The Relative Strengths of Industry and Country Factors in Global Equity Markets

Jose Menchero
Andrei Morozov

April 2011
Introduction

The relative strengths of industry versus country factors can be of major importance for global equity portfolio managers. If country effects dominate, then primary consideration can be given to the country allocation decision. On the other hand, if global economic integration is reducing the distinctions between countries, then an industry-first investment process may be more appropriate.

One early study of the relative strength of industries versus countries was provided by Grinold, Rudd, and Stefek (1989). They regressed monthly local excess returns (currency hedged) against a set of global factors that included 24 countries, 36 industries, and four styles. They showed that country factors had higher statistical significance and greater explanatory power than industry factors over the period 1983-1988.

Heston and Rouwenhorst (1995) also investigated the question of industries versus countries, but focused instead on developed Europe. They regressed monthly stock returns (in German marks) against a set of 7 industry factors and 12 European countries. Using equal-weighted regression (i.e., ordinary least squares), they found that country factors were more volatile than their industry counterparts over the time period 1978-1992.

In a subsequent study, Rouwenhorst (1999) performed monthly cap-weighted regressions of developed European stock returns (in German marks) against a set of 7 industry factors and 12 country factors during the sample period 1978-1998. He found that country factors were more volatile than industry factors over the 20-year sample period. He also introduced mean absolute deviation (MAD), given by the cap-weighted mean absolute factor return, as a way to measure the relative strength of industries versus countries. Using this measure, Rouwenhorst once again found that countries in developed Europe consistently dominated industries during the period 1978-1998.

Cavaglia, Brightman, and Aked (2000) studied the relative strength of industries versus countries, but considered a broader universe comprising 21 global developed markets and 36 industries. They performed weekly cap-weighted regressions using local excess returns to remove the effects of currencies. Employing MAD to measure the strength of the factors, they found that industries had overtaken countries by the late 1990s.

Another notable study was carried out by Estrada, Kritzman, and Page (2006), who investigated the strength of industries versus countries in emerging markets. Using a bootstrapping statistical procedure with annual US dollar returns as inputs, they examined the return dispersion of simulated portfolios and concluded that country effects dominated industries in emerging markets over the period 1989-2002.

More recently, Menchero and Morozov (2011) studied the contributions to cross-sectional volatility coming from styles, industries, and countries. They conducted monthly cross-sectional regressions (cap-weighted) from 1994-2010 on a universe of securities comprising 24 developed markets and 24 emerging markets. They reported that countries dominated industries from 1994 to 1999. From 1999 to 2003, however, the situation reversed, with industries dominating countries. Since 2003, they reported that the two effects were more or less comparable. Surprisingly, they found that during periods of market turmoil, style factors actually made the greatest contribution to cross-sectional volatility.

These previous studies shed light on the relative importance of industries versus countries in various segments of the global equity markets. Nonetheless, differences in methodology, analysis periods, weighting schemes, observation frequencies, and explanatory variables make it difficult to directly
compare the results, leaving important questions unanswered. For instance, has industry importance
grown over time, or diminished? Are industry effects more important in developed Europe, or emerging
markets?

The aim of this paper is to apply a unified methodology and dataset to systematically compare the
strength of industries versus countries across several segments of the global equity markets. In
particular, the three segments that we examine are (a) the entire world, (b) emerging markets, which
represent the least economically integrated segment of the global equity market, and (c) developed
Europe, which represents the most tightly integrated economic zone in the world. We also apply our
framework to investigate how the strength of industries versus countries depends on market
capitalization, which may have important implications for global small-cap managers.

Model and Methodology

A basic problem that must be immediately faced by any researcher investigating industries and
countries is how to disentangle the two effects. For instance, roughly half of the market capitalization of
the automobile sector is based in Japan. Similarly, about 40 percent of the Norwegian equity market is
contained within the energy sector. How can one disentangle the energy effect from the Norway effect,
or the Japan effect from the automobile effect? Factor models are designed for this purpose.

To investigate the relative importance of countries and industries across the entire world, we construct
a global factor model containing one world factor, 48 country factors, 24 industry factors, and eight style
factors. The estimation universe is the MSCI All Country World Investable Market Index (ACWI IMI),
which broadly reflects the full range of investment opportunities in developed and emerging markets.
Every stock is assigned an exposure of 1 to the world factor. The 48 country factors in the global model
correspond to the set of all countries within the MSCI ACWI IMI as of October, 2008. Country exposures
are given by 0 or 1, in accordance with official MSCI classification. The industry factors are taken to be
the 24 industry groups of the Global Industry Classification Standard (GICS®), with exposures given by 0
or 1. The eight style factors are derived from the Barra Global Equity Model, GEM2, as described by
Menchero, Morozov, and Shepard (2010). However, in order to avoid introducing possible biases that
may favor either countries or industries, we standardize all style factors on a global-relative basis. The
eight style factors are volatility (essentially representing market beta), size, momentum, value, growth,
leverage, liquidity, and non-linear size.

