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Another look at the role of the industrial structure of markets for international diversification strategies[1]

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Abstract

This paper re-examines the extent to which gains from international diversification are due to differences in industrial structure across countries. Recent papers by Roll (1992), Journal of Finance 47, 3–42 and Heston and Rouwenhorst (1994), Journal of Financial Economics 36, 3–27 investigate this issue and find conflicting evidence. Using a new database, the Dow Jones World Stock Index, with coverage in 25 countries and over 66 industry classifications, we decompose comprehensively both country and industrial sources of variation. We confirm that little of the variation in country index returns can be explained by their industrial composition. We also uncover differences in the proportion of variation in industry index returns that is captured by country and industry factors and discuss the implications for global diversification strategies. © 1998 Elsevier Science S.A. All rights reserved.

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1. Introduction

Knowing what factors drive the covariation in stock returns across countries has long challenged both academics and professional portfolio managers. Early studies by Grubel (1968), Levy and Sarnat (1970), and Solnik (1974) document low correlations between index returns in different countries and argue that the benefits of international diversification outweigh the numerous costs, including higher direct trading costs, regulatory and cultural differences, and currency and political risks. It is not clear, however, how these gains from diversification arise. Many analysts maintain that the gains stem from the diversity of economic conditions underlying foreign capital markets due to differences in monetary and fiscal policies, movements in interest rates, budget deficits, and national growth rates. Others propose that the benefits from international diversification come largely from the diversity of industrial structures across countries. Could a US investor, for example, diversifying into Indonesian stocks achieve some of the same benefits by creating a purely domestic portfolio disproportionately weighted in oil and rubber stocks? Does a US investor with disproportionate holdings of US oil stocks achieve the same diversification benefits from investments in oil stocks abroad as from investments in overseas banking or real estate stocks?

Lessard (1974) first considered the importance of differences in industrial composition for explaining the variation in global stock returns. But recent papers by Roll (1992) and Heston and Rouwenhorst (1994) have revived the issue.[2] Roll suggests that three pervasive forces cause variation in a country's index portfolio returns. First, the 'technical procedures of index construction' generate some country indexes that are large and well diversified, while others are not. Second, the industrial composition of an index can explain some variation. Third, both real and nominal exchange rate behavior causes variation in common currency-denominated index returns. Roll uses daily data for 24 country indexes from April 1988 through March 1991 and finds that industry factors explain approximately 40% and exchange rates approximately 23% of the volatility in stock returns. Roll does not have individual stock or industry returns index returns on a country level. He assumes that each country's returns contain seven industry factors and an error term that is independent across countries. He uses Fama and MacBeth (1973) regressions to extrapolate the industry factors. Heston and Rouwenhorst, however, use a different sample and time period to demonstrate that Roll's method for extracting the industry factors includes country effects, thereby overstating the importance of industry

[2] Solnik and de Freitas (1988), Grinold et al. (1989), and Drummen and Zimmerman (1992) also examine the importance of industrial composition for international portfolio investment strategies.

effects. They use monthly returns from stocks in seven industries and 12 European countries from 1978 to 1992 and show that less than 1% of the differences in volatility of national index returns can be explained by their industry composition. They also replicate Roll's methodology to show how their industry portfolios, like Roll's, can have spuriously negative correlations.

Our paper re-examines the role of country and industry-specific sources of variation in international asset returns for global portfolio diversification strategies. We employ the new Dow Jones World Stock Index database, which has daily index prices for 66 industry classifications and over 25 countries. Our analysis spans the period from January 1992 through April 1995. We decompose stock returns into industry and country components using a dummy-variable regression model similar to the work of Solnik and de Freitas (1988), Grinold et al. (1989), Roll (1992), and Heston and Rouwenhorst (1994). We compare the country and industry effects using nine aggregate industry sectors as well as the more refined industry classifications of Dow Jones World Stock Index. Both data sets confirm Heston and Rouwenhorst's finding that on average little (less than 4%) of the variation in country indexes can be explained by their industrial composition. With the more finely partitioned industrial classifications, we also uncover some interesting cross-sectional differences in the variances of industry effects for industry indexes. For industries that do not produce goods traded internationally (hereafter 'nontraded-goods industries') such as media, heavy construction, plantations, conglomerates, and real estate, country factors explain a relatively larger proportion of the variation in index returns. For industries which produce goods traded internationally (or 'traded-goods industries') such as automobiles, computers, office equipment, pharmaceuticals and semi-conductors, the variance of industry factors is relatively larger. We discuss the important implications of these cross-sectional differences.

The rest of the paper is organized as follows. Section 2 describes the Dow Jones World Stock Index data and compares the data to other data sets that have been used to test international diversification strategies. Section 3 outlines the methodology, and our results appear in Section 4. We discuss economic implications in Section 5 and offer a summary in Section 6.

2. The Dow Jones World Stock Index data

The Dow Jones World Stock Index data were introduced in 1993 to provide benchmarks for international investors with comprehensive coverage of 66 industries and an additional 45 sub-industry classifications spanning 25 countries. Coverage begins in December 31, 1991, and we use the daily data through April 1, 1995. Dow Jones assigns companies to industry group codes according to their respective lines of business with companies in multiple lines assigned on a revenue-weighted basis. These assignment rules are consistently applied for all companies around the world. They also screen for investability using measures of liquidity, foreign access regulations, currency-convertibility and multiple classes of stock. The Wall Street Journal publishes the Dow Jones World Stock Index data daily (Dow Jones and Company, 1993).

2.1. Characteristics of the data

One important advantage of our data in examining the roles of industry and country effects is the comprehensive coverage across industries. Roll (1992) and Heston and Rouwenhorst (1994) both grouped their securities into just seven industry sectors. Such broad industry classifications may not provide enough cross-sectional variation in returns across industries to distinguish between country variation and industry-specific sources of variation. Thus, tests using these groups may be biased against finding any industry effects. By contrast, inter-industry studies of US data usually use two or three-digit SIC (Standard Industrial Classification) codes, which typically have about 62 different industry classifications at just the two-digit level (Guenther and Rosman, 1994). Using fewer industry classifications can be even more problematic when grouping firms from different countries, which are even more likely to have different characteristics.

