Square Mile Review of Strategic Asset Allocation Tools that are available to Retail Advisers

SQUARE MILE
INVESTMENT CONSULTING & RESEARCH

Contents

1.
Executive Summary & Conclusions

- The primary value of the strategic asset allocation (SAA) models appears to be as an objective tool that can be used within a suite of financial planning products. Such a financial planning suite may include tools to determine:

    - attitude to risk assessment
    - risk mapping
    - strategic asset allocation
    - savings programme assessment
    - risk illustration tools

    In our opinion the SAA models that we have reviewed will perform a satisfactory role in meeting the needs of investors though advisers should be aware of the possible limitations of the approach.

- These are models that rely upon advanced statistical techniques and a sophisticated assessment of financial markets. These models cannot and do not predict the future. They may be a step up from advisers' traditional 'rules of thumb' in their financial planning but they act as no panacea. These models can only ever approximate the likely behaviour of financial products and can only act as a guide. Care should be taken to ensure that they do not create a false sense of security for advisers and their clients.

- A number of the models assume that returns are normally distributed and that correlation coefficients remain constant. Empirical evidence demonstrates that these assumptions are false. As a result, the underlying risks described by some SAA models may not be fully represented and care may be required in interpreting the outputs of some models.

2.
Aim of Paper

To review the SAA models currently widely used by retail advisers and to help advisers understand the options available, what differentiates the products and to help adviser firms identify which product may best suit their clients' requirements.

To quote from the FSA's 2011 Guidance Paper 'Assessing Suitability':

"If a firm uses a third-party tool to help make suitability assessments for their customers, we expect that firm to:

- ensure that the tool is suitable for use with its customer base;
- understand how the tool works, so it can interpret and evaluate the results when it is applied to individual customers;
- understand to what extent the tool will help meet its regulatory requirements;
- have a robust process to mitigate shortcomings or limitations of the tool; and
- where a tool (such as an asset-allocation or fund-selection tool) suggests investment selections, to understand the product, market and asset risks for these investments."

We expect this paper to help adviser firms meet these requirements.

Scope of Paper

This paper focuses on the main strategic asset allocation tools that are available in the adviser market. These tools sit within a wider set of adviser tools that are used in the planning process. This wider set can be summarised as:

Risk Profiling Tools	Risk Mapping Tools	Strategic Asset Allocation	Goal Validation

Attitude to risk profiling tools are often used in conjunction with the SAA models and the two main providers, Oxford Risk and FinaMetrica are briefly considered in the appendix.

3.

The Differences Between Deterministic and Stochastic Modelling Approaches

One of the important underlying distinctions between the various models available is whether the underlying model engine is 'deterministic' or 'stochastic' in approach. The word stochastic is used to describe something having a random probability distribution or pattern that may be analysed statistically but may not be predicted precisely. *Put simply, a deterministic approach is likely to be simpler than a stochastic approach but is possibly less refined in the results that it generates.*

Definitions

Deterministic Model

- Considers a fixed state using a limited number of defined inputs

- The user/modeller selects the input assumptions and these assumptions "determine" the results

- The results will only change if the input assumptions (or the equations inside the model) are changed

Stochastic Model

- An element of randomness is introduced within the model. Therefore each time the model is run, a different result is generated. These models can be run numerous times and the results can be averaged to produce a 'steady state' (where running the model further makes negligible impact on the results). Such models produce a range of outcomes that can be used to analyse and to compute a range of likely outcomes.

- Stochastic models can involve simulating multiple scenarios. Monte-Carlo (MC) simulation techniques can be used to generate very large numbers of scenarios in order to understand the potential behaviour of financial products in a diverse range of possible financial conditions.

- Stochastic models may be 'term centric'. This is perhaps best explained via an example:

    I. Investing with a two-year horizon, a short term gilt-edged strategy will provide a very certain outcome. Alternatively an equity strategy will generate a highly uncertain outcome.

    II. Investing with a twenty year period, an investment strategy focusing on short dated gilts will have a higher level of uncertainty attached. Conversely, an equity strategy will produce a more certain outcome since stockmarket returns are more reliable over 20 year periods.

Deterministic models are generally simpler and are likely to assume that outcomes are normally distributed [see tail risks]. Stochastic models better deal with the uncertainty that is prevalent in financial markets. Such models can incorporate both the likelihood of an event occurring, the timing impact on the portfolio and the magnitude of the impact that the event creates.

