composition as the European equally-weighted index, and is therefore free of country effects. By similar reasoning, $\hat{\alpha} + \hat{\gamma}_k$ is an estimate of the pure return on the country portfolio k. This portfolio is industrially diversified in the sense that it has the same industry composition as the European equally-weighted market, and therefore has no incremental industry effect.

This estimation procedure allows a decomposition of R_k^{ew}, the actual equally-weighted index of country k, into a component that is common to all countries, $\hat{\alpha}$, the average of the industry effects of the securities that make up its index, and a country-specific component, $\hat{\gamma}_k$,

$$R_k^{ew} = \hat{\alpha} + \frac{1}{m_k} \sum_i \sum_{j=1}^{7} \hat{\beta}_j I_{ij} + \hat{\gamma}_k \,, \tag{4}$$

where the i-summation is taken over firms in country k. Eq. (4) states that the return in Spain may differ from the return on the European equally-weighted market for two reasons. First, because the industrial composition of the Spanish index is different from the industrial composition of the European market. If, on average across Europe, utilities outperform and capital goods firms underperform the European market, the overall industry effect for Spain will (all else equal) be positive because Spain has proportionally more utilities and proportionally fewer firms in capital goods than the European equally-weighted market. Second, the return on Spanish firms is different from firms which are in the same industry but located a different country. The country effect for Spain is a measure of the how well each industry in Spain performed relative to the average European firm in that sector.

Similarly, each equally-weighted industry index return R_j^{ew} can be decomposed into a component that is common to all industries, $\hat{\alpha}$, the weighted average of several country components, and an industry-specific component, $\hat{\beta}_j$,

$$R_j^{ew} = \hat{\alpha} + \hat{\beta}_j + \frac{1}{n_j} \sum_i \sum_{k=1}^{12} \hat{\gamma}_k C_{ik} \,, \tag{5}$$

where the i-summation is taken over firms in industry j. Note that there are no disturbance terms in (4) and (5) because, for each country and industry, the residuals sum to zero by construction.

It is straightforward to construct a similar decomposition of the value-weighted country and industry indices by estimating Eq. (2) using weighted least squares. The weights are simply the market capitalizations of the securities at the beginning of the month. The restrictions that imply that the value-weighted European index has neither country nor industry effects become

$$\sum_{j=1}^{7} w_j \beta_j = 0 \,, \tag{6a}$$

$$\sum_{k=1}^{12} v_k \gamma_k = 0 \,, \tag{6b}$$

where w_j and v_k are the value weights of industry j and country k in the European value-weighted market, and $\sum_k v_k = \sum_j w_j = 1$. Under these restrictions, the weighted least-squares estimate of the regression intercept now becomes the European value-weighted index. As before, industry and country returns are diversified portfolios in the sense that they have the same (value-weighted) geographical and industrial distribution as the European value-weighted index.

Note that the regressions above produce the industry and country effects for one particular month. By running a cross-sectional regression for every month, we obtain a *time series* of geographically-diversified industry returns, $\hat{\alpha}_t + \hat{\beta}_{jt}$, and of industrially diversified country returns, $\hat{\alpha}_t + \hat{\gamma}_{kt}$. These returns can provide insight into the underlying sources of variation in the country and industry index returns.

4. Empirical results

We show in Eq. (4) that the excess return of a country index over the European market can be decomposed into a pure country effect and a weighted average of seven industry effects. Similarly, an excess industry return equals a weighted average of 12 country effects plus a pure industry effect. In Table 3 we present the results of this decomposition. The top panel shows that most of the variance of excess equally-weighted country returns can be attributed to country-specific effects. The variance of the combined industry effects is on average only 0.6% of the variance of excess country returns, due in part to the diversification of country indices across industries. The more important reason becomes clear from looking at the decomposition of industry indices in the bottom panel of the table. Although most of the variation in excess industry returns is due to industry effects, the average variance of the pure industry effects is 5.43% squared, which is much smaller than the average variance of the pure country effects (24.18% squared). With the exception of the energy sector, the variances of the pure industry effects are all smaller than the variances of the pure country

Table 3
Decomposition of excess index returns into country and industry effects

The table gives the variance of the components of the equally-weighted (EW) and value-weighted (VW) excess country and industry index returns over the European market. Each excess country index return is decomposed in a pure country effect and a sum of seven industry effects. Each excess industry index return is decomposed in the sum of 12 country effects and a pure industry effect. Returns are measured in percent per month. The ratio relative to the market gives the ratio of the variance of that component to the variance of the index return in excess of the European market.

