CONTRIBUTOR

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The Story of Factor-Based Investing

1.0 INTRODUCTION

For decades, investment portfolios were constructed from a combination of market cap weighted index funds and active funds. Cap weighted index funds can provide a basis for investors to acquire the market portfolio in a simple, transparent, and cost-effective manner. By contrast, active funds promise potentially higher returns, albeit at the cost of greater complexity and higher fees.

In recent years, institutional investors have employed a new approach to portfolio construction: factor-based investing.

In recent years, institutional investors have employed a new approach to portfolio construction: factor-based investing.[1] This increasingly popular approach lies between passive and active investing, allowing investors to target specific risk factors (return drivers) as well as market beta. These strategies use a transparent, systematic, rules-based method at relatively low costs. This enables investors to implement active strategies while remaining under the passive umbrella.

In this paper, the origins and evolution of factor-based investing are examined. The theories underpinning factor-based investing, developed from the Capital Asset Pricing Model (CAPM),[2] and its multifactor extensions are discussed. The economic intuition behind factor performance is analyzed, along with its implementation. Finally, likely innovations and future product strategies are briefly considered.

[1] Betas measure exposures to a given factor. One invests in factors, not betas. Therefore, terms such as alternate beta and smart beta will not be used in this paper.

[2] Over the years, CAPM has had its critics. Numerous research studies have documented the inefficiencies of the simple single factor approach. However, the basic intuition behind CAPM holds true—that factors' underlying assets determine asset risk premia, and these risk premia provide compensation for investors bearing systematic risk.

2.0 FACTOR THEORY

Factor risks are the driving force of assets' risk premia. One of the first financial theories to model asset returns as a function of factor risks was the linear CAPM. This model was formulated in the 1960s and stated that there is only one factor, the market factor, driving the returns of assets. Moreover, the CAPM stipulates that the return of an asset is the sum of systematic return and specific return, as shown in equation one.

$$r_i = r_f + \beta_i \left(r_M - r_f\right) + \varepsilon_i$$

Equation 1

where:

This model was formulated in the 1960s and stated that there is only one factor, the market factor, driving the returns of assets.

r_i = return for asset i

r_f = risk-free rate

β_i = beta for asset i

r_M = market factor return

ε_i = asset i specific return

The CAPM models the systematic return as a function of the beta that measures the sensitivity of assets' returns to the market return. An asset's beta is given by:

$$\boldsymbol{\beta_i = \frac{\rho_{i,M}\,\sigma_i}{\sigma_M}}$$

Equation 2

where:

$\boldsymbol{\rho_{i,M}}$ = the correlation coefficient between asset $\boldsymbol{i}$ and the market

$\boldsymbol{\sigma_i}$ = the volatility of asset $\boldsymbol{i}$

$\boldsymbol{\sigma_M}$ = the volatility of the market

Note that the last term in Equation 1, the specific return component, is modeled as a normal random variable with a mean of zero - $\boldsymbol{\varepsilon_i \sim N\left(0, \theta_i^2\right)}$. Therefore, the specific risk of asset $\boldsymbol{i}$ is $\boldsymbol{\theta_i}$.

The CAPM assumes that for an individual asset, the systematic return and the specific return are independent of each other (uncorrelated). Moreover, if the specific returns of different assets are also assumed to be independent of each other, then it can be shown that a portfolio holding N assets will have variance defined as:

$$\boldsymbol{\sigma_p^2 = \beta_p^2 \sigma_M^2 + \sum_{i=1}^{N} w_i^2 \theta_i^2}$$

Equation 3

where:

$\boldsymbol{\sigma_p}$ = portfolio volatility

$\boldsymbol{\beta_p}$ = portfolio beta

$\boldsymbol{w_i}$ = asset weight $\boldsymbol{i}$

A traditional, long-only portfolio holding many assets would have most of its risk exposed to the market.

Equation 3 highlights two sources of risk within any portfolio, one systematic and the other specific. This has important implications for portfolio construction. First, the specific component may be diversified away by holding many assets. For example, an equal-weighted portfolio holding N assets, all with the same specific risk, would result in a portfolio specific risk of $\boldsymbol{\frac{\theta}{\sqrt{N}}}$. As the number of assets N increases, the specific risk decreases. Second, the systematic risk is a function of the portfolio beta and market risk. Therefore, a traditional, long-only portfolio holding many assets would have most of its risk exposed to the market.

This analysis views the CAPM as a possible risk tool. However, this model was originally developed as an equilibrium pricing model, where its function was to provide return expectations of individual assets. Therefore, in terms of pricing, it can be rewritten as:

$$\mathbb{E}(\boldsymbol{r_i - r_f}) = \boldsymbol{\beta_i}[\mathbb{E}(\boldsymbol{r_M}) - \boldsymbol{r_f}]$$

Equation 4

Note that the specific term has been dropped.[3] Equation 4 reveals valuable insight into the mechanics of investment performance, namely that expected returns of assets are proportional to their systematic risks, as measured by their betas. On the other hand, specific risks may be diversified away and are not rewarded with excess returns.

The discovery of the subtle differences between how the CAPM can be used, whether in risk or expectation, provided the foundation for many of the risk and alpha models that followed. The 1970s saw the incorporation of more factors (beyond just the market factor) to improve the CAPM as a risk tool. The first multi-factor model was developed by Stephen Ross in

[3] The expectation of the specific term, which is modeled as a normal random variable with a mean of zero, is zero.

1976. Many of today's commercial risk models are based on his Arbitrage Pricing Theory (APT) including macroeconomic factor models, fundamental factor models, and statistical factor models.

