Research Brief: Building Smart Beta Portfolios

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Why is smart beta important? We believe that smart beta is continuing to gain momentum among a variety of constituencies, including ETF providers, asset managers and asset owners. Smart beta can be defined as a factor-based approach in which an index is constructed, not by traditional market cap weighting, but instead by weighted based on share exposure to one or more "style" factors: dividend yield, price momentum, value, growth, etc. The goal is to outperform the benchmark index and/or reduce risk.

The idea of factor investing is not new. In 1976, Stephen Ross published a seminal paper [Arbitrage Pricing Theory] that defined the concept of factor investing. A flood of academic factor research followed, with many of today's smart beta funds and indices based on these academic findings, including Fama French's 1992 three-factor model and Carhart's four-factor extension of that model in 1997.

This brief focuses on aiding asset owners and managers in building their own "internal" smart beta processes. It begins with a review of popular approaches to implementing smart beta, looks at multi-factor selection for a more robust model, and ends with an all-important [in our view] look at portfolio construction, with examples of how to properly optimize for portfolio constraints and factor neutrality.

Background

Over the last few years, there has been a flurry of new index and ETF introductions based on a transparent, rule-driven smart beta approach. The value proposition is simple – using a systematic approach based usually on a single factor, ETF providers can claim to capture a good amount of the active returns provided by mutual fund managers at a fraction of the price.[1]
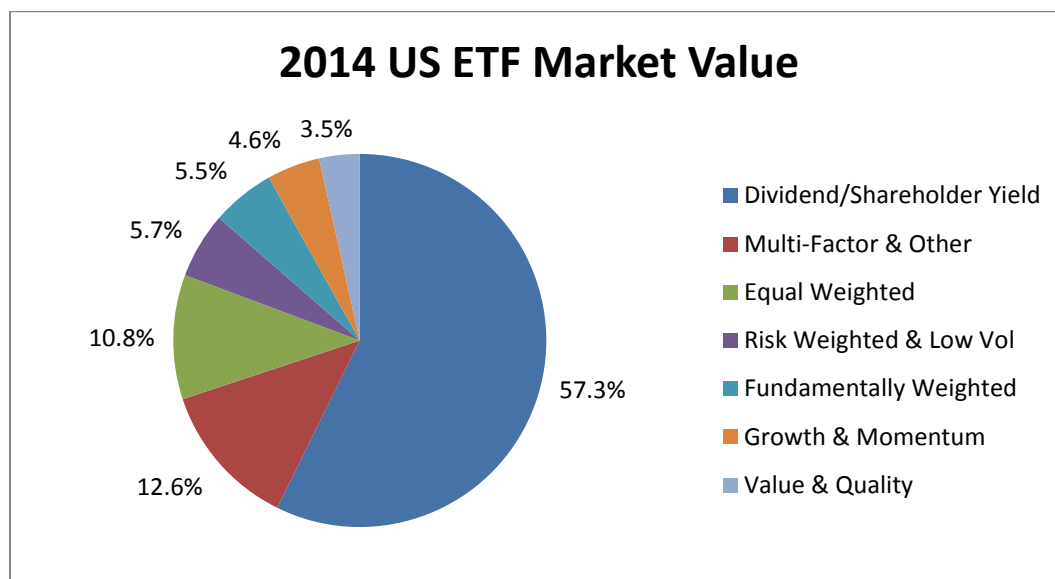
According to Invesco,[2] smart beta ETFs accounted for 17% of US ETF inflows [but only 11% of assets] in 2014, with over 350 smart beta products [$230B AUM] up from 212 in 2012 [$65B]. Nevertheless, we estimate that U.S. smart beta equity ETF's only comprise around 1% of traditional institutional U.S. equity manager assets.

As shown in Figure 1, smart beta ETFs are dominated by a few styles, with particular concentration in high-dividend yield strategies targeted at the retail market. Institutional investors appear not to be targeted, as traditional value and growth styles represent a very small share of the overall category.