	EW indices				VW indices			
	Pure country effect[a]		Sum of 7 industry effects[b]		Pure country effect[a]		Sum of 7 industry effects[b]	
Country	Variance	Ratio relative to market	Variance	Ratio relative to market	Variance	Ratio relative to market	Variance	Ratio relative to market
Austria	34.29	1.016	0.08	0.002	35.74	1.028	0.76	0.022
Belgium	12.75	0.992	0.22	0.017	15.87	1.033	1.00	0.065
Denmark	23.97	0.997	0.19	0.008	26.23	1.030	0.83	0.033
France	18.93	0.998	0.04	0.002	24.33	0.989	0.10	0.004
Germany	10.61	1.027	0.05	0.005	14.01	0.987	0.56	0.039
Italy	35.09	1.002	0.03	0.001	44.26	0.994	0.63	0.014
Netherlands	15.58	1.001	0.09	0.006	7.14	0.754	4.06	0.429
Norway	35.18	0.984	0.18	0.005	40.00	0.874	3.80	0.083
Spain	44.73	1.083	0.48	0.012	33.99	1.053	1.99	0.062
Sweden	34.11	0.991	0.20	0.006	30.81	0.965	0.86	0.027
Switzerland	10.53	1.013	0.06	0.006	10.68	0.955	0.70	0.063
United Kingdom	14.35	0.997	0.02	0.001	8.74	0.967	0.08	0.009
Cross-country average	24.18	1.008	0.14	0.006	24.32	0.969	1.28	0.071

	EW indices				VW indices			
	Sum of 12 country effects[c]		Pure industry effect[d]		Sum of 12 country effects[c]		Pure industry effect[d]	
Industry	Variance	Ratio relative to market	Variance	Ratio relative to market	Variance	Ratio relative to market	Variance	Ratio relative to market
Finance	0.07	0.054	1.24	0.954	0.28	0.125	1.88	0.839
Energy	1.10	0.058	17.67	0.933	1.50	0.077	18.48	0.948
Utilities	3.78	0.413	9.20	1.004	4.84	0.441	8.14	0.741
Transport	1.81	0.243	5.89	0.792	0.90	0.087	9.66	0.937
Consumer	0.17	0.187	0.76	0.835	0.18	0.118	1.51	0.987
Capital	0.33	0.164	1.87	0.930	0.25	0.072	3.11	0.899
Basic	0.31	0.208	1.36	0.913	0.88	0.317	2.47	0.888
Cross-industry average	1.08	0.190	5.43	0.909	1.26	0.177	6.46	0.891

[a]The pure country effect measures the average return of firms in a country relative to firms which are in the same industry but located in a different country.

[b]The sum of the seven industry effects represents the component of a country's return that can be attributed to the difference between the industrial composition of its market and the industrial composition of the European market.

[c]The pure industry effect measures the average return of firms in an industry relative to firms which are located in the same country but belong to a different industry.

[d]The sum of the 12 country effects represents the component of an industry's return that can be attributed to the difference between the geographical composition of its index and the geographical composition of the European market.

effects. Consequently, country effects in industry indices are generally larger than industry effects in country indices.[4] The right panel shows a similar pattern for the value-weighted indices. Industry effects account for about 7% of excess country returns, and are most important for the Netherlands and Norway, which have large energy sectors. Country effects are most prevalent for the utilities industry, which is heavily concentrated in Spain and the United Kingdom. However, the most important conclusion from this table is that pure country effects are on average much larger than pure industry effects, and therefore more likely to be important for explaining cross-country correlations. These findings contrast with previous studies that have found a large role for industry effects. For instance Drummen and Zimmermann (1992), using a different methodology, find that for the two largest European markets, Germany and the U.K., industry effects are more important than country effects. They also report that the country effects in industry indices are larger than the industry effects themselves.