Moreover, pricing anomalies[4] were soon discovered that contradicted the CAPM and its use as a pricing model. The Fama-French Three-Factor Equity Model, incorporating the size and value effects in addition to the market, was widely regarded as an improvement (Fama and French, 1993).[5] An extension of this three-factor model is the Carhart four-factor model, where the momentum effect is included (Carhart, 2012).[6] From a practitioner's point of view, this highlights that there may be other priced factors, in addition to the market, that could reward investors over time. This can be written as:

$$\mathbb{E}(\boldsymbol{r_i} - \boldsymbol{r_f}) = \boldsymbol{\beta_{i,1}}\mathbb{E}(\boldsymbol{f_1}) + \boldsymbol{\beta_{i,2}}\mathbb{E}(\boldsymbol{f_2}) + \cdots + \boldsymbol{\beta_{i,K}}\mathbb{E}(\boldsymbol{f_K})$$

Equation 5

where:

$\boldsymbol{\beta_{i,k}}$= beta for asset $\boldsymbol{i}$ with respect to factor $\boldsymbol{k}$

$\mathbb{E}(\boldsymbol{f_k})$ = the risk premium of factor $\boldsymbol{k}$

These factors drive the performance of investment portfolios. They underpin many of the factor-based products currently available in the market.[7]

Behavioral theories argue that the value risk premium might be driven by investors incorrectly extrapolating the past earnings growth rates of companies.

3.0 EQUITY FACTORS

3.1 Value

The benefits of value investing have been known since the 1930s. Its strongest advocates were Benjamin Graham and, more recently, Warren Buffet. Considerable academic research documents the value effect. Most agree that value stocks provide above-market returns. However, there is no single consensus as to why this is the case, and explanations fall broadly into two camps: the rational and the behavioral.

Rational theories explain how the value premium arises from investors requiring compensation for bearing higher systemic risk in the form of financial distress (Fama and French 1996). For example, in recessionary environments, value firms (like manufacturing) find it difficult to shift their

[4] Within this paper, the terms "factors" and "anomalies" are used interchangeably.

[5] The small-cap effect is the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks. The value effect is the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks.

[6] The momentum effect is the difference between the return on a portfolio of high-performing stocks and the return on a portfolio of low-performing stocks.

[7] For further details on Factor Theory see Qian et al, 2007.

activities to more profitable ones. By contrast, growth firms (such as technology) can disinvest relatively easily, as a large proportion of their capital is human capital. Hence, value firms are perceived as being riskier than their growth counterparts and, as such, should command a premium.

The S&P 500 Dividend Aristocrats is designed to measure the performance of S&P 500 constituents that have increased dividends every year for the past 25 consecutive years.

Behavioral theories argue that the value risk premium might be driven by investors incorrectly extrapolating the past earnings growth rates of companies (Lakonishok et al 1994). High profile, glamorous stocks that have high valuations are bought by naïve investors expecting continued high growth rates in earnings. This pushes up their prices and, as a consequence, lowers their rates of return. At the same time, value stocks are cheap, as investors underestimate their future growth rates. Their cheapness does not arise from the fact that they are fundamentally riskier.

There are many ways to define value. For example, cash-flow yield and earnings yield examine cheapness while emphasizing profitability. Dividend yield provides insight into management's assessment of future profitability. Using the balance sheet item of net assets (book) gives a measure of liquidation value. Other value measures include predicted earnings yield and EBITDA[8]-to-enterprise value. Equity products that aim to harvest the value premium can be constructed by using one or a combination of these measures.[9]

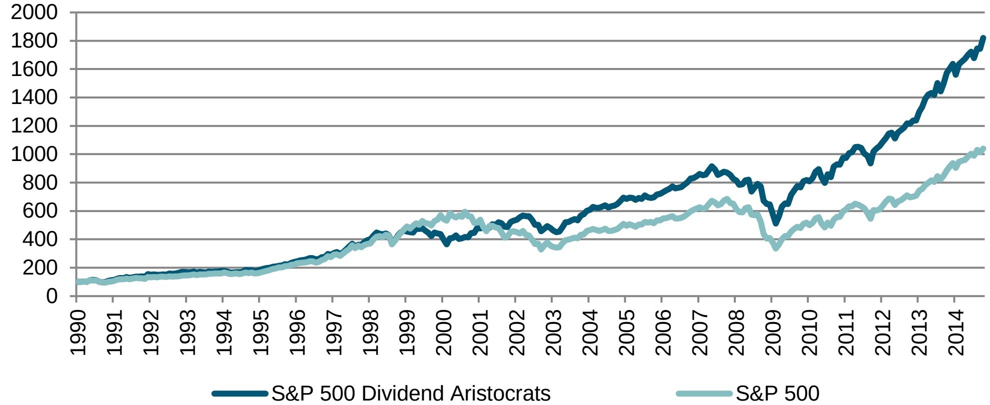
An example of an index seeking to capture the value risk premium is the equal-weighted S&P 500® Dividend Aristocrats®. This index is designed to measure the performance of S&P 500 constituents that have increased dividends every year for the past 25 consecutive years. Therefore, this index emphasizes dividend yield, as well as the quality of dividend payments. Compared with indices that focus solely on dividend yield, where heavy concentrations of financials and utilities stocks are common, this index is more diversified across sectors.

Exhibits 1 and 2 illustrate the performance of the S&P 500 Dividend Aristocrats has been superior to its parent index. This demonstrates the successful capture of the value risk premium.

[8] EBITDA: earnings before interest, tax, depreciation, and amortization.