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[1] Mutual fund fees are falling, according to the Investment Company Institute: the average asset-weighted expense ratio for U.S. funds fell to 70 bps in 2014, from 99 bps in 2000. Average ETF expense ratios are 44 bps.
[2] "The Continued Rise of Smart Beta" by Invesco Power Shares, 4/28/2015

Figure 1: 2014 Market Value of U.S. Smart Beta ETFs by Style Category

2014 US ETF Market Value

- Dividend/Shareholder Yield — 57.3%
- Multi-Factor & Other — 12.6%
- Equal Weighted — 10.8%
- Risk Weighted & Low Vol — 5.7%
- Fundamentally Weighted — 5.5%
- Growth & Momentum — 4.6%
- Value & Quality — 3.5%

Source: How smart are "smart beta" ETFs? Denys Glushkov, University of Pennsylvania 2015.Data as of December 31, 2014.

We believe that asset managers are adopting smart beta strategies internally or through separately managed accounts. European and Canadian public pension funds have been increasingly relying on internalized smart beta, with the largest U.S. pension funds and endowments also adopting the approach.

A recent Russell survey[3] found that 68% of European asset owners with AUM greater than $10B have smart beta allocations, and among global asset owners, the most popular smart beta categories are low volatility, fundamental weighting, value, and multi-factor.

Asset managers are adopting smart beta processes in support of fundamental analysts and portfolio managers by employing quantitative screening and back-testing[4] or by developing more complex systematic products, with closer to active fees, where smart beta can have greater pay-offs (e.g., for Europe, Australasia and Far East [EAFE] or emerging market mandates).

Factor Selection Example

As a first step, we'll illustrate how value can be added simply by moving from a typical single-factor approach to a multi-factor approach, in this case by combining two well-known factors:
- Universe: S&P 1500 Composite Index
- Factors: Price to Earnings (P/E) and Return on Invested Capital (ROIC)[5]
- Rebalance period: Quarterly
- Test horizon: Jan 1, 1995 to June 30, 2015
- Returns: Total returns for indices and top 100 stocks for each factor[6] as well as top 100 stocks for the combined factors[7]

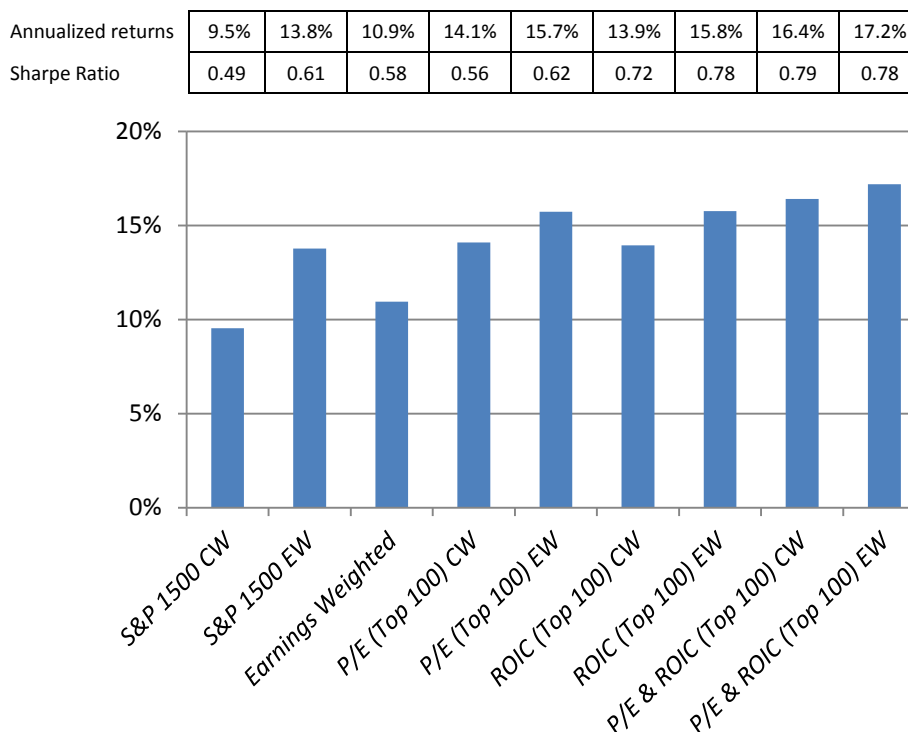[3] "Smart beta: 2015 global survey findings from asset owners" by FTSE Russell, May 2015
[4] A so-called "quantamental" process, which mixes quantitative analysis and qualitative/fundamental-based investing.
[5] P/E defined as the closing price divided by next fiscal year consensus EPS estimate. ROIC is defined as operating profit after tax divided by total invested capital. See our Alpha Factor Library for more detailed definitions.
[6] For back-testing, we rank the top 100 stocks by P/E ratio in ascending order (lowest P/E ranks top) and by ROIC in descending order (highest ROIC ranks top).

