DEMYSTIFYING ACTIVE QUANT

Dan Jelicic (chairman)
Mike Brooks
Steve Holt
Simon Jagger
Malcolm Kemp
Paul Lavin
Colin Wilson

Quantitative Techniques Working Party

Faculty and Institute of Actuaries
Investment Conference
Hatfield Heath, 25-27 June 2000

Abstract: This paper aims to remove certain misconceptions that hinder the broader acceptance and understanding of quant techniques. There is no universally accepted definition of what constitutes active quant. The paper focuses on managing equity portfolios and discusses the areas of stock selection, portfolio construction and risk control. We conclude, partly based on US experience, that quant investment is likely to achieve increased market penetration over time.

1. Introduction

1.1 This paper aims to remove certain misconceptions that are hindering the broader acceptance of quantitative techniques (or “quant”) in fund management. Quant is widely accepted as a valid investment style in the US and is seeing increasing interest in the UK, partly due to the well-publicised performance problems of many traditional active managers.

1.2 In this paper we focus on the management of equity portfolios and consider the investment process in 3 stages, namely stock selection, portfolio construction and risk control. Different fund managers will make use of quant techniques to varying degrees in the different stages, as is discussed in section 5. Whilst there is no universally accepted definition of what constitutes “quant”, in general such techniques will be characterised by explicit data-driven processes as opposed to more subjective approaches which rely on intuition.

1.3 The remainder of the paper is structured as follows:

- Section 2 describes the application of quantitative techniques to stock/security selection.
- Section 3 covers portfolio construction.
- Section 4 discusses risk management.
- Section 5 then gives an overview of the current use of quantitative techniques in investment.
- Section 6 provides conclusions on the future of quant and raises questions that might be addressed by future research.

There are also a number of appendices containing more details in particular areas:

- Appendix A contains a short glossary of selected quantitative stock techniques.
- Appendix B demonstrates the theoretical impact on the information ratio of various portfolio construction techniques.
- Appendix C lists some advantages and disadvantages of different types of multi-factor model for risk control.

2. Security Selection

2.1 The first stage in any quantitatively driven investment process (that is seeking to add value) is to identify which stocks or sectors etc. to over or under weight. As with any form of active management, the aim is to overweight those stocks that are expected to do well relative to other investments the fund might hold, and to underweight those that are expected to do badly.

2.2 There are many different approaches that can be used. These range from what are effectively fundamental research or technical approaches involving extensive human judgement but dressed up in a quantitative guise through to highly computer driven techniques with very limited human intervention once the system has been set up.

2.3 For example, at one extreme the choice of stocks within a given universe could operate as follows. Companies could be assigned ranks according to a range of different criteria including some which involved significant research and human judgement, e.g. not only P/E relatives and, say, recent earnings surprise data, but also more qualitative indicators, such as management quality, penetration of the company within the industry in which it operates, the competitiveness (and profit margins) ruling in that industry, or indicators that depend on both, such as valuation measures based on dividend discount models etc.. Individual scores for each criterion could then be converted into an overall score, based on some algorithm, which is then passed onto the implementation stage of the investment process.

2.4 Such an approach conceptually differs little from what a rigorous fundamental research house might do, apart from the explicit use of the algorithm used to determine the final overall score. Most institutional investment consultants are seeking greater clarity in investment processes, and therefore many fundamental research based houses are re-presenting their existing processes in a manner that highlights the disciplined/quantitative aspects.

2.5 At the other extreme, a manager could focus on a very narrow range of indicators that are more explicitly amenable to quantitative analysis. Assume for the sake of an example that the manager's approach concentrates solely on recent earnings surprises. These would be calculated automatically for a very extended universe, and would be the sole drivers of the score passed on to the implementation stage of the investment process.

2.6 Several points can be highlighted across the entire range of possible approaches:

(a) What is more quantitative to some may be less quantitative to others, and indeed can be expected to change over time as computational power increases. For example, it would have been impractical to rank companies according to earnings surprise until this data was collated across the industry.

(b) Essentially all quantitative investment processes, even those that are marketed as "pure" quant, involve judgmental input, albeit sometimes only when the model is first set up or is amended. Even a process driven purely off earnings surprise does use the qualitative judgements of the brokers included in the surveys being used and who are therefore "surprised" by the relevant earnings upgrades or downgrades.

Also, even the choice of this factor as a potential predictor of future stock performance is a judgmental call by the process creator. Almost all approaches will involve more than one indicator or there will have been some flexibility over precisely which of several similar indicators should be used (e.g. earnings surprise over the last year, 6 months, 3 months etc.?).