[9] Combining different factors (measures) can be achieved through the Z-score method. A Z-score is a stock's standardized exposure to a factor. For each stock in an investment universe, subtract the universe's mean factor exposure from the individual stock's factor exposure. Then divide this number by the standard deviation of the factor exposures for the universe. Z-scores can then be added to derive an overall score and subsequent exposure to a set of factors.

Exhibit 1: The S&P 500 Dividend Aristocrats Versus the S&P 500



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 2: S&P 500 Dividend Aristocrats and S&P 500 Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P 500 Dividend Aristocrats	12.4	13.6	0.91
S&P 500	9.9	14.6	0.68

Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Price momentum is observed in many asset classes including commodities, government and corporate bonds, and industries.

3.2 Momentum

The first major academic study of momentum was by Jegadeesh and Titman (1993). They document price momentum as an investment factor where recent winners continue to win and losers continue to lose. Price momentum is observed in many asset classes including commodities, government and corporate bonds, and industries. Commodity Trading Advisor funds (CTAs) have successfully pursued these strategies since the 1980s.

Momentum arises because of the biased way that investors interpret or act on information. Explanations of the price momentum effect are predominantly behavioral and fall on two sides: overreaction and underreaction. Daniel et al (2001) argue that some investors are overconfident and overestimate their abilities to forecast firms' future cash flows. Based on this overconfidence, they overreact, pushing up the prices of stocks and generating momentum. Hong et al (2000) show that the slow diffusion of information into prices causes an initial underreaction; investors then learn about the quality of this information, which pushes prices up further.

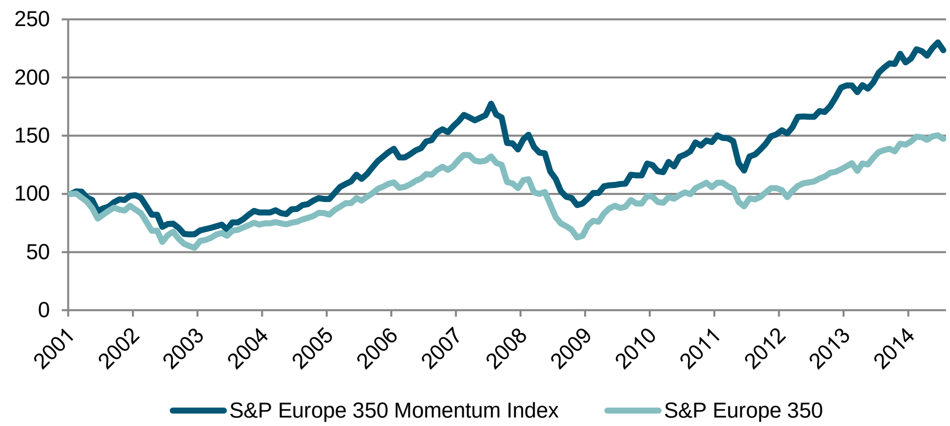
Other theories point to the imperfect information available to all investors and to imperfect market structure. Imperfect information refers to the agency problem, wherein management has strong incentives to promote good news and hide bad news. Institutional fund managers can arbitrage good news, but the vast majority are unable to exploit bad news due to short-selling constraints of what is, in practice, an imperfect market structure.

Typical measures of price momentum may involve one or a combination of the following: one-month reversals, six-month return, and twelve-month return. Some practitioners risk adjust performance returns too. More complicated measures include moving averages, relative strength index (RSI), and Bollinger bands.

Constituent weights are determined by a simple transformation—score multiplied by float-adjusted market capitalization.

The S&P Europe 350® Momentum Index seeks to capture the momentum anomaly. This index is based on price momentum, combining one-month reversals and twelve-month returns, and it is adjusted for volatility. The final Z-score combinations are ranked, and the top quintile is selected for inclusion in the index. Constituent weights are determined by a simple transformation—score multiplied by float-adjusted market capitalization.

Exhibit 3: The S&P Europe 350 Momentum Index Versus the S&P Europe 350



Source: S&P Dow Jones Indices LLC. Data from April 30, 2001, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 4: S&P Europe 350 Momentum Index and S&P Europe 350 Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P Europe 350 Momentum Index	6.1	14.3	0.43
S&P Europe 350	2.9	15.6	0.19

Source: S&P Dow Jones Indices LLC. Data from April 30, 2001, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Over the period, targeting the momentum factor increases the risk-adjusted return.

3.3 Quality

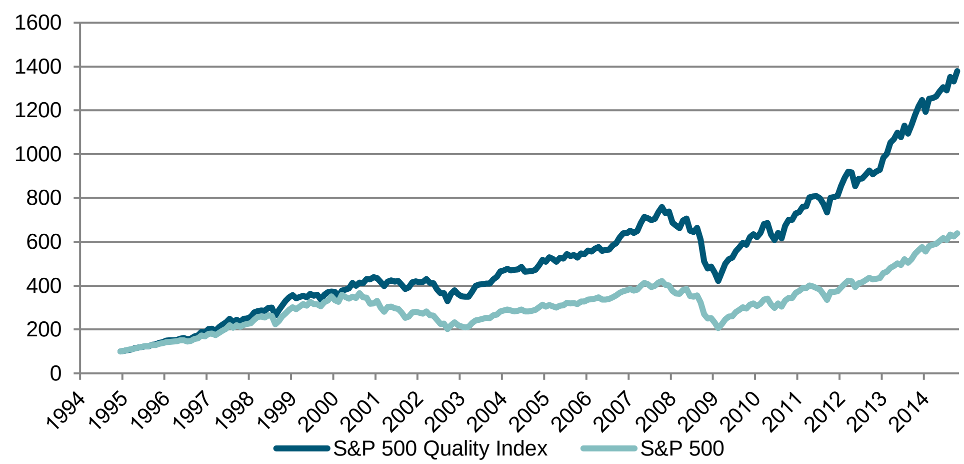
In contrast to momentum factors embedded in behavioral bias, investing based on quality factors is more fundamental in approach. Investors endeavor to ascertain the health of a firm's business and the competence of its management. Quality factors attempt to identify firms that generate abnormal profits from their competitive operations. Moreover, management delivers these profits directly to shareholders, without succumbing to the agency problem.

