DIVERSIFICATION POTENTIAL: UNTAPPED ALPHA IN NON-U.S. EQUITIES

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Key Ideas

- Market cap-weighted indexes aren't as diversified as they seem. Even indexes with a large number of stocks, or stocks from many countries, may only access a small fraction of the available diversification given their constituents.
- We introduce the diversification potential, which measures the highest additional return accessible by rebalancing to fixed target weights within a universe of stocks. Evaluating this measure requires only estimates for the covariance matrix, so that volatilities and correlations are the critical components of performance.
- Assessing this diversification potential is useful for measuring the degree of market efficiency and the incremental diversification gain of broadening the universe of investable assets, and comes with the opportunity for attractive risk-adjusted returns over the long term. However, accomplishing this at scale requires sophisticated statistical and trading methodologies, including the appropriate risk controls.

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Short-term performance and public perception of equity markets have long been connected with a small, and gradually changing, group of headline names. The Nifty Fifty, an informal collection of an arbitrary number of blue-chip stocks that dominated the NYSE in the 1960s and 70s, collectively courted lofty P/E ratios well above the rest of the market. That is, until they crashed harder than their contemporaries as that bull market inevitably came to an end. In the late 90s, red-hot startups such as the now-infamous Pets.com soared to IPO valuations during the dot-com bubble that seem patently absurd with the benefit of hindsight – until they faced the economic realities of profit and loss. Perhaps the world's most well-known stock index, the Dow Jones Industrial Average, is constructed using a methodology that you might charitably describe as antiquated. Hardly anyone invests in vehicles modeled on its thirty (price-weighted!) holdings. Still, its performance is frequently quoted in points at the top of news broadcasts before far more comprehensive indexes when discussing significant market moves.

Today's iteration is the ubiquitous FAANG (or FAAMA, if you prefer to include Microsoft). Some of these firms have built competitive moats that may seem unassailable. They loom large in both our daily lives and in the returns of nearly any index in which they're included. A perusal of lists of the ten-largest market caps by year over the past several decades, however, will remind you of many once-dominant firms (remember Kodak?) that have fallen out of favor, or even out of business. It's worth noting that IBM (in its heyday, a tech stock analogous to Apple), AT&T (a communications company which combined some of the characteristics of Facebook and Google), and General Motors were proportionally 35-75% larger than any companies in the U.S. market today. While stocks with lofty capitalizations can persist in dominating the market for long periods, history suggests that they likely will eventually cease to do so, and often in ways that surprise investors despite ample warning. Regulatory action, runaway success (leading to bloat and unwieldiness that invites hungrier competitors), changing customer tastes, technological progress, globalization, and other forces have caused industrial and financial titans to fall many times in the past; there is no reason to expect that this is not going to happen again.

While U.S. markets have garnered the majority of focus and flows recently[1], this reality is no different elsewhere. Intuition may tell us that non-U.S. developed equity markets are inherently more diversified due to the inclusion of stocks from many different countries, each with their own governments, regulations, cultures, geographies, and industrial specialties. And they are that. Still, indexes that attempt to replicate these equity markets' performance via the time-honored tradition of capitalization weighting barely scratch the surface of the markets' diversification potential. There's plenty more still to be gained by weighting stocks more efficiently through exploiting their volatilities and correlations.

We advocate for a closer look at the frequently overlooked alpha that exists within nearly any collection of stocks. This is alpha that can be captured without forecasting, but via the systematic application of diversification and rebalancing. And we'll introduce a new statistical measure we've developed – **diversification potential** – to do so.

In this paper, we'll use non-U.S. equity markets in order to:

- introduce the concept of diversification potential;
- explore the return upside in improving diversification – as well as the pitfalls; and
- demonstrate how sophisticated risk controls and implementation can help maintain access to the return while also mitigating the risks.

"While stocks with lofty capitalizations can persist in dominating the market for long periods, history suggests that they likely will eventually cease to do so..."