(c) The degree of "quant-ness" (if there is such a word) of the process will depend on the degree to which the process creator believes ongoing detailed judgmental (human) input helps to identify good investment opportunities relative to a computer driven process. The skills required to create and maintain the process going forward do differ according to the type of process. It is not obvious what mix between quant and non-quant approaches is necessarily the best at identifying good opportunities (or the cheapest at doing so).

2.7 Appendix A sets out short summaries of some techniques most relevant to quant styles of investment management.

3. Portfolio Construction

3.1 This section describes a number of quantitative methods to construct portfolios once we have made our stock selection decisions. Further details can be found in Grinold and Kahn (1995). We highlight portfolio construction as a separate step in managing portfolios, quite independent from stock selection. Indeed our stock selection could be based either on a fundamentally driven judgmental process reflected in analyst buy and sell lists or on a quantitative criterion e.g. attribute screening (value/ growth, size and so on).

3.2 We describe five portfolio construction methods with gradually increasing levels of complexity. Their objectives vary from simply maximising return to balancing the conflicting requirements of maximising return whilst minimising risk. We compare these various approaches in Appendix B.

3.3 Method 1 would be simply to convert buy and sell recommendations directly into portfolios by either equally or capitalisation weighting our "buys" and by avoiding our "sells".

3.4 Method 2 would be to screen and then rank stocks from our universe in line with our preferences (which may or may not be model driven) and then to attach a score to each stock. For instance, we may want to overweight high yield stocks. We could then attach a score of 2 to the top quartile (i.e. highest yield) stocks, a score of 1 to the next quartile stocks followed by scores of 0 and -1 for the bottom quartile. There are numerous ways to construct portfolios using scores, for instance we could buy only stocks with a score of 2 (top quartile stocks) and sell stocks with a score of -1 (bottom quartile stocks). Alternatively, we could add lower absolute score stocks to the portfolios and weight them less than the first and the last quartiles. Clearly, there should be a rule to translate scores into a weighting scheme.

3.5 Method 3 controls for risks by stratification[1]. For instance, we may want to keep the same weights in distinct portfolio sub-groups (such as economic sectors or countries) as in the benchmark. Either method 1 or method 2 techniques could be used to weight stocks within the sub-groups. Alternatively, if expected return is a linear function of the

---

[1] The technique of stratification breaks down the sample population into sub-groups in the same proportion as the sub-groups of the total population and it thus avoids sample bias (i.e. it makes the sample representative of the total population).

score, we could increase the level of sophistication by employing linear optimisation algorithms.

3.6 Methods 1, 2 and 3 are all based on a single stock selection criterion. Method 4 builds on these methods to incorporate multiple criteria, that is, scores could be derived from many variables or signals. A weighting scheme would need to be devised to weight different signals. If signals are equally weighted, we could construct the portfolio by either calculating combined scores for all stocks or by constructing and then overlaying single criterion portfolios. For instance, in a case of two equally weighted signals, a stock could have a combined score of 3, a result of being in the first (score of 2) quartile and the second (score of 1) quartile respectively from two signals. In the case where our weights are linearly related to the scores, overlay techniques would lead to the same answer as directly constructing portfolios from combined signals.

3.7 Signal weights are also sometimes called "aggressiveness factors". Aggressiveness factors would be a function of confidence in a particular factor. Most sophisticated portfolio construction techniques will have an optimal structure for weighting the signals in a dynamic fashion depending on market conditions (or market "regimes")Such systems are also sometimes called "regime switching" systems.

3.8 Portfolio construction methods 1, 2, 3 and 4 are based only on the first moments of the return distribution i.e. expected returns. Method 5 controls for portfolio risks by considering second moments i.e. volatilities of return as well as expected returns. As a precondition we would need to add more information i.e. a variance/covariance matrix for our stock universe and a criterion for portfolio selection e.g. the investor's utility. Optimal portfolios could then be derived using Markowitz mean variance quadratic optimisation. Reverse optimisations (whereby the implied expected returns are backed out from stock weights and the covariance matrix) are also sometimes used by portfolio managers.

3.9 Market practitioners will be aware of some pitfalls of standard quadratic optimisations. For instance, small changes in input expected returns can sometimes lead to big differences in allocation output - this is sometimes described as a "close substitute" problem. Another problem is that statistical properties of expected returns are ignored which often leads to "error maximisation" as optimisers cannot distinguish between expected returns on the basis of quality.[2] More

[2] See Michaud (1998) for a fuller discussion.

sophisticated techniques such as those using a Bayesian framework (often referred to as Black-Litterman) have been devised to deal with some of the pitfalls of standard optimisations. In addition techniques have been developed to take into account higher moments of asset returns, in particular skewness and kurtosis.

