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Country versus Region Effects in International Stock Returns

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Abstract

An empirical regularity in the portfolio diversification literature is the importance of country effects in explaining international return variation. We develop a new decomposition that disaggregates these country effects into region effects and within-region country effects. We find that half the return variation typically attributed to country effects is actually due to region effects, a result robust across developed and emerging markets, with the remaining variation explained by within-region country effects. For the average investor, this means that diversifying across countries within Europe, for example, delivers half the risk reduction possible from diversifying across regions globally.

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One of the most pronounced empirical regularities in the portfolio diversification literature is the importance of country effects in international stock returns. This regularity has been documented at the global level by Griffin and Karolyi [1998], for Western Europe by Heston and Rouwenhorst [1994, 1995], and in emerging markets by Serra [2000].[1] We investigate the extent to which country effects are capturing region-specific versus within-region, country-specific variation. We estimate an augmented version of the Heston and Rouwenhorst [1994] (HR hereafter) model, which decomposes international returns into country and industry effects, with an additional decomposition that further disaggregates country effects into region effects and within-region country effects. The former capture common variation in the HR country effects within regions. The latter are estimated as the deviations of these country effects from the relevant region effect and thus measure within-region return heterogeneity. From the perspective of an international investor, the importance of within-region country effects is a measure of the diversification gains associated with diversifying across country portfolios within the average region, while the importance of region effects captures the incremental diversification gain from diversifying across regions.

The paper is organized as follows. The next sections describe our model and data. We then discuss our results and finally conclude.

The Model

We extend HR such that the return on each stock has five components: a common factor (α), global industry factors (β), region-specific factors (λ), within-region country-specific factors (π) and a firm-specific disturbance (e). We estimate the factors by running the following market capitalization weighted regression every month:

$$R_i = \alpha + \sum_{j=1}^{J} \beta_j I_{ij} + \sum_{s=1}^{s} \lambda_s M_{is} + \sum_{s=1}^{S} \sum_{k_s=1}^{K_s} \pi_{k_s} C_{ik_s} + e_i \qquad (1)$$

where I_{ij} and M_{is} denote industry and region affiliations of stock i, respectively. There are J industries and S regions in total. C_{ik_s} identifies country affiliation within a given region, there being k_s countries within region s. To estimate the industry and region effects as deviations from the capitalization weighted mean return, we impose the restrictions:

$$\sum_{j=1}^{J} \beta_j w_j = 0 \tag{2}$$

$$\sum_{s=1}^{s} \lambda_s w_s = 0, \tag{3}$$

where w_j and w_s are the capitalization shares of industry j and region s in the sample. We impose additional restrictions on the π_{k_s} parameters, to estimate them as deviations from the relevant region effect:

$$\sum_{k_s=1}^{K_s} \pi_{k_s} w_{k_s}^{s} = 0. \tag{4}$$

Estimating (1) subject to the restrictions in (2), (3), and (4) extracts the same amount of variation from international returns as the HR model. Region effects in our decomposition are the capitalization weighted means of the original HR country effects within each region. The within-region country effects are deviations of the HR country effects within each region from the respective region effect. In other words, our model decomposes the HR country effects exactly into region and within-region country effects.

The Data

We estimate our model for monthly total US dollar-denominated returns for 9,679 stocks in 42 developed and emerging markets from January 1985 to April 2003. Each company belongs to one of 40 (Level 4) Datastream industries. Brooks and Del Negro [forthcoming] show that the sample provides a realistic representation of the global stock market and provide descriptive statistics.

Following the Morgan Stanley Capital International (MSCI) indices, we divide our sample into three broad regions: the Americas, Asia and Europe. We further distinguish between developed and emerging markets within each region, again following MSCI in designating a country as a developed or an emerging market. Our benchmark model thus allows for six regions: Developed Americas, Emerging Americas, Developed Asia, Emerging Asia, Developed Europe and Emerging Europe.[2]

Evidence of Region Effects in the HR Model

We first investigate whether there is evidence of region effects in the standard HR model, which has global, country and industry effects, but no region effects. We estimate the country effects in this model, which we call HR country effects, and compute their pairwise correlations from September 1993—when all countries have joined the data—to April 2004. Panel A in Table 1 shows the median pairwise correlation coefficients of these HR country effects, across all countries and within regions. The median correlation coefficient across all 42 HR country effects is 6.8 percent. Within regions, however, this number ranges from 16.7 to 39.4 percent, compelling evidence that region effects are embedded in HR country effects.