Arguably, a stochastic model may provide a better approximation of the outcomes than a deterministic approach, although a more important factor influencing the results may be the quality of the capital market assumptions supporting the model and the approach taken to calibrate the model.

4.
Further
Background

Capital Market Assumptions

The capital markets assumptions used within the model have a material impact on the outputs. At the highest level, there are three key variables.

- Expected returns
- Risk (volatility)
- Covariance - describing how one asset performs in relation with another

The calculation of these variables may rest upon multiple capital market assumptions, such as, the outlook for interest rates, inflation rates, growth rates, exchange rates, dividend yields etc.

The assumptions drawn will be largely based upon historical analysis. Adjustments may be made to reflect current valuations and some model providers incorporate a qualitative overlay. A stochastic approach permits multiple scenario analyses to be incorporated into a model and these help stress test the outputs under different conditions and assumptions.

Quality of Inputs

Stochastic models are constituted using a variety of scenarios and a range of different assumptions. Any fanciful assumptions made within this array are unlikely to have a material impact on the output.

Deterministic models may be more reliant on a single set of assumptions. If these assumptions prove to be erroneous, it may have a material impact on the output. The old saying of garbage in, garbage out comes to mind.

Invariably there is a necessity to strike a balance between making the model as realistic as possible and keeping the model simple.

Sensitivity of Output

The greater number of asset classes and sub asset classes used, the greater the sensitivity of the output to the inputs. This will have implications on the practical application of the resulting asset allocation outputs. Models considering a wide range of asset types are likely to suffer regular and widespread changes to the resulting asset allocation output. A portfolio following such models will have high turnover levels and suffer high aggregate transaction costs as a result.

A common solution to this is to limit the number of sub-asset classes modelled. For example, the equities component of the model may be simplified into two factors: domestic equities and international equities. Such steps will greatly reduce the variability of the output with only a minor compromise to the efficiency of the portfolio.

Model Constraints

Models may be run with various constraints. Technically any constraint reduces the effectiveness of a model (though the constraint may be put in place to overcome a potential weakness in the underlying model assumptions). For example, property exposure might be limited to 10% to reflect the potential illiquidity in the asset class.

Other constraints, such as ensuring that a sterling based investor is predominately invested in sterling assets may help to act as a sanity check to keep the output within rational bounds.

5.
The Main Providers

Distribution Technology

Who they are and what they offer

Founded in 2003, Distribution Technology (DT) is a private company located in Reading and principally owned by its founders and directors. DT is best known for its Dynamic Planner (DP) software, which is a financial planning tool that helps advisers profile, plan and manage their clients. Around 6,000 advisers regularly use this software. Their clients include advisers; asset managers and wealth connect partners, which encompasses Wrap Platforms and Life Companies.

DT also offers risk-profiling services for investment funds, which feed in to their DP software. This service attempts to make it easier for advisers to find funds that match investors' risk tolerances. Currently they risk rate around 800 funds from some 80 investment organisations. This has been a growth area for the business over the last few years with the investment companies paying a fee for each fund that is risk rated.

Within Dynamic Planner software, a risk profiler is also available. This has been built in conjunction with Oxford Risk, with the adviser having the choice of either a 10 or 20 question versions. DT recommends that the 20-question version be used. DT understands that this is only the start of any client discussion and that an adviser should make further investigations to fully understand a clients' capacity to accept risk. Dynamic Planner allows an adviser to do this through individual cash-flow assessment in addition to showing the expected volatility (5th, 95th percentile) of a given allocation. Definitions have all been signed off by the Plain English campaign.

Their Model

DT's solutions are based on mean variance optimisation (MVO) techniques. Using assumptions for expected returns, volatility and correlation as inputs to the MVO process, DT aims to produce optimised asset allocations across a wide range of risk profiles. This asset allocation is reliant on the inputs to the model.

However the MVO-derived asset allocations are qualitatively assessed to ensure that the results are reasonable and pass a common sense test. The models are created using both forward looking and historical data; however, it is much more heavily skewed towards quantitative analysis. The qualitative oversight is provided by the DT Investment Committee (see validation).

Time Frame

DT's Capital Market Assumptions are based on a long term outlook, although no precise time frame is specified. They are reviewed and updated each quarter as new information becomes available. DT does not look to create tactical short term views on individual markets when setting allocations and therefore their asset allocations are seen as being primarily strategic in nature.