Table 4 presents summary statistics for the estimated country returns corrected for industry composition, $\hat{\alpha} + \hat{\gamma}$, and the industry portfolio returns corrected for country effects, $\hat{\alpha} + \hat{\beta}$. The entries in this table can be directly compared to the statistics on raw returns in Table 2 to gauge the importance of industry composition for country returns, and of country composition for industry returns. If industry composition were important for explaining cross-sectional differences in volatility, the average returns and volatilities would look more uniform after correction. Similarly, if industry effects were important for explaining country correlations, then one would expect our correction for industry composition to increase the correlations among indices. However, the differences between the entries in Tables 2 and 4 are strikingly small, both in terms of the level of average returns and their volatility, as well as the correlation structure of index returns. Countries that performed poorly, such as Austria and Switzerland, apparently did not do so because they specialized in poorly performing industries but because the country-specific component of their index returns was low. Sweden, the market with the highest average raw return, performed even better after correcting for industry effects. Therefore Sweden did well despite the fact that it specialized in industries that performed below average. Similarly, countries that had high volatility also have high volatility after correcting for industry effects. The correction for industry effects has the largest impact on the volatility of the value-weighted indices of the relatively undiversified countries of the Netherlands and Norway. A single energy firm comprises 53% and 43% of their respective value-weighted indices. Since the

[4] Note that the country and industry effects in indices are not uncorrelated. As a result the variance ratios of country effects and industry effects do not add up to one, due to the relatively small covariances between them.

weight of energy firms in the European index is only 12.5%, the industry correction downweights this sector in the corrected country indices for the Netherlands and Norway. Because the energy sector has the highest volatility of all industries, the volatility of both country indices corrected for industry effects falls. Overall, the industry corrections have a small impact on the volatility of country indices. We conclude that cross-sectional differences in volatility across countries are largely the consequence of cross-sectional differences in the volatility of country effects, rather than the result of industrial specialization.

For industries, the largest corrections occur for those sectors that are relatively undiversified geographically. The volatility of the value-weighted energy index falls, after correction for country effects, from 6.30% to 6.06%. Three quarters of the energy sector is made up by U.K. and Dutch firms, which comprise only 45% of the European index. Downweighting these countries in the industry index, and therefore achieving better diversification across countries, causes the corrected volatility of the energy sector to fall. A similar decline occurs in the volatility of the relatively underdiversified equally-weighted utilities index.

From our previous discussion of the return decompositions, it is not surprising that the country correlations, corrected for industry composition, are very close to the raw correlations in Table 2. As shown in Table 3, only around 1% of the variation of country returns in excess of the European index can be attributed to industry effects, which consequently have little effect on the country correlations. The average correlation between equally-weighted country correlation rises from 0.407 to 0.415 corrected for industry effects. The value-weighted correlations actually drop on average from 0.434 to 0.431. Because country effects constitute a larger proportion of the variance of industry returns than industry effects do of country returns, the country correction has a slightly larger effect on the industry correlations. The average equally-weighted industry correlation rises from 0.714 to 0.741, and the average value-weighted correlation rises from 0.757 to 0.769. In sharp contrast to the findings of Roll (1992), we conclude that industry composition cannot account for the low country correlations.

It should perhaps be pointed out that our sample includes fewer countries than some previous studies on the role of industry and country effects; for instance, Grinold, Rudd, and Stefek (1989) and Roll (1992) include the U.S. and Japan. Since many of the European countries are economically strongly integrated, yet diverse in industrial composition, it is even more surprising to find that country effects dominate, and that industrial structure explains so little of the correlation structure and the cross-sectional differences in volatility of index returns.

