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Smart Beta:
Part 1: Origins

What is smart beta?

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1. Introduction

While the advent of the modern stock market index is usually traced to the creation of the Dow Jones Industrial Average in 1896, it was the pioneering asset pricing work some 60 years later of Harry Markowitz[1] who introduced the world to the phrase 'Modern Portfolio Theory' in the 1950's and the work of Eugene Fama[2] which introduced the investment world to the notion of the Efficient Market Hypothesis (EMH) that essentially formed the intellectual basis for a style of investing that has become known invariably as 'passive investing' or 'index tracking'. Subsequently Burton Malkiel[3] and Charles Ellis[4] each wrote forcefully about the case for investing in line with financial market indices that were calculated on a market capitalisation-weighted basis as an alternative to investing with an 'active' fund manager.

With this intellectual firepower behind it, index tracking as an approach to investing has grown dramatically over the past forty years. The first institutional funds designed specifically to track a market cap-weighted equity index were created in 1973, these were closely followed in 1976 by the launch of the first index mutual fund by Vanguard. Today passive, or to be more precise, index tracking investment vehicles are widely available, both to institutional investors, and to retail investors. According to the ICI 2015 Factbook[5] in North America $17.9trn was invested in mutual at the end of 2014; of this total just over $2.0trn was invested in indexed mutual funds, up from $27.8bn at the end of 1993. According to the Investment Association's Annual Survey of the UK's fund management industry, 20% of total UK assets under management were managed on a "fully passive" basis.[6]

So what is the attraction of investing in a fund that tracks a financial market index? Arguably the extent to which investors believe in passive investing or not, depends upon their view of the EMH. Back in 1970 Fama argued that an efficient market is one where all publicly available and relevant past information about assets is already incorporated in current prices, and that all new public information is incorporated instantaneously into security prices. If a market conforms to this description it follows that it will be very difficult for any investor, including professional investors such as fund managers, to make systematic, risk-adjusted profits from trading the securities in such a market. In other words, 'beating' this market would be very difficult. Thus, the logic proceeds, if beating the market by taking active positions on individual stocks is difficult, if not impossible, then investing in the stocks in this market on a market cap-weighted basis would produce for the investor the return on this market, minus index tracking fees, that tend to be lower than the fees charged by active managers.

But as well as offering investors a potentially cheaper investment vehicle, investing in a fund that tracks a market cap-weighted index has other, potential benefits[7], among them:

- the indices that funds track are often familiar, for example, the FTSE-100 or S&P500 Composite indices, whose values can be found easily in the press, making them very accessible, keeping monitoring costs low;
- they represent an investable opportunity set, since a market cap-weighted tracking portfolio is effectively a slice of the market;
- they are transparent and scalable, thus accommodating substantial investment; and
- turnover tends to be lower, which in turn keeps transaction costs relatively low too.

Of course, an investor may not see these attributes as being very advantageous if they believe that a particular market is not efficient; in this case they may be more willing to appoint an active fund manager who seeks to exploit any inefficiencies to the benefit of the investor.

However, there is more to investing on an indexed basis than simply allocating investor wealth according to market capitalisation weights. Indeed, an investor may believe that a market is efficient in the EMH sense, but be uncomfortable allocating a significant portion of their wealth to one or two stocks, simply because they constituent a large portion of the market of interest by market capitalisation. There are an infinite number of ways in which one could specify the constituent weights of a financial market index. This paper will explore some of these alternative approaches and their intellectual origins. The financial industry has given these alternative approaches to indexing the moniker of 'smart beta', although others refer to the concept of 'alternative beta'. The paper is the first of a series of four. The second paper in this series will focus on the empirical evidence for 'smart beta' investing; the third paper will explore the possibility of building portfolios with smart beta vehicles; while the final paper will consider the implications for investor due diligence when using 'smart beta' mutual funds and ETFs.

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1 Markowitz, H.M. (March 1952). "Portfolio Selection". The Journal of Finance 7 (1): 77–91.
2 Fama, Eugene (1970). "Efficient Capital Markets: A Review of Theory and Empirical Work". Journal of Finance 25 (2): 383–417.
3 B. G. Malkiel, A Random Walk Down Wall Street, W.W. Norton, New York, 2012 (first published in 1973).
4 C.D. Ellis, The Loser's Game, The Financial Analysts Journal, Vol. 31, No. 4, July/August 1975, 19-26. New York.
5 https://www.ici.org/pdf/2015_factbook.pdf
6 http://www.theinvestmentassociation.org/investment-industry-information/research-and-publications/asset-management-survey/
7 For a fuller list of the potential benefits see: An Improvement on the Market Capitalisation Approach? Aon Hewitt, 2012.