In practice, fund managers use a combination of measures as a proxy for quality, such as gross profit margin, quick ratio, and total asset turnover ratio. However, a robust combination should target three key company attributes: profitability (competitiveness), earnings quality (agency problem), and capital structure (financial risk). The S&P 500 Quality Index combines return on equity, the accruals ratio, and financial leverage, respectively.[10] These items require information from all financial statements. This index selects the top 100 stocks with the highest quality scores. Weights are computed as the product of the overall quality score and the float-adjusted market capitalization.

The S&P 500 Quality Index combines return on equity, the accruals ratio, and financial leverage, respectively.

Exhibits 5 and 6 show the successful capture of the quality risk premium over the analyzed period.

Exhibit 5: The S&P 500 Quality Index Versus the S&P 500



Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

[10] Return on equity is calculated by dividing a company's trailing, 12-month earnings-per-share by the company's latest book-value-per-share. The accruals ratio is the change in net operating assets over the past year divided by the company's average net assets over the past two years. Financial leverage is computed by taking the latest total debt figures available and dividing this by the company's book value. Note: these are combined using the Z-score method.

Exhibit 6: S&P 500 Quality Index and S&P 500 Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P 500 Quality Index	14.1	14.0	1.01
S&P 500	9.8	15.2	0.64

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

3.4 Size

The market capitalization of a company (its size) has long been a popular investment factor. Considerable research points to the outperformance of small-cap stocks relative to large-cap stocks over the long run.

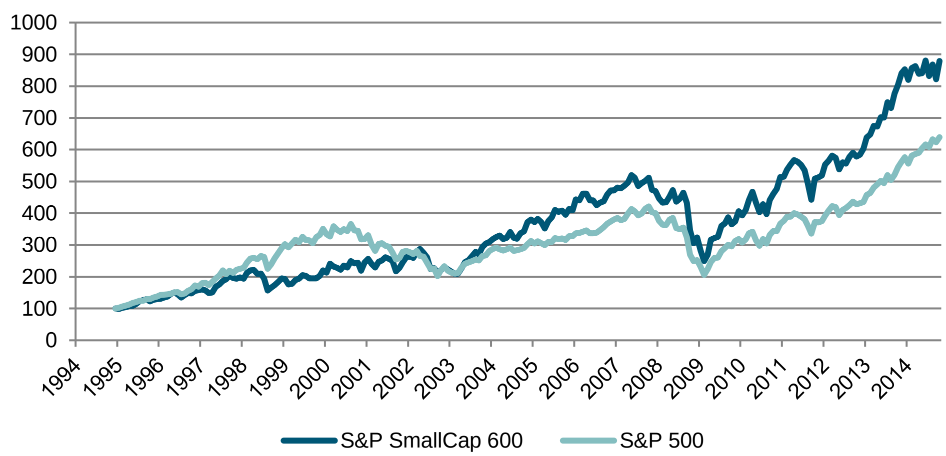
Explanations for this anomaly include the fact that investors require an additional risk premium, as small-cap stocks are less established and therefore more risky than large-cap stocks, small-cap stocks receive relatively less analyst coverage resulting in more mispriced opportunities, and investors require additional compensation for stocks that are not household names.

The size effect does have its critics. Since the mid-1980s, small-cap stocks have done better than large-cap stocks (in general). However, after adjusting for market exposure, the size effect quickly disappears (Dimson et al 2011). Therefore, arguably, the size effect should no longer be included in the Fama-French Three-Factor Model.

Exhibits 7 and 8 compare the performance of the S&P SmallCap 600® to the S&P 500.

Since the mid-1980s, small-cap stocks have done better than large-cap stocks (in general).

Exhibit 7: The S&P SmallCap 600 Versus the S&P 500



Source: S&P Dow Jones Indices LLC. Data from Dec. 30, 1994, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 8: S&P SmallCap 600 and S&P 500 Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P SmallCap 600	11.6	18.9	0.61
S&P 500	9.8	15.2	0.64

Source: S&P Dow Jones Indices LLC. Data from Dec. 30, 1994, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The risk-adjusted return of the S&P SmallCap 600 is slightly lower than that of the S&P 500, suggesting that the size effect has eroded since the mid-1980s.

Share repurchase programs (unlike dividends) are not tied to a preannounced policy.

3.5 Corporate Finance: Share Repurchases

Share repurchases center on share buybacks, insider purchases, or a combination of both. Share buybacks may provide information to investors about future earnings and valuation of a company's stock. Merton and Rock (1985) argue that managers that anticipate higher future cash flows are more likely to distribute cash in advance to their shareholders through stock repurchases or cash dividends. Moreover, research by Ikenberry et al (1995) suggests that management initiates buyback programs when it believes its company's stock is undervalued.