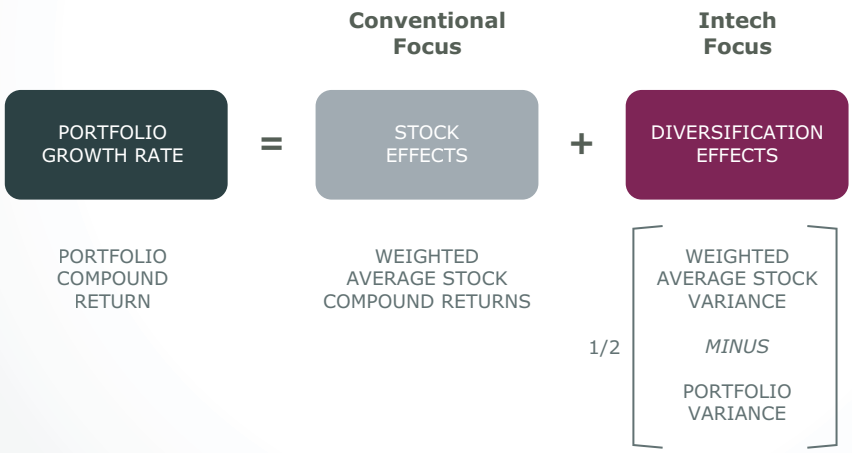
[1] In the developed markets (using the MSCI World Index as a proxy), the U.S. weight has increased from 49% at the beginning of 2010 to 64% at the beginning of 2020.

What is the Diversification Potential?

We've previously explored how a portfolio's compound return is greater than the weighted compound returns of the underlying stocks in our 2017 paper, *How to Harness Volatility to Unlock Alpha*. There's an additional diversification effect – the 'excess growth rate' – that also contributes to the portfolio compound return. This component is due to the diversification benefit a portfolio experiences based on the volatilities and correlations of the stocks within the portfolio.

As Intech's founder discovered almost 40 years ago, we can attribute portfolio growth into two main contributions: stock effects and diversification effects (see below). The former reflect stocks' individual growth, which tends to be variable and difficult to forecast over the short term. At the same time, the latter directly relate to a simple measure of portfolio diversification: half the difference between the average stock variance and the portfolio variance. This quantity is also known as the **excess growth rate**. By examining stock interactions and combining those that are complementary to each other, we improve portfolio diversification per unit of active risk, thus increasing a portfolio's potential to outperform consistently.

STOCHASTIC PORTFOLIO THEORY



Fernholz, R., & Shay, B. (1982). Stochastic Portfolio Theory and Stock Market Equilibrium. The Journal of Finance, 37(2), 615–624. doi: 10.1111/j.1540-6261.1982 tb03584.x

Because we can decompose a portfolio's return in this way, there are two ways to increase that return: 1) selecting stocks that have higher compound return without focusing on their diversification, and 2) combining stocks into a more favorable mix based on their variances and covariances without attempting to pick winners[2]. While the former requires forecasting stocks' returns, the latter only requires reliable estimates of their volatilities and correlations.

Toward this end, we present a new concept:

> **Di·ver·si·fi·ca·tion po·ten·tial** – a measure of the maximum excess growth available by rebalancing to fixed target weights in a universe of stocks.

For those interested in the underlying math, we have provided a technical appendix at the end of the paper.

In practical terms, this statistic is useful because it:

1) reveals differences in potential alpha from diversification effects, e.g., between a cap-weighted index and what's achievable via optimal reweighting and rebalancing;

2) highlights variations in market efficiency over time; and

3) quantifies the additional diversification that's possible as the investment universe expands.

For our test cases, we'll focus on two popular presumably diversified indexes: the MSCI EAFE and MSCI Europe. The MSCI Europe Index represents a narrower constituents list than the MSCI EAFE Index, and follows a similar construction methodology from the same index provider (see the table below for more details). As a result, it's particularly useful in illustrating diversification differences due to the number of stocks available.

Comparing Non-U.S. Indexes[3]

	MSCI EAFE Index	MSCI Europe Index
Definition	Captures large and mid cap representation across Developed Markets countries around the world, excluding the U.S. and Canada.	Captures large and mid cap representation across Developed Markets countries in Europe.
Countries	21	15
Constituents	918	438
Overlapping Names	434	
Overlapping Market Cap	62% of the MSCI EAFE	