If there exists the possibility of 'smart beta' that must mean that somewhere else there is a less smart beta, or even a 'dumb beta' approach to indexing an investment portfolio; in Section 2 of this paper we will briefly describe the original idea of 'beta', so that we can draw a distinction between it and alternative betas. Section 3 of this paper describes the academic roots of some of the most popular types of alternative beta. In Section 4 we will review two models that attempt to pull the academic research on alternative betas into a single, coherent framework. And finally, Section 5 concludes the paper with a summary.

2. What is Beta, and what is Alpha?

Before exploring the options that smart, or alternative beta investing offers investors we need to explore briefly the origins of 'ordinary' beta and to understand what it is that the industry means by 'beta exposure' and 'beta risk'. The finance industry uses these and similar terms very loosely, but beta has its origins in rigorous academic theory.

2.1 *Beta*

Arguably the most famous, though some would say 'infamous' model in finance is the Capital Asset Pricing Model (CAPM). This model was originally developed in the 1960s by William Sharpe[8] and was a direct development of Markowitz' mean-variance analysis. The basic intuition of the CAPM is that the risk inherent in any investment portfolio can be summarized by its relationship with 'market risk'. Market risk is that element of risk that cannot be diversified away by holding a large portfolio of risky assets. Although market risk is more difficult to define than one might expect, the finance industry generally uses a broad equity index as a proxy for market risk. An investment portfolio's relationship with market risk is usually summarised in the portfolio's 'beta'. More precisely, beta is a measure of the covariance between the returns in excess of the risk free rate[9] of the portfolio and the returns of the market in excess of the same risk free benchmark. If we can accept that these broad indices are suitable proxies for market risk, then according to the CAPM, on average, the expected return on any risky portfolio, or asset, can be described as follows:

Equation 1:

$$E(R_i) - R_f = \alpha_0 + \beta_i \times (E(R_m) - R_f)$$

where $E(R_i)$ is the expected return on the risky portfolio i; R_f is the return achievable on a risk-free asset, like a government T-bill, over the same period; $E(R_m)$ is the expected return on the market; $(E(R_m) - R_f)$ is the expected return on the market over and above the risk-free rate of return, known as the risk premium; and β_i is a parameter that maps the relationship between market risk and the return on the asset. α_0 in this expression – the alpha – should be equal to zero, but we will explain what alpha signifies once we have explored the significance of beta.

If the performance of an investment portfolio is more volatile than the return on the market so that, for example, when the market goes up by 1 per cent the portfolio goes up by 1.5 per cent and when the market goes down by 1 per cent the portfolio produces a return of minus 1.5 per cent then the beta coefficient will be greater than one, because the portfolio's returns are more volatile than the returns produced by the wider market. The converse is true if the returns are less volatile, that is, the portfolio's beta will be less than one. According to the CAPM then, a portfolio that has a calculated beta of 1.5 has approximately 50% more market risk than the market, while a portfolio that has a beta of 0.5 has approximately 50% less risk than the market. If the CAPM is broadly correct, a fall in the market of 5 per cent would be accompanied by a fall of 7.5 per cent for the former, but only a fall of 2.5 per cent in the case of the latter. This is what is meant by the term "beta risk" – it is the element of return generated by an investment portfolio that is, in turn, generated by the market itself. Clearly investors can access this beta risk by investing in a portfolio that tracks a market capitalisation-weighted index of that market. In turn this means that an index tracking manager will, on average, manage any market capitalisation-weighted portfolio such that it has a beta close to 1.0.

2.2 *Alpha*

As well as using the term 'beta' liberally and loosely, the finance industry also uses another term that has its origins in the CAPM: alpha. In the algebraic expression (1) the alpha term represents the regular addition to return, over and above that element of return that comes from being exposed to the market (beta risk). If the market is efficient and the CAPM is the appropriate model of expected return and risk, on average alpha will be equal to zero. Evidence that alpha is not zero, can be interpreted as meaning that the investment manager has added value to the portfolio if alpha is positive or, if alpha is negative, has detracted from the value of the portfolio. It follows then that a competent

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8 Sharpe, William F. (1964). "Capital Asset Prices – A Theory of Market Equilibrium Under Conditions of Risk". Journal of Finance XIX (3): 425–42; and William F. Sharpe, Portfolio Theory and Capital Markets, McGraw Hill, 1970.