Dow Jones World Stock Index also offers comprehensive coverage across countries. Heston and Rouwenhorst used 829 stocks from 12 European countries, but the Dow Jones World Stock Index contains value-weighted industry indexes from over 2400 stocks in 25 countries. Because international investors are not restricted to investing solely in European stocks, our analysis should give sharper estimates of the benefits of international diversification attributable to country or industry-specific effects.

Use of the Dow Jones World Stock Index data also involves tradeoffs, since the data are available only over a recent period (1992–1995) and on a daily and weekly basis. With daily data, our analysis is immediately comparable to that of Roll (1992), although for a more recent period. Roll uses the 'FT Actuaries/Goldman Sachs International Indices' published in the London Financial Times for 24 countries from March 1988 to April 1991. The Dow Jones World Stock Index, however, contains daily price indexes for each industry in each country as well as an overall price index for each country. Second, while a longer time period would benefit an analysis of country and industry effects by allowing more precise estimation of covariances, the structure of covariances in global equity market returns is not stationary over time. Several studies show that the level of integration among economies or stock markets has changed over the past 20 years as restrictions on capital repatriation, additional taxes to investing abroad, and other investment barriers have become less severe. Additionally, because of increases in world trade, economies and corporate profits should be much more correlated, resulting in less dispersion and higher stock-return correlations between countries.[3] Nevertheless, even if global stock-return correlations have increased overall, the relative importance of industry and country factors has not necessarily changed, because market capitalizations vary over time and because firms enter and exit the sample. Finally, although the use of high frequency returns can increase statistical precision over a shorter sample period, the bias induced by non-synchronous trading hours across markets is exacerbated as the observation interval decreases. Since international markets trade at different times, examining industry effects with one-day returns on a calendar-day basis may lead to incorrect inferences about the degree of comovement in returns. For example, consider a global news announcement that affects the steel industry in the US and Japan similarly and contributes to a higher positive correlation between the two industries. Using one-day returns will capture the correlation between the US and Japan steel industry portfolio returns on that trading day but ignore the influence that US stocks can have on the next-day returns in Japan. The US market is one of the last markets to trade and the Japanese market one of the first, for example. (See Hamao et al. (1990), Lin et al. (1994), King et al. (1994), Bae and Karolyi (1995), Karolyi and Stulz (1996) for studies of return correlations with high frequency data.) Thus, using daily data captures half of the industry-specific variation. Using weekly returns is only a partial solution to this problem because it ignores important dynamics in the auto- and cross-covariances of the joint-returns process. Our analysis below examines only weekly returns but evaluates the sensitivity of our conclusions to daily returns.

Table 1 shows the coverage of indexes both across countries and across industries. Some smaller countries lack representation in many industries, as can be seen in Panel A. The US is represented in 64 industries, while Norway, Finland, Ireland and Mexico are represented in fewer than ten industries. Table 1, Panel B shows the number of countries covered by a particular industry classification, as well as the number of industries that have representation in a country. More than half of the 66 industry groupings have coverage in at least 9 countries.

2.2. Traded goods and nontraded goods industries

The comprehensive coverage across many industry groups provided by the Dow Jones World Stock Index data permits investigation of inter-industry

[3] Adler and Dumas (1983) and Stulz (1995) provide intuitive discussions of changing global capital-market integration and international stock-return correlations. Some empirical studies demonstrate how financial-market integration has increased global stock-return correlations, including Harvey (1991), Chan et al. (1992), Bekaert and Harvey (1995), Dumas and Solnik (1995), DeSantis and Gerard (1997), Longin and Solnik (1995) and Errunza et al. (1995).

Table 1
Industry and country composition of Dow Jones World Stock Index data

Only some industries have coverage in any given country. Panel A shows the number of industries in each country (with the number of companies covered in parentheses); Panel B shows the number of countries with representation in each industry with the aggregate economic group code as follows: B – Basic, C – Consumer Cyclical, N – Consumer, Non-cyclical, E – Energy, F – Finance, I – Independent, D – Industrial, T – Technology, U – Utilities. Traded-goods industries using definitions from Bodnar and Gentry (1993) have a '(T)' to the right of their name in Panel B

Panel A

Country	No. of Indust.	Country	No. of Indust.	Country	No. of Indust.
US (713)	64	Germany (91)	35	Switzerland (59)	19
Canada (129)	40	Netherlands (30)	20	Australia (75)	30
Mexico (31)	9	Italy (73)	24	Thailand (70)	19
Austria (22)	12	Norway (19)	7	Hong Kong (79)	29
UK (255)	53	Belgium (36)	11	Indonesia (32)	14
Denmark (32)	14	Finland (27)	8	Japan (514)	54
Spain (32)	15	Ireland (11)	9	Malaysia (76)	24
France (117)	42	Sweden (40)	18	Singapore (51)	21
				New Zealand (17)	12