Region Versus Within-Region Country Effects

How much return variation do region effects explain? Figure 1 addresses this question. The "Country and Industry Effects" line plots a two-year lagged moving average for the R-squared of the standard HR model. The "Country Effects" line focuses on the explanatory power of country effects in that model. It drops the industry effects from the monthly calculation of the R-squared, setting these coefficients to zero. The "Region Effects" line comes from estimating our augmented model and calculating the R-squared for region effects only, setting to zero within-region country and global industry effect estimates. Figure 1 shows that the decline in importance of HR country effects, noted by L'Her et al. [2002]

and others, is driven largely by a decline in region effects. During the first two years of the sample, region effects explain 15 percent of international return variation. During the last two years of data, they explain only 5.52 percent of international return variation.

How important are region versus within-region country effects? To address this, we use our model to compute the ratio of the R-squared from region effects only (setting to zero within-region country and global industry effects) to the R-squared from region plus within-region country effects (setting to zero global industry effects). Panel B in Table 1 shows the average of this ratio for the full sample period, the first two years, and last two years. It also tests if the change in this ratio over time is statistically significant. The first row examines the R-squared ratio across all countries in the sample. On average, region effects account for 52 percent of the return variation explained by HR country effects. However, the importance of region effects has fallen over time. During the first two years, this ratio is 59 percent, while it averages 46 percent in the last two years. The p-value associated with this decline is 1 percent, suggesting that the balance of variation explained by country effects in the HR model has shifted significantly in favor of within-region country-specific shocks.

The result that half the return variation attributed to HR country effects is due to region effects is surprisingly robust. One concern is that the Developed Americas region is dominated by the US, which raises the possibility that the Developed Americas region effect is a US country effect. The second row in Panel B examines the R-squared ratio excluding stocks in the Developed Americas region. This R-squared ratio averages 48 percent over the sample, only slightly below that for the full sample.

We next examine the R-squared ratio for mature versus emerging markets. The R-squared ratio averages 51 percent for mature markets and there is no evidence of a significant decline in the relative importance of region effects. In emerging markets the average R-

squared ratio measures 48 percent. Surprisingly, there is little difference between developed and emerging markets in terms of the relative importance of region versus within-region country effects. Neither is there strong evidence that region effects have fallen significantly over time in emerging markets. Though the decline is larger in absolute magnitude than for developed markets, the associated p-value measures 15 percent.

When we use equal instead of value (capitalization) weighting, region effects are still important. The fifth row in Panel B examines the R-squared ratio for equal weighted regressions. For this specification, the R-squared ratio averages 36 percent. Finally, the sixth row shows the R-squared ratio based on equal weighted regressions and local currency returns. For this specification, the R-squared ratio averages 31 percent over the sample.

What does all this mean in terms of portfolio diversification? Figure 2 addresses this question, using the graphical representation in Heston and Rouwenhorst [1994]. It gives the average portfolio variance as the number of stocks in a portfolio increases from 1 to 40, as a percentage of the average variance of all individual stocks. The "global portfolio" line shows the diversification benefit from a value weighted portfolio across all stocks. This portfolio has a variance of 10 percent relative to the average stock. The "within country (across industries)" line is the average variance across value weighted country portfolios that diversify across industries within a given country. Such portfolios achieve a more modest risk reduction of 20 percent of the average stock. The difference is the additional risk reduction from diversifying across countries. The "within regions (across countries and industries)" line depicts the average variance of value-weighted regional portfolios that diversify across countries and industries within a given region. By construction, this line lies between the "within country (across industries)" and the "global portfolio" lines: the average variance of the regional portfolio is 15 percent of the average stock. How does this graphical

representation map into our regression results? The vertical distance between the "within country (across industries)" and the "within regions (across countries and industries)" lines captures the additional diversification benefit—beyond diversifying within countries across industries—from diversifying across countries within the average region portfolio. The vertical distance between "within regions (across countries and industries)" and "global portfolio" lines captures the additional diversification benefit—beyond diversifying within regions—from diversifying across regions. The fact that the "within regions (across countries and industries)" line lies roughly halfway between the "within country (across industries)" and the "global portfolio" lines is visual confirmation of our regression results: region and within-region country effects in international stock returns are of roughly equal importance.[3]

VI. Conclusion

We investigate the relative importance of region versus within-region country effects in international stock returns. We augment the HR model, widely used to assess the importance of country and industry effects in international stock returns, with a new decomposition that further disaggregates pure country effects into region and within-region country effects. We find that, embedded within the pure country effects of the HR model, region effects are an important source of return variation, explaining half the return variation accounted for by the HR country effects. For a Dutch investor deciding whether to diversify within Europe, or whether to diversify globally, these results suggest that diversifying within Europe gets her half the risk reduction benefit associated with diversifying globally. We find that this relation is remarkably robust. In particular, it holds in equal measure in developed and emerging markets.