Figure 2 shows the annualized return of the standard capitalization weighted benchmark, the equal weighted benchmark, and a fundamentally weighted benchmark using trailing twelve months earnings. It also shows portfolios of the top 100 stocks as ranked by P/E and ROIC individually and combined (capitalization and equal weighting each). These are all examples of rules-based approaches to constructing smart beta portfolios.

Figure 2: S&P 1500 Benchmark Index & Smart Beta Returns, January 1995- June 2015

Annualized returns	9.5%	13.8%	10.9%	14.1%	15.7%	13.9%	15.8%	16.4%	17.2%
Sharpe Ratio	0.49	0.61	0.58	0.56	0.62	0.72	0.78	0.79	0.78

Source: S&P Capital IQ, ClariFI information Jan. 1, 1995 to June 30, 2015. For illustrative purposes only.
Note: Past performance is not an indication of future results. Indexes are unmanaged, statistical composites and it is not possible to invest directly in an index. These results are inherently limited because they do not represent the results of actual trading and were constructed with the benefit of hindsight. The returns shown do not reflect payment of any sales charges or fees an investor would pay to purchase the securities they represent. The imposition of these fees and charges would cause actual and back tested performance to be lower than the performance shown.

As can be seen from Figure 2, significant performance improvement was gained just by equal-weighting the benchmark. Weighting the benchmark by earnings improved returns only slightly, while single factor P/E and ROIC portfolios – both capitalization and equal weighted – showed significant improvement versus the benchmark. The strongest performing portfolio by far was the equal-weighted combined P/E and ROIC portfolio.

The cap-weighted combined factor portfolio had annualized returns of 16.4% and the equal-weighted combined factor portfolio had returns of 17.2%, versus 9.5% for the cap-weighted benchmark and 13.8% for the equal-weighted benchmark.

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[7] For the combined factor portfolios we rank each factor, sum the ranks and re-rank the sums, and then choose the top 100 stocks by the final rank.

The equal weighted portfolios benefit from the "size" effect (smaller companies have tended to outperform larger companies, see e.g. Banz [1981]) in addition to the explicit factor tilts. However, the benefits of equal weighting do not come for free, as equal weighting produces increased portfolio turnover, a bias toward small cap and low liquidity stocks, and often, higher volatility of returns as compared to cap weighting.

Also note that returns exclude transaction and market impact costs and therefore ignore the issues of turnover and liquidity, which will materially detract from realized returns. We'll show how to effectively implement portfolio constraints on turnover and liquidity (as well as tracking error and position size) in the final section of this brief.

Smart Beta Portfolio Approaches

Smart beta strategies begin with fundamental factor selection. Factors are intended to represent sources of both increased risk and increased return to compensate investors for the added risk.