Panel B

Industry	Agg.	No. Cou.	Industry	Agg.	No. Cou.	Industry	Agg.	No. Cou.
Food (T)	N	23	Pharmaceutical (T)	N	10	Consumer Products	N	6
Banks	F	22	Gas Utilities	U	10	Heavy Machinery (T)	D	6
Building Materials	D	19	Lodging	C	10	Office Equipment (T)	T	6
Insurance: All	F	19	Non-Ferrous Metal (T)	B	10	Oil: Majors (T)	E	6
Financial Services	F	18	Textiles & Apparel (T)	C	10	Overseas Trading	I	6
Chemicals (T)	B	17	Aerospace & Defense	T	9	Precious Metals (T)	B	6
Media	C	15	Auto Parts & Equip (T)	C	9	Industrial Techn.	T	5
Paper Products (T)	B	15	Electric Compon. (T)	D	9	Mining (T)	B	5
Conglomerate	I	14	Entertainment	C	9	Software (T)	T	5
Heavy Construction	D	14	Food Retail/Wholesa.	N	9	Air Freight	D	4
Diversified Industries	D	14	Home Construction	C	9	Coal (T)	E	4
Real Estate	F	14	Securities Brokers	F	9	Forest Products (T)	B	4
Industrial Services	D	14	Telephone Systems	U	9	Medical and Biotech.	T	4
Beverages	N	13	Tobacco (T)	N	9	Water Utilities	U	4
Home Furnishing	C	12	Communications Tech.	T	8	Advertising	C	3
Marine Transportion	D	12	Computers (T)	T	8	Cosmetics (T)	N	3
Oil: Secondary (T)	E	12	Containers & Pack	D	8	Railroads	D	3
Retailers: Broadline	C	12	Medical Supplies	N	8	Semiconductors (T)	T	3
Retailers: Specialty	C	12	Auto Manufactur. (T)	C	7	Health Care	N	2
Airlines	C	11	Factory Equipment (T)	D	7	Pipelines	E	2
Electric Utilities	U	11	Oil Equip. & Serv. (T)	E	7	Plantations	I	2
Steel (T)	B	11	Transport. Equip. (T)	D	7	Savings & Loans	F	1

differences in the relative importance of country or industry factors in stock returns. For firms in some industries, the sources of variation in global industry factors can be more important for stock returns because their profitability, cash flows and asset values are more sensitive to: (a) price fluctuations in an internationally traded input commodity common to firms in that industry, (b) price fluctuations of an output good or product that those firms competitively market, or (c) changes in the terms of competition with foreign firms for domestic exporters and import competitors. An example can be drawn from the coal industry, which produces an internationally traded, homogenous commodity. Shocks to the supply and demand conditions for coal would be an important determinant of the input costs, profitability and current and future operating cash flows of coal-producing firms worldwide. Similarly, exchange-rate shocks would alter the relative input and output prices of coal and therefore the terms of competition for domestic and foreign coal-producing firms.

Distinguishing between firms in traded and nontraded-goods industries is a useful classification scheme to measure the relative importance of industry and country factors. Nontraded-goods industries are defined to be those for which high transportation costs prevent international trade. The exchange-rate and industrial-organization literature provides a precedent for this classification. The early macroeconomic models of Dornbusch (1973, 1987) advance hypotheses about how changes in an exchange rate may affect wages, goods, and asset prices in nontraded goods industries differently. For traded goods, since the exchange rate is the relative price of domestic and foreign goods, its movements change the relative input and output prices that affect the industry's profitability. In the finance literature, Adler and Dumas (1984) and Levi (1994) model how exchange-rate fluctuations affect the market values and investment decisions of firms in traded and nontraded-goods industries. Empirical work by Bodnar and Gentry (1993), Allayannis and Uhlrig (1996), and Williamson (1996) provides industry-level analysis of exchange-rate exposures and focuses on differences between traded and nontraded-goods industries, in particular. Because traded-goods industries have common sources of variation (due to changes in relative input and output prices), theory predicts and empirical studies find that share prices of these firms are more sensitive to exchange-rate fluctuations. Fluctuations in input and output prices imply a common industry source of variation that is a more important factor for the stock returns of traded-goods firms.

We classify the Dow Jones World Stock Index industry groups into those that produce traded and nontraded goods using the definitions set out in Bodnar and Gentry (1993), data appendix. Panel B of Table 1 denotes traded-goods industries with a 'T' in parentheses. Examples of traded goods include paper products, oil-secondary, steel, textiles and apparel, automobiles and semiconductors. Our hypothesis parallels the preceding exchange-rate literature and anticipates that industry effects explain a larger fraction of the variation in industry index returns than country effects for traded-goods industries. The test methodology described below provides a natural framework to evaluate this hypothesis.

3. Methodology

The variation in the return of a given stock can be the product of one of several forces, including common variation within the country in which the stock is located, the currency in which the stock is denominated, and the industry to which a stock belongs. The residual variation can be ascribed to other sources uncorrelated with country, currency, or industry-specific influences and can simply be classified as company-specific variation.

Heston and Rouwenhorst (1994) provide an intuitively appealing dummy variable regression framework that we follow and extend to evaluate this problem. We, however, apply the dummy variable regression analysis for value-weighted index returns of individual securities, and not for individual security returns. In general, with 'condensed' data, regression models should yield different results because the dispersion of the regressors around their respective group means are ignored. In our case there is no loss of information when using the 'condensed' index-level data, since all of the cross-sectional dispersion in the independent variables for individual stocks derives from the dispersion of the group values (Kmenta, 1986, Section 9.2; Haitovsky, 1973). The weighted least-squares estimators for the individual stocks and country/industry indexes can be shown to be equal. (An appendix demonstrating this fact is available directly from the authors upon request.)

The return on a given stock in a given industry is assumed to vary due to country effects or industry effects, plus an error-term. We estimate the following equation weekly for each country and industry index:

$$R_{ic} = \alpha + \beta_1 I_{i1} + \beta_2 I_{i2} + \cdots + \beta_n I_{i66} + \gamma_1 C_{i1} + \gamma_2 C_{i2} + \cdots + \gamma_{i25} C_{i25} + e_i, \quad (1)$$

where R_{ic} is the return on the industry value-weighted index i in country c.