Table 1. Panel A. Region Effects in the Heston and Rouwenhorst [1994, 1995] Model
(Median Correlations of HR Country Effects in Percent: 1993.9 - 2004.4)

	All Markets	Mature Markets	Emerging Markets
World	6.79	12.86	12.38
Europe	21.61	25.29	16.70
Asia	15.42	19.76	17.84
Americas	20.16	39.36	30.94

Notes: The table shows median correlations of country effects within different regions and across all markets. Country effects are estimated using the dummy variable model of Heston and Rouwenhorst [1994, 1995], which decomposes international stock returns into country and industry effects. The underlying data cover monthly US dollar-denominated stock returns for 9,679 stocks in 42 developed and emerging markets from January 1985 to April 2003.

Table 1. Panel B. The Relative Importance of Region versus Within-Region Country Effects
(R-Squared Ratios in Percent)

	1985.1 - 2003.4	1985.1 - 1986.12	2001.5 - 2004.4	P-Value
All Markets	52.30	58.95	45.85	1.14
All Markets w/o Developed Americas	47.61	53.86	42.38	3.23
All Mature Markets	51.23	56.53	49.36	23.84
All Emerging Markets	48.16	78.77	35.58	14.92
US Dollar Returns and Equal-Weighting	35.53	41.02	35.21	22.08
Local Currency Returns and Equal Weighting	31.14	30.10	33.27	54.63

Notes: The table shows the ratio of the R-squared of region effects to the R-squared of region plus within-region country effects, based on regression model (1) subject to restrictions (2), (3) and (4). The variance of the R-squared ratio is calculated every month using the Delta method, which is described in Green (1993). The p-value is based on the following statistic: if x_1 is the initial two-year average of the R-squared ratio and x_2 is the end-of-sample two-year average, we use the test statistic $t=(x_2-x_1)/(\mathrm{sqrt}(\mathrm{var}(x_1)+\mathrm{var}(x_2)))$, which is asymptotically distributed as a $N(0,1)$, to test if the initial and terminal ratios are significantly different.

Figure 1 explores the relative importance of region and within-region country effects for the full sample. The "Country and Industry Effects" line is a moving average for the R-squared of the Heston and Rouwenhorst [1994] regression model. The "Country Effects" line shows the R-squared of the country effects only from that regression. The "Region Effects" line shows the R-squared of region effects estimated using our augmented model in equation (1).

Figure 1. The Relative Importance of Region versus Within-Region Country Effects
(2-Year Lagged Moving Average of the R-Squared in %)