3.10 We have introduced the most commonly used quantitative portfolio construction techniques with various levels of sophistication. Everything else being equal, more sophisticated methods should lead to portfolios with higher information ratios. This is demonstrated in Appendix B using an example. But beware, by introducing new parameters we are also liable to make more errors. Ultimately it is a fine balancing act on the part of the model builder to establish the optimal level of sophistication in the light of the difficulty in estimating an increasing number of parameters.

4. Risk Control

4.1 Models to measure and manage portfolio risk are widely used by investment managers. Their uses vary from manager to manager:

- Some simply use them to produce headline risk numbers (tracking errors) to satisfy clients and consultants.
- Others make more use of them to understand the sources of risk within their portfolios and to identify, and control, concentrations of risk.
- And some managers use a risk model within their portfolio construction process (c.f. method 5 of section 3).

4.2 Despite the widespread usage of these models, their complex and secretive "black box" nature means they are poorly understood within the industry. In this section of the report we look to make these models more accessible by explaining their rationale, the different types of model available and their weaknesses.

Benefits of risk management

4.3 In the past many fund managers saw risk management as a distraction. A common attitude was "if we look after the expected return the risk will look after itself". Unfortunately no fund manager can guarantee outperformance. Even the most skilful of managers will have periods of underperformance from time to time. Without adequate risk management procedures, these periods of underperformance can be very damaging to the client.

4.4 In recent years clients and their consultants have been taking a greater interest in risk management. As a result managers are finding that the adequacy of their risk management procedures is a factor in their ability to attract and retain clients. This has helped to align managers and clients interests in this area[3].

4.5 The main aim of risk management is to ensure that the fund is managed in line with client expectations. On the one hand this means ensuring that the client does not get any nasty surprises in the form of unacceptable levels of underperformance. On the other it means ensuring that the fund is running sufficient risk in order to be able to

---

[3] Arguably, one of the main reasons for investment banks having more extensive risk management functions than investment managers is that it is their own money that is at risk.

achieve the return objectives. It is important to note that although the word "risk" has negative connotations, in active management the client explicitly takes on a certain amount of risk in an effort to enhance performance.

4.6 An effective risk management policy also has other benefits. It can help a fund manager to ensure risk is efficiently diversified within a portfolio and focused where the return opportunities are greatest. This can be achieved by identifying and eliminating any unwanted or extreme risk exposures. The use of risk management tools also helps the manager to check for consistency between the funds that they manage.

Some fundamental issues

4.7 The objective of risk measurement is to describe the potential future range of returns of a portfolio. This should provide insight into the relative likelihood of different changes in portfolio value and help us to answer questions like:

- What is the chance of the portfolio falling in value by 10% or more over the next year?
- How likely is it that the portfolio will underperform the index by more than 2% p.a. over the next 3 years?

4.8 In order to do this we first need to make an assumption about the shape of the distribution of portfolio returns. Typically portfolio returns are assumed to follow a Normal distribution. Empirical evidence suggests that this assumption is not unreasonable for a reasonably diversified portfolio (e.g. >30 stocks) although it is generally agreed that in reality there are more extreme returns than would be expected under the normal distribution.

4.9 This assumption of normality implies that returns are symmetric. Therefore although we are primarily interested in the risk of negative returns this is equivalent to the risk of deviation in either direction, i.e. standard deviation is an appropriate measure of risk. This simplifies the issue considerably.

4.10 The majority of actively managed funds are concerned with performance relative to a benchmark (e.g. a stock market index). In this case we are more interested in the risk of underperforming <u>relative</u> to this benchmark. The standard deviation of relative performance is therefore the most commonly used measure of risk for actively managed funds. This is more commonly referred to as **active risk** or **tracking error**[4].

4.11 The tracking error statistic has some desirable properties. For example, a fund with a tracking error of 2% p.a. is expected to have two-thirds of its annual returns fall within -2% and +2% of the benchmark and 95% of its returns within -4 % and +4%.

Estimating risk

4.12 In 1952 Harry Markowitz produced his paper "Portfolio Selection" which introduced Modern Portfolio Theory. This revolutionised investment to such a degree that almost 40 years later he was awarded the Nobel Prize for Economics in recognition. This paper introduced, amongst other things, key concepts for understanding portfolio risk. In particular it recognised the value of diversification and the importance of the variance and correlation of stock returns. This basis for calculating portfolio risk underpins all of the current models.