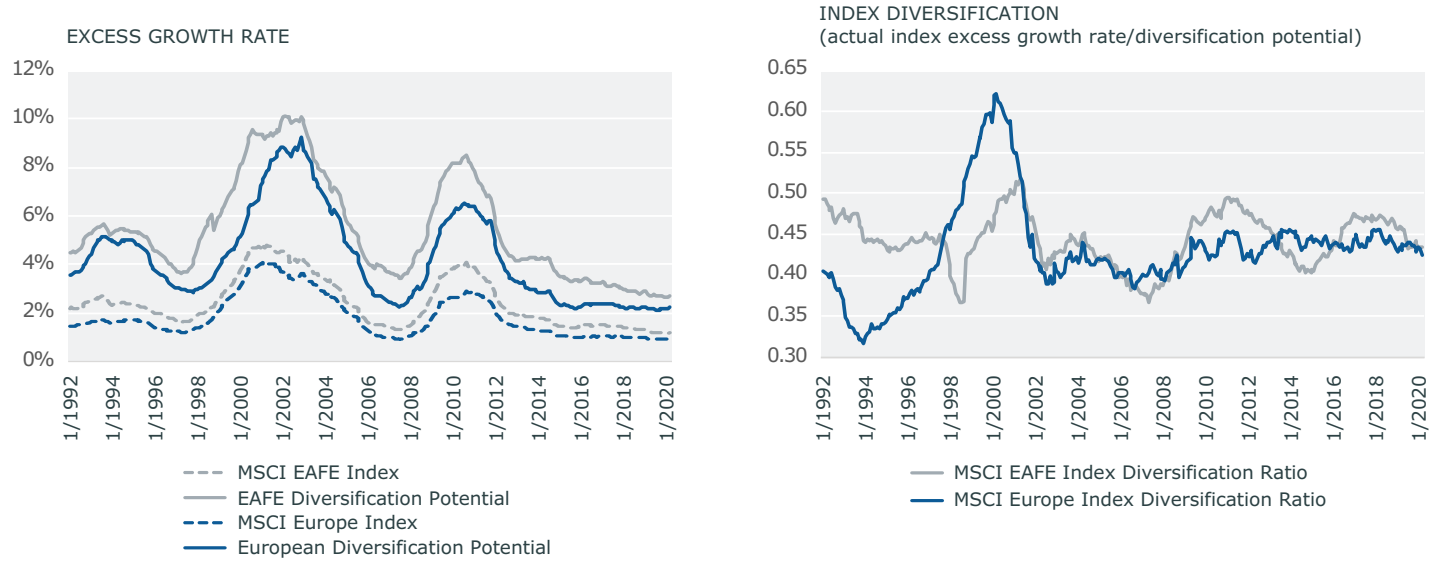
[2] As you might expect, in practice, these are not independent. Attempting either may affect the other, as we'll explore further along in the paper.

[3] Index data is as of March 31, 2020.

FIGURE 1

CAP-WEIGHTED INDEXES VS. DIVERSIFICATION POTENTIAL

JANUARY 1, 1992 – MARCH 31, 2020



Sources: MSCI and Intech. See Dislcaimer for additional information.

In Figure 1 on the left, we show the excess growth rate respectively for cap-weighted indexes and for portfolios approximating the diversification potential that use their constituents as an investable universe. Here are a few observations that confirm the consistency of this measure with the uses stated above:

1) The maximum achievable excess growth rate via optimal diversification is significantly higher than the excess growth rate achieved by the cap-weighted index.

2) There is substantial variability in the index's diversification potential as the market conditions change.

3) Indexes with expanded constituents (e.g., MSCI EAFE vs. MSCI Europe) have a higher potential excess growth rate because of the larger opportunity set of stocks' correlations and volatilities.[4]

[4] The diversification potential increases not when you have more stocks, but when you add stocks. For example, if index A has 100 stocks and index B has 150 stocks, you can't tell which one will have a higher diversification potential based purely on the number of names. However, if you know that B is A plus another 50 names, then you can prove mathematically that B will have a higher diversification potential than A.

The most important takeaway here is that there's quite a bit of diversification opportunity left on the table when investing in cap-weighted indexes, because they do not explicitly take into account volatilities and correlations in their construction methodology. To distill the relative level of difference between the indexes' actual level of diversification and their potential, we also use diversification potential as the denominator of a ratio, with the actual excess growth rate of the index in the numerator (see Figure 1 on the right). This ratio, which we call the index diversification, reflects how diverse the index is based on current constituents and weightings relative to those constituents' potential in a portfolio maximizing the excess growth.