Since each return belongs to both one country and one industry, there is an identification problem if dummy variables are defined for every country and industry. One way to avoid this identification problem is to pick one country and one industry as the benchmark and interpret the dummy variable coefficients as differences from the benchmark. To avoid the interpretation problem of an arbitrary benchmark, we can impose the constraint that, for value-weighted portfolios, the sum of the industry coefficients equals zero and the sum of the country coefficients equals zero (Kennedy, 1986). We estimate Eq. (1)

cross-sectionally for the 66 industry groupings (I) in each of the 25 countries (C) subject to the following restrictions:

$$\sum_{j=1}^{66} w_j\beta_j = 0, \tag{2a}$$

$$\sum_{k=1}^{25} v_k\gamma_k = 0, \tag{2b}$$

where w_j and v_k denote the value weights of industry j and country k in the world market portfolio. The least-squares estimate of the intercept in Eq. (1) can then represent the return on the value-weighted world market portfolio. Since estimated disturbances are orthogonal to all industry and country dummies by construction, the average residual is zero in every industry and in every country. Since the world market index is simply the value-weighted average over all industries and countries, the average disturbance for the world value-weighted market index is also zero; the intercept can thus signify the value-weighted market.

Weighted least squares (WLS) estimates for Eq. (1) are computed each week subject to the restrictions in Eqs. (2a) and (2b). The weekly cross-sectional regressions yield a time series of the intercept and the country and industry coefficients. We interpret the coefficient $\hat{\beta}$ as the estimated 'pure' industry effect relative to the value-weighted world market portfolio, and $\hat{\gamma}$ as the estimated 'pure' country effect relative to the value-weighted world market portfolio. The time series of these coefficients reveals whether country or industry effects have greater variation. A similar analysis can be performed with the nine broad economic sectors.

4. Results

We compute weekly continuously-compounded dollar-denominated returns for all indexes from Wednesday to Wednesday prices. Separate WLS regressions are run weekly for the cross-section of country/industry indexes and we then use the estimated coefficients to construct a time series of estimated 'pure' country effects, γ's, and 'pure' industry effects, β's. We can decompose the value-weighted index returns on, for example, Canada (AC), given as R_{AC}, into a component common to all countries, $\hat{\alpha}$, the value-weighted average of the industry effects based on the unique industrial composition of the Canadian index, and a pure country specific component, $\hat{\gamma}_{AC}$, as follows:

$$R_{AC} = \hat{\alpha} + \sum_{i=1}^{66} x_{AC,i}\hat{\beta}_i I_{AC,i} + \hat{\gamma}_{AC}, \tag{3}$$

where $x_{AC,i}$ denotes the proportion of the total market capitalization of Canada included in industry group i. Eq. (3) states that the return on the Canadian country index can differ from the return on the world market portfolio because the industrial composition of the market differs (i.e. a higher proportion of mining, non-ferrous metal and forest products stocks) and because the returns on Canadian stocks differ from the returns on stocks in the same industry in other countries. We can perform a similar construction for a global industry index, say the steel industry (STL), with a pure industry component and a cumulative effect of country factors depending on the representation of companies from around the world in that particular industry. Consider

$$R_{STL} = \hat{\alpha} + \sum_{j=1}^{25} \phi_{j,STL}\hat{\gamma}_j C_{j,STL} + \hat{\beta}_{STL}, \tag{4}$$

where $\phi_{j,STL}$ represents the proportion of the capitalization of the global steel industry index composed of country j's stocks. The proportion of the total variance of the returns of any country or industry index in excess of the world market portfolio return is computed with a ratio of the variance of the pure country or industry effect to the variance of the sum of that pure effect and the sum of the value-weighted industry and country effects.

4.1. Tests using broad industry groupings

Table 2 shows the time-series variances of these components for each country and industry using weekly US dollar-denominated returns and just nine broad economic sectors. In Panel A, we can compare the variance of the 'pure' country effects to the cumulative sum of the variances of the industry effects for the country indexes. Several results are noteworthy. First, there are considerable cross-sectional differences in the total variances of the pure country components. The US has one of the smallest country effect variances (1.51%-squared) and Mexico, the largest (30.88%-squared), about 20 times that for the US. Second, the cumulative industry-effect variance can explain on average only 2% of the total variance of the country indexes. This ratio is even lower than the average 7.1% variance found in Heston and Rouwenhorst (their Table 3) with value-weighted returns. This more dramatic result is expected because they only study 12 European countries, whereas our sample includes 25 Asia-Pacific, European and North American countries. Indeed, in a follow-up study, Heston and Rouwenhorst (1995) conjecture that a sample including countries from outside Europe could reveal a larger role for country effects. Panel B compares the variances of the pure industry factors relative to the cumulative effects of the 25 country factors in terms of their explanatory power for the nine industry sector portfolios. The energy sector has the largest variance of pure industry factors at 1.614%-squared. When we compare the average variance of the country effects (8.042%-squared) to the average variance of the industry effects (0.704%-squared), we find a ratio of 12 : 1 which is much larger than Heston and Rouwenhorst find. We can thus conclude that country effects are an even more important determinant of variation in international returns than other studies

Table 2
Decomposition of index returns into country and industry effects using nine aggregate industry classifications and US dollar-denominated weekly returns

The table gives the variance of the components of the value-weighted country and industry index weekly returns from the Dow Jones World Stock Indexes from January 1992 to April 1995. Each country index return is decomposed into a pure country effect and the cumulative sum of industry effects using the dummy variable regression methods. Each industry index return is similarly decomposed into a pure industry effect and the cumulative sum of country ffects. The ratio relative to the market is the ratio of the variance of that component relative to the variance of the index return in excess of world market return. Returns are defined in percentages per week.