Underlying Capital Market Assumptions

As of 1st January 2015 the process for calculating correlations has changed. Previously correlations were based on different timeframes, reflecting the different asset class data sets. It has now moved to a more consistent approach, based on rolling 15 year correlations across all asset classes. This strikes us as a more logical approach. A 15 year time frame should ensure stability of the correlations.

Volatility is also derived from 15 year historical data and is calculated in sterling.

Expected return figures are calculated using a variety of index and market data with information from indices being used from as far back as possible. More details of how the return expectation for each asset class is calculated is provided below.

For inflation, DT currently assume a 0.5% factor on top of the Bank of England longer term target of 2% to give an inflation expectation of 2.5%. Note, DT calculate both the nominal and real return expectation for each asset class.

Asset Class	Return Assumptions
Cash	Interpolated 2.5% yield on 5-15 year index linked gilts.
Conventional Gilts	Barclays All Maturity Gilts index gross redemption yield.
Index Linked Gilts	Interpolated 2.5% yield based on All UK index linked gilts.
UK corporate bonds	iBoxx Corporate Bond index yield and an allowance for the default risk premium (0.2% currently).
International Bonds	BoA Merrill Lynch Global Bond Market Index yields. This is largely US Treasuries, UK Gilts and German Bunds.
Global High Yield Bonds	BarCap Global High Yield Bond Index yield and an allowance for default probability (1.7% currently).
Equities	All geographical equity regions use the MSCI indices for return expectations. Inputs to the final figures include an appreciation of the earnings yield via the payout ratio, dividend yield and GDP forecasts plus inflation for each region, based on consensus forecasts.
Property	Excess return of IPD index over gilts.
Commodities	In line with the global growth forecast from the IMF.
Hedge Funds	Risk Premium over Gilts (around 1.2%).

The Investment Committee is responsible for agreeing and approving the CMA's that are produced by the Financial Analytics Team.

Updates to the CMAs are undertaken on a quarterly basis and final asset allocations are generally updated within the DP software on an annual basis. This usually goes live at the end of Q3 each year, based on the Q1 CMA's. The Q1 CMA's are signed off in May and so a reasonable lead in time is given. The All-return figures are quoted gross of management fees and taxes.

Portfolio Optimisation

The expected return, risk and correlation figures are then fed into an optimiser (covariance matrix), which creates a set of portfolios, which fall close to the mid point for each of the 10 risk profiles along the efficient frontier.

A set of asset class constraints is then overlaid. The constraints are listed below:

1. Portfolio 1 is 100% cash for nominal capital preservation purposes.

2. The minimum allocation per asset class when utilised in the portfolio is 5%. There is no maximum allocation per asset class, other than property, which shall not exceed 10% in any allocation, reflecting its potential illiquidity.

3. Asset class changes will not generally exceed 5% between periods, although the committee reserves the right to exceed this in extreme circumstances.

4. Portfolios 3 to 7 represent the most diversified and well used portfolios. They will be constituted using at least two broad asset classes. A broad asset class is considered: Cash, Equity, Bond or Property.

5. Portfolios 8 to 10 are the highest risk portfolios and will be dominated by equity assets.

6. There should be a smooth progression across the broad asset class split as the risk parameters increase. For example, they expect a transition from a predominance of bonds to higher equity weightings.

7. The change in efficiency (expected return per unit of risk) from the unconstrained to the proposed allocation will be minimal i.e. the portfolios should continue to sit on or very close to the efficient frontier.

The Investment Committee has some discretion on how these constraints are applied. When applying these constraints, the Committee is sensitive to the requirements set out by the unconstrained model and any revisions made will be consistent with the unconstrained model.

Validation

The primary role of the Investment Committee is to ensure the consistency of the models on an ongoing basis by bringing a more qualitative approach to the process and ensuring a number of constraints are referenced. Details of the current members of the committee are as follows:

Chris Fleming (Chairman) - Chris is the head of Distribution Technology's Financial Analytics Team and member of the Executive Management Team. He joined Distribution Technology from Aon Hewitt in March 2012 where he was a senior investment consultant providing advice to the Trustees of large UK pension schemes. This involved recommending asset allocations and the appropriate fund manager in the context of the prevalent market conditions, whilst considering a scheme's unique circumstances. Prior to this, Chris spent four years with Deutsche Asset Management, where he held a role in fund analysis. Chris holds a degree in Mathematics from the University of Canterbury, New Zealand and has completed the Chartered Financial Analyst (CFA) and the Investment Management Certificate (IMC) qualifications.