9 Academics often refer to a "risk free rate", by which they mean the rate of return that can be earned without taking investment risk.

index tracking manager will, on average, manage any market capitalisation-weighted portfolio such that it has an alpha of zero, gross of fees.

In practice it is very difficult to tell whether any alpha generated by a manager is due to skill, or just luck, after all a bad manager can be lucky while, on the other hand, a good manager can be unlucky. More recent work by Fama and others has revealed that when an active manager has outperformed the market over some time horizon, that most of the time this 'outperformance' is due to luck and not to skill[10]. Taken together modern portfolio theory and the CAPM imply that the returns generated by any active fund manager comprises three distinct elements:

- Skill – alpha
- Exposure to market risk – beta risk
- Manager luck – good and bad

By investing in a fund that is indexed to a market capitalisation-weighted index, consciously or not, an investor automatically eliminates the impact of manager luck on the performance of their investment and forgoes the possibility of enhancing the returns on their portfolio by employing a manager with investment skill. It is only beta risk that is embedded in the risk profile of their investment.

However, the preceding statement is only correct if the CAPM characterises the relationship between risk and return correctly. Although the CAPM has been much criticised, it is the testing of this model by academics throughout the 1980s and 1990s that has ultimately given rise to the alternative and smart beta investment opportunities that this series of papers will explore. It could be argued that without the CAPM and the closely related EMH, there would be no smart beta industry today. In the next section of this paper we will describe the academic origins of some of the most commonly exploited alternative betas, that is, alternative to the single, CAPM beta described above.

3. Smart beta: origins

Section 2 above explained what the finance industry means by 'beta risk'. It is the risk that one assumes when investing in an index tracking fund where the constituents of the index are weighted according to their market capitalisation. Exposure to this beta risk leads ultimately to market returns (minus fees). The skills needed to construct an indexed portfolio of this kind can be programmed into a computer easily. Because of this and because this approach to investing by definition allocates the largest portion of an investor's capital to the largest constituent, index fund managers can benefit from huge economies of scale and these economies of scale can be passed on to investors in the form of lower fees.

3.1 *Rules versus discretion*

Investing in an index tracking portfolio where the weights are determined by the market capitalisation of the components means that investors can harvest the return generated by the market. This approach to investing is normally referred to as passive investing. But how passive is this approach?

Imagine for the moment that market-cap weighted indices had not been invented and that a manager told you about a new and cheap way of investing. The manager offers to apply their strategy to UK equities for you. He describes the investment strategy to you which comprises the following, simple steps:

(a) at the end of a quarter, consider all the stocks in the London Stock Exchange;
(b) identify the 100 largest stocks by market capitalisation;
(c) invest in these 100 stocks in the market capitalisation proportions;
(d) hold this portfolio for the following quarter;
(e) at the end of the quarter repeat the process, removing stocks that are no longer the largest 100 on the LSE and adding those that have entered the top 100 over that quarter, again in their market cap proportions;
(f) and then simply repeat this process.

The steps above describe a rules-based investment strategy. They also loosely describe the way in which the FTSE-100 is constructed by FTSE International Ltd. Investing in a fund that tracks the FTSE-100 index gives the investor exposure to this rules-based investment strategy. Just because the investment 'decisions' are rules-based does not mean that the process is passive. Viewed in this way, we can see that there is actually no such thing as passive investing!

Following the development of the CAPM as the investment paradigm, in their efforts to test its predictions and/or those of the Efficient Market Hypothesis, academics began exploring a range of rules-based investment strategies.

[10] Fama, Eugene and Kenneth French (2010), Luck versus skill in the cross-section of mutual fund returns. Journal of Finance 65 (5): 1915-1947.

3.2 *Smart beta origins*

Soon after the CAPM had become a benchmark model (for the academic community at least) evidence began to emerge that questioned its key predictions and those of the EMH. Researchers started investigating the nature of the risk-return relationship and at the same time began experimenting with certain rules-based investment strategies that seemed to produce returns over and above what could be expected as a result of exposure to 'beta risk'. These experiments seemed to indicate the existence of other betas, that is, other sources of systematic risk to which investors could get exposure to earn returns.