Share repurchase programs (unlike dividends) are not tied to a preannounced policy. If a company needs to reduce its redistribution of cash to shareholders, it can stop its repurchase program, while maintaining its current dividend policy. This may help a company avoid the adverse market reaction that is often associated with dividend cuts (Lintner 1956).

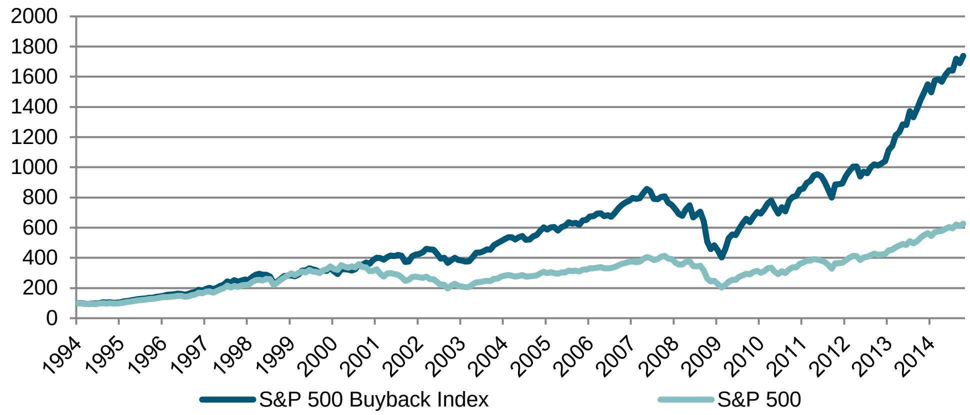
The agency problem may be at play too. Managers have the capacity to put their own interests ahead of those of their shareholders. The main concern for shareholders is that management may invest in projects with poor returns in order to achieve growth. Easterbrook (1984) and Jensen (1986) both argue that the potential for the misallocation of cash exists, and that one way to mitigate such agency costs is for management to return capital to shareholders via dividends or share repurchases.

Insider purchases can reflect promising news about a stock or the confidence that senior managers have in their companies. Of note, the reverse is equally true. This can be simply calculated as the number of insiders purchasing shares minus the number of insiders selling.

The S&P 500 Buyback Index targets the share repurchase anomaly. This equally weighted index is designed to measure the performance of the top

100 stocks with the highest buyback ratios[11] in the S&P 500. Its performance is compared to its parent index in Exhibits 9 and 10.

Exhibit 9: The S&P 500 Buyback Index Versus the S&P 500



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1994, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The inverse relationship between equity risk and return contradicts the conventional hypothesis that higher risk should result in higher expected return.

Exhibit 10: Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P 500 Buyback Index	14.8	15.9	0.93
S&P 500	9.2	15.0	0.62

Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1994, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

3.6 Volatility

First documented in the early 1970s, the inverse relationship between equity risk and return contradicts the conventional hypothesis that higher risk should result in higher expected return (Friend and Blume 1970). In addition, it called into question the CAPM and many of its multifactor extensions. In terms of pricing, Equations 4 and 5 clearly state that the expected return of an asset is a function of its covariance with risk factors. Furthermore, the asset's specific risk component (under expectation) was dropped, as it was modeled as a normal random variable with a mean of zero. Possibly, the CAPM fails because it does not address imperfect market structure and participants' preferences for holding some assets over others for exogenous reasons.

Recent studies documenting this inverse relationship include Ang et al (2009) and Dutt and Humphery-Jenner (2013). Explanations for the

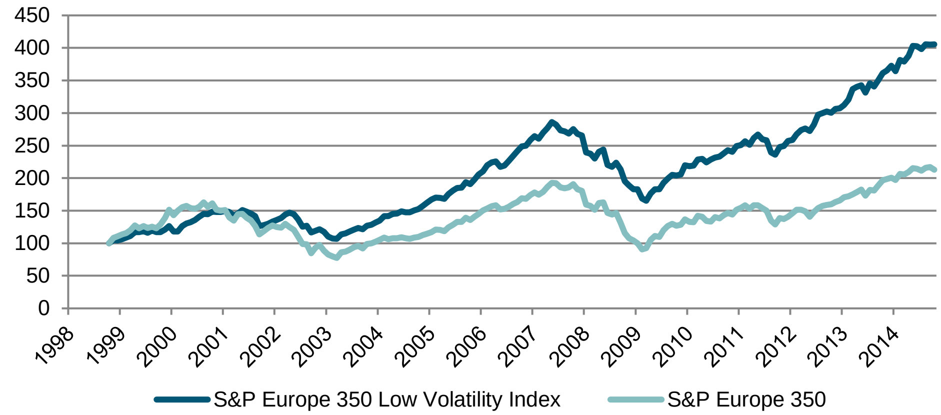
[11] The buyback ratio is defined as the monetary amount of cash paid for repurchasing common shares (under the program) in the last four calendar quarters divided by the total market capitalization of common shares at the beginning of the buyback period.

phenomenon differ, and a clear consensus seems distant. Theories include imperfect market structure, illiquidity, and lottery preferences.

Idiosyncratic volatility can be computed using the Fama-French Three-Factor Model. Alternatively, the much simpler approach of using total volatility over a given period achieves remarkably effective results, as demonstrated by the S&P Europe 350 Low Volatility Index. This index measures the performance of the 100 least volatile stocks in the S&P Europe 350. Constituents are weighted relative to the inverse of their corresponding volatility, with the least volatile stocks receiving the highest weights.

Idiosyncratic volatility can be computed using the Fama-French Three-Factor Model.