Panel A

	Pure country effect		Cumulative sum of industry effects	
	Variance	Ratio relative to market	Variance	Ratio relative to market
US	1.508	1.00	0.010	0.01
Canada	3.231	0.98	0.021	0.01
Mexico	30.877	1.00	0.075	0.00
Austria	4.458	1.03	0.047	0.01
UK	2.301	0.97	0.017	0.01
Denmark	5.635	1.01	0.055	0.01
Spain	7.043	1.07	0.210	0.03
France	2.986	1.01	0.006	0.00
Germany	3.741	1.08	0.050	0.01
Netherlands	1.990	1.00	0.137	0.07
Italy	15.732	1.02	0.157	0.01
Norway	6.408	0.98	0.179	0.03
Belgium	3.165	1.06	0.098	0.03
Finland	17.944	1.00	0.110	0.01
Ireland	5.780	1.08	0.117	0.02
Sweden	6.919	0.97	0.048	0.01
Switzerland	3.158	1.02	0.182	0.06
Australia	5.498	0.96	0.049	0.01
Thailand	19.358	1.02	0.208	0.01
Hong Kong	12.479	1.02	0.111	0.01
Indonesia	9.900	0.99	0.042	0.00
Japan	5.875	0.99	0.017	0.00
Malaysia	12.436	1.00	0.040	0.00
Singapore	7.443	1.01	0.087	0.01
New Zealand	5.196	0.98	0.110	0.02
Mean (median)	**8.042 (5.780)**	**1.01 (1.00)**	**0.087 (0.075)**	**0.02 (0.01)**

Table 2. Continued.

Panel B

	Cumulative sum of country effects		Pure industry effects	
	Variance	Ratio relative to market	Variance	Ratio relative to market
Basic	0.029	0.05	0.556	0.93
Independent	1.006	0.63	0.658	0.41
Cyclical	0.046	0.20	0.261	1.14
Energy	0.458	0.24	1.614	0.86
Finance	0.177	0.18	0.741	0.75
Industrial	0.273	0.67	0.231	0.56
Non-cyclical	0.226	0.23	0.674	0.69
Technology	0.095	0.09	0.869	0.87
Utilities	0.166	0.22	0.732	0.96
Mean (median)	**0.275 (0.177)**	**0.28 (0.22)**	**0.704 (0.674)**	**0.80 (0.86)**

indicate. Again, the most likely explanation for our stronger result is that our sample includes emerging market countries such as Mexico, Thailand, Hong Kong, and Malaysia, which exhibit very strong country effects.

4.2. Tests using disaggregated industry groupings

A key hypothesis that we test is whether the dominance of country factors over industry factors in global stock returns is robust to the definition of industry – that is, the preceding tests may be biased against finding any industry effects. Table 3 provides summary statistics for the country and industry effects with the more finely-partitioned 66 industry indexes. The variance of the country effects in Panel A closely resembles the variance calculated in Table 2, averaging about 8.02%-squared. The variance of the cumulative industry effects also appears similar, at about 0.187%-squared; this component only represents about 4% of the variance of the excess returns on the country indexes. For the industry indexes, the variance of the pure industry effects (Panel B) is considerably higher at 2.416%-squared, than in Table 2, and this average is about double that of the variance of the cumulative sum of country effects (at 1.019%-squared). Nevertheless, the variation in the pure country effects (8.02%-squared) is much higher than those of the pure industry effects (2.416%-squared) – a ratio of 4 : 1. Hence the dominance of country factors in global stock returns is robust to the definition of industry classification.

A potential objection is that our analysis does not adequately control for exchange rate-fluctuations. Since both real and nominal currency effects exist,

Table 3
Decomposition of index returns into country and industry effects using 66 aggregate industry classifications and US dollar-denominated weekly returns

The table gives the variance of the components of the value-weighted country and industry index weekly returns from the Dow Jones World Stock Indexes from January 1992 to April 1995. Each country index return is decomposed into a pure country effect and the cumulative sum of industry effects using the dummy variable regression methods. Each industry index return is similarly decomposed into a pure industry effect and the cumulative sum of country effects. The ratios relative to the market is the ratio of the variance of that component relative to the variance of the index return in excess of world market return. Returns are defined in percentages per week.

Panel A					*Panel B*									
Country	Pure country effect		Cumulative industry effects		Industry group	Cumulative country effects		Pure industry effect		Industry group	Cumulative country effects		Pure industry effect	
	Var	Ratio	Var	Ratio		Var	Ratio	Var	Ratio		Var	Ratio	Var	Ratio
US	1.499	0.97	0.018	0.01	Advertising	1.131	0.24	3.616	0.76	Industrial technology	0.895	0.28	2.145	0.66
Canada	3.241	0.98	0.143	0.04	Aerospace/defense	0.803	0.33	1.716	0.70	Insurance: all	0.484	0.49	0.601	0.61
Mexico	31.284	1.02	0.173	0.01	Air freight	0.607	0.11	4.632	0.82	Lodging	0.925	0.36	1.963	0.76
Austria	4.635	1.06	0.145	0.03	Airlines	0.333	0.20	1.459	0.88	Marine transport.	0.616	0.29	1.223	0.57
UK	2.351	0.99	0.074	0.03	Auto manufact.(T)	0.455	0.24	1.958	1.02	Media	0.661	0.52	0.556	0.44
Denmark	5.767	1.03	0.170	0.03	Auto parts/Equ.(T)	0.791	0.70	0.850	0.75	Medical supplies	0.644	0.18	3.145	0.86
Spain	7.119	1.08	0.271	0.04	Banks	0.601	0.23	1.616	0.63	Medical/Biotech	1.071	0.12	7.760	0.84
France	2.930	0.98	0.029	0.01	Beverages	0.349	0.25	0.942	0.68	Mining (T)	1.464	0.34	2.088	0.48
Germany	3.675	1.06	0.107	0.03	Building materials	0.247	0.24	0.705	0.70	Non-ferrous metals (T)	0.163	0.07	2.159	0.91
Netherlands	1.975	0.94	0.240	0.11	Chemicals (T)	0.064	0.10	0.570	0.93	Office equipment (T)	0.675	0.50	1.448	1.06
Italy	15.232	0.99	0.149	0.01	Coal (T)	0.396	0.12	3.076	0.96	Oil equip./services (T)	0.829	0.13	5.818	0.92
Norway	6.572	1.00	0.215	0.03	Communic. tech.	0.353	0.10	2.938	0.81	Oil: majors (T)	0.814	0.30	2.127	0.79
Belgium	3.024	1.01	0.127	0.04	Computers (T)	0.309	0.08	3.968	1.03	Oil: secondary (T)	0.086	0.08	0.980	0.89
Finland	18.108	0.98	0.321	0.02	Conglomerate	1.003	0.62	0.646	0.40	Overseas trading	3.147	0.66	1.141	0.24
Ireland	5.316	0.99	0.146	0.03	Consumer products	1.006	0.33	1.576	0.52	Paper products (T)	0.084	0.07	1.162	0.91
Sweden	7.012	0.98	0.124	0.02	Container/package	0.161	0.14	0.947	0.85	Pharmaceutical (T)	0.228	0.11	2.102	0.99
Switzerland	3.142	1.01	0.384	0.12	Cosmetics (T)	0.181	0.10	1.390	0.77	Pipelines	1.489	0.37	3.172	0.79
Australia	5.317	0.93	0.133	0.02	Divers. industries	0.090	0.15	0.486	0.83	Plantations	12.439	0.57	7.014	0.32