3.2.1 *Low volatility investing*

One of the main tenets of modern portfolio theory is that as long as an investor holds a well-diversified portfolio of risky securities then over time the higher the inherent expected risk in that portfolio the higher should be the expected return. Mean-variance analysis, as the name suggests characterises risk as volatility (usually expressed as standard deviation). This is the accepted practice and few question this idea today, although it was quite revolutionary back in the 1950s when Markowitz first proposed it. If high risk should lead over time to higher return then one could expect that stocks that produce returns with low volatility should generate lower returns over time than stocks that generate a higher return volatility. This is a testable hypothesis, and in 1972 two academics, Robert Haugen and James Heins[11] tested it. Remarkably they found that there was a strong negative relationship between return and volatility in both the stock and bond market. Since that time other academics have tested the same proposition and a number have come up with the same conclusion.[12] The conclusion that many have come to with regard to these results is that investing in low volatility stocks can produce higher returns than investing in high volatility stocks.

3.2.2 *The size effect*

In the late 1970s, cognisant of the mean variance framework, its logical conclusion, the CAPM and of the EMH, some academics saw the opportunity to test the predictions of this paradigm. It was well known that US small cap stocks had outperformed their large cap equivalents substantially over the preceding decades[13]. The CAPM explanation for this outperformance was relatively straightforward: if small cap stocks produced a higher return than large cap stocks, it was because small cap stocks were more risky and had higher CAPM betas than large cap stocks. This explanation of the outperformance then would have been entirely consistent with the EMH/CAPM paradigm.

In 1981 Rolf Banz[14] published a paper that tested this hypothesis. Unfortunately for the paradigm, Banz found the complete opposite. Not only did Banz find that small cap US stocks outperformed large cap US stocks he found that they did so even though on average they had lower betas than the large cap stocks. This evidence appeared to be a direct challenge to the testable conclusions of the CAPM, and, at the same, time seemed to identify another risk factor: size.

3.2.3 *The PE effect*

In the mid-1970s researchers began to investigate the relationship between US stock performance and the Price to Earnings ratio (PE) of these stocks (sometimes expressed as the earnings yield (E/P)). It had been discovered that investing in stocks with a low PE ratio or, conversely, a high earnings yield, tended to lead to higher returns than a strategy that instead invested in stocks with a high PE ratio or, conversely, a low earnings yield. Again, as long as the low PE stocks had, on average, higher CAPM betas than the high PE stocks, then this would be entirely consistent with the theory.

In 1983 Sanjoy Basu published a paper that demonstrated this 'PE effect', showing that investing in low PE stocks could generate higher returns relative to that could have been earned by investing in high PE stocks, and with less systematic risk. But he also found that this PE effect was closely related to the size effect documented by Rolf Banz. In other words, low PE ratio stocks did tend to outperform on a risk-adjusted basis, but these stocks tended to be small stocks. Basu's results led to some questions as to whether there were two risk factors, size and PE ratio, or whether these effects were one and the same. We will return to this point later.

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[11] Haugen, Robert A. and A. James Heins (1972), On the Evidence Supporting the Existence of Risk Premiums in the Capital Markets, Wisconsin Working Paper, December 1972.

[12] For example see Jagannathan R. and T. Ma (2003), Risk Reduction in Large Portfolios: Why Imposing the Wrong Constraints Helps, The Journal of Finance, pp. 1651-1684.

[13] See Ibbotson SBBI Classic Yearbook 2014: Market Results for Stocks, Bonds, Bills and Inflation 1926-2013, R. Ibbotson and Morningstar, 2014.

[14] Banz, R.W., The relationship between return and market value of common stocks, Journal of Financial Economics, 9 (1981) 3-18.

3.2.4 *The Book to Price effect*

Barr Rosenberg, Kenneth Reid and Ronald Lanstein[15] published a paper in 1985 investigating the seemingly anomalous relationship between stock performance and the ratio of a stock's book price, that is, the value of its assets minus its liabilities as recorded in the company accounts, relative to the value of the company as assessed by the market, that is, its market capitalisation. This information is publicly available and therefore according to the EMH basing an investment strategy on this information should not yield higher risk-adjusted returns. However, the researchers found that by investing in stocks with a high book-to-market value rather than in companies with a low book-to-market value, they could generate better performance. The authors even concluded that their results led to the "inescapable conclusion that prices on the NYSE are inefficient".