We perform both weekly and monthly cross-sectional regressions to estimate factor returns. Weekly
factor returns are used to estimate factor volatilities (with an 18-week half-life) and factor correlations
(with a 104-week half-life), while monthly factor returns are used to compute the MAD measure for
industries and countries. In all regressions, we use local excess returns; this eliminates currency effects
and allows us to compare countries and industries on a level playing field. Finally, we adopt market
capitalization for the regression weights, as this better reflects the opportunity set for global investors.

In Table 1, we list the 48 countries and 24 industries contained within our global model. We also report
the average beginning-of-month weight and average volatility forecast for each country and industry
during the period January 1997 to September 2010. The first three columns correspond to the 24
developed market countries, the next three columns are for the 24 emerging market countries, and the
final three columns pertain to the 24 industry groups.
Casual inspection of Table 1 shows that the volatility of most country factors is far higher than the average volatility of industry factors, thus suggesting the primacy of countries over industries. Closer inspection, however, reveals that the most volatile countries tend to have very small weight. Moreover, larger countries tend to have lower volatilities, with the extreme case being the US factor, which has the largest weight and the lowest volatility of any country or industry factor.

Industry factors, by contrast, exhibit no strong relationship between the size of the industry and the corresponding volatility. For instance, although the most volatile industry (semiconductors) is relatively small, the second most volatile industry (energy) is one of the largest. Furthermore, the smallest industry (commercial services & supplies) turns out to be the least volatile industry factor.

Rather than compare the equal-weighted mean volatility of factors, which make countries appear far more important than industries, it is more relevant to compare the cap-weighted means. For countries, the cap-weighted mean volatility is 9.33 percent, versus 8.96 percent for industries. By this measure, therefore, the strength of industries and countries appears roughly comparable within the 48-country global model during the sample period considered.

Factor Portfolios

Local excess stock returns $r_n$ within our global factor model are decomposed as

$$r_n = f_w + f_c(n) + f_i(n) + \sum_s X_{ns} s + u_n,$$

(1)

where $f_w$ is the return of the world factor, $f_c(n)$ and $f_i(n)$ are the country and industry factor returns pertaining to stock $n$, $X_{ns}$ is the stock exposure to style factor $s$, $s$ is the return of the style factor, and $u_n$ is the specific return of the stock. Style exposures are standardized globally to have a cap-weighted mean of 0 over the estimation universe, and a standard deviation of 1.

Note that the regression in Equation 1 contains two exact collinearities. Namely, the sum of country factor exposures replicates the world factor exposure, and likewise for the sum of industry factors. Therefore, two constraints must be applied to obtain a unique solution. We set the sum of cap-weighted country and industry factor returns to zero every period, which leads to an intuitive interpretation of the factors as we now describe them.
Factor returns can be represented as the returns of factor-mimicking portfolios,

\[ f_k = \sum_n \Omega_{kn} r_n, \]

where \( \Omega_{kn} \) is the weight of stock \( n \) in factor portfolio \( k \). Note that the factor portfolios are pure in the sense that they isolate the effect of the particular factor, while maintaining zero exposure to all other factors.

In Table 2, we present segment weights of several pure factor portfolios for June 2009. Under the model specification described above, the pure world factor portfolio is exactly represented by the cap-weighted estimation universe. For instance, the pure world factor has a weight of 10.72 percent in Japan, which corresponds to the weight of Japan in the estimation universe. With the exception of the fully invested world factor, all other factor portfolios are zero-investment in the sense that their weights sum to zero. The pure country factor portfolios are 100 percent long the particular country, 100 percent short the world portfolio, and have zero exposure to every industry and style factor. Similarly, pure industry factor portfolios are 100 percent long the particular industry, 100 percent short the world portfolio, and have zero exposure to every country and style factor. Finally, pure style factors have unit exposure to the particular style, and zero exposure to every other style factor, country, and industry.

This regression approach cleanly disentangles the effects of multi-collinearity, and captures the pure effect for every factor. For instance, we can now discuss the performance of Norway net of energy, or the performance of automobiles net of Japan. For a more thorough discussion of factor portfolios, see Menchero (2010).

To investigate the strength of industries versus countries in emerging markets, we construct a factor model identical to the global factor model described above except that we limit the estimation universe to the 24 emerging-market countries contained in Table 1. Similarly, to study developed Europe, we construct a factor model with an estimation universe consisting of the 16 developed European countries listed in the first column of Table 1. Note that the emerging-market model and the developed-Europe model each contain the same eight style factors and 24 industry groups as in the 48-country global model.

### Diversification Potential

An important measure of diversification is the volatility ratio between a portfolio that is fully invested in a single industry or country and one that is diversified across the entire world. To cleanly disentangle the effects of multi-collinearity, however, we must employ pure factor portfolios. Unlike the pure factor portfolios considered previously, which had net weights of zero, we now construct full-investment pure factor portfolios.