Smart beta managers and index providers usually begin with the selection of style factor(s) combined with a portfolio construction methodology. This methodology includes a view on whether the portfolio should be neutralized for exposures to other (unintended) factors than the target style factor(s). Neutralization for unintended factor exposures, if desired, can occur either as part of the factor definition process or during portfolio construction.

Figure 3. A Smart Beta Process Flow Chart
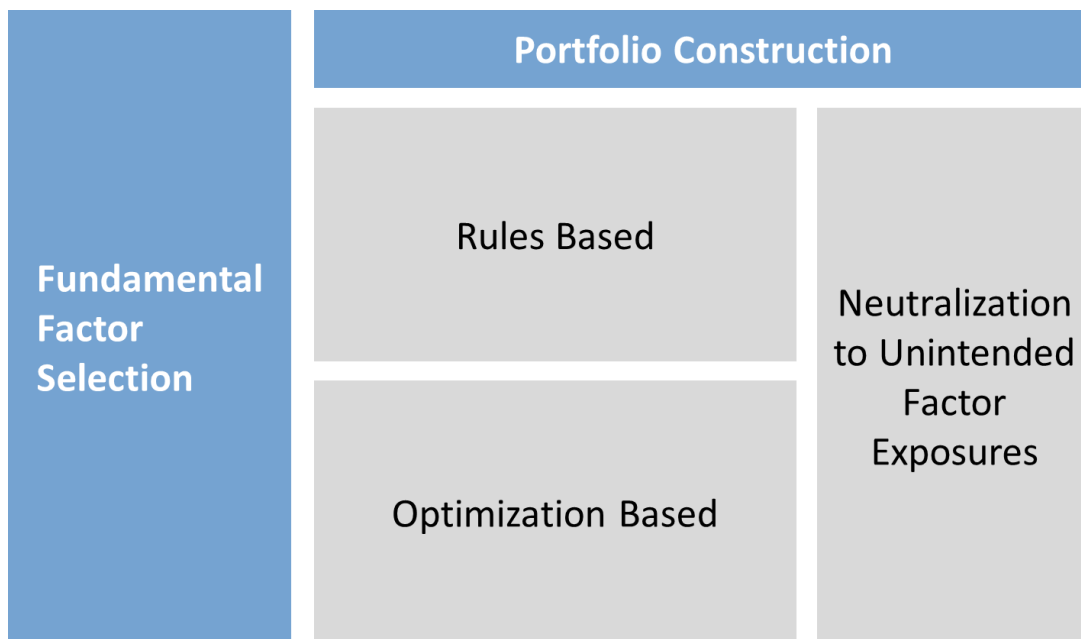
In terms of portfolio construction, a rules-based approach, used in most early smart beta products, benefits from being easy to explain and lends itself well to simple strategies such as equal or fundamental weighting. For implementing more complex portfolios and constraints, optimization-based construction may yield the best results. We'll show an example of the optimization-based approach, along with factor neutralization, in the following section.

Portfolio Construction – Optimization Based

We'll now derive an investable strategy from the two-factor P/E and ROIC model within the S&P 1500 by adding realistic portfolio constraints. Let's assume that we want to construct quarterly rebalanced portfolios with the following characteristics:

A.   Exactly 100 holdings, fully invested
B.   Maximum 60% annual one-way turnover
C.   Maximum trade size of 30% of average daily volume given a starting capital of $500 million
D.   Maximum 9% tracking error[8]
E.   No single holding less than 0.25% of the portfolio
F.   Holding size
      1.   Maximum 3% of portfolio, or
      2.   Maximum 5 times benchmark (B*5)

By switching from a rules based to an optimization based approach, it is straight-forward to impose these constraints: At the end of every quarterly rebalancing period, we ask the optimizer to select 100 stocks such that the overall two-factor model score is maximized but subject to the full set of constraints (A through E, and F1 or F2) above.