As a result, such a portfolio uses the same constituents as the index. Yet, it will hold most of the names at zero weight to achieve the highest possible diversification potential. The outcomes illustrate the level of market efficiency at a given time – and in fact, levels of index diversification near historical extremes in either direction tend to coincide with times of greater market stress. Index diversification also varies over time, but adding stocks to an investment universe doesn't equate to added efficiency, even though it increases the potential excess growth rate.

Active management has an opportunity to improve upon the level of diversification in traditional cap-weighted indexes. That said, accessing it meaningfully with an investor's risk-return goals in mind comes with practical obstacles, as we'll explore in the remainder of the paper.

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Diversification Can Add Return – With Risks

The fraction of the diversification potential not realized by the market is clear evidence of a largely untapped alpha source within a typical cap-weighted index. In the previous section, we demonstrated the opportunity to improve the diversification potential of a market cap-weighted index via optimized reweighting for an increased excess growth rate. Applying the diversification potential in practice faces a number of challenges.

This is because diversification-potential portfolios are optimized *strictly* to maximize the portfolio excess growth rate via diversification. They don't concern themselves with controlling the first half of the portfolio compound growth formula (i.e., the weighted average stock returns). If maximum excess growth is the only goal, the portfolio will be heavily concentrated. Those stocks tend to be more volatile, and the most volatile stocks tend to underperform the index. These portfolios will also generally have high exposure to size, because smaller-capitalization names within an index are relatively more volatile, which can further increase their active risk. Furthermore, the portfolios tend to be concentrated in less-liquid stocks, making it costly to rebalance and undermining long-term return potential. The result of not controlling for stock risk is substantial tracking error to their respective index at the risk of lower returns, which presents a significant challenge for many investors.

Nevertheless, a skillful manager can largely mitigate those practical challenges and take advantage of most of the untapped diversification potential provided by the investable universe.

FEWER STOCKS = MORE DIVERSIFIED?

You may be surprised that a diversified portfolio has far fewer holdings than the index. Isn't diversification about spreading out your bets? Yes and no. Even a collection of a relatively high number of individual assets – in this case, individual stocks – is only as diversified as the stocks' covariance matrix allows. As you might expect, many stocks tend to move together, limiting the opportunity to diversify, rebalance and capture alpha. In an optimized portfolio with the objective of diversification, the consideration of volatility and correlation, rather than the inclusion of many different assets, does the heavy lifting. When using optimization techniques, the natural outcome may be to construct a portfolio of significantly fewer stocks that's still significantly more diverse than a cap-weighted portfolio of far more holdings, due to how the stocks tend to interact with each other.

A More Sophisticated Approach

To achieve this goal of practically accessing the untapped diversification potential, managers need to rely on sophisticated statistical techniques, risk control, and trading implementation to help smooth out the ride. Managers must allow for practical levels of capacity while maintaining meaningful excess returns that add real value to investor outcomes.

Statistical techniques must focus on reliability, carefully treating data outliers that may mislead when analyzing the diversification opportunity of individual stocks, and avoiding unstable stocks that exhibit higher volatility and lower correlation only transiently. They must also correspond to the risk controls; for example, constraining the portfolio with respect to systematic risk factors (like size or momentum) increases the significance of idiosyncratic sources of diversification.

Maintaining the portfolio diversification requires regular rebalancing as stocks' characteristics change; doing that efficiently, especially at scale, is of paramount importance. Practically, this requires tuning the trading implementation to control trading costs (whether due to liquidity or information leakage) without at the same time incurring a high opportunity cost.

Putting these pieces together can make a tremendous difference in maintaining access to the diversification alpha, while also controlling risk. In Figure 2, we provide risk and return outcomes for the hypothetical portfolio. The tracking error is greatly reduced while excess return is improved – the net result of which is an attractive information ratio that significantly exceeds both the equal-weighted and diversification-potential portfolios. We believe this approach is a reliable method of harnessing the ever-present alpha source of stock-price volatility.