From Table 2, observe that by adding the world factor to a pure country factor (e.g., Japan) we obtain a portfolio that is 100 percent net long the particular country, has zero exposure to every style factor, and is industry neutral in the sense that the industry weights match those of the world portfolio. Similarly, by

---

1 Since the world portfolio contains positive weight in every country, the long and short weights of country factor portfolios will partially cancel. For example, the net weight in Japan is 89.28 percent for the Japan factor portfolio.
adding the world factor to a pure industry factor (e.g., autos) we obtain a portfolio that is 100 percent long the particular industry, has zero exposure to every style, and is country neutral.

The return \( \tilde{f}_k \) of the full-investment pure factor is given by,

\[
\tilde{f}_k = f_k + f_w ,
\]

where \( f_k \) is the return of the zero-investment pure factor. The variance \( \tilde{\sigma}_k^2 \) of the full-investment factor portfolio is given by the standard expression,

\[
\tilde{\sigma}_k^2 = \sigma_w^2 + \sigma_k^2 + 2\sigma_w\sigma_k\rho_{kw} ,
\]

where \( \sigma_w \) is volatility of the world factor, \( \sigma_k \) is volatility of the zero-investment factor, and \( \rho_{kw} \) is correlation between the zero-investment factor and the world factor.

Figure 1 provides a useful geometric representation of the algebraic expression in Equation 4. The volatility of the world factor is given by the length of the solid horizontal line at the base of the triangle. Similarly, the length of the line labeled \( \sigma_k \) gives the volatility of the zero-investment factor portfolio. The length of the line labeled \( \tilde{\sigma}_k \) represents the volatility of the full-investment pure factor portfolio.

The correlation \( \rho_{kw} \) is given by the cosine of the angle \( \theta_k \). In other words, \( f_k \) and \( f_w \) are uncorrelated if the line denoted \( \sigma_k \) is perpendicular to the line labeled \( \sigma_w \). In practice, the correlations \( \rho_{kw} \) tend to be fairly small for two reasons: first, the factors \( f_k \) have net zero weight, and hence zero exposure to the world factor; second, the factors have zero exposure to the volatility factor, which to a good approximation translates into zero beta relative to the world factor.

We define diversification potential for a single country \( k \) as the volatility ratio \( \tilde{\sigma}_k / \sigma_w \). This measures, net of industries and styles, the reduction in volatility that can be achieved by diversifying the portfolio across the world instead of concentrating it within a single country. Diversification potential can be aggregated across all countries to obtain

\[
DP(C) = \sum_{k \in C} w_k \left( \frac{\tilde{\sigma}_k}{\sigma_w} \right) ,
\]

where \( w_k \) is the weight of country \( k \). Diversification potential for industries \( DP(I) \) can be similarly defined. By comparing diversification potential for industries and countries, we obtain a measure of the relative strength of the two effects.
Factor Correlation

Another important measure of the strength of industry and country factors is the correlation \( \hat{\rho}_{kw} \) between the full-investment factor \( \tilde{f}_k \) and the world factor \( f_w \).

As suggested by Figure 1, if the correlation \( \rho_{kw} \) is fairly small, a high volatility \( \sigma_k \) for the zero-investment factor \( f_k \) leads to a low correlation \( \hat{\rho}_{kw} = \cos(\hat{\theta}_k) \). This, in turn, implies attractive diversification opportunities.

The factor correlation \( \hat{\rho}_{kw} \) can be aggregated across countries to obtain

\[
\bar{\rho}(C) = \sum_{k \in C} w_k \hat{\rho}_{kw},
\]

with a similar expression holding for industries. By comparing mean factor correlations for industries and countries, we obtain a measure for the relative strength of the two effects.

Mean Absolute Deviation

Rouwenhorst (1999) proposed using mean absolute deviation (MAD) as a measure of the relative strength of industries versus countries. For countries, \( \text{MAD}(C) \) is defined as the cap-weighted average of the absolute value of the country factor returns,

\[
\text{MAD}(C) = \sum_{k \in C} w_k |f_k|,
\]

with a similar definition for industries. The MAD can be thought of as the return on a “perfect-foresight” strategy that takes long positions in factor portfolios that earn positive returns and short positions in factor portfolios that earn negative returns.

The MAD measure is complementary to the factor correlation and diversification potential measures. Whereas the latter two quantities depend directly on the volatility of the world factor, MAD depends only on the magnitude of the factor returns. Furthermore, factor correlation and diversification potential represent risk-based measures, whereas MAD is a return-based measure. An advantage of return-based measures is that they require no risk forecast, and therefore longer histories can be obtained\(^2\).

\(^2\) Generally, several years of factor returns are required before reliable risk forecasts can be obtained.
Empirical Results

In Figure 2, we report diversification potential and factor correlation for the 48-country global model. The analysis period is January 1997 through September 2010. One striking feature of Figure 2 is that diversification potential and factor correlation are essentially mirror images of one another. This is reassuring, since both measures lead to the same conclusions. It also implies that the correlations \( \rho_{kw} \) are small on average.