Option F1 pushes the portfolio more toward equal weighting (small-caps over weighted) whereas option F2 pushes more toward capitalization weighting (large-caps over weighted). Because the constraints are not necessarily binding on every rebalancing, the average achieved characteristic across the entire simulation is likely to be less than the level at which the constraint is set, e.g. the average achieved tracking error was well below 9% in all cases.[9] In practice, many of the constraints chosen may be mandate-specific and a good optimizer[10] will allow for a variety of custom constraints.

Figure 4: P/E & ROIC Constrained Portfolio Results

	Sharpe Ratio	Annual Return	Tracking Error	Annual Turnover	Avg. P/E	Avg. ROIC	Avg. Mkt. Cap.[$B]
Top 100, Max 3% Holding Size	0.67	13.8%	7.2%	56%	10.7	27.9%	27.7
Top 100, Max B*5 Holding Size	0.65	12.5%	6.0%	56%	12.6	25.1%	115.4
Benchmark (S&P 1500 Cap. Weighted)	0.49	9.5%	-	-	17.6	15.6%	79.5

Source: S&P Capital IQ, ClariFI test dates Jan. 1, 1995 to June 30, 2015. For illustrative purposes only.
Note: Past performance is not an indication of future results. Indexes are unmanaged, statistical composites and it is not possible to invest directly in an index. These results are inherently limited because they do not represent the results of actual trading and were constructed with the benefit of hindsight. The returns shown do not reflect payment of any sales charges or fees an investor would pay to purchase the securities they represent. The imposition of these fees and charges would cause actual and back tested performance to be lower than the performance shown. Turnover is one-way.

Once all the constraints were applied, the return of the two-factor model dropped from 17.2% (equal weighted no constraints) and 16.4% (capitalization weighted no constraints) to 13.8% and 12.5% respectively, but still outperformed the cap weighted benchmark by 4.3% and 3.0% respectively.

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[8] Tracking error is defined as the annualized standard deviation of the active (excess) portfolio returns relative to the benchmark.
[9] As an aside, this brief is not focused on traditional mean-variance optimization but instead on how to construct investable portfolios mainly by controlling for turnover and liquidity. The tracking error constraint is optional in this context.
[10] We use the S&P Capital IQ ClariFI optimization module.

The next step we'll take is to neutralize exposures to unintended factor bets.[11] Strict sector neutralization (i.e., imposing portfolio sector weights equivalent to those of the benchmark) tends to simply push strategy risk and return toward overall benchmark risk and return characteristics. While this may be desirable in some cases, the results are not particularly interesting and we will not show them here.

Neutralization of unintended style factor bets is arguably more of an art than a science in that "styles" are subjectively defined and exposures to those styles can be measured in various ways. For this example, we use the style factor exposures as defined by S&P Capital IQ's Alpha Factor Library and U.S. Equity Risk Model, which employ a market factor and eight style factors: price momentum, historical growth, analyst expectations, earnings quality, valuation, capital efficiency, size, and volatility.

We chose to only neutralize exposure to the market (beta) and historical growth factors, while imposing greater than or equal to benchmark exposures to valuation, capital efficiency, and earnings quality styles. The idea was to have the market and growth characteristics of our portfolio be similar to those of the benchmark (no unintended bets on market beta, market timing, or growth, since we are pursuing a value strategy). At the same time, consistent with our two-factor P/E and ROIC model, we'd like to emphasize exposure to valuation, capital efficiency, and earnings quality (arguably, our intended bets).