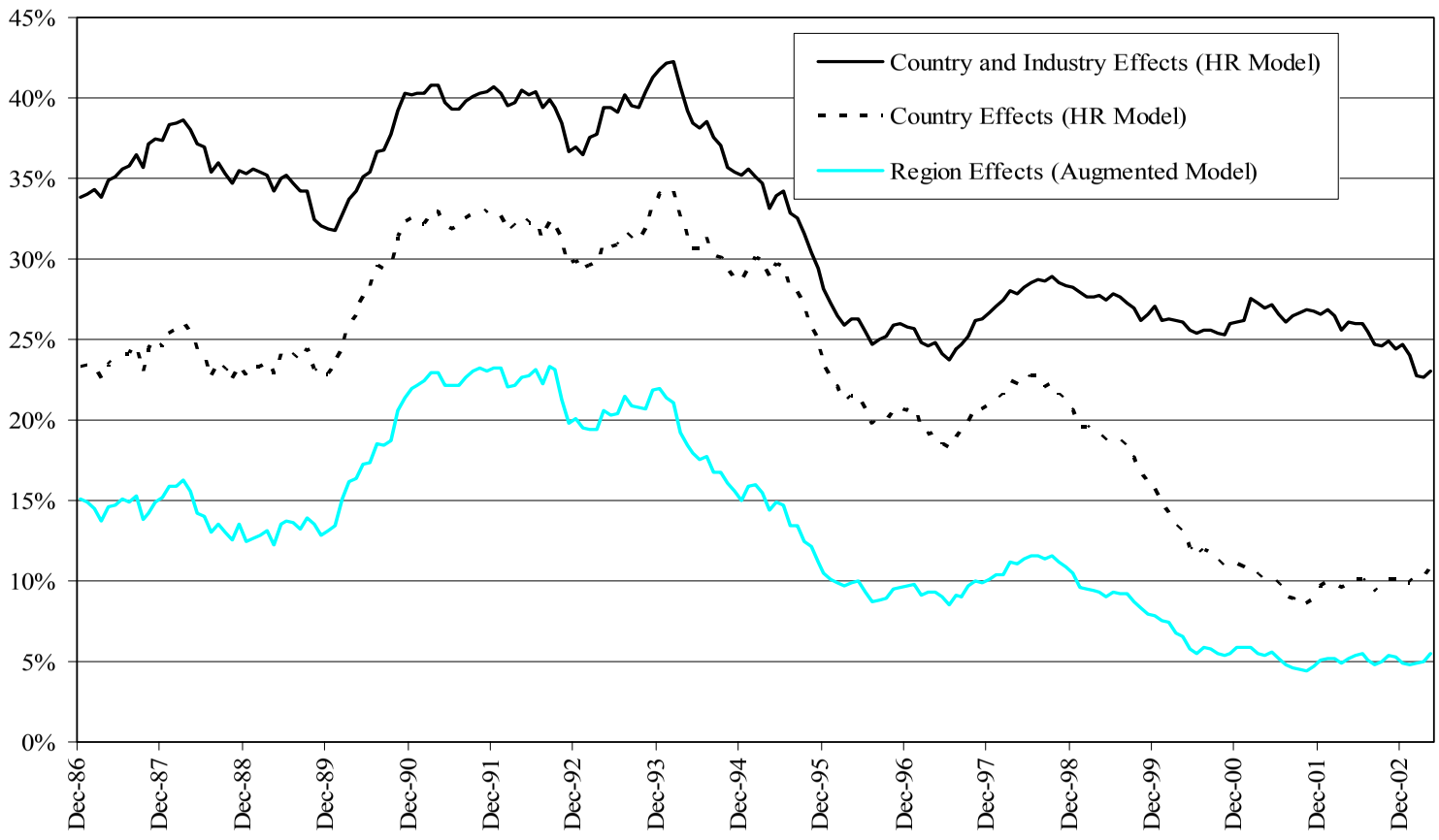
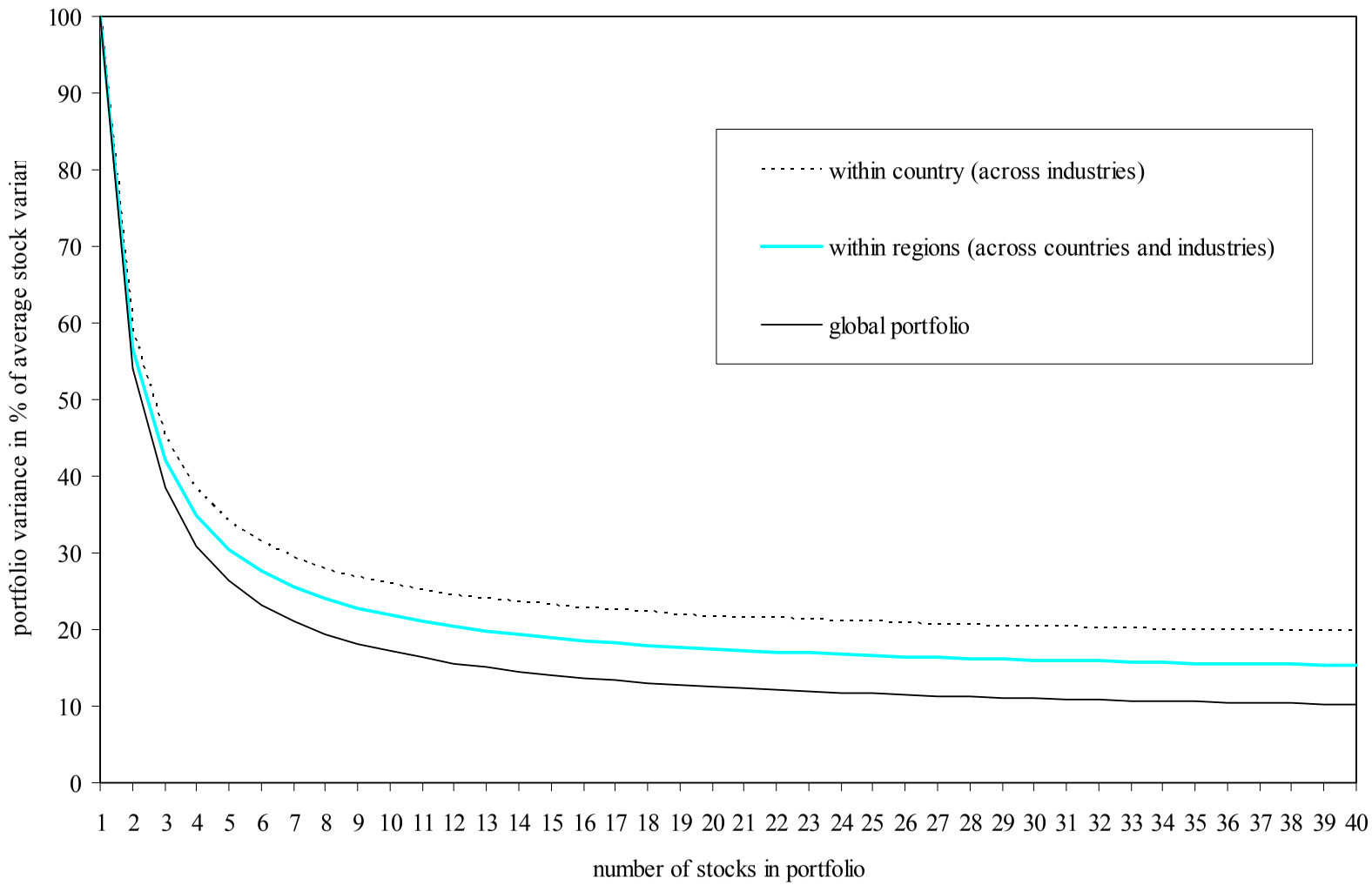