Exhibit 11: The S&P Europe 350 Low Volatility Index Versus the S&P Europe 350



Source: S&P Dow Jones Indices LLC. Data from Oct. 30, 1998, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 12: S&P Europe 350 Low Volatility Index and S&P Europe 350 Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P Europe 350 Low Volatility Index	9.1	11.1	0.82
S&P Europe 350	4.8	15.6	0.31

Source: S&P Dow Jones Indices LLC. Data from Oct. 30, 1998, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Incorporating the volatility factor in a portfolio may provide some drawdown protection. Over the period studied, the maximum drawdown was 42% for the S&P Europe 350 Low Volatility Index, with a maximum drawdown duration of 5.1 years. Over the same period, the parent index reported 53% and 6.3 years, respectively.

4.0 COMMODITY FACTORS

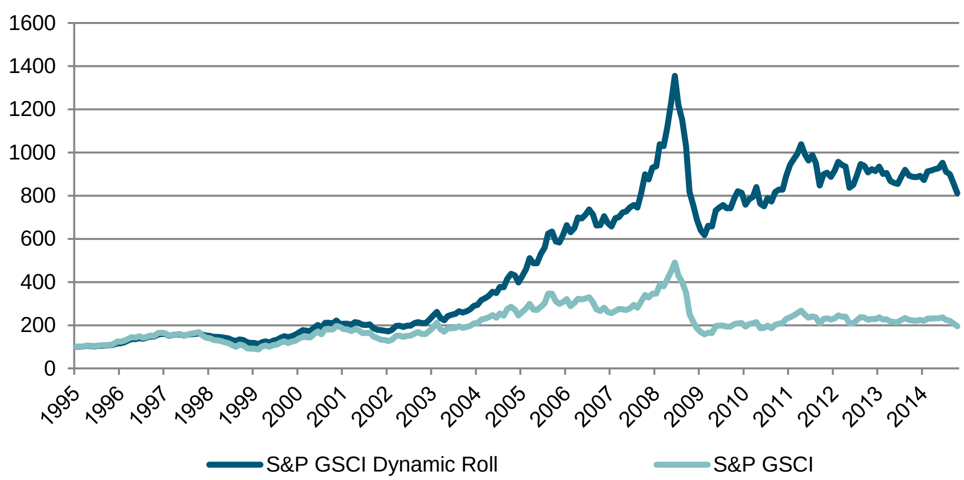
4.1 Roll Yield

Roll yield strategies harvest a systematic risk premium by purchasing contracts at the longer end of the futures curve. In theory, producers sell long-dated contracts, often at a discount, to hedge their production output. On the other hand, consumers purchase short-dated contracts at a premium to secure near-term consumption. This dynamic leads to a structural systematic risk premium. In reality, the shape of the curve is determined by the overall impact generated from the interaction between all market participants, including nonindustrial players such as passive investors and hedge funds. All of these participants will have their own objectives and time horizons (Kang and Ung 2013).

Roll yield strategies harvest a systematic risk premium by purchasing contracts at the longer end of the futures curve.

The simplest strategy to capture this risk premium is to roll into futures contracts of a predefined maturity, such as the three-month contract. The S&P GSCI 3-Month Forward Index employs this approach. More dynamic strategies aim to minimize the effect from contango or maximize the effect from backwardation[12] by adopting a different roll strategy with respect to the term structure of the commodity concerned—for instance, the S&P GSCI Dynamic Roll.

Exhibit 13: The S&P GSCI Dynamic Roll Versus the S&P GSCI



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1995, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

[12] Contango is a situation where the futures price of a commodity is above the expected spot price. Backwardation is the market condition wherein the price of a futures contract is trading below the expected spot price at contract maturity. Therefore, the opposite market condition to backwardation is contango.

Exhibit 14: S&P GSCI Dynamic Roll and S&P GSCI Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P GSCI Dynamic Roll	11.2	17.2	0.65
S&P GSCI	3.4	21.9	0.16

Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1995, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Like its parent index, the S&P GSCI Dynamic Roll weights its constituents by world production. However, it searches for optimal contracts along each commodity's futures curve, improving risk-adjusted performance. The dynamic roll algorithm also considers the liquidity of current and future contracts.

The S&P GSCI Dynamic Roll weights its constituents by world production.

4.2 Momentum

As with equities, much of the theory underpinning momentum in commodities is behavioral. These biases aside, industrial market participants can act as catalysts in initiating price trends, as exemplified by large industrial producers executing their hedging programs to reduce price risk.

Investors can achieve effective results from using simple measures such as moving averages, which is a popular technique with many CTA managers.

5.0 FUTURE PROGRESS

5.1 Multifactor

The equity strategies previously discussed are centered on single factors, for example, value, momentum, or quality.[13] However, factors can be combined to improve portfolio risk/return characteristics. Current products exist within this area, but the growing needs of investors mean that innovation is likely.

In general, there are two main methods of creating portfolios that target exposure to many different investment factors—sequential stock screening and simultaneous stock screening.[14] Sequential stock screening initially prioritizes desired factors. The investment universe is then reduced based on the most important factor. The next most important factor is then applied to the new, reduced universe. This process is repeated until all factors have been applied. The benefits of this approach are that it is easy to understand and to implement. However, if too many factors are used,

[13] As we have seen, these factors themselves can be a combination of measures. For example, the S&P 500 Quality Index is a combination of three underlying measures.

[14] There is a third way; one can target exposures to many factors by simply combining single factor-based portfolios—a fund of funds approach.