The relative size of country and industry effects has important implications for portfolio diversification. Fig. 1 shows that randomly combining European securities in large portfolios reduces variance to 18% of the variance of the

Table 4

Summary statistics: Estimated country and industry indices

Panel A summarizes the mean and the standard deviation of the monthly equally-weighted (EW) and value-weighted (VW) estimated country returns, corrected for industry effects. Panel B contains the summary statistics for the monthly returns on equally- and value-weighted industry portfolios, corrected for country effects. All returns are measured in Deutschmarks and expressed in percent per month. The correlations above the diagonal refer to value-weighted index returns, those below the diagonal are between the equally-weighted index returns.

A: Country indices adjusted for industry effects[a]

		EW return		VW return		Correlations												
Country		Mean	Std. dev.	Mean	Std. dev.	A	B	D	F	G	I	Ne	No	Sp	Swe	Swi	UK	Eur
Austria	(A)	0.813	6.521	0.713	6.450		0.301	0.090	0.327	0.529	0.236	0.309	0.289	0.267	0.254	0.413	0.272	0.445
Belgium	(B)	1.300	5.357	1.155	5.271	0.376		0.297	0.538	0.515	0.384	0.635	0.526	0.458	0.404	0.532	0.490	0.675
Denmark	(D)	1.099	5.480	0.988	5.390	0.147	0.389		0.263	0.313	0.331	0.404	0.350	0.307	0.360	0.372	0.393	0.469
France	(F)	1.483	6.533	1.374	6.426	0.338	0.582	0.314		0.500	0.392	0.498	0.450	0.388	0.297	0.449	0.414	0.642
Germany	(G)	0.950	4.651	0.932	5.276	0.539	0.616	0.395	0.527		0.354	0.618	0.400	0.325	0.385	0.636	0.396	0.715
Italy	(I)	1.509	7.732	1.507	7.981	0.282	0.401	0.326	0.419	0.424		0.420	0.261	0.438	0.419	0.307	0.379	0.552
Netherlands	(Ne)	1.213	5.515	1.317	4.654	0.306	0.601	0.397	0.488	0.599	0.324		0.517	0.478	0.549	0.688	0.664	0.828
Norway	(No)	0.795	7.758	1.122	7.912	0.324	0.478	0.453	0.389	0.430	0.409	0.452		0.358	0.459	0.522	0.506	0.602
Spain	(Sp)	1.222	8.688	1.102	7.209	0.280	0.471	0.361	0.406	0.399	0.409	0.446	0.422		0.479	0.327	0.479	0.589
Sweden	(Swe)	1.648	7.283	1.436	6.909	0.226	0.377	0.328	0.315	0.356	0.377	0.463	0.461	0.425		0.476	0.471	0.597
Switzerland	(Swi)	0.747	4.931	0.902	4.645	0.445	0.637	0.416	0.481	0.685	0.373	0.675	0.496	0.441	0.486		0.545	0.741
United Kingdom	(UK)	1.434	6.388	1.336	6.000	0.305	0.516	0.401	0.428	0.462	0.400	0.502	0.508	0.501	0.465	0.570		0.882
Europe	(Eur)	1.234	4.524	1.105	4.412	0.486	0.751	0.535	0.748	0.748	0.645	0.708	0.648	0.652	0.598	0.768	0.812	

B: Industry indices adjusted for country effects[b]

Industry		EW return		VW return		Correlation matrix							
		Mean	Std. dev.	Mean	Std. dev.	F	E	U	T	Co	Ca	B	Eur
Finance	(F)	1.181	4.387	1.124	4.680		0.570	0.744	0.800	0.922	0.889	0.902	0.956
Energy	(E)	1.485	5.578	1.278	6.059	0.625		0.508	0.475	0.557	0.555	0.570	0.705
Utilities	(U)	1.345	3.765	1.158	4.290	0.731	0.531		0.641	0.736	0.725	0.721	0.785
Transport	(T)	1.268	5.239	0.899	5.530	0.842	0.546	0.633		0.810	0.823	0.846	0.828
Consumer	(Co)	1.360	4.459	1.248	4.535	0.940	0.636	0.713	0.856		0.918	0.930	0.963
Capital	(Ca)	0.968	5.184	0.848	5.019	0.920	0.613	0.715	0.862	0.941		0.918	0.938
Basic	(B)	1.204	5.171	0.986	4.916	0.928	0.652	0.696	0.877	0.945	0.951		0.949
Europe	(Eur)	1.234	4.524	1.105	4.412	0.969	0.672	0.747	0.887	0.981	0.969	0.980	