FIGURE 2

ADDING RISK CONTROLS WITH DIVERSIFICATION LEADS TO IMPROVED RISK AND RETURN OUTCOMES

JANUARY 1, 1992 – MARCH 31, 2020

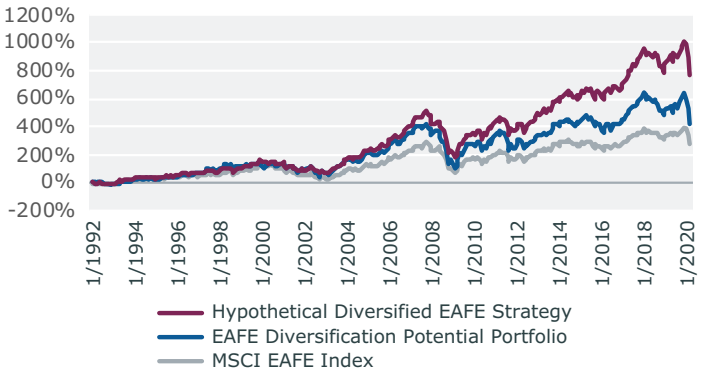
Annualized	MSCI EAFE Index	EAFE Diversification Potential Portfolio	Hypothetical Diversified EAFE Strategy	MSCI Europe Index	European Diversification Potential Portfolio	Hypothetical Diversified European Strategy
Return	4.84%	6.02%	7.95%	6.53%	5.81%	9.25%
Excess Return	—	1.18%	3.10%	—	-0.72%	2.71%
Tracking Error	—	7.77%	2.93%	—	9.08%	3.22%
Information Ratio	—	0.15	1.06	—	-0.08	0.84
Standard Deviation	16.1%	19.0%	15.7%	17.0%	22.0%	17.0%
Sharpe Ratio	0.15	0.18	0.35	0.24	0.15	0.40
Holdings						
-Max	1210	54	334	622	42	294
-Median	995	42	161	535	28	119
-Min	898	33	117	431	20	80
-Current	918	36	136	438	36	94

(continued on next page)

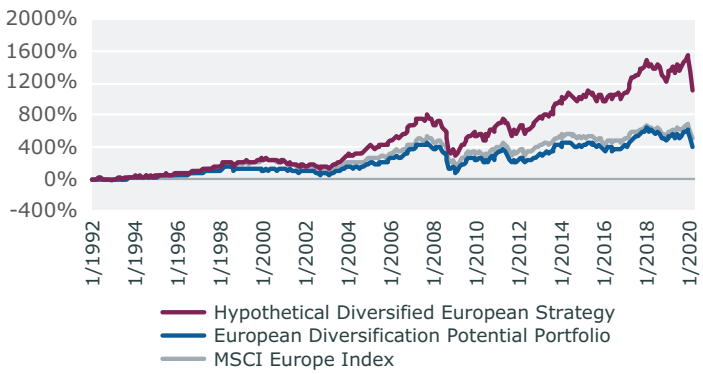
Sources: MSCI and Intech. See Disclaimer for additional information.