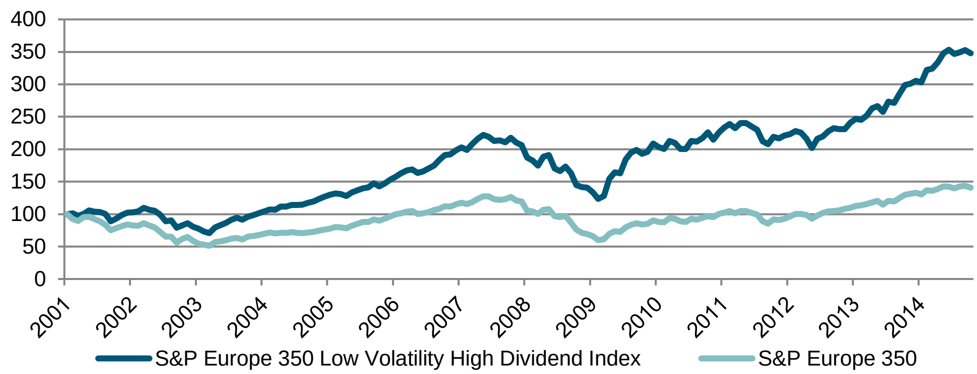
resulting portfolios may be too concentrated, with portfolio-specific risks unacceptably high.

Simultaneous screening applies only one screen to a combination of all chosen factors. Normally, factors are combined using the Z-score method. For example, a simple value and momentum model might assign 50% weight to the value Z-score and 50% weight to the momentum Z-score. This approach allows greater flexibility within the portfolio design stage, as practitioners can tinker with the weights to control portfolio outputs. By contrast, portfolios created from sequential screening tend to strongly reflect the first dominant screen. For more sophisticated simultaneous screening models, algorithms can be designed to adjust the weights applied to factors to better align with the current market or economic environment. This informs dynamic weighting schemes.

The S&P Europe 350 Low Volatility High Dividend Index attempts to capture both the value and low volatility anomalies.

The S&P Europe 350 Low Volatility High Dividend Index employs the sequential stock screening approach. This equally weighted index (with 50 constituents) attempts to capture both the value and low volatility anomalies.

Exhibit 15: S&P Europe 350 Low Volatility High Dividend Index Versus S&P Europe 350 Index



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 2001, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 16: S&P Europe 350 Low Volatility High Dividend Index and S&P Europe 350 Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
S&P Europe 350 Low Volatility High Dividend Index	9.5	15.6	0.61
S&P Europe 350	2.5	15.7	0.16

Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 2001, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

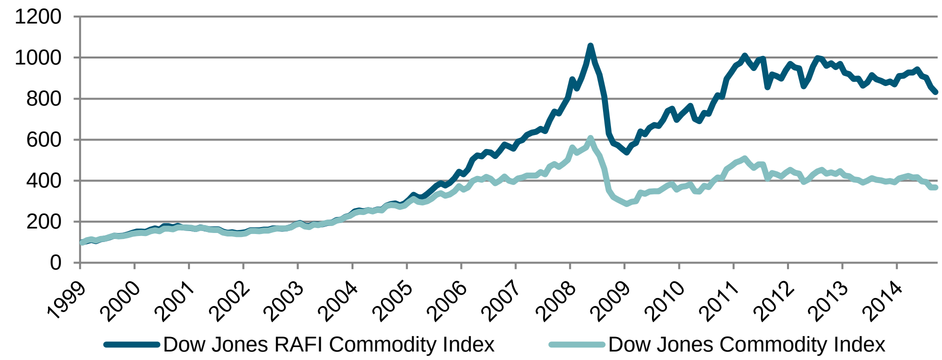
Exhibits 15 and 16 show that combining both factors in an index can work well. Of note, the order of the screens is important. Within this index, the dominant screen aims to harvest the value risk premium by selecting high dividend yielding stocks. Unlike the S&P 500 Dividend Aristocrats, which seeks consistency in dividend payments as well as yield, this index's initial screen is based purely on yield.[15] However, a form of quality control is implemented through the use of the second screen (volatility). This second screen mitigates against possible value traps by eliminating stocks with high price volatility.

The Dow Jones RAFI Commodity Index aims to retain the desirable characteristics of capacity, high liquidity, effective diversification, and broad market economic representation.

There are alternative approaches. The Dow Jones RAFI Commodity Index weights its constituents by a combination of two factors. It employs roll yield in conjunction with price momentum, attempting to improve roll return without unintentionally injecting negative momentum.[16] The Dow Jones RAFI Commodity Index aims to retain the desirable characteristics of capacity, high liquidity, effective diversification, and broad market economic representation.

Furthermore, the index dynamically selects futures contracts on the forward curve to minimize the effects from contango, or maximize positive roll yields from backwardation.

Exhibit 17: The Dow Jones RAFI Commodity Index Versus the Dow Jones Commodity Index



Source: S&P Dow Jones Indices LLC. Data from Feb. 26, 1999, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 18: Dow Jones RAFI Commodity Index and Dow Jones Commodity Index Performance Comparison

INDEX	ANNUALIZED RETURN (%)	ANNUALIZED RISK (%)	RISK-ADJUSTED RETURN
Dow Jones RAFI Commodity Index	14.5	16.4	0.88
Dow Jones Commodity Index	8.7	16.6	0.52

Source: S&P Dow Jones Indices LLC. Data from Feb. 26, 1999, to Oct. 31, 2014. Past performance is no guarantee of future results. Charts and tables are provided for illustrative purposes and may reflect

[15] Country and sectors are capped at 15 stocks to avoid concentration.