[a]The corrected country index returns are computed as the sum of the return on the European equally- or value-weighted market and the estimated equally- or value-weighted country-specific component of return variation in each country, and therefore exclude the sources of return variation that are due to the industrial composition of the country indices.

[b]The corrected industry index returns are computed as the sum of the return on the European equally- or value-weighted market and the estimated equally- or value-weighted industry-specific component of return variation in each sector, and therefore exclude the sources of return variation that are due to the geographical composition of the industry indices.

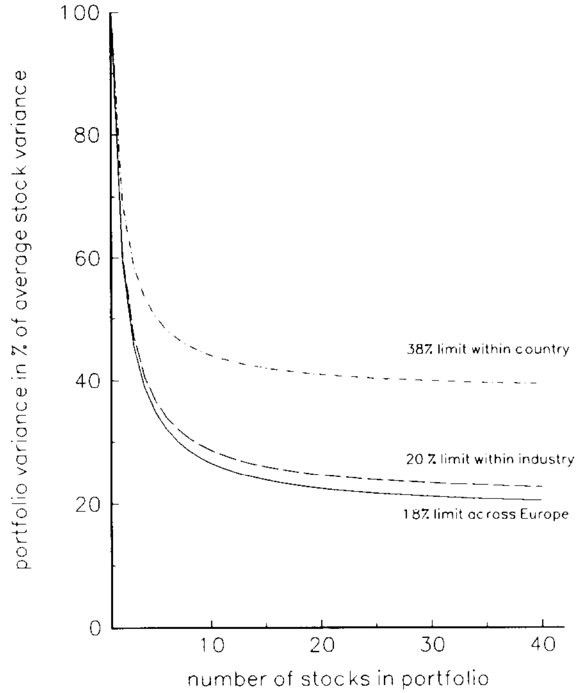

Fig. 1. The figure gives the portfolio variance as the number of stocks in the portfolio increases, expressed as a percentage of the variance of a typical stock. The top line is the variance of a portfolio that diversifies across industries within a single country. The middle line gives the variance of a portfolio that diversifies across countries within a single industry. The bottom portfolio diversifies across both countries and industries.

average security. This investment strategy diversifies both over countries as well as over industries. Diversification across industries within a single country only reduces portfolio variance to 38% of the average stock variance, but diversification across countries within a single industry reduces the portfolio variance to 20%.[5]

In practice, it would be difficult to perfectly diversify across industries within some countries, or to perfectly diversify across countries within some industries. But since country effects are larger than industry effects, we conclude that

[5] The average stock return has a variance of 0.0111 per month. An equally-weighted portfolio of N such stocks has a variance equal to $0.0111/N$ plus $(N-1)/N$ times the average covariance among these stocks. The average covariance in a large group of stocks is just equal to the variance of an equally-weighted index. When diversifying across all European stocks, the average covariance is $(0.04524)^2$, the variance of the equally-weighted European index (see Table 2). This is only 18% of the average variance of an individual stock. The weighted average variance of equally-weighted indices across countries is 0.0042, and the weighted average variance of equally-weighted indices across industries is 0.0023. These numbers are 38% and 20% of the average security variance, respectively.

country diversification is a more effective tool for achieving risk reduction than industry diversification.