Figure 5: P/E & ROIC, Constrained & Market Beta/Growth "Neutral"

	Sharpe Ratio	Annual Return	Tracking Error	Annual Turnover	Avg. P/E	Avg. ROIC	Avg. Mkt. Cap.[$B]
Top 100, Max 3% Holding Size	0.68	13.9%	7.0%	55%	11.5	28.2%	27.4
Top 100, Max B*5 Holding Size	0.56	10.8%	4.9%	57%	12.9	25.1%	113.4
Benchmark (S&P 1500 Cap. Weighted)	0.49	9.5%	–	–	17.6	15.6%	79.5

Source: S&P Capital IQ, ClariFI information Jan. 1, 1995 to June 30, 2015. For illustrative purposes only. Note: Past performance is not an indication of future results. Indexes are unmanaged, statistical composites and it is not possible to invest directly in an index. These results are inherently limited because they do not represent the results of actual trading and were constructed with the benefit of hindsight. The returns shown do not reflect payment of any sales charges or fees an investor would pay to purchase the securities they represent. The imposition of these fees and charges would cause actual and back tested performance to be lower than the performance shown.

Again, when based on the absolute 3% holding constraint favoring small caps, the two-factor strategy performed quite well. However, when combined with the benchmark relative holding constraint which favors large caps, the imposition of style "neutrality" had a significant negative impact on performance. The implication is that, in all likelihood, there were some unintended bets in the original benchmark-relative holding-constrained strategy (e.g. higher market beta than the benchmark or well-timed growth tilts) which accounted for a significant part of the performance.

Said another way, in the large-cap biased strategy, exposures to other factors than P/E and ROIC accounted for most of the outperformance relative to the benchmark. Of course an investor might want these other exposures (e.g., high market beta) but that probably shouldn't be labeled as a strategy which takes advantage of attractive valuations (low P/E) and high capital efficiency (high ROIC).

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[11] As mentioned previously, this choice is up to the firm constructing the portfolio. In general, we believe that factor neutralization makes for a stronger and more defensible smart beta approach.

In Closing

As smart beta strategies continue to gain popularity, much effort is going into identifying factors likely to produce positive excess returns in the future. To avoid the pitfalls associated with data mining, it is always advisable to select factors that are based on economic theory. We believe that multifactor (i.e., two or more factor) models are likely to produce stronger risk-adjusted returns than single-factor models, particularly if the factors selected are complementary.

We also stress the importance of portfolio construction in controlling for liquidity and turnover, in order to build a strategy that not only works well on paper but can be implemented in reality. Risk tolerance assumptions should also be part of the portfolio construction process along with a view on what type of risk appetite the target investor is likely to have: relative risk (tracking error), absolute risk, or possibly a combination of both.

Finally, a view must be taken as to whether to neutralize for unintended factor bets which, as we mentioned, is more art than science as the list and definition of factors to be neutralized for varies, as does the measurement of exposure. Although a rules-based portfolio construction approach may work for a simple strategy, we believe that more complex strategies will benefit from the use of optimization in the portfolio construction phase.

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How smart are "smart beta" ETFs? Denys Glushkov, University of Pennsylvania, 2015.

"The Continued Rise of Smart Beta" by Invesco Power Shares, 4/28/2015.

"Smart beta: 2015 global survey findings from asset owners", FTSE Russell, May 2015.

Our Recent Research

August 2015: [Research Brief: Airline Industry Factors](#)
In this brief, we examine S&P Capital IQ's industry-specific factors for the airline industry. The seven airline industry factors contained in S&P Capital IQ's Alpha Factor Library address airline profitability in terms of growth, capacity utilization, and operating efficiency and consist of industry-specific financial ratios widely used by financial analysts.

August 2015: [Point-In-Time vs. Lagged Fundamentals – This time i(t')s different?](#)
The common starting point for alpha discovery and risk analysis is the backtesting of historical company financials using a research database. Whether internally constructed or licensed, research databases can be distinguished by two primary formats – Point in Time and Non-Point in Time. This paper focuses on the major practical differences between Point in Time (PIT) and Non-Point in Time (Non PIT) data for both backtesting and historical research. PIT data is defined by its ability to answer two questions: When was the information known? and What information was known at the time?.