3.2.5 *The dividend yield effect*

In 1985 Donald Keim[16] published a paper that investigated the relationship between dividend yields and performance. His paper confirmed previous findings that focussing on high dividend yield stocks produced higher returns over time than an equivalent strategy focussing on investment in stocks with low dividend yields. Again, this result would have been consistent with the CAPM if high dividend yield stocks on average had higher beta risk. But once again this was not the case. Keim found that the quintile of highest dividend yielding stocks had a beta of around one third that of the quintile of lowest dividend yield stocks. These results implied that higher returns could be earned by taking less systematic risk. Interestingly, in a paper published in 1995, Gareth Morgan and Steve Thomas[17] found that this 'dividend yield' effect was even stronger for UK stocks.

3.2.6 *The momentum effect*

In 1993 two researchers, Narasimhan Jegadeesh and Sheridan Titman[18] published a paper that investigated the phenomenon of momentum investing. The researchers found that by buying stocks that had performed well in the past and selling stocks that had performed poorly in the past significant positive returns over the next 3 to 12-month holding periods could be earned. These results were in clear violation of the EMH. In an efficient market a successful strategy of buying past winners and selling past losers would soon be traded away.

3.2.7 *Anomalies summary*

By the early 1990s there appeared to be a whole range of phenomena that the CAPM could not explain, and that were at odds with the EMH. High, risk-adjusted returns could be generated by simple rules-based investing in: low volatility stocks; small cap stocks; stocks with low PEs; stocks with high book-to-market value; stocks with high price momentum; and high dividend yield stocks. These results were all at odds with the EMH. For example, if it was possible to earn high, risk adjusted returns simply from investing in stocks with high dividend yields, why didn't rational investors realise this and buy high dividend yielding stocks, thereby increasing their price and reducing their return advantage?

Each of these anomalies, now referred to as risk factors, can be accessed using a set of rules very similar to those that are required to track a market capitalisation-weighted portfolio. Indeed the methods used by the academics to unveil these risk factors are very, very similar to a set of index rules. As an example, here's how you might gain exposure to the dividend yield factor:

(a) at the end of a quarter, consider all the stocks in the London Stock Exchange;
(b) identify the 20% of stocks with the highest dividend yield;
(c) invest in these stocks on either an equally-weighted or a market cap-weighted basis[19];
(d) hold this portfolio for the following quarter;
(e) at the end of the quarter repeat the process, by once again identifying the 20% of stocks with the highest dividend and investing in these stocks on either an equally-weighted or a market cap-weighted basis;
(f) and then simply repeat this process.

The process looks very familiar doesn't it! And yet academics realised that this sort of simple, repeatable strategy was all it took to produce performance that was superior to that of a market cap-weighted investment in the market. Furthermore, these strategies appeared to generate alpha.

Table 1 shows the performance of the strategies, based on the rules for each one. The values presented in the table represent the annualised return on decile portfolios formed on the basis of the factor. For example, in row 1 we present the results of using a volatility rule. Over the period from 1963 to 2014,

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15 Rosenberg B., K. Reid and R. Lanstein, Persuasive evidence of market inefficiency, The Journal of Portfolio Management, Spring 1985, 9-16.
16 Keim, D.B., Dividend yields and stock returns: Implications of abnormal January returns, Journal of Financial Economics 14 (1985) 473-489.
17 Morgan, G. and S. Thomas, Taxes, dividend yields and returns in the UK equity market, Journal of Banking and Finance 22 (1998) 405-423.
18 Jegadeesh, N. and S. Titman Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, The Journal of Finance, The Journal of Finance, Volume 48, Issue 1, pages 65–91, March 1993.
19 The effect is very similar.

constantly investing in the ten percent of US stocks with the lowest past volatility would have produced a return of 10.7%pa. While investing in the ten percent of stocks with the highest volatility would have produced a return of 4.6%pa. The other annualised return figures in the row represent the returns that would have been achieved by investing in the intermediate, volatility deciles.

In every case investing according to the rules produced high returns relative to doing the opposite of what the rule says. The most impressive performance has been produced by the application of the momentum rule. Investing in the ten percent of US stocks with the highest price momentum produced an annualised return since 1927 of 19.9%, compared with a return of 4.0% that could have been achieved by investing in the ten percent of US stocks with the lowest price momentum.