[16] Rather than using Z-scores, the Dow Jones RAFI Commodity Index combines roll yield and momentum equally, using a ranking process.

hypothetical historical performance. Please see the Performance Disclosures at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The index risk/return profile improves on its parent index, providing a stronger inflation hedge, and it is arguably a more suitable commodity component of diversified global portfolios.

5.2 Risk Premia

The indices discussed so far combine the market and the targeted risk premia. Therefore, market risk accounts for a considerable portion of the total risk in each of these strategies. However, it is possible to isolate risk premia. For example, a value index seeks to provide exposure to both the market and the value risk premium. Taking a long position in this index and a corresponding short position in a growth index would remove a large proportion of market risk, while isolating the value risk premium. Similarly, the small-cap risk premium can be isolated by taking a long position in a small-cap index and a short position in a large-cap index. Combining both examples effectively isolates the risk premia (excluding market) incorporated in the Fama-French Three-Factor Model.

During the financial crisis of 2008-2009, many investors who believed that their portfolios were diversified discovered that they were not.

The same approach can be implemented within both the commodities and fixed income spaces. For example, a long position based on the 10+-Year U.S. Treasury bond index and a short position based on an index at the short end of the yield curve, say 1-3-Year U.S. Treasury bonds, would isolate the term spread. A similar approach could be taken to isolate the credit and high-yield spreads, as well.

During the financial crisis of 2008-2009, many investors who believed that their portfolios were diversified discovered that they were not. Holdings across multiple asset classes, including hedge funds and private equity, and different strategies, failed to mitigate the market meltdown because their portfolios were still exposed to broad common factors. The risk premia approach could allow investors to harvest return-producing units across asset classes, while possibly removing a large proportion of market risk. Moreover, evidence exists that over the long term, many of these units are barely correlated with each other, thus providing clear diversification benefits.

Innovation in this area is likely, as investors seek to build more robust portfolios.

5.3 Fixed Income

A large amount of research and development has expanded the range of factor-based indices and equity products. By comparison, relatively little work has been done in the fixed income sphere.

Traditional fixed income indices are market-value weighted—the size of the issue multiplied by its price. Therefore, investors find themselves exposed to countries or corporations that are more indebted. In addition, as these indices are price based, if a bond increases in price, it receives higher weighting within the index. As a result, the index automatically increases the weights of more expensive bonds. Conversely, these indices systematically reduce the exposure of more inexpensive bonds that offer a higher yield.

Products that address the suboptimal weighting of traditional, market-value fixed income indices are likely to become an important investment tool. Moreover, fixed income return drivers (factors), such as the term structure, credit spread, and high yield, are likely to become prominent in fixed income products in the future. Finally, more sophisticated products may acquire information from the financial statements, such as cash flows, total assets, and interest cover, to build more robust fixed income indices.

It is likely that the potential advantages of factor-based products, particularly their transparent and systematic rules and relatively low costs, will mean practitioners continue to utilize and develop them.

6.0 CONCLUSIONS

The economic intuition behind the CAPM is important—factors underlying assets determine asset risk premiums, and these risk premiums provide compensation for investors bearing systematic risks. On the other hand, specific risks can be diversified away and are not rewarded with excess returns.

Since the CAPM's formulation in the 1960s, academics and practitioners have continually improved it. Pricing anomalies such as value, momentum, and quality have provided excess returns within the equity domain. The same principles are increasingly applied to commodities, and awareness is growing within the fixed income sphere as well.

The economic intuition behind factors is important. Back-tested performance alone is insufficient to execute an investment program. Moreover, we now know that strategies must be tested over multiple periods to understand performance over different business cycles and economic regimes, to help construct more robust portfolios. When combining factors, cross correlations can reveal diversification benefits. Factor combinations should always have an economic rationale.

Weighting schemes are important. For example, index constituents can be equally weighted, which is relatively agnostic. Alternatively, they can be transform weighted (market capitalization multiplied by a factor score), retaining some of the parent index's characteristics. Finally, weights can be determined purely by factor score (beta), providing a strong solution for those that find traditional market capitalization indices unacceptably inefficient.

It is likely that the potential advantages of factor-based products, particularly their transparent and systematic rules and relatively low costs, will mean practitioners continue to utilize and develop them. The next few years will be interesting.

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The S&P GSCI was launched on May 1, 1991, the S&P 500 Dividend Aristocrats Index was launched on May 2, 2005, the S&P Europe 350 Momentum Index was launched on Nov. 18, 2014, the S&P 500 Quality Index was launched on July 8, 2014, the S&P 500 SmallCap 600 Index was launched on Oct. 28, 1994, the S&P 500 Buyback Index was launched on Nov. 29, 2012, the S&P Europe 350 Low Volatility Index was launched on July 9, 2012, the S&P Europe 350 Equal Weight Index was launched on Jan. 21, 2014, the S&P GSCI Dynamic Roll Index was launched on Jan. 26, 2011, the S&P Europe 350 Low Volatility High Dividend Index was launched on Jan. 22, 2014, the Dow Jones RAFI Commodity Index was launched on Sept. 10, 2014, the S&P Europe 350 Index was launched on Oct. 7, 1998, the S&P 500 Index was launched on March 4, 1957, and the Dow Jones Commodity Index was launched on Oct. 26, 2011. All information for an index prior to its launch date is back-tested. Back-tested performance is not actual performance, but is hypothetical. The back-test calculations are based on the same methodology that was in effect on the launch date. Complete index methodology details are available at www.spdji.com. It is not possible to invest directly in an index.

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Past performance of the Index is not an indication of future results. Prospective application of the methodology used to construct the Index may not result in performance commensurate with the back-test returns shown. The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at www.spdji.com for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

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