FIGURE 2 *(continued)*

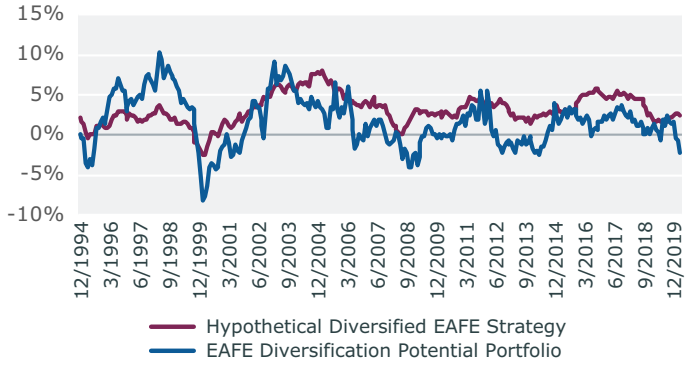
CUMULATIVE RETURN



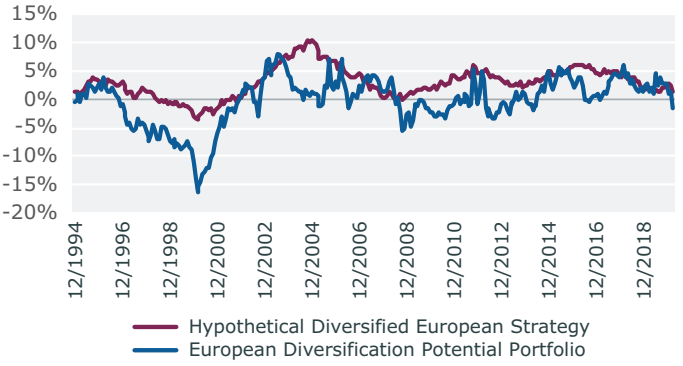
CUMULATIVE RETURN



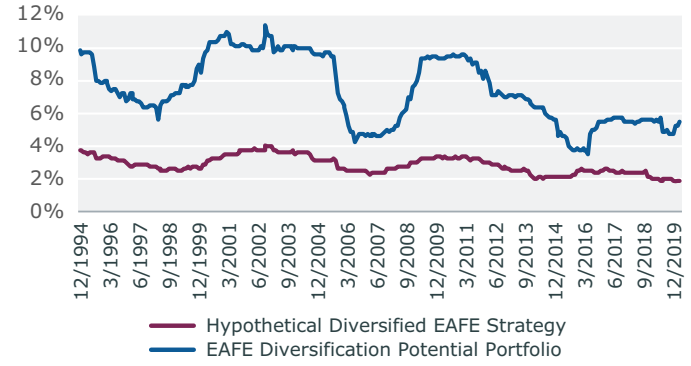
3-YEAR EXCESS RETURN VS. MSCI EAFE INDEX



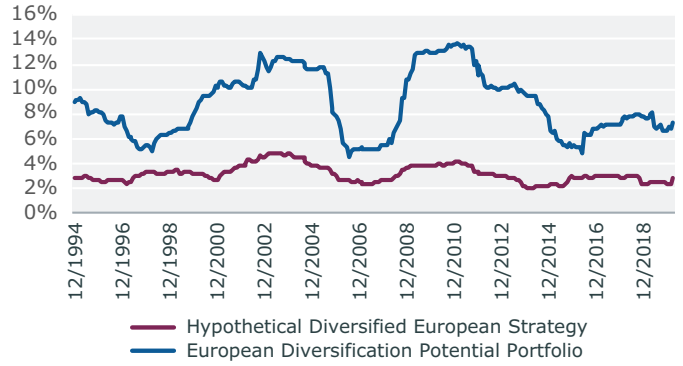
3-YEAR EXCESS RETURN VS. MSCI EUROPE INDEX



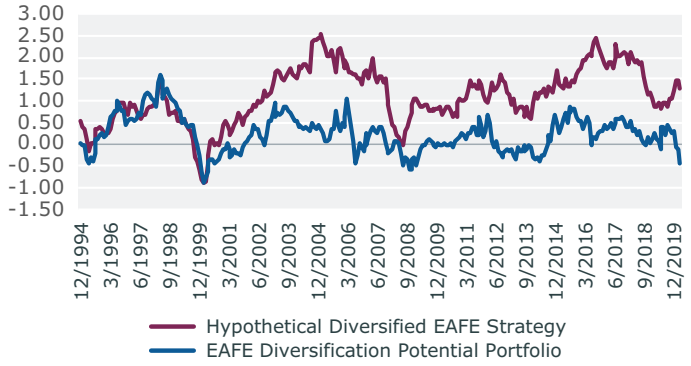
3-YEAR TRACKING ERROR VS. MSCI EAFE INDEX



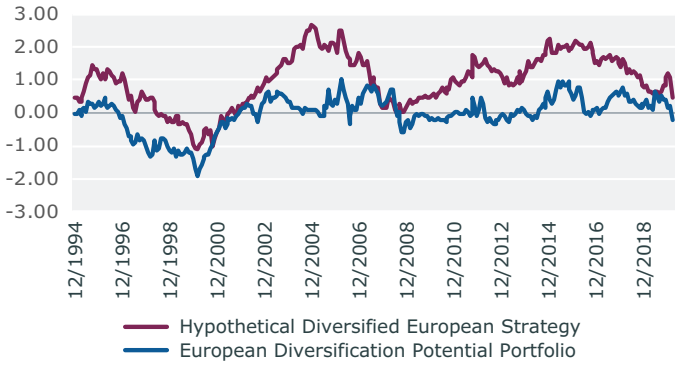
3-YEAR TRACKING ERROR VS. MSCI EUROPE INDEX



3-YEAR INFORMATION RATIO VS. MSCI EAFE INDEX



3-YEAR INFORMATION RATIO VS. MSCI EUROPE INDEX



Sources: MSCI and Intech. See Disclaimer for additional information.