4.13 In order to estimate a portfolio's risk, we need to estimate the volatilities and correlations of all the stocks that the portfolio holds[5]. One way of doing this is to rely solely on historic data, i.e. the volatilities and correlations of stocks over the past n years. This is known as the **full covariance matrix** approach. This approach has the following weaknesses:

- For a stock universe of 1,500 stocks, over a million correlations need to be calculated. When risk models were first being developed in the 1970's this was computationally burdensome to say the least. Also an extremely long data history is required in order to robustly calculate these correlations.
- It is overly reliant on historic data. It is intuitive to believe that there should be some reasons for stocks to be correlated. Some historic correlations may be spurious and not based on any underlying fundamental relationship.
- The nature of stocks changes over time and therefore relationships that existed previously may no longer be relevant. It is also difficult

[4] The term "tracking error" is misleading in that active positions have been taken intentionally and are in no way an error in tracking the index. Unfortunately this term, having been introduced by index-trackers, is now used so widely that it is difficult to move to a more meaningful term such as "active risk".

[5] For active risk we also need to include all of those stocks held by the benchmark but not held by the portfolio.

to estimate statistics for stocks that are new to the market.

4.14 These problems tend to be less relevant at the country or regional level and this technique is often used to estimate country volatilities and correlations. At the stock level a simpler and more intuitive approach is desirable. This led to the development of factor models.

4.15 Factor models are based on the premise that there are underlying fundamental reasons why stocks will be correlated with one another. An intuitive approach to understanding the rationale for factor models is to consider what makes stock prices move. Stock prices typically move as a result of items of news hitting the market. Some items of news will be company-specific (e.g. a profits warning) and will therefore only impact the price of one stock. Other items of news will be more generic (e.g. a change in interest rates) and will affect a number of stocks.

4.16 There are a number of different types of factor model but they all share some fundamental characteristics:

- Risk is split into systematic risk (which is captured by one or more factors) and stock-specific risk. The systematic risk aims to capture exposure to these generic items of news discussed above.
- Historic data is used to estimate the volatilities of factors and stocks. The frequency and length of the historic data used is critical to the risk estimates provided by the model.

4.17 At the simplest level we have the Capital Asset Pricing Model (CAPM). This was developed by Sharpe (and others) in the 1960's. It proposes that stock risk can be split into two components: systematic risk and unsystematic risk. Systematic risk is the portion of an asset's variability that can be attributed to a common factor (commonly perceived to be the return on the market). Under the CAPM the exposure of a portfolio to the market is referred to as the portfolio's beta. If a portfolio has a beta greater (less) than 1 this suggests that the portfolio will outperform (underperform) in a rising market and vice versa in a falling market.

4.18 The advantage of the CAPM is its simplicity and flexibility. This is also its weakness in that it misses some important factors. In practice the tracking error numbers produced by using this model could differ significantly from those obtained using more complex models.

Multi-factor models

4.19 Multi-factor risk models can be broadly divided into three categories: macroeconomic, fundamental and statistical. These terms refer to the types of factors they use to explain systematic risk.

4.20 Macroeconomic models use macro-economic factors such as interest rates, exchange rates, or GDP growth to explain systematic risk. This assumes that all of the generic pieces of news impacting stock prices will be related to these macro-economic variables. Examples of macroeconomic models in current use include Salomon Smith Barney's RAM models and (arguably) Quantec's X-country model.

4.21 Fundamental models approach the problem from a different angle. They work on the assumption that the stock prices of similar companies will react similarly to whatever generic pieces of news hit the market. For example, companies within the same industry or of a similar size will tend to show some correlation. They therefore use company characteristics such as industry classification, market capitalisation, and price-earnings ratio as factors. Examples of fundamental models in current use include those of BARRA and UBS Warburg.

4.22 Statistical (or "blind factor") models are the most difficult to understand. They interrogate historical data and draw out the most significant factors without identifying what they are.

4.23 The advantages and disadvantages of these models are discussed in more detail in Appendix C.

Weaknesses of risk models

4.24 All models explicitly use the past as a guide to the future. To the extent that this is not the case the model will prove to be inaccurate. In particular:

- Models usually assume that asset volatility is constant over time. In reality it is common to observe periods of low volatility interspersed with short bursts of high volatility. The occurrence and duration of these extreme periods are difficult to predict.
- The importance of factors changes over time. Factors not important in the past may suddenly become important and then perhaps fade away. For example, in 1997 a stock's exposure to the Far East was an important factor but this was not important before and has not been important since.
- Structural breaks and shocks may occur. For example the

abandoning of a currency peg or a market crash will result in extreme returns that could not have reasonably been predicted.