For the 48-country global model, we see that countries dominated industries during 1997-1999. With the onset of the internet bubble in 1999, however, industries began to dominate countries for several years. Since 2003, country and industry effects have been roughly comparable, with perhaps countries retaining a small edge. These results are consistent with those reported by Menchero and Morozov (2011) using the cross-sectional volatility framework.

It is also interesting to observe in Figure 2 that correlation hits an all-time low during the internet crisis. This is contrary to conventional wisdom that “all correlations go to 1 during a crisis.” This effect, however, can be understood by the nature of the crisis. That is, the internet crisis was characterized not so much by an increase in the volatility of the world factor, but rather by a divergence in the performance of “old economy” and “new economy” stocks. This is to be contrasted with the financial crisis of 2008, during which correlation did reach an all-time high due to the dominating effect of the world factor.

In Figure 3, we show diversification potential and factor correlation for the 24-country emerging market model. Once again, the two measures are essentially mirror images of one another, and thus lead to the same conclusions. For emerging markets, countries consistently dominated industries over the entire sample period. This result is in line with intuition and consistent with the findings of Estrada, Kritzman, and Page (2006). It is also interesting to note in Figure 3 the clear secular trend toward decreasing diversification potential and increasing correlation among emerging markets. This supports the view that emerging markets are steadily integrating with the global economy.

In Figure 4, we present diversification potential and factor correlation for the 16 countries of developed Europe. During 1997-1998, industries and countries were approximately of equal strength. However, coinciding roughly with the introduction of the Euro in 1999, industry effects began to strongly dominate country effects. During the internet bubble period, diversification potential for industries was particularly high. The strong industry domination of countries in developed Europe post-1999 supports the view that developed Europe has become a tightly integrated economic zone where distinctions between countries are relatively small compared to the differences among industries.

We now turn our attention to analyzing the relative strengths of industries versus countries through the lens of mean absolute deviation (MAD). As noted, MAD provides additional history compared to risk-based measures. In Figure 5, we report rolling 12-month MAD from February 1994 to September 2010 for the 48-country global model. During 1994-1997, countries strongly dominated industries. Since 1997, the results are largely consistent with Figure 2. Namely, countries dominated industries during 1997-1999, with the situation reversing during 1999-2003. Since 2003, the two effects have been roughly comparable, although countries appear to be retaining a slight advantage since 2010.

Figure 5 also demonstrates the sense in which MAD complements diversification potential and factor correlation. For instance, Figure 2 shows that diversification potential was particularly low during 2009. From Figure 2, however, it is impossible to determine whether this was caused by weak industry and country factors, or by a highly volatile world factor. Figure 5 clearly illustrates that it was the latter case, since both industry and country factors were quite strong in 2009.
It is interesting to compare our *MAD* results with those of Cavaglia, Brightman, and Aked (2000). They computed *MAD* using weekly cap-weighted regressions during the period 1989 to 1999. Qualitatively, the trends we observe during the overlap period (1994-1999) are very similar to theirs. The main difference is that they witness industry factors surpassing countries as early as 1997, whereas we observe the same effect roughly two year later.

There are two main explanations to account for this difference. First, our model contains eight style factors, whereas their model contained none. During the late 1990s, much of the performance differential between “old-economy” and “new-economy” industries could be explained by style factors. Excluding style factors from the model, therefore, would likely increase industry volatility relative to country volatility.

The second reason why Cavaglia, Brightman and Aked observed relatively stronger industry effects lies with their choice of estimation universe. They selected the MSCI World Developed Markets Index, whereas we use the much broader MSCI ACWI IMI, which includes both emerging markets and small-cap stocks. Adding emerging markets to the estimation universe has the effect of boosting the average diversification potential of countries. Furthermore, as we discuss in greater detail below, adding small-cap stocks to the estimation universe serves to *decrease* the average diversification potential of industries.

In Figure 6, we report *MAD* for the 24-country emerging-market model. The sharp increase in country *MAD* during the Asia crisis of 1997 and the Russian default of 1998 is clearly visible in Figure 6. Overall, the *MAD* results are consistent with diversification potential and factor correlation in Figure 3. That is, in emerging markets, countries have consistently dominated industries over the sample period.

In Figure 7, we report *MAD* for developed Europe. The results are again consistent with the diversification potential and factor correlation presented in Figure 4. Namely, since 1999, industries have strongly dominated countries in developed Europe. During 1994-1998, however, Figure 7 shows that countries dominated industries by a small margin. It is also interesting to note that industry *MAD* for developed Europe peaked in 2000, the same year as for the 48-country global model (Figure 5) and the emerging-market model (Figure 6).