Clive Hale - Clive is an external Committee member and has over 30 years of experience including Investment Director and Chief Investment Officer roles at several leading organisations, such as Towry and Skandia Investment Group. He is currently a partner at the Albemarle Street Partners LLP as well as director of FundCalibire.

Jim Henning - Jim holds a BSC in Economics from the University of Birmingham and holds the Investment Management Certificate. Jim has accumulated over 25 years' experience specialising in investment platform proposition design, fund governance mechanisms and promotional support. This has encompassed a wide variety of roles, most recently in the offshore investment market for Friends Provident International (FPI).

Chris Brooks - Chris is Professor of Finance, Deputy Head of School and Director of Research at the ICMA Centre. He was formerly Professor of Finance at the Cass Business School, London. He holds a PhD and a BA in Economics and Econometrics, both from the University of Reading. His areas of research interest include asset pricing, fund management, behavioural finance, financial history, and econometric analysis and modelling in finance and real estate. Chris acts as consultant for various banks, corporations and professional bodies in the fields of finance, real estate, and econometrics. He is Course Convenor of the Securities, Futures and Options, and Introductory Finance modules and also teaches on the PhD programme.

Jason Dewar - Jason has over 25 years investment experience having held positions at Zurich, AEGON, Marlborough Investment Managers and Prudential. Prior to joining DT in August 2015 he was head of Research and Technical Services at Sesame Bankhall Group managing a team of 11 people delivering fund, platform and Discretionary Fund Management research.

Graham Bentley - Graham is the second external committee member who has a wealth of experience in the investment industry having worked at Henderson, M&G Investments and Old Mutual. Graham is founder and managing director of gbi2, who advises asset managers, distributors and advisers on Investment Proposition formation, Asset Management Marketing and Distribution Strategy, an Investment training. As well as being on the Investment Committee, Graham is also on the advisory board at DT, as well as the advisory boards of Hilbert Investment Solutions and Alexander Beard Group.

Over the last 12 months, Raj Hallen, Barry Miller and Paresh Shah have left the committee while Jason Dewar and Graham Bentley have joined.

Asset Classes

Within Dynamic Planner the standard asset allocation covers 15-asset class CMAs. Of these 15, 13 are included in the 10 Models.

Asset Class	Index	Inception Date
Cash	Bank of England, Monthly Average of UK banks base rates	Jan 1978
UK Gilts	Barclays Capital UK Government All Maturities Gilt Index	Dec 1980
UK Index Linked Gilts	Barclays Capital UK Government Inflation Linked Bond Index	May 1981
UK Corporate Bonds	iBoxx £ Corporate Index	Dec 1997
International Bonds	BoA Merrill Lynch Global Broad Market Index	Dec 1996
Global High Yield Bonds*	Barclays Global High Yield Index	June 1990
UK Equity	MSCI UK Total Return Index	Dec 1969
Europe ex UK Equity	MSCI Europe (ex UK) Total Return Index	Dec 1969
North American Equity	MSCI North America Total Return Index	Dec 1969
Japanese Equity	MSCI Japan Total Return Index	Dec 1969
Pacific ex Japan Equity	MSCI Pacific (ex Japan) Total Return Index	Dec 1969
Emerging Market Equity	MSCI Emerging Markets Total Return Index	Dec 1987
UK Commercial Property	IPD UK Monthly Property Index	Dec 1986
Commodities	*S&P GSCI Total Return Index*	*Jan 1970*
Hedge Funds	*HFRI Fund Weighted Composite Index*	*Dec 1989*

The two asset classes in italics are not included as standard in the DT models but are available for advisers to add should they wish. * added in Q1 2015