4.1. Estimating industry factors from aggregate data: A comparison with Roll (1992)

In order to estimate separate country and industry effects, one must use returns which vary separately across country and industry. By using individual security returns, one can compare firms in the same industry across different countries, or compare firms in different industries within the same country. Roll (1992) only had data on aggregate country index returns available, and therefore could not separately estimate country effects. He specialized Eq. (2) to

$$R_i = (\alpha + \beta_1)w_{i1} + (\alpha + \beta_2)w_{i2} + \cdots + (\alpha + \beta_7)w_{i7} + e_i\,, \tag{7}$$

where the R_i are value-weighted index returns from 24 countries, and where w_{ij} represents the proportion of country i's market capitalization in industry j. Because the industry weights sum to unity in every country, Eq. (7) does not include a separate constant term to avoid perfect multicollinearity, and only the seven $(\alpha + \beta_j)$ sums are estimated by ordinary least-squares:

$$\hat{\alpha} 1_7 + \hat{\beta} = u'R\,, \tag{8}$$

where

$$u' = (W'W)^{-1}\, W'\,,$$

1_7 is the 7×1 unit vector, $\hat{\beta}$ is the 7×1 vector of $\hat{\beta}_j$'s, and W is the 12×7 matrix of industry proportions in each country at the beginning of the return interval. The matrix W has full column rank because, as shown in Table 1, country indices differ in terms of their industry composition. One can show that the columns of u sum to unity, so that each of the estimated industry factors $\hat{\alpha} + \hat{\beta}_j$ is the return on a portfolio of country indices.[6] For each month we estimated industry factor returns in this fashion, using the 12 value-weighted portfolios of our disaggregate data to obtain a time series of the industry factor returns. The summary statistics of this procedure are given in Table 5. Although our sample covers only a subset of the countries in Roll's (1992) sample, our results are qualitatively similar. The average industry factor returns are large in absolute value, and the standard deviations of the estimated industry factor returns are often much larger than the typical standard deviation of the country index returns. Also, more than half of the correlations between the estimated

[6] The fact that seven industry weights sum to unity in all 12 countries can be written as $1_{12} = W1_7$, Premultiplying this equality by $(W'W)^{-1}\,W'$ gives $(W'W)^{-1}\,W'\,1_{12} = u'1_{12} = 1_7$ which means that the seven industry estimates are indeed unit investment portfolios. Because $u'W$ is simply the 7×7 identity matrix, the industry estimate for the jth industry is the return on a portfolio which invests one unit in that industry, and zero net wealth in other industries.

Table 5
Summary statistics of industry factors estimated from aggregate data

The table gives the means, standard deviations, and the correlation matrix of the estimated industry factors using Roll's (1992) methodology. In each month the industry factor returns are estimated as the coefficients in a cross-sectional regression (excluding a constant term) of the value-weighted (VW) country index returns on the weights of each of the seven industries in the country indices. By running a cross-sectional regression for each month during the period 1978–1992, we obtain a time series of industry factor returns. All returns are expressed in percent per month.

		Factor return		Correlation matrix					
Industry		Mean	Std. dev.	F	E	U	T	Co	Ca
Finance	(F)	1.670	14.459						
Energy	(E)	1.124	9.946	0.310					
Utilities	(U)	1.391	17.762	− 0.427	− 0.137				
Transportation	(T)	− 6.604	124.333	− 0.393	− 0.397	0.137			
Consumer	(Co)	0.578	14.978	− 0.538	− 0.012	0.408	− 0.122		
Capital	(Ca)	4.318	30.673	− 0.454	0.030	0.207	0.016	− 0.523	
Basic	(B)	− 0.841	19.799	− 0.342	0.103	− 0.257	0.179	0.094	− 0.624

industry factor returns are negative, and except for five entries, the signs of the correlations match those in Roll (1992). However, the correlations do not resemble those obtained from our disaggregate procedure. For example, the negative correlation between consumer goods and capital goods of − 0.52 in Table 5 matches neither our country corrected correlation of 0.941 in Table 4, nor the raw sample correlation of 0.936 in Table 2. The negative correlations are particularly suspect, because it is difficult to find negatively-correlated stocks, let alone portfolios, and the actual industry portfolios themselves are strongly positively correlated.