4.25 Models can be tested to identify systematic errors resulting from these weaknesses. New versions are typically released from time to time after research into stability, structure and factor significance has been conducted. Such efforts help to correct but do not eliminate the weaknesses noted above.

4.26 In identifying the sources of risk there is another weakness arising from factors that are only sporadically important. Because these factors are not consistently relevant they are not included in the model. However, as all of a stock's historic volatility needs to be captured in the model in one way or another the volatility relating to these factors ends up in the catch-all residual of stock-specific risk. This can result in the proportion of the risk of the fund described as "stock-specific" appearing overstated when looking back.

4.27 The future is unpredictable. Any attempt to predict the future is destined to fail to some degree. All of the weaknesses discussed above relate to this fundamental issue. Notwithstanding this, we believe that these models add significant value to a risk management process.

5. Overview of Current Practice

5.1 In practice, the stock selection, portfolio construction and risk management parts of the investment process can embrace quantitative techniques to varying degrees. Indeed many active fund managers use quantitative stock screening techniques even if they do not consider themselves quantitative fund managers. For example, stocks could be ranked on any or all of a number of factors such as dividend yield, price to book ratio, recent relative price performance, price to cashflow, price to sales, etc. The resulting rankings could then be used in a variety of ways – those stocks considered "cheapest" could be selected directly, they might be used to limit the universe of stocks which can be included in portfolios, or they might simply be used to help direct resources to analysis of fundamentals of certain stocks.

5.2 Dividend discount models which are traditionally used to analyse the intrinsic value of equities can also be considered quant especially when a form of the capital asset pricing model is used to calculate the beta of a stock and therefore the appropriate discount rate to use.

5.3 When combining stocks to construct suitable portfolios, a number of quantitative techniques may be used. Traditionally, constraints such as maximum stock and sector bets may have been imposed. These may be replaced by or combined with limits on tracking error as estimated by a multi-factor model such as BARRA, Quantec and others. Indeed some fund managers will use an optimiser to combine their chosen stocks in such a way that minimises the estimated tracking error.

5.4 Similar screening/valuation techniques to those used to analyse stocks can be used to analyse markets. Indeed portfolio construction and risk monitoring can also be carried out in the same way, since Tactical Asset Allocation (or TAA) is conceptually no different from stock selection.

5.5 It is also possible to use the concept of efficient frontiers when combining asset classes to form a portfolio. However, it is more common to do this for strategic rather than tactical asset allocation.

5.6 We now address each of our three stages of the investment process in more detail.

Stock selection

5.7 In many firms, company research is provided by in-house analysts. In others, externally provided stock ratings and earnings forecasts are used. For instance, analysts could forecast short and/or long term earnings and/or dividends. Discounted dividend type models are often used to predict the expected rate of return, and this is then used to rank stocks within their sector.

5.8 The approach can either be "bottom-up" or "top-down" depending on whether or not the stock selection decision is allowed to drive the country, sector and/or size allocation decision. Some managers even claim that their approach is "bottom-up" and "top-down", for instance this could be achieved by using overlay techniques.

5.9 It is often useful to think of managers in terms of their style, such as "value" and "growth", as well as those moving between styles i.e. style rotators. Value and growth styles are not in themselves uniquely defined terms: value styles are based on price related statistics (book to price, dividend yield, earnings yield) and are inversely related to price, while growth styles are based either on historical or prospective growth (of earnings or sales) or statistics such as return on equity. As they are generally based on historic accounting or price data, value measures can be more measurable than growth measures, so that quant managers would more often than not belong to the "value" side of the market.

Portfolio construction

5.10 Methods 1-5 described in section 3 of this paper are encountered in some form across most of the asset management industry. For instance, combinations of methods are often used e.g. methods 1 (ranking) and 3 (stratification) are used to select attractively ranked stocks on a sector neutral basis.

5.11 Some managers use a model portfolio with target ex-ante tracking error. A high percentage alignment of actual portfolios with the model portfolio is sought, so that portfolios conform to house views on sectors and themes.

5.12 Other managers blend quant techniques into portfolio construction by using reverse optimisation. In this mode optimisations are carried out in reverse to back out implied returns starting from original stock weightings. This is then used to check either implied rankings or excess returns against expectations.

5.13 An approach that is often used as a substitute for a pure quantitative approach is disciplined portfolio construction, for instance to exclude unintentional risks and risks taken without an information advantage.

5.14 Most traditional managers will adopt an approach best described as "fund manager discretion within set stock/sector limits". Proposed portfolios may then be run through a risk model in order to ensure consistency with any tracking error objectives prior to implementation.