Table 1: Annualised returns by decile, from investing based on anomalous factors

1. Low Vol	2	3	4	5	6	7	8	9	High Vol
10.7%	12.6%	12.8%	12.4%	12.8%	14.3%	14.8%	14.8%	12.5%	4.6%
2. Small cap	2	3	4	5	6	7	8	9	Large cap
18.5%	16.4%	16.3%	15.7%	15.1%	15.3%	14.2%	13.7%	12.9%	11.2%
3. High PE	2	3	4	5	6	7	8	9	Low PE
11.2%	10.6%	12.2%	12.0%	12.8%	14.5%	15.2%	16.2%	17.1%	18.2%
4. Low BE/ME	2	3	4	5	6	7	8	9	High BE/ME
10.9%	12.2%	12.2%	12.2%	12.8%	13.2%	13.3%	15.4%	16.9%	17.8%
5. Low DY	2	3	4	5	6	7	8	9	High DY
11.1%	11.9%	11.5%	12.8%	11.1%	12.3%	13.5%	13.9%	13.7%	13.0%
6. Low Mom	2	3	4	5	6	7	8	9	High Mom
4.0%	8.8%	9.5%	11.0%	11.1%	12.0%	13.0%	14.5%	15.5%	19.9%

Source: Authors' calculations, based upon data available at the Kenneth French website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html). Row 1 presents the decile results from investing based on stock price volatility since 1963; row 2 presents the decile results from investing based on market capitalisation since 1926; row 3 presents the decile results from investing based on a stock's PE ratio since 1951; row 4 presents the decile results from investing based on book value (BE) divided by market value (ME) of a stock since 1951; row 5 presents the decile results from investing based on the dividend yield of a stocks since 1926; and row 6 presents the decile results from investing based on the price momentum of a stock since 1927. Past performance is not a guide to future returns.

4. Pulling it all together

4.1 *The Fama and French three factor model*

Dissatisfaction with the CAPM's performance in explaining these 'anomalies', and the suspicion that they could be linked to one another led Eugene Fama and Kenneth French to investigate a number of these candidate risk factors allowing them to compete against one another. Their paper led to the establishment of what has been referred to as the Fama and French three factor model[20].

The three factor model was the result of exhaustive empirical analysis, where the various anomalous factors discussed above (plus others) were all 'competing' with one another in the experiments to see which of these potential factors were the most powerful. Unlike the CAPM, the model itself has no rigorous theoretical basis, but it seemed to work. In the end Fama and French settled on the following three factor model, summarised in expression (2):

Equation 2:

$$E(R_i) - R_f = \alpha_0 + [\beta_1 \times (E(R_m) - R_f)] + [\beta_2 \times (SMB)] + [\beta_3 \times (HML)]$$

where SMB represents a proxy for the small cap effect and where HML represents a proxy for the book-to-market value effect. Essentially the Fama-French model proposes that there are three sources of systematic risk: market risk, size and book value relative to market value. An investment portfolio's exposure to these risk factors is what determines its return over time. And these exposures are represented by three, rather than one beta. The second and third betas offer an alternative risk/return exposure than that offered by the CAPM's single beta.

4.2 *The Fama and French five factor model!*

The Fama and French three factor model has become a benchmark model for assessing investment performance, at least within the academic community. Essentially the model implies that there are three sources of risk: the market (beta risk); size and book-to-market value. The model postulates that over time passive exposure to these sources of risk should deliver positive returns; and that the more exposed that an investors' portfolio is to any one of these factors the higher the return expectations would be for this portfolio. If the model is right this could present a real challenge to active fund managers who seek to add value to their portfolios through discretionary investment decision making.

But the academics were not finished yet. Following work on the three factor model by many academics, in 2014 Fama and French produced a five factor model that they believe to be superior to the original three factor model. Again the model has an empirical, rather than a theoretical basis. To the three factor model the researchers proposed adding two further factors. The first was related to profitability. They found that companies with high operating profitability tended to outperform those with low operating profitability. In the equation below this factor is represented by the term [RMW]. The second factor that they added is related to investment. Fama and French found that companies that tended to invest less, also tended to have higher returns – a rather depressing finding! In expression (3) this factor is represented by the term CMA.