Conclusion

We introduced the diversification potential as a statistical measure that can be used to quantify the available diversification opportunity in an investable universe. It can be used to isolate how a portfolio's positioning takes advantage of diversification, describes market efficiency over time, and reveals the incremental diversification potentials in comparisons of increasingly broad investment universes.

The challenge: investment managers must endeavor to translate intellectual pursuits into a value proposition for their clients. Carefully measured risk controls and practical implementation can temper the risks of optimizing solely for diversification. We believe that diversification and rebalancing, in the right hands, provide an opportunity to access a persistent alpha source – stock-price volatility – that can be translated into improved outcomes for the investor.

Technical Appendix

We summarize the steps used to generate the results above. For more details on the methodology, including the motivation for the various approximations, please refer to http://ssrn.com/abstract=3622775.

The logarithmic return of a portfolio p regularly rebalanced to constant target weights is the sum of two contributions: the portfolio-weighted logarithmic stock return, and the portfolio excess growth, which is given by

$$\gamma_p^* = \frac{1}{2}\left(\sum_{i=1}^{n}\sigma_{ii}p_i - \sum_{i,j=1}^{n}\sigma_{ij}p_i p_j\right).$$

In order to estimate the maximum excess growth available to an all-long[5] portfolio (i.e., the diversification potential) in a relatively simple and non-proprietary way, we implement the following steps:

1. Compose the matrix R of total, logarithmic, stock returns, where rows correspond to different stocks, and columns to different trading days.

2. Winsorize the returns on a stock-by-stock basis:

   a. For every row i (corresponding to stock i), sort the returns in ascend ing order and compute the 5th percentile $R_{i,bot}$ and 95th percentile $R_{i,top}$.

   b. Replace all returns $R_{i.}$ that are below $R_{i,bot}$ with $R_{i,bot}$.

   c. Replace all returns $R_{i.}$ that are above $R_{i,top}$ with $R_{i,top}$.

3. Compute the sample covariance matrix via

$$\hat{\sigma} = \frac{T_0}{T}\left(\boldsymbol{R}\cdot\boldsymbol{R}^T - \frac{1}{T}(\boldsymbol{R}\cdot\boldsymbol{e})\cdot(\boldsymbol{R}\cdot\boldsymbol{e})^T\right)$$

   where T is the number of trading days in the look-back period (36 months), $T_0 = 256$ is the nominal number of trading days in a year, e is a vector of all 1s.

4. Relativize the sample covariance matrix with respect to the market portfolio m using

$$\tau = \sigma - \sigma\cdot m\cdot e^T - e\cdot m^T\cdot\sigma + (m^T\cdot\sigma\cdot m)e\cdot e^T$$

5. Identify the stocks with extreme volatilities, and zero the matrix rows and columns that intersect them.

6. Suppress the non-diagonal terms of the covariance matrix – the resulting diagonal matrix is called the adjusted relative-covariance matrix.

7. Sort the diagonal elements of the adjusted relative-covariance matrix and identify the number m of stocks contributing to the all-long portfolio maximizing the excess growth by finding the smallest value m which satisfies

$$\sum_{i=1}^{m-1}\frac{1}{\sigma_{(i)}^2} > \frac{m-3}{\sigma_{(m)}^2}$$

   where $\sigma_{(1)}{}^2$ is the highest variance, $\sigma_{(2)}{}^2$ is the second-highest variance, etc.

8. Compute the normalization constant through

$$L = \frac{\frac{m}{2}-1}{\sum_{i=1}^{m}\sigma_{(i)}^{-2}}$$

9. Compute the diversification potential through

$$\hat{\gamma} = \frac{1}{2}\sum_{i=1}^{m}\sigma_{(i)}^2\left(\frac{1}{2}-\frac{L}{\sigma_{(i)}^2}\right)\left(\frac{1}{2}+\frac{L}{\sigma_{(i)}^2}\right)$$

10. Compute the portfolio realizing the diversification potential through

$$p_i = \begin{cases}\frac{1}{2}-\frac{L}{\sigma_i^2}, \text{top } m \text{ stocks by volatility}\\ 0, \text{otherwise}\end{cases}$$

[5] This concept can be easily extended to a long-short portfolio; for technical details, see http://ssrn.com/abstract=3622775.

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