Risk control

5.15 Many houses claim to use proprietary models for risk management. Generally the focus of portfolio managers is the tracking error. For instance, a target tracking error exists for stock selection within each country/region, country allocation and currency allocation. More risk aware houses would also use real-time systems providing an overview of portfolio information, client parameters and restrictions.

5.16 Other houses use externally developed risk management tools such as BARRA or Quantec to analyse portfolio biases and calculate tracking errors. Control of risk is also often a by-product of portfolio construction carried out using optimisation; variances can be decomposed into the macroeconomic factors and specific volatility and optimisation ensures that portfolio volatility closely matches the benchmark's volatility.

5.17 Another approach, which may be used instead of or as well as tracking error constraints, aims to limit exposure to unexpected events. Event risk control constrains the weights of stocks relative to index weights and similarly sector and country weights within a certain percentage of index weight.

6. Conclusions

6.1 This paper has not sought to claim that "quant" is superior to traditional active fund management, just that it is different and warrants greater attention. In fact these techniques have already achieved significant penetration within many fund managers, especially in the field of risk control, even amongst managers who would not claim to be quantitative.

6.2 Indeed the level of penetration into various stages of the investment process can be seen as a measure of "quant-ness". "Hard quant" manager would generally aim for a model driven process throughout, sometimes associated with a black box approach. "Soft quant" manager on the other hand would combine subjective human overlay with quant techniques within specific parts of the investment process. For example, stock selection can be based on qualitative inputs.

6.3 It can be argued that one benefit of quant is a focus on the scientific approach, that is, research and testing rather than simply intuition. Of course, opponents of quant might argue that many models rely on datamining rather than genuine out-of-sample backtesting!

6.4 Another benefit of quant is in transparency and clarity of the investment process. Indeed, a disciplined and a structured traditional investment process is often mistakenly characterised as a quant.

6.5 Quantitative investment processes are often perceived as lacking of human judgement. This, in fact, is not true as human judgement indeed plays a critical part during a model building stage. The main difference between quant and traditional manager therefore is in the timing and not the presence of the judgmental input.

6.6 Based on US experience, it is likely that quant will achieve greater acceptance within the UK, perhaps as an additional means of diversifying style risk within equity portfolios. The increasing interest in behavioural finance and possible predictable patterns in stock returns also points towards potential advantages of quantitative stock techniques. It would certainly be interesting to see the results of a definitive survey into how widespread the use of quant techniques is within the UK investment community and the attitude of investment consultants.

References

GRINOLD, R. C. & KAHN, R. N. (1995) *Active portfolio management: quantitative theory and applications*. Probus Publishing Company.

Michaud, R (1998) *Efficient Asset Management: A Practical Guide to Stock Portfolio Optimization and Asset Allocation*. Harvard Business School Press.

Appendix A: Glossary of Selected Quant Techniques

Index management – a style of managing investments in which the aim is to track the performance of a given index as closely as possible (subject to appropriate cost constraints). There are several variants, e.g. sampled/fully replicated etc.

Dividend Discount Model – an approach to estimating the "right" valuation to assign to a particular stock by projecting forward all the cash flows accruing to the holders of the stock (or the company itself) and discounting them at a suitable rate of interest. Stocks are then chosen by reference to how far the DDM valuation differs from the current market valuation of the stock. DDM valuations can be heavily dependent on the growth rate assumed for the company, the discount rate or rates deemed applicable to individual companies and the time over which super- or sub-normal growth rates are assumed to blend back to industry or country norms. The same approach can also be used to identify valuations to be placed on entire sectors or markets, but using more macro-economic inputs.

Momentum investing – an approach in which stocks are chosen because they have recently performed well (in contrast to *contrarian* investing in which stocks are chosen because they have recently fallen out of favour with the market). Sometimes markets appear to exhibit momentum, and at other times the reverse. A key problem that needs to be tackled with this sort of style is to identify a method of telling when the market dynamics are likely to change.