Equation 3:

$$E(R_i) - R_f = \alpha_0 + [\beta_1 \times (E(R_m) - R_f)] + [\beta_2 \times (SMB)] + [\beta_3 \times (HML)] + [\beta_4 \times (RMW)] + [\beta_5 \times (CMA)]$$

The most important thing to note now is that Fama and French's new model embodies five betas: the original CAPM beta (β_1), and four alternative betas, (β_2 to β_5). Again, other things equal, the greater the exposure to these factors the higher the return that could be expected from the investment.

Table 2 shows results that are analogous to those presented in Table 1, but where the investment strategy is based upon Fama and French's profitability and investment rules. Row 1 of the table shows that investing in the 10% of companies with the lowest profitability yielded an annualised return since 1963 of 9.8%, but that investing in the ten percent of companies with the highest profitability produced an annualise return of 12.5%. The results are more striking when we consider the investment rules. Investing in the 10 percent of stocks with the lowest investment rates produced an annualised return of 15.1%, while investing in the ten percent of companies with the highest rates of investment produced an annualised return of 8.9%.

[20] Fama, E.F. and K.R. French, The cross-section of expected stock returns, The Journal of Finance, 47, 2, 1992, 427-465.

Table 2: Annualised returns by decile, from investing based on profitability and investment

1. Low Profit	2	3	4	5	6	7	8	9	High Profit
9.8%	11.1%	10.5%	11.2%	11.2%	11.4%	12.1%	11.8%	14.0%	12.5%
2. Low Inv	2	3	4	5	6	7	8	9	High Inv
15.1%	15.3%	13.0%	12.7%	12.5%	11.9%	12.8%	11.5%	12.2%	8.9%

Source: Authors' calculations, based upon data available at the Kenneth French website Kenneth French website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html). Row 1 presents the decile results from investing based on company profitability since 1963; and row 2 presents the decile results from investing based on company investment since 1963. Past performance is not a guide to future returns.

4.3 *From alternative beta to smart beta*

Every one of the anomalies identified in section 4 above, including the ones that make up the Fama and French three and five factor models, were all identified using simple, transparent, rules-based processes that can be easily replicated and therefore easily transformed into an index. These indices in turn can be tracked as easily as the more familiar market capitalisation-weighted indices like the FTSE-100 and S&P500 Composite indices, and so can form the basis for mutual funds and ETFs.

In this paper we have reviewed the origins of several alternative betas, as well as the origin of the original beta. So in what way are these alternative betas "smart"? We are not certain of the origin of this phrase, but it is certainly true that the academic community would generally refer to alternative betas, rather than smart betas. But if it is smart not to rely simply on the way investors have approached rules-based (passive) investing in the past, particularly when the new approach has generated superior, risk-adjusted returns, then these betas do appear to be smart.

5. Summary

In this paper we have reviewed the origins of smart beta. We traced their origins back to academic papers that were published, in some cases, over 40 years ago. The next paper in this series will look at the challenges that the finance industry has to overcome to turn the results from the laboratories of the academic researchers', into investible products. The paper will also investigate the nature of the return generating process of some of the commercially available smart beta strategies. The third paper in this series will then consider whether it is possible to build a "smart beta portfolio" comprising ETFs based on smart beta strategies. The final paper in this series will then focus on how the use of smart beta ETFs might change the way in which investors monitor investment performance.

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Andrew Clare is the Professor of Asset Management at Cass Business School and the Associate Dean responsible for Cass's MSc programme, which is the largest in Europe. He was a Senior Research Manager in the Monetary Analysis wing of the Bank of England which supported the work of the Monetary Policy Committee. While at the Bank Andrew was responsible for equity market and derivatives research. Andrew also spent three years working as the Financial Economist for Legal and General Investment Management (LGIM), where he was responsible for the group's investment process and where he began the development of LGIM's initial Liability Driven Investment offering. He is the co-author of "The Trustee Guide to Investment". He has also published extensively in both academic and practitioner journals on a wide range of economic and financial market issues. In a survey published in 2007, Andrew was ranked as the world's ninth most prolific finance author of the past fifty years. Andrew serves on the investment committee of the GEC Marconi pension plan, which oversees the investments and investment strategy of this £4.0bn scheme, and is a trustee and Chairman of the Investment Committee of the £2.5bn Magnox Electric Group Pension scheme.

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Source: Cass Business School, as at end of October 2015.

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Sir John Cass's Foundation has supported education in London since the 18th century and takes its name from its founder, Sir John Cass, who established a school in Aldgate in 1710. Born in the City of London in 1661, Sir John served as an MP for the City and was knighted in 1713.

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