Thailand	18.366	1.00	0.166	0.01	Elect. compon. (T)	1.038	0.58	1.020	0.57	Precious metals (T)	0.778	0.07	9.178	0.88
Hong Kong	12.487	1.00	0.127	0.01	Electric utilities	0.083	0.07	1.223	1.08	Railroads	1.109	0.69	1.226	0.76
Indonesia	9.868	0.99	0.205	0.02	Entertainment	0.087	0.10	0.790	0.90	Real estate	1.602	0.59	0.809	0.30
Japan	5.784	0.96	0.046	0.01	Factory equip (T)	2.959	0.72	1.409	0.34	Retailers: broad	0.100	0.08	1.182	0.90
Malaysia	12.719	1.00	0.140	0.01	Financial services	0.520	0.50	0.574	0.55	Retailers: special	0.760	0.30	1.849	0.74
Singapore	7.429	1.03	0.206	0.03	Food (T)	0.144	0.16	0.751	0.81	Savings & loans	1.499	0.23	4.409	0.69
New Zealand	5.629	1.07	0.828	0.16	Food retail/whole	0.105	0.10	0.997	0.91	Securities brokers	1.212	0.17	3.936	0.56
					Forest products (T)	1.253	0.18	5.475	0.77	Semiconductors (T)	0.224	0.03	7.222	0.97
					Gas utilities	1.395	0.40	1.831	0.53	Software (T)	0.968	0.14	5.238	0.75
					Health care	1.182	0.12	7.757	0.82	Steel (T)	2.249	0.57	1.846	0.47
					Heavy construct.	1.586	0.41	1.815	0.47	Telephone syst.	1.029	0.57	1.207	0.67
					Heavy mach (T)	1.330	0.40	2.018	0.61	Textiles/apparel (T)	0.880	0.53	0.808	0.49
					Home construction	1.811	0.50	1.922	0.53	Tobacco (T)	0.857	0.12	5.680	0.80
					Home furnishing	2.851	0.65	2.662	0.61	Transport equip. (T)	0.305	0.18	1.510	0.90
					Industrial services	0.110	0.17	0.518	0.78	Water utilities	1.655	0.36	2.864	0.63
Mean	**8.019**	**1.00**	**0.187**	**0.04**							**1.019**	**0.29**	**2.416**	**0.72**
(Median)	**(5.767)**	**(1.00)**	**(0.146)**	**(0.03)**							**(0.784)**	**(0.24)**	**(1.766)**	**(0.76)**

currency influences can not be eliminated in our current dollar-denominated analysis. We can avoid, however, nominal currency effects by examining results with returns denominated in foreign countries' local currency. This is hardly an ideal correction, since both dollar and local-currency returns still contain a currency risk premium (Dumas and Solnik, 1995). From the perspective of a US investor, the dollar returns indicate an investor completely unhedged against currency risk, and the local currency returns show the return of an investor who is hedged against nominal currency fluctuations. Unreported results using local currency weekly returns with 66 industries reveal that the variances of the industry effects are nearly identical to those obtained using dollar-denominated returns, while country effects are not as large. The local currency results thus support the finding that the industrial composition of country indexes can only explain around 4% of the variation in the average country index.

4.3. Traded and non-traded goods industries

Another interesting feature of Table 3 is the cross-sectional dispersion of the variances of the pure industry effects. For example, real estate, overseas trading, conglomerates, plantations, and factory equipment have pure industry effect variances that proportionately represent less than 40% of the total variation in their index returns, while almost all of the variation in the index returns for automobile manufacturing, computers, electric utilities, office equipment, and semiconductors, comes from pure industry effects. Why do stock returns in some industries have a dominant pure industry factor and why do returns in other industries still retain a dominant country component?

Estimation error offers one explanation. Industry-effect variances are likely to be much larger in industries represented in only a few countries because the effects are not estimated with as much precision as those for industries with representation in many countries. Thus, for health care, pipelines, and savings and loans industries, the proportionately large industry-effect variances likely occur because these industries only have representation in three or fewer countries. A second related explanation stems from the possibility that portfolios for industries that have relatively poor geographical representation (such as plantations, which are represented only in Thailand and Malaysia) are not very well diversified across firms (e.g., ten companies from Malaysia and three from Thailand). Inspection of the pure industry-effect variances in Table 3 for such groups shows them to be higher than the average, which is consistent with less diversification across firms and/or countries.

We also offer an alternative economic explanation for the cross-sectional dispersion in industry-effect variances. From the macroeconomics (Dornbusch, 1973, 1987) and exchange-rate literature (Adler and Dumas, 1983; Levi, 1994), we hypothesize in Section 2.2 that pure industry effects may be relatively more important for firms in traded-goods industries. If the current and future cash flows of these firms are more sensitive to changes in either an internationally priced input or output good, stock-return covariation (in an absolute sense) among these firms would tend to be higher. As a result, industry factors can explain a relatively larger proportion of the total variation in the index returns of traded-goods industries. From Table 3, traded-goods industries (denoted by 'T') do have among the highest industry effects both in absolute (the variance of pure industry factors) and relative (the proportion of the total variance of industry index returns due to pure industry factors) terms. For example, of those with the five highest pure industry-effect ratios (each above 99% of total return variation), all but one (electric utilities) represents a traded-goods industry. Among those with the five lowest pure industry-effect ratios (below 45% of total return variation), all but one (factory equipment) are nontraded-goods industries.