We now compare our results with those of Rouwenhorst, who also computed *MAD* for developed Europe from 1978 to 1998. During the four-year overlap period (1994-1998), Rouwenhorst reports country effects dominating industries by wide margin, whereas Figure 7 shows countries dominating industries only slightly. There are several possible explanations to account for this qualitative difference. First, Rouwenhorst smoothed his results using a 36-month moving average (versus 12 months for our study), which has the effect of damping the major increase in industry strength that we observe beginning in 1997. Second, Rouwenhorst used a coarse set of 7 industry factors, versus 24 used in our study; it is likely that the coarser set used by Rouwenhorst fails to capture significant sources of equity return co-movement. Finally, Rouwenhorst utilized base currency returns (in German marks) for his study. By contrast, we used local excess returns (currency hedged) in order to compare industries and countries on an equal footing. Naturally, using base currency returns makes country effects appear relatively stronger compared to industries.
Market Capitalization Dependencies

Thus far, our results have been based on cap-weighted regressions and cap-weighted segment averages (Equation 5). This strongly tilts the description towards large-cap stocks, which best reflect the investment opportunities for most global investors. Small-cap managers, on the other hand, are primarily interested in how these results translate to the small-cap universe.

Our framework can be easily extended to describe the behavior of small-cap stocks via the following model specification: (a) we perform ordinary least squares regression, which assigns equal weight to every stock, (b) we set the regression-weighted sum of industry and country factor returns to zero each period, and (c) we standardize the style factor exposures to be equal-weighted mean zero. We refer to this as the “equal-weighted” regression model. Under this model specification, the return of the world factor is simply the equal-weighted return of the estimation universe. Industry (country) factor portfolios go long for the equal-weighted industry (country) and short for the equal-weighted world portfolio, while maintaining zero weight in every country (industry) and zero exposure to every style. Since small-cap stocks greatly outnumber large-cap stocks, this model specification essentially probes the small-cap universe.

In Table 3, we report average diversification potential from January 1997 to September 2010 for the 48-country global model, under a variety of weighting schemes. We consider both cap-weighted and equal-weighted regression models. For the segment weighting in Equation 5, we also consider both capitalization weighting and equal weighting.

Under the full cap-weighted model, we see that the diversification potential for industries and countries is 1.18 and 1.20, respectively. These values represent the time-series averages of the curves shown in Figure 2. Table 3 also reports diversification potential for the case of cap-weighted regressions and equal-weighted segments (Equation 5). Interestingly, the diversification potential for industries (1.17) remains nearly unchanged, while for countries it increases dramatically to 1.65. This represents the same effect we observed in Table 1: namely, small countries generally have much higher volatility and diversification potential, whereas such a relationship does not hold for industries.

For the small-cap manager, the most relevant and interesting case to consider is equal-weighted regression. From Table 3, we see that when we perform equal-weighted regression while maintaining equal-weighted segment averages, the diversification potential of industries drops dramatically to 1.09. By contrast, country diversification potential is reduced only slightly to 1.58.

To investigate why equal-weighted regressions dampen industry effects more than country effects, we compute for each factor the volatility ratio of zero-investment pure factors using equal-weighted and cap-weighted regressions. The mean volatility ratio for country factors at time \( t \) is given by

\[
V_t(C) = \frac{1}{K_C} \sum_{k \in C} \frac{\sigma_{k,t}^{(equal)}}{\sigma_{k,t}^{(cap)}},
\]

where \( \sigma_{k,t}^{(equal)} \) is the predicted volatility (using equal-weighted regressions) of the zero-investment pure country factor at time \( t \), \( \sigma_{k,t}^{(cap)} \) is the corresponding volatility using cap-weighted regressions.

---

3 Regression weights in this case are proportional to the number of stocks in a country or industry.
and $K_c$ is the number of country factors. We adopt a similar expression for the mean industry volatility ratio.

In Figure 8, we plot the mean volatility ratio versus time for industries and countries. For countries, the mean volatility ratio was approximately 1.0 over most of the sample period. This shows that country effects were equally important for both small-cap and large-cap stocks. For industries, by contrast, the volatility ratio was much lower, ranging from 0.6 to 0.8. This demonstrates that, over the sample period, industry effects were consistently much weaker for small stocks than for large ones. These results support the view that, all else being equal, a country-first investment approach may be more appropriate for global small-cap managers.

**Summary**

We have investigated the relative strengths of industries versus countries in the global equity markets. We considered three regions: (a) a 48-country global model comprising both developed and emerging markets, (b) a 24-country model for emerging markets, and (c) a 16-country model for developed Europe. In emerging markets, we found that countries consistently dominated industries since 1994. In developed Europe, industries have strongly dominated countries since 1999. Globally, the result is more balanced, with industries dominating for some periods and countries dominating in others. We also studied market capitalization dependencies in the relative strength of industries versus countries. We found that for small-cap stocks, industry effects become relatively weaker, whereas country effects retain their full strength.
References


Table 1

Average monthly weights and predicted volatilities of country and industry factors for the 48-country model. Equal-weighted average volatilities are reported in the bottom row. The cap-weighted average volatility is 9.33 percent for countries, and 8.96 percent for industries. The sample period is January 1997 to September 2010.