Inspection of the weights of the replicating portfolios, u, shows that these negative correlations are caused by taking large positive and negative positions in the same countries in order to isolate the industry factors. For instance, the replicating portfolio that invests one Deutschmark in consumer goods in January 1988 consists in part of a short position of DM 1.68 in the Norwegian index and long positions of DM 1.68 and DM 2.05 in the Swiss and U.K. markets, while at that time the portfolio that invests one Deutschmark in the capital goods industry takes a long position of DM 3.45 in Norway and short positions of DM 2.68 and DM 0.72 in Switzerland and the U.K.[7] Consequently, the

[7] The standard deviations in Table 5 are generally larger and the correlations more extreme than those reported by Roll (1992). Because Roll's sample covers more countries than ours (24 vs. 12), he has more 'degrees of freedom' in constructing the industry portfolios, which are consequently somewhat better diversified than ours.

industry factor returns estimated from aggregate data are contaminated by the large country-specific components of index returns. A comparison of our estimates of corrected industry returns from the disaggregate data and those from the aggregate country index data shows that the two sets of estimates are not closely related, and in some cases are even negatively correlated.

Roll (1992) reports that, on average across countries, global industry factors, computed strictly from returns in other countries, explain about 40% of the variance of country index returns, which is interpreted as evidence of the importance of industrial structure. Replicating this procedure for the 12 European countries, we find that estimated industry factor returns explain 43% of the variance of country index returns. How can these findings be reconciled with our earlier conclusion that the influence of industrial structure accounts for only around 1% of the variance of equally-weighted excess country index returns and 7% of the variance of value-weighted excess returns? The key is that the regressors in Roll (1992) are industry returns, rather than industry effects. The former include the common factor α, whereas industry effects are measured as *deviations* from the common factor, i.e., from the European market. Since we can only measure differences in industrial structure between countries, we need to gauge the importance of industrial composition by measuring the incremental variance explained by industry effects. Using the data from our disaggregate procedure, we find an average R^2 across countries of 0.4664 when we regress equally-weighted country index returns on a constant and the European equally-weighted market. Including the weighted sum of the seven industry effects as an additional regressor, increases the R^2 to 0.4737. Similar regressions with value-weighted indices give average R^2's of 0.4221 and 0.4456.[8] We therefore conclude that cross-sectional *differences* in industrial composition explain only a small fraction of the variation in country index returns.

4.2. Can currency conversion explain the country effect?

The presence of large country-specific sources of return variation does not provide a comprehensive explanation of why country correlations are low, but merely shifts the focus to the driving source behind these country effects. Many of these factors are likely to be found in the area of general economic policy, which is beyond the scope of this paper. One simple possibility is that country effects are in part induced by the conversion of local currency returns into Deutschmarks, affecting all securities of that country equally. Since country effects are defined relative to the return on the value- and equally-weighted

[8] The incremental explanatory power of industry effects for value-weighted indices is less than the 7% reported in Table 3 due to nonzero covariances between the value-weighted European market and the sum of the industry effects for some countries.

European index, it is natural to define currency effects relative to the currency baskets in the European index. The currency components of the DM return on the equally- and value-weighted country indices of country k relative to the European market are given by

$$S_k - \frac{1}{N}\sum_k m_k S_k \,, \tag{9a}$$

$$S_k - \sum_k v_k S_k \,, \tag{9b}$$

where S_k equals the percentage change in the exchange rate measured in DM per unit of local currency of country k, $\sum_k m_k = N$ and $\sum_k v_k = 1$.