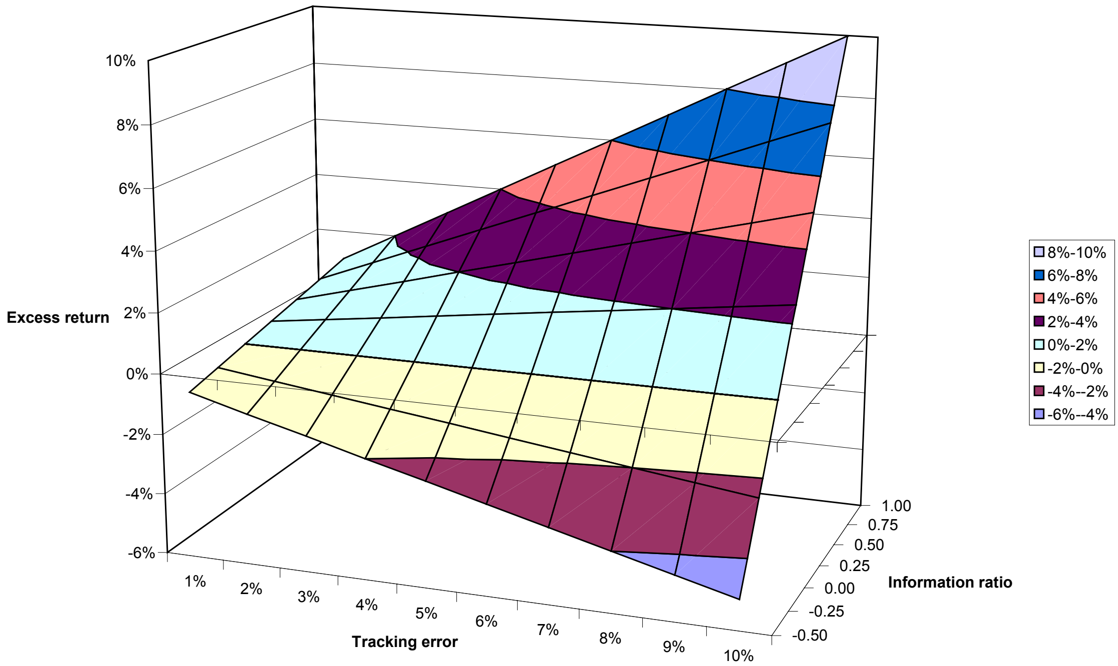
Earnings surprise – an approach in which stocks are over or under weighted depending on whether their earnings announcements have surprised brokers on the upside or the downside. With modern information flows, however, stocks can move almost immediately after the earnings announcement takes place, so simple versions of such techniques may be too slow to be of help. More sophisticated approaches could involve over or under weighting stocks where brokers seem to be increasing or reducing their earnings forecasts. How successful this might be depends on the degree to which stocks are influenced in the short term by earnings figures, the overall quality of broker estimates, and the speed and extent to which broker revisions influence market valuations.

Style investing – an approach in which a manager explicitly concentrates on stocks exhibiting a particular characteristic, e.g. high "growth" or high "value", even though this is not part of the benchmark against which the manager is operating. A difficulty here is to identify a style that is expected to perform well in the longer term, or to identify a means of moving between styles when one falls out of favour. Essentially the task becomes one of style selection rather than stock selection. Regression and other quantitative techniques may be of help here.

Merger arbitrage – an approach in which a fund concentrates on investing in companies currently in merger talks, taking a position in whichever of the two (sometimes more) companies are viewed to provide the most attractive way of gaining exposure to the relevant merged entity. This is perhaps more common as a long-short strategy (e.g. for a hedge fund), going long one stock and short the other, but may come unstuck, as not all mergers end up consummated.

Appendix B: Portfolio Construction Example

B.1 In portfolio analysis we define the information ratio as the ratio of excess return over excess risk (tracking error). This measure of performance focuses on both risk and return, and as such it is generally used as a proxy for a portfolio manager's skill. We should distinguish between the measured or ex-post information ratio and the expected or ex-ante information ratio. Alternatively we can describe excess return as a function of the information ratio and excess risk. Tracking error can be targeted and if we are confident about the ex-ante information ratio, we should be able to derive expected excess returns. The following chart demonstrates excess return as a function of the information ratio and the tracking error.



B.2 We now demonstrate the portfolio construction techniques previously introduced via an example and focus on the information ratio as a main measure of the success of a technique. Our intention is to focus exclusively on portfolio construction: we achieve this by assuming that a priori we have knowledge (perfect foresight) of the return generating process. We proceed by constructing portfolios according to the different methods and then by comparing such analytically derived information ratios.

B.3 We assume that there are 12 stocks in our universe, which is split according to two economic sectors, financials and non-financials. The stock data including stock alphas is summarised in the table below:

Stock	Sector	Alpha
1	Non-Fin	5.5
2	Fin	4.5
3	Fin	3.5
4	Fin	2.5
5	Non-Fin	1.5
6	Non-Fin	0.5
7	Fin	-0.5
8	Non-Fin	-1.5
9	Non-Fin	-2.5
10	Fin	-3.5
11	Fin	-4.5
12	Non-Fin	-5.5

B.4 We assume that returns are normally distributed and generated from a simple 3 factor model as follows:

$$R_i = \alpha_i + \sum_{j=1,2,3} B_{ij} F_{ij} + \sigma_i$$

B.5 Our assumed factors are the market and two economic sectors and stock exposures (Betas) are equal to 1 for the market and 1 for a stock's own sector and zero otherwise. The following table summarises systematic factor return and risk data.