August 2015: [Introducing S&P Capital IQ Stock Selection Model for the Japanese Market](#)
S&P Capital IQ® provides professional investors with high quality data, stock selection models (signals), and value-added research, helping its clients achieve superior results. Since the launch S&P Capital IQ's four U.S. stock selection models [("US Stock Selection Models Introduction")](#) in January 2011, we released a suite of global stock selection models targeting both developed [("Introducing S&P Capital IQ Global Stock Selection Models for Developed Markets")](#) and emerging markets [("Obtaining an Edge in Emerging Markets")](#). In this report, we introduce a stock selection model for the Japanese equity market that completes our global model offering.

July 2015: [Research Brief: Liquidity Fragility](#)
In this brief, we examine liquidity in arguably one of the most liquid equity markets in the world: The Standard & Poor's 500 (S&P 500). Whereas the overall index is highly liquid, not all issues within the index are equally liquid. We examine where in the S&P 500 liquidity exists and where it is constrained.

June 2015: [Equity Market Pulse – Quarterly Equity Market Insights Issue 4](#)
The Q2 issue of Equity Market Pulse features a spotlight on developed Europe, which has the highest estimated growth rates and most attractive valuations among developed markets.

May 2015: [Investing in a World with Increasing Investor Activism](#)
Investor activism has gained mainstream acceptance as activists with larger-than-life personas have waged a string of successful campaigns. Activist hedge funds' assets under management (AUM) have swelled to $120 billion, an increase of $30 billion in 2014 alone. It was among the best performing hedge fund strategies in 2014 as well as over the last three- and five-year periods. In this report, we explore an investment strategy that looks to ride the momentum surrounding the announcement of investor activism. We further explore what, if any, changes to targeted companies activists are able to influence.

April 2015: [Drilling for Alpha in the Oil and Gas Industry – Insights from Industry Specific Data & Company Financials](#)
During the recent slide in oil prices, clients frequently asked us which strategies have historically been effective in selecting stocks in declining energy markets. This report answers this question,

along with its corollary: which strategies work in rising energy markets? We also explore the value of oil & gas reserve data used by fundamental analysts/investors, but not used in a majority of systematic investment strategies. The analysis in this report should help both fundamental and quantitatively-oriented investors determine how to best use industry-specific and generic[1] investment metrics when selecting securities from a pool of global oil & gas companies.

March 2015: Equity Market Pulse – Quarterly Equity Market Insights Issue 3
Driven by proprietary data and analytics from S&P Capital IQ™, Equity Market Pulse provides professional investors with insights into global equity market fundamentals and performance at a glance. Spanning developed and emerging markets in the Americas, Europe, and Asia, it provides perspective on fundamentals, valuations and investment strategy effectiveness.

February 2015: U.S. Stock Selection Model Performance Review – The most effective investment strategies in 2014
Since the launch of the four S&P Capital IQ™ U.S. stock selection models in January 2011, the performance of all four models (Growth Benchmark Model, Value Benchmark Model, Quality Model, and Price Momentum Model) has been positive and 2014 was no exception. Our models' key differentiators - distinct formulation for large cap and small cap stocks, special treatment for the financial sector, sector neutrality to target stock specific alpha, and factor diversity - enabled the models to outperform across various market environments. In this report, we review the underlying drivers of each model's performance over the 12 months ended December 31, 2014, document performance from January 2011 when the models went live, and provide full model performance history from January 1987.

January 2015: Research Brief: Global Pension Plans - Are Fully Funded Plans a Relic of the Past?
With strong equity and bond market performances over the past few years, one might assume that pension shortfalls have declined sharply. Since our last research brief (September 2013), funding statuses have indeed improved in the U.S. and Asia, though not in Europe (Exhibit 1). However, while the S&P 500 Index has been making higher highs (Exhibit 2, red line), the number of S&P 500 plans with a funding status of 90% or higher has been in a sharp decline (blue bars).