The covariance between exchange rates and returns will generally depend on the nature and the transmission of shocks affecting economies differently. For example, an increase in the discount rate in Germany might lead to a depreciation of other currencies against the DM. Foreign companies might find it on average easier to compete in Germany, leading to a positive stock price response in their local markets. This can result in a slope coefficient below unity in a regression of the DM return on these foreign stocks on the exchange rate change. If foreign central banks were to respond with a discount rate increase of their own to limit the consequences for their exchange rate, this might negatively affect their local stock markets through the increased anticipated cost of doing business, and lead to a larger slope coefficient. By contrast, a once-and-for-all unexpected increase in the money supply in Italy may raise the local currency security prices in Italy and proportionally lower the DM/lira exchange rate, which would lead to a slope coefficient of zero. Adler and Simon (1986) provide evidence of changing slope coefficients around changes in economic policy regimes. Economic policy decisions can therefore induce a correlation between stock returns and exchange rates beyond a mere currency conversion effect.

Table 6 presents the results of regressing each of the country effects $\hat{\gamma}_k$ on these currency effects. With the exception of Belgium, France (equally-weighted), the Netherlands (value-weighted), and Sweden, one cannot reject the hypothesis that the slope coefficients in the regression are unity, which implies that the country effects measured in *local* currency are approximately uncorrelated with exchange rate movements. For the purpose of this paper, the more important question is how much of the variance of country-specific return variation is explained by currency movements. Inspection of the R^2 of the regressions indicates that most of the variance of the country effect cannot be explained by currency movements. Currency effects explain only between 1% (Sweden) and 25% (U.K.) of the variance of the country effect. As shown in Table 2, European exchange rates are less volatile than European stock returns, so they cannot explain the bulk of country index movements, unless slope coefficients are

Table 6
Country effects and excess exchange rate returns

Slope and the R^2 of a regression of the country effect relative to the European equally-weighted (EW) and value-weighted (VW) index on the difference between the relative change in the DM/FX exchange rate and the relative change in the exchange rate of the DM versus the weighted average of European currencies (EW and VW). Standard errors are in parentheses.

	EW		VW	
Country	Slope	R^2	Slope	R^2
Austria	0.591 (0.400)	0.012	0.542 (0.333)	0.015
Belgium	0.432 (0.258)	0.016	0.661 (0.234)	0.043
Denmark	0.980 (0.275)	0.067	0.713 (0.248)	0.044
France	1.804 (0.285)	0.184	1.486 (0.253)	0.163
Germany	1.377 (0.230)	0.168	1.266 (0.211)	0.168
Italy	0.960 (0.238)	0.046	0.746 (0.316)	0.030
Netherlands	0.831 (0.310)	0.039	0.664 (0.167)	0.081
Norway	1.036 (0.315)	0.057	1.057 (0.309)	0.061
Spain	1.591 (0.340)	0.110	1.336 (0.287)	0.109
Sweden	0.309 (0.258)	0.008	0.374 (0.231)	0.014
Switzerland	0.849 (0.123)	0.212	0.846 (0.117)	0.227
United Kingdom	0.991 (0.135)	0.232	0.971 (0.126)	0.249

substantially larger than unity. We conclude that industry and currency diversification can only account for a small proportion of the substantial benefits of international diversification.

5. Conclusion

This paper investigates the country and industry structure of European stock returns using data on 829 stocks in 12 European countries and seven industries.

By separately measuring country and industry effects, we are able to examine why country stock indices differ in volatility and why correlations between stock indices are so low. Country indices are generally more volatile and less highly intercorrelated than industry indices. This might simply be explained by the fact that industries are more diversified across countries than countries are diversified across industries. However, our analysis shows that this is not the case: industry-specific effects are simply much smaller than country effects. Industrial specialization explains less than 1% of the variance of equally-weighted country index returns. Moreover, controlling for industry structure does not substantially change the correlations among European country stock indices. Because industry effects are so small, country diversification is a more effective tool for achieving risk reduction than industry diversification.

It is not possible to explain the large country effects in terms of currency movements. For many countries, stock returns measured in local currency are uncorrelated with exchange rate changes. In addition, country index returns are too volatile to be explained by the less variable exchange rates. We conclude that there are substantial benefits to international diversification beyond the amounts attributable to industrial or currency diversification. These findings do not identify the origin of these strong independent country movements. Different explanations may attribute them to various forms of economic policy; we leave their consideration for future research.

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