	Return Mean	Return Standard Deviation
Market	10%	15%
Financials	2%	18%
Non-Financials	-2%	12%

B.6 In addition, we assume that all stock-specific standard deviations equal 10%, as well as 0 sector correlation and 0.5 sector market correlation. In this way we can derive the following expected annual returns (%) and standard deviations (%) of returns for all 12 stocks:

Stock	Return %	Risk %
1	13.5	23.6
2	16.5	28.0
3	15.5	28.0
4	14.5	28.0
5	9.5	23.6
6	8.5	23.6
7	11.5	28.0
8	6.5	23.6
9	5.5	23.6
10	8.5	28.0
11	7.5	28.0
12	2.5	23.6

B.7 We proceed by calculating portfolios according to the various methods and we obtain the following portfolios:

	Method 1	Method 2	Method 3	Method 5
Stock	Weight	Weight	Weight	Weight
1	16.7%	16.7%	16.7%	24.8%
2	16.7%	25.0%	16.7%	19.8%
3	16.7%	25.0%	16.7%	16.6%
4	16.7%	16.7%	16.7%	13.3%
5	16.7%	8.3%	16.7%	11.7%
6	0.0%	0.0%	16.7%	8.4%
7	16.7%	8.3%	0.0%	3.4%
8	0.0%	0.0%	0.0%	1.9%
9	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%
11	0.0%	0.0%	0.0%	0.0%
12	0.0%	0.0%	0.0%	0.0%

B.8 When constructing portfolios we assume expected returns according to our model above. Our benchmark is a portfolio with equal weight (i.e. $1/12^{ths}$) in each stock. Method 4 was the one where signals from various sources are combined and is included implicitly as expected returns in this example are derived from alpha as well as beta exposures. Methods 1 and 2 are selected by considering expected return only. Method 3 also aims to be sector neutral and imposes a maximum tactical stock bet of $1/12^{th}$. Method 5 takes tracking error into the optimisation framework and aims to maximise return subject to a 3% level of tracking error.

B.9 The following table summarises our results:

	Method 1	Method 2	Method 3	Method 5
Excess return	3.50	4.42	3.00	3.47
Excess risk	4.62	6.35	2.89	3.00
Information Ratio	0.76	0.70	1.04	1.16

B.10 We can see that with perfect foresight the excess return from Method 1 is 3.5% and the information ratio is 0.76. By attaching more weight to stocks with high expected return, as in Method 2, we get a greater excess return but at the cost of an even greater proportional increase in excess risk resulting in an information ratio decrease. It is clear that trying solely to increase return does not improve the information ratio. Methods 3 and 5 lead to higher information ratios by focusing on risk as well. Method 5 leads to a higher information ratio than Method 3 by explicitly focusing on excess risk rather than the size of sector bet.

Appendix C: Pros and Cons of Different Multi-Factor Models

C.1 Macro-economic

a) Arguably exhibit stable behaviour because they are tied to the real economy through genuinely pervasive factors.
b) Provide portfolio managers with insight into top-down economic effects on their portfolios.
c) Cannot readily capture risks that are not part of the economic state, e.g. product liability risks of tobacco companies.
d) Markets are often driven by *expectations* of economic variables rather than actual changes.
e) Rely on historic relationships that may be out of date. It is also difficult to incorporate new companies.

C.2 Fundamental

a) Use security characteristics which are very familiar to portfolio managers.
b) Usually have higher in-sample explanatory powers than economic models (due to greater number of factors).
c) Factor exposures can be immediately observed and therefore changes to a company are immediately accounted for rather than relying on historic relationships. This also means that new companies can be incorporated immediately.
d) Main criticism is that there are often so many overlapping effects that it is nearly impossible to correctly sort them all out, making such models less effective at predicting future conditions than they are at explaining the past.

C.3 Statistical (blind factor)

a) The structure of the common factors can evolve over time to fit new data. This makes them good tools to use when you have a short-term horizon in order to capture the volatility clustering of short-term data.
b) The factors are orthogonal, allowing explicit stress testing of the model.
c) The factors are uninterpretable and the approach non-intuitive.
d) The model may be unduly influenced by noise in the data.