<table>
<thead>
<tr>
<th>Country</th>
<th>Weight</th>
<th>Vol</th>
<th>Country</th>
<th>Weight</th>
<th>Vol</th>
<th>GICS Industry Group</th>
<th>Weight</th>
<th>Vol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.19%</td>
<td>12.2%</td>
<td>Argentina</td>
<td>0.09%</td>
<td>27.1%</td>
<td>Energy</td>
<td>7.88%</td>
<td>13.1%</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.63%</td>
<td>11.1%</td>
<td>Brazil</td>
<td>0.97%</td>
<td>19.0%</td>
<td>Materials</td>
<td>6.10%</td>
<td>8.1%</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.40%</td>
<td>12.7%</td>
<td>Chile</td>
<td>0.21%</td>
<td>15.5%</td>
<td>Capital Goods</td>
<td>7.34%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Finland</td>
<td>0.60%</td>
<td>18.5%</td>
<td>China Int’l</td>
<td>1.17%</td>
<td>25.8%</td>
<td>Commercial Services &amp; Supplies</td>
<td>1.34%</td>
<td>5.5%</td>
</tr>
<tr>
<td>France</td>
<td>4.31%</td>
<td>7.8%</td>
<td>Colombia</td>
<td>0.06%</td>
<td>22.6%</td>
<td>Transportation</td>
<td>2.16%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Germany</td>
<td>3.28%</td>
<td>9.8%</td>
<td>Czech Rep</td>
<td>0.08%</td>
<td>20.9%</td>
<td>Automobiles &amp; Components</td>
<td>2.45%</td>
<td>11.2%</td>
</tr>
<tr>
<td>Greece</td>
<td>0.28%</td>
<td>22.1%</td>
<td>Egypt</td>
<td>0.07%</td>
<td>27.4%</td>
<td>Consumer Durables &amp; Apparel</td>
<td>2.18%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.24%</td>
<td>13.8%</td>
<td>Hungary</td>
<td>0.06%</td>
<td>21.4%</td>
<td>Consumer Services</td>
<td>1.36%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Italy</td>
<td>2.02%</td>
<td>12.0%</td>
<td>India</td>
<td>0.84%</td>
<td>22.2%</td>
<td>Media</td>
<td>3.18%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.64%</td>
<td>9.7%</td>
<td>Indonesia</td>
<td>0.18%</td>
<td>26.9%</td>
<td>Retailing</td>
<td>3.22%</td>
<td>9.9%</td>
</tr>
<tr>
<td>Norway</td>
<td>0.39%</td>
<td>12.4%</td>
<td>Jordan</td>
<td>0.03%</td>
<td>22.1%</td>
<td>Food &amp; Staples Retailing</td>
<td>1.93%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.21%</td>
<td>14.1%</td>
<td>Korea</td>
<td>1.19%</td>
<td>22.6%</td>
<td>Food Beverage &amp; Tobacco</td>
<td>4.66%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Spain</td>
<td>1.49%</td>
<td>11.5%</td>
<td>Malaysia</td>
<td>0.46%</td>
<td>19.9%</td>
<td>Household &amp; Personal Products</td>
<td>1.45%</td>
<td>10.4%</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.04%</td>
<td>10.7%</td>
<td>Mexico</td>
<td>0.47%</td>
<td>15.2%</td>
<td>Health Care Equipment &amp; Services</td>
<td>2.18%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.55%</td>
<td>8.8%</td>
<td>Morocco</td>
<td>0.05%</td>
<td>18.9%</td>
<td>Pharma, Biotech &amp; Life Sciences</td>
<td>6.74%</td>
<td>10.3%</td>
</tr>
<tr>
<td>UK</td>
<td>8.35%</td>
<td>6.8%</td>
<td>Pakistan</td>
<td>0.03%</td>
<td>37.0%</td>
<td>Banks</td>
<td>10.32%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Australia</td>
<td>1.87%</td>
<td>9.2%</td>
<td>Peru</td>
<td>0.05%</td>
<td>18.6%</td>
<td>Diversified Financials</td>
<td>5.44%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Canada</td>
<td>2.80%</td>
<td>8.6%</td>
<td>Philippines</td>
<td>0.07%</td>
<td>23.2%</td>
<td>Insurance</td>
<td>4.48%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1.13%</td>
<td>17.3%</td>
<td>Poland</td>
<td>0.14%</td>
<td>21.5%</td>
<td>Real Estate</td>
<td>2.13%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Israel</td>
<td>0.23%</td>
<td>16.1%</td>
<td>Russia</td>
<td>0.82%</td>
<td>39.9%</td>
<td>Software &amp; Services</td>
<td>3.93%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Japan</td>
<td>11.12%</td>
<td>13.6%</td>
<td>South Africa</td>
<td>0.72%</td>
<td>14.0%</td>
<td>Technology Hardware &amp; Equipment</td>
<td>5.84%</td>
<td>10.5%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.08%</td>
<td>12.0%</td>
<td>Taiwan</td>
<td>1.30%</td>
<td>20.7%</td>
<td>Semiconductors</td>
<td>2.37%</td>
<td>18.6%</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.54%</td>
<td>15.3%</td>
<td>Thailand</td>
<td>0.22%</td>
<td>27.3%</td>
<td>Telecommunication Services</td>
<td>6.88%</td>
<td>9.1%</td>
</tr>
<tr>
<td>US</td>
<td>45.08%</td>
<td>5.1%</td>
<td>Turkey</td>
<td>0.23%</td>
<td>37.0%</td>
<td>Utilities</td>
<td>4.42%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Total/Avg</td>
<td>90.46%</td>
<td>12.1%</td>
<td></td>
<td>9.54%</td>
<td>23.6%</td>
<td></td>
<td>100.0%</td>
<td>9.0%</td>
</tr>
</tbody>
</table>
Table 2
Segment weights for a representative set of pure factor portfolios, June 2009.