Figure 2 shows average portfolio variance as the number of stocks increases, in percent of the average stock. The "within country" line is the variance of a portfolio that diversifies across industries, averaged across countries. The "global portfolio" line diversifies across all stocks in the sample and represents the maximum risk reduction possible. The "within regions" line depicts the average variance of a portfolio that diversifies across industries and countries within regions, averaged across regions.

Figure 2. Risk Reduction from Diversifying Across Value-Weighted Country, Region and Global Portfolios



References

Brooks. R. and M. Del Negro. Forthcoming. The Rise in Comovement across National Stock Markets: Market Integration or IT Bubble? Journal of Empirical Finance.

Cavaglia, S., Brightman, C. and M. Aked. 2000. The Increasing Importance of Industry Factors. Financial Analysts Journal, September/October, 41-54.

Green, W. 1993. Econometric Analysis. Macmillan Publishing Company, New York.

Heston, S. and G. Rouwenhorst. 1994. Does Industrial Structure Explain the Benefits of International Diversification? Journal of Financial Economics 36, 3-27.

Heston, S. and G. Rouwenhorst. 1995. Industry and Country Effects in International Stock Returns. The Journal of Portfolio Management, Spring, 53-58.

L'Her, J., Sy, O. and Y. Tnani. 2002. Country, Industry and Risk Factor Loadings in Portfolio Management. Journal of Portfolio Management 28 (4), 70-79.

Serra, A. 2000. Country and Industry Factors in Returns: Evidence from Emerging Markets' Stocks. Emerging Markets Review, September 2000, Volume 1, Issue 2, 127-151.

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[1] Cavaglia et al. [2000] and others find that industry effects have recently surpassed country effects in explaining international return variation. However, Brooks and Del Negro [forthcoming] argue that much of the observed rise in industry effects could be temporary, driven by sectors central to the recent IT stock market bubble.

[2] Developed Europe has 17 countries: the UK, France, Germany, Italy, Austria, Belgium, Denmark, Ireland, the Netherlands, Norway, Spain, Sweden, Switzerland, Finland, Greece, Portugal, Luxembourg. Emerging Europe has 4 countries: South Africa, Turkey, Poland and Czech Republic. The Developed Americas consist of 2 markets: Canada and the US. The Emerging Americas have 6 markets: Argentina, Brazil, Chile, Colombia, Mexico and Peru. Developed Asia has 5 markets: Australia, Hong Kong, Japan, New Zealand and Singapore. Emerging Asia comprises 8 markets: Malaysia, South Korea, Thailand, Philippines, Taiwan, India, Indonesia and China. See (http://www.msci.com/equity/coverage_matrix.pdf) for more information on the MSCI classification.

[3] Figure 2 is constructed using portfolio variances for the full sample period and thus captures the average importance of region versus within-region country effects over time.