A number of other CMA's are also calculated by DT which sit outside of Dynamic Planner and are used with clients on a more bespoke basis. These include, in addition to the above, UK Equity Small Cap, UK Equity Mid Cap, UK Equity Large Cap, Europe ex UK Equity Small Cap, Europe Ex UK Equity Mid Cap, Europe Ex UK Equity Large Cap, North American Equity Small Cap, North American Equity Mid Cap, North American Equity Large Cap, Japanese Equity Small Cap, Japanese Equity Mid Cap, Japanese Equity Large Cap, UK Gilt Short Duration, UK Gilt Mid Duration, UK Gilt Long Duration, UK Index Linked Gilts Short Duration, UK Index Linked Gilts Mid Duration, UK Index Linked Gilts Long Duration, Global Investment Grade Bonds, Global Investment Grade Sovereign Bonds, Global Investment Grade Corporate Bonds, Global High Yield Sovereign Bonds, Global High Yield Corporate Bonds. Emerging Market Bonds. These are all calculated on a similar basis however some of the indices do not have particularly long track records.
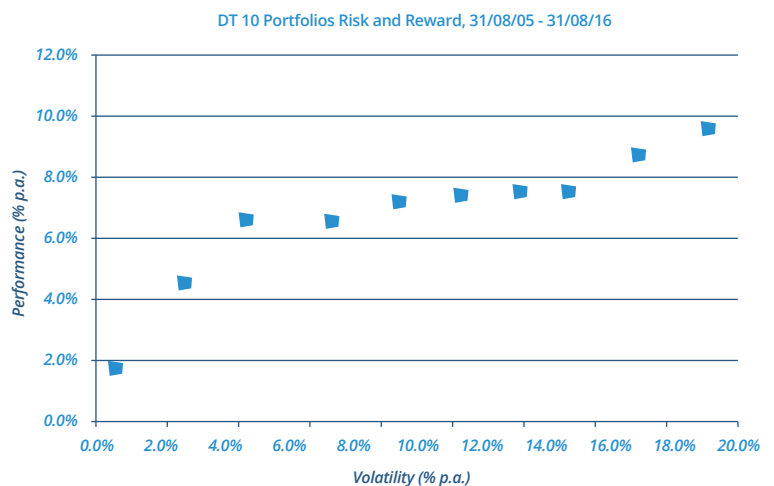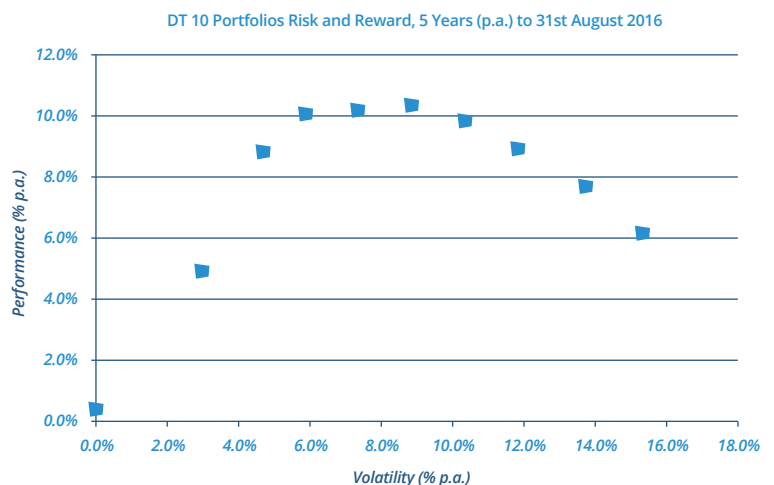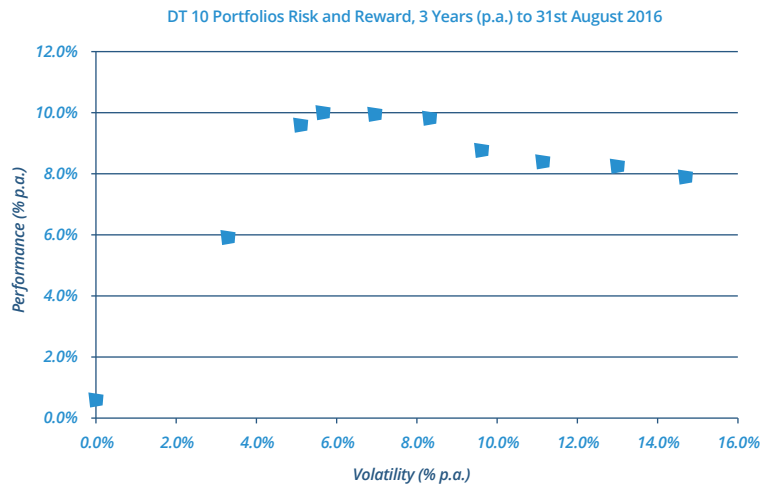
What is the experience and resources of the team?

Financial Analytic Team – The team currently consists of 7 individuals from an array of academic and market backgrounds including actuaries, PhD graduates and strong financed based degrees.

What services are offered as standard?

Within Dynamic Planner CMA's for each of the 15 asset classes. These are updated on a quarterly basis. The asset allocation is updated on an annual basis. A risk profile summary is also generated which provides forecasting in terms of probability of returns based on the target asset allocation.

Performance

DT have provided us with the returns and standard deviations of their 10 risk profiles over 3 year and 5 year periods as well as since inception (31/08/2005) to 31st August 2016 (see graphs). The returns do not assume an OCF has been applied and for the DT portfolios, the allocation to each asset class has been invested in the indices mentioned in the table above.

DT 10 Portfolios Risk and Reward, 3 Years (p.a.) to 31st August 2016

DT 10 Portfolios Risk and Reward, 5 Years (p.a.) to 31st August 2016

DT 10 Portfolios Risk and Reward, 31/08/05 - 31/08/16

Source: Distribution Technology
Since Inception: 31st August 2005

EValue

Who they are and what they offer

EValue provide analysis, forecasting and planning tools to enable advisers and consumers to understand the potential risk and return from different investment choices. EValue's origins start in 1993 when Towers Perrin created a global economic model that generated statistical forecasts for future investment returns. Following the merger of Towers Perrin and Watson Wyatt in 2010, EValue was formed using the Towers Perrin model. The business now operates as an associate company of Financial Express.

EValue claim that more than 90% of UK product providers and banks and over 50% of the adviser market have access to their tools and solutions. This equates to 15,000 advisers and 250,000 consumers. These solutions are provided to Accenture, Aviva, Axa, BBC, BlackRock, GE, HSBC, Irish Life, Legal & General, Lloyds, RBS, Standard Life, Santander, Scottish Widows and Zurich. However EValue ultimately see their end consumer being private investors making decisions on long-term investments through collective investment schemes.

Advisa Centa is EValue's advisory offering which provides a risk profiler solution through three standard questionnaires, which meet the requirements of different distribution channels. Advisa Centa also offers financial planning tools for different investor circumstances, as well as, portfolio analysis and fund risk assessment.

The suite of tools includes:

- Risk Profiler – a psychometric questionnaire that's allows assessment of a clients' attitude to investment risk.
- Investment Planner – a module that compares potential outcomes over time from the different investment strategies available; graphically illustrating the trade-offs between risk and reward based on the proposed amount to be invested and the specific goals outlined by the customer.
- Retirement Planner – helps communicate the potential size of the client's retirement pot based on his/her pension and investment arrangements. The tool helps show a holistic retirement plan and shows the chance of reaching an income target given the levels of investments and contributions.

- Protection Planner – enables advisers to quickly see the impact of providing protection for a client's cash flow needs. Key factors such as debts, assets and existing cover can be taken into account.
- Lifetime Planner – helps advisers and clients review their financial position throughout life.
- Portfolio Optimiser – enables advisers to analyse clients existing assets at a product and fund level taking into account fund performance, the clients risk profile, charges and taxation allowing recommendation of different product solutions, if appropriate.
- At Retirement – helps advisers recommend income strategies for their clients at the point of and into retirement.
- Pensions Freedom Planner – specifically designed to focus on pensions freedoms and the options now available to consumers
- Funds Risk Assessor – Supports the recommendations of individual funds taking into account the clients overall portfolio to ensure they are aligned to the clients' risk profile.

Their Model

EValue's solutions are based on a stochastic approach, which models a range of possible outcomes for an investment proposition. EValue use their own economic scenario generator (ESG) model, Insight, which reflects both short and long-term forecasts in its outputs. Insight generates future scenarios rather than using historical data and a simple MVC model to illustrate how an investment strategy or asset will perform in the future. The ESG is built to be self-consistent and for both asset allocation and projection. Self-consistency means that updates are consistent with market developments and economic changes over time and responses match those assumed in the model.

EValue runs approximately 10,000 scenarios to establish their key asset allocations and a subset of 1,000 scenarios are used for the calculations in the on-line planning tools.

EValue's stochastic asset model is based on data from each major economic market currently covering the UK, Japan, the US, the Eurozone, Asia-Pacific ex Japan and Emerging Markets. It is designed to provide realistic simulations of currencies ensuring that the risk of investments held in other currencies is not understated.

EValue claim to follow a systematic and quantitative update process within their model which minimises any discretion they

exercise during updates. The model is updated quarterly to ensure asset allocations remain up to date. Additional reviews of the asset model may also be considered if market conditions have changed to such an extent that significant portfolio changes are likely. For example, following the recent Brexit vote, EValue carried out an accelerated update of its asset allocations