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>Pure World Factor</th>
<th>Pure Japan Factor</th>
<th>Pure US Factor</th>
<th>Pure Auto Factor</th>
<th>Pure Volatility Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>World (Net)</td>
<td>100.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Long</td>
<td>100.00</td>
<td>109.75</td>
<td>66.03</td>
<td>128.46</td>
<td>62.32</td>
</tr>
<tr>
<td>Short</td>
<td>0.00</td>
<td>-109.75</td>
<td>-66.03</td>
<td>-128.46</td>
<td>-62.32</td>
</tr>
<tr>
<td>Japan (Net)</td>
<td>10.72</td>
<td>89.28</td>
<td>-10.72</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Long</td>
<td>10.72</td>
<td>89.28</td>
<td>0.35</td>
<td>45.98</td>
<td>5.76</td>
</tr>
<tr>
<td>Short</td>
<td>0.00</td>
<td>0.00</td>
<td>-11.07</td>
<td>-45.98</td>
<td>-5.76</td>
</tr>
<tr>
<td>US (Net)</td>
<td>35.42</td>
<td>-35.42</td>
<td>64.58</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Long</td>
<td>35.42</td>
<td>6.31</td>
<td>64.64</td>
<td>20.30</td>
<td>22.91</td>
</tr>
<tr>
<td>Short</td>
<td>0.00</td>
<td>-41.73</td>
<td>-0.06</td>
<td>-20.30</td>
<td>-22.91</td>
</tr>
<tr>
<td>Auto (Net)</td>
<td>2.41</td>
<td>0.00</td>
<td>0.00</td>
<td>97.59</td>
<td>0.00</td>
</tr>
<tr>
<td>Long</td>
<td>2.41</td>
<td>6.71</td>
<td>0.84</td>
<td>97.59</td>
<td>1.29</td>
</tr>
<tr>
<td>Short</td>
<td>0.00</td>
<td>-6.71</td>
<td>-0.84</td>
<td>0.00</td>
<td>-1.29</td>
</tr>
<tr>
<td>Japan Auto (Net)</td>
<td>1.15</td>
<td>6.71</td>
<td>-0.47</td>
<td>45.98</td>
<td>0.16</td>
</tr>
<tr>
<td>Long</td>
<td>1.15</td>
<td>6.71</td>
<td>0.09</td>
<td>45.98</td>
<td>0.41</td>
</tr>
<tr>
<td>Short</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.56</td>
<td>0.00</td>
<td>-0.25</td>
</tr>
<tr>
<td>US Auto (Net)</td>
<td>0.18</td>
<td>-0.90</td>
<td>0.55</td>
<td>8.18</td>
<td>0.45</td>
</tr>
<tr>
<td>Long</td>
<td>0.18</td>
<td>0.00</td>
<td>0.55</td>
<td>8.18</td>
<td>0.46</td>
</tr>
<tr>
<td>Short</td>
<td>0.00</td>
<td>-0.90</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Figure 1
Geometric interpretation of factor portfolio risk. The lengths of the lines labeled $\sigma_w$, $\sigma_k$, and $\tilde{\sigma}_k$ represent the volatilities of the world factor, the zero-investment pure factor, and the full-investment pure factor, respectively. The correlations are given by the cosines of the angles.

Figure 2
Diversification potential and factor correlation for the 48-country global model. Results are based on cap-weighted regressions and cap-weighted segment averages.
Figure 3
Diversification potential and factor correlation for the 24-country emerging-market model. Results are based on cap-weighted regressions and cap-weighted segment averages.

Figure 4
Diversification potential and factor correlation for the 16-country developed-Europe model. Results are based on cap-weighted regressions and cap-weighted segment averages.
Figure 5
Mean absolute deviation (MAD) for the 48-country global model. Results are based on cap-weighted regressions and cap-weighted segment averages.