January 2015: Profitability: Growth-Like Strategy, Value-Like Returns - Profiting from Companies with Large Economic Moats

Value-based strategies have been the favorite weapons in many investors' arsenals, historically yielding large returns and consistently outperforming. Most value investors focus on the price side of the equation – i.e., buying assets that are priced below their intrinsic values. Yet, there's another dimension to the value equation that has been complementary to value and just as critical in generating excess returns. Enter profitability. Profitability has historically worked as an investment strategy because instead of focusing on the cheapness of an asset it focuses on the productiveness of an asset - i.e., its ability to generate earnings for the investor. Our results from January 1996 to August 2014 show:The S&P 500® continues to be the preeminent regional performer in terms of both financial results and price appreciation Risk and Return: Tracks the dynamics of equity market returns and volatility.

- **Profitability-based strategies have historically produced excess returns on par with those generated by value-based strategies** and have historically produced higher excess returns than those generated by quality and price momentum strategies.
- Profitability-based strategies **have historically produced excess returns even after controlling for quality-, value- and price momentum-based strategies.**
- Profitability-based strategies **have historically consistently produced excess returns across different regions, time periods, and market capitalization categories.**
- **Highly profitable firms have historically consistently shown above average growth** with two-year top- and bottom-line growth rates that are 10% and 31% higher, respectively, than those for least profitable firms.
- **Profitability measures that are cleaner (i.e. higher up in the income statement such as gross profit) have historically shown higher excess returns and lower volatility** than measures that are lower in the income statement (e.g., net profit).
- **Gross profitability ratio has historically been 2.07x, 2.22x and 3.12x times more persistent than quality, value and momentum, respectively, after 5 years.**

November 2014: [Equity Market Pulse – Quarterly Equity Market Insights Issue 2](#)

Driven by S&P Capital IQ's™ proprietary data and analytics, **Equity Market Pulse** provides professional investors with insights into global equity market fundamentals and performance at a glance. Spanning developed and emerging markets in the Americas, Europe, and Asia, it provides perspective on valuations, operating efficiency, and investment strategy effectiveness.

- The **S&P 500® continues to be the preeminent regional performer** in terms of both financial results and price appreciation Risk and Return: Tracks the dynamics of equity market returns and volatility.
- **Investor preference for developed markets continues**, as developed markets show rising P/E multiples versus the emerging markets on much stronger financial performance.
- **Emerging markets appear cheap** on a valuation-to-projected-growth basis, with forward P/E to earnings growth (PEG) ratios of less than half those of the developed market average.

October 2014: [Lenders Lead, Owners Follow - The Relationship between Credit Indicators and Equity Returns](#)

This paper demonstrates a strong link exists between credit events and equity returns, suggesting a potential investment strategy. Whereas previous academic work focused on ratings changes within the U.S., this analysis takes a global perspective and includes the post-financial crisis period. Shareholders should note that even in a benign credit environment Standard & Poor's Ratings Services ("S&P Ratings Services") downgraded 68 U.S. speculative grade companies in the second quarter of 2014, and forecasts the rate of speculative grade defaults to increase next year to 2.2% from 1.6% in 2014. Year to date, there have been 303 instances where credit default swap spreads have widened by more than 50 basis points.

August 2014: [Equity Market Pulse – Quarterly Equity Market Insights Issue 1](#)

Equity Market Pulse provides professional investors with insights into global equity market fundamentals and performance at a glance. Spanning developed and emerging markets in the Americas, Europe, and Asia, it provides perspective on valuations, operating efficiency, and investment strategy effectiveness. The content of the Equity Market Pulse is driven by S&P Capital

IQ's fundamental data and analytics including S&P Capital IQ Estimates, Global Point-in-Time Fundamentals, and the Alpha Factor Library. The analysis is broken into four themes:

- Valuation: Analysis of valuation multiples coupled with consensus outlook for earnings and revenue growth.
- Operating Performance: Trends in operating performance with return on equity deconstructed into: net profit margins, asset turnover, and leverage
- Risk and Return: Tracks the dynamics of equity market returns and volatility.

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