To evaluate the relative importance of industry-effect variances in a more formal manner, we proceed in two ways. First, we report in Table 4 the mean and median industry-effect variances separately for the traded and nontraded-goods industries. Results confirm that traded-goods industries on average have higher industry effects and a lower proportion of the variance explained by country effects. The average (median) industry effect is 2.764 (1.988)%-squared for traded-goods industries, which represents about 85% of the total variation in index returns. For nontraded-goods industries, the average (median) industry effect is 2.189 (1.596)%-squared, which represents 70% of the total variation. On the other hand, the average (median) cumulative sum of the country effect variances for traded-goods industries is 0.751 (0.727)%-squared (15% of the total variation) which is lower than for nontraded-goods industries, with 1.194 (0.849)%-squared (30% of the total variation). Second, we can evaluate differences in country and industry effects between traded and nontraded-goods industries by pooling the individual industry distinctions within each category and by calculating the average industry effect and cumulative sum of country effects directly from the dummy variable regression model. This approach lets us compute a ratio of the variances that can be formally tested with an F-statistic. Indeed, Table 4 reports the cumulative sum of country-effect and pure industry-effect variances for the traded and nontraded-goods categories and the associated F-statistics (1.59 for cumulative country effects and 0.79 for pure industry effects). These results strongly reject the null that either the variances of pure industry effects or the cumulative sum of the country effects are equal between traded and nontraded-goods industries.

5. Economic implications

The relative size of country and industry effects has important economic implications for international diversification strategies. A popular diagnostic

Table 4
Examination of disaggregate industry effects for traded and nontraded-goods industries

'Mean (Median)' across industries is calculated by taking the average (median) of the cumulative country effects, pure industry effects, or their respective ratio across the disaggregated industries (as reported in Table 3) separately for traded and nontraded-goods industries. See Table 1 for the classification scheme. "Average Variance" for traded and nontraded-goods industries is estimated by pooling the time series of all cumulative country or pure industry effects across the industries in that subset and estimating the variance separately for nontraded and traded-goods industries. The F-statistic reported is computed for the ratio of the variances across groups separately for the cumulative sum of country effects and pure industry effects and tests for the equality of variances between nontraded and traded-goods industries

	Cumulative country effects		Pure industry effect	
	Variance	Ratio	Variance	Ratio
Mean (median)				
Nontraded goods	1.194 (0.849)	0.320 (0.285)	2.189 (1.596)	0.678 (0.695)
Traded goods	0.751 (0.727)	0.255 (0.150)	2.764 (1.988)	0.799 (0.845)
Average variance				
Nontraded goods	1.191	0.339	2.184	0.622
Traded goods	0.748	0.215	2.764	0.795
F-statistic (p-value)	1.59 (0.000)		0.78 (0.000)	

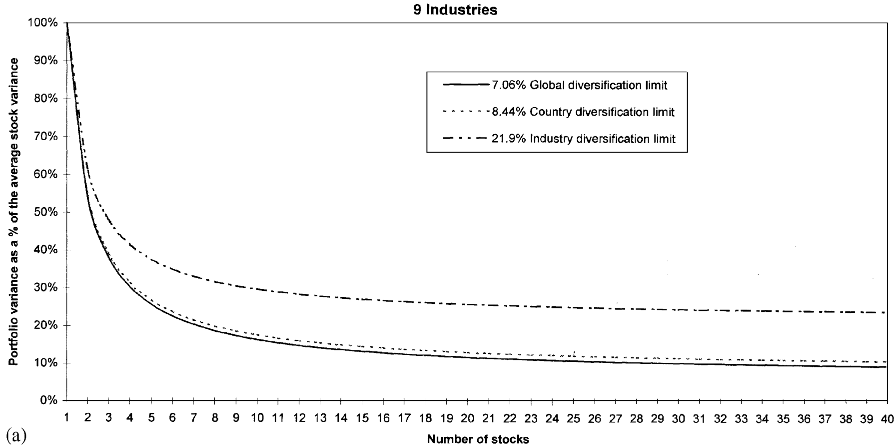
computes the proportion of the return variance of a single representative firm's stock that can be reduced by combining this stock with other stocks randomly selected from the total population. Solnik's (1974) seminal study argued the case for international diversification showing that, although US investors could diversify their risk domestically to approximately 27% of the average risk of a typical US stock, they could lower their diversification limit to as little as 11% by expanding the population of stocks internationally. In our study, we are interested in how close investors get to these global diversification limits if we constrain them (a) to diversify across countries but within specific industries, and (b) to diversify across industries but within specific countries. Moreover, we seek to determine whether the industrial diversification limits are different for traded goods and non-traded goods industries.

We cannot perform this type of analysis using index returns from the Dow Jones World Stock Index database. We, therefore, obtained data on individual stocks directly from Datastream International, an on-line data facility. Our sample of firms comes from the 2400 firms in the Dow Jones World Stock Index database. As selection criteria, we choose a single stock from each country/industry group for which stock price information is available for the entire period from January 1993 to April 1995. This results in a sample of 577 stocks.

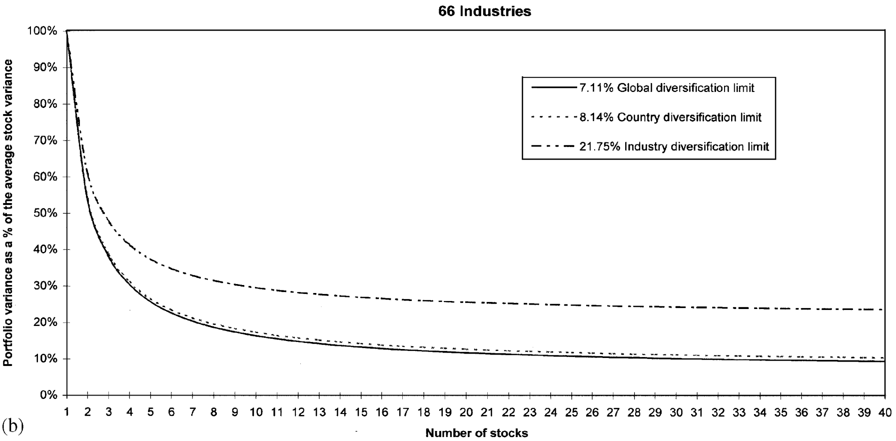
The average local-currency stock return variance is 21.67%-squared per week, which is considerably larger than for the pure country and industry factors in Tables 2 and 3. To assess diversification benefits, we examine the covariances between stocks based on their industrial and country memberships as a percentage of the average stock variance. The average covariance between stocks in the same country but different industries gives the unconditional limit to a pure industry diversification strategy. The average covariance between stocks in the same industry but different countries gives the unconditional diversification limit to a pure country diversification strategy. We can measure the gains from both industry and country diversification by taking the average covariance between stocks that are in different countries and in different industries.

We perform this experiment separately for industry groupings based on the broad classifications, as in Table 2, and the finer classifications, as in Table 3. Fig. 1a and b contrast this diagnostic for the nine broad industry indexes with those from the disaggregated 66 sub-industry indexes. Fig. 1a shows that randomly combining securities across different industries into large portfolios within each country can reduce the variance to 21.9% of the variance of the average individual stock. By contrast, diversification across countries even within single, broadly-defined industries can achieve almost 8.4% of the average individual stock variance, which is close to the unrestricted limit of 7.06%. Fig. 1b reveals a similar picture: the limit to pure industry diversification within a country is around 21.75% of the average stock variance and that for pure country diversification is around 8.14% of the average stock variance. The unrestricted limit to both country and industry diversification is not much lower at 7.11% of the average stock variance.

We find little difference in diversification limits when constrained within industries even when using the 66 industries. Given the dispersion of the role of the pure industry factor across the finer industry categories in Table 3, however, we choose to examine these conclusions further by evaluating country-only, industry-only, and unconstrained global diversification strategies for investors in different categories. These results are not reported in tables, but are available from the authors upon request. Specifically, we examine separately strategies for investors diversifying across traded-goods and nontraded-goods industries (as identified in Table 1) and for investors in the G-6 industrialized countries and those in emerging markets. Interpretation from a disaggregated level of analysis (traded versus nontraded-goods industries, emerging versus developed market investors) of diversification strategies is complex because of the interaction effects. After all, the proportion of traded-goods industries is higher in emerging markets. Computing the average within-industry covariances across markets for traded and nontraded-goods markets also captures differences in covariances between developed and emerging markets. Developing an econometric model that explicitly captures all interactive effects with this level of disaggregation is



(a)



(b)

Fig. 1. Benefits of international diversification – nine and 66 industry cases

This figure displays the portfolio variance as the number of stocks in the portfolio increases, expressed as a percentage of the variance of a typical stock. Weekly data on 577 individual stock returns sampled from the Dow Jones World Stock Indexes come from Datastream International for January 1992 to April 1995. The top line is the variance of a portfolio that diversifies across the nine aggregate or 66 disaggregated industry groups within a single country. The middle line gives the variance of a portfolio that diversifies across countries within a single aggregate industry. The bottom line is associated with the portfolio that diversifies across both countries and industry groups.

beyond the scope of the current paper. In traded-goods industries, cross-country covariances for firms within a given industry are higher than cross-country covariances across firms in different industries. This distinction is particularly notable when examining covariances in developed markets. For example, in the industrialized G-6 capital markets (US, Japan, UK, France, Germany and Canada), the pure country diversification limit within the traded goods industries is 10.9% on average, whereas the global diversification limit within these industries is 6.4% on average. For the nontraded-goods industries, by contrast, there is almost no differences in cross-country covariances between stocks that are in the same industry and those that are in different industries.

The implications of these covariances depends on the global diversification strategy that the investor follows. For the majority of investors, who purchase an industrially diversified basket of securities (such as a country-specific index), the industrial structure explains only a small proportion of the index returns, because no single industry represents a large fraction of the portfolio and industry effects are prevalent in traded-goods industries which represent the minority (only 26 of 66 by the classification system of Table 1). As a corollary, however, the diversification potential for people who invest abroad in a manner that is heavily tilted towards traded-goods industries can be impaired by ignoring the industrial composition of their diversification program.[4] We offer these extended findings as a suggestion for a new avenue of future research.

6. Summary

This paper re-examines the extent to which differences in industrial structure across countries produce gains from international diversification. Using a new database, the Dow Jones World Stock Index, with coverage in 25 countries and over 66 industry classifications, we decompose comprehensively both country and industrial sources of variation. We confirm the previous finding in Heston and Rouwenhorst (1994) that less than 4% of the variation in country index returns can be explained by their industrial composition. We also find that these patterns vary across different industry groups. That is, traded-goods industries tend to have higher industry effects. This variation could reflect important differences in the underlying economic factors that influence international stock return correlations. Portfolio managers with larger domestic holdings in traded versus nontraded-good industries thus should consider different global investing strategies. Our findings on this question are only preliminary. We hope to see additional research on the fundamental economic factors that influence

[4] An example of such a diversification strategy is an investor diversifying abroad by buying natural resource ADRs (Royal Dutch Petroleum) or an international mutual fund (Merrill Lynch Global Resources B, United Services Gold Shares) that tilts the portfolio toward the natural resource sector.

cross-country stock-return correlations over time and the role that industrial structure plays in this relationship.

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