Figure 6
Mean absolute deviation (MAD) for the 24-country emerging-market model. Results are based on cap-weighted regressions and cap-weighted segment averages.
Figure 7
Mean absolute deviation (MAD) for the 16-country developed-Europe model. Results are based on cap-weighted regressions and cap-weighted segment averages.

![MAD graph for the 16-country developed-Europe model](image)

Table 3
Diversification potential for the 48-country global model under different weighting schemes, January 1997 to September 2010.

<table>
<thead>
<tr>
<th>Regression Weighting</th>
<th>Segment Weighting</th>
<th>Diversification Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Cap</td>
<td>Market Cap</td>
<td>1.18</td>
</tr>
<tr>
<td>Market Cap</td>
<td>Equal</td>
<td>1.17</td>
</tr>
<tr>
<td>Equal</td>
<td>Equal</td>
<td>1.09</td>
</tr>
</tbody>
</table>

(Countries) | (Industries)
Figure 8
Mean volatility ratio of zero-investment pure factors for equal-weighted regression versus cap-weighted regression.

![Chart showing mean volatility ratio](chart.png)
Notice and Disclaimer

This document and all of the information contained in it, including without limitation all text, data, graphs, charts (collectively, the "Information") is the property of MSCI Inc., its subsidiaries (including without limitation Barra, Inc. and the RiskMetrics Group, Inc.) and/or their subsidiaries (including without limitation the FEA, ISS, and CFRA companies) (alone or with one or more of them, "MSCI"), or their direct or indirect suppliers or any third party involved in the making or compiling of the Information (collectively (including MSCI), the "MSCI Parties" or individually, an "MSCI Party"), as applicable, and is provided for informational purposes only. The Information may not be reproduced or redisseminated in whole or in part without prior written permission from the applicable MSCI Party.

The Information may not be used to verify or correct other data, to create indices, risk models or analytics, or in connection with issuing, offering, sponsoring, managing or marketing any securities, portfolios, financial products or other investment vehicles based on, linked to, tracking or otherwise derived from any MSCI products or data.

Historical data and analysis should not be taken as an indication or guarantee of any future performance, analysis, forecast or prediction.

None of the information constitutes an offer to sell (or a solicitation of an offer to buy), or a promotion or recommendation of, any security, financial product or other investment vehicle or any trading strategy, and none of the MSCI Parties endorses, approves or otherwise expresses any opinion regarding any issuer, securities, financial products or instruments or trading strategies. None of the information, MSCI indices, models or other products or services is intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision and may not be relied on as such.

The user of the Information assumes the entire risk of any use it may make or permit to be made of the Information.

NONE OF THE MSCI PARTIES MAKES ANY EXPRESS OR IMPLIED WARRANTIES OR REPRESENTATIONS WITH RESPECT TO THE INFORMATION (OR THE RESULTS TO BE OBTAINED BY THE USE THEREOF). AND TO THE MAXIMUM EXTENT PERMITTED BY LAW, MSCI, ON ITS BEHALF AND ON THE BEHALF OF EACH MSCI PARTY, HEREBY EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES (INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF ORIGINALITY, ACCURACY, TIMELINESS, NON-INFRINGEMENT, COMPLETENESS, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY OF THE INFORMATION.

Without limiting any of the foregoing and to the maximum extent permitted by law, in no event shall any of the MSCI Parties have any liability regarding any of the information for any direct, indirect, special, punitive, consequential (including lost profits) or any other damages even if notified of the possibility of such damages. The foregoing shall not exclude or limit any liability that may not by applicable law be excluded or limited, including without limitation (as applicable), any liability for death or personal injury to the extent that such injury results from the negligence or willful default of itself, its servants, agents or sub-contractors.

Any use of or access to products, services or information of MSCI requires a license from MSCI. MSCI, Barra, RiskMetrics, ISS, CFRA, FEA, EAFE, Aegis, Cosmos, BarraOne, and all other MSCI product names are the trademarks, registered trademarks, or service marks of MSCI in the United States and other jurisdictions. The Global Industry Classification Standard (GICS) was developed by and is the exclusive property of MSCI and Standard & Poor’s. “Global Industry Classification Standard (GICS)” is a service mark of MSCI and Standard & Poor’s.

About MSCI

MSCI Inc. is a leading provider of investment decision support tools to investors globally, including asset managers, banks, hedge funds and pension funds. MSCI products and services include indices, portfolio risk and performance analytics, and governance tools.

The company’s flagship product offerings are: the MSCI indices which include over 120,000 daily indices covering more than 70 countries; Barra portfolio risk and performance analytics covering global equity and fixed income markets; RiskMetrics market and credit risk analytics; ISS governance research and outsourced proxy voting and reporting services; FEA valuation models and risk management software for the energy and commodities markets; and CFRA forensic accounting risk research, legal/regulatory risk assessment, and due-diligence. MSCI is headquartered in New York, with research and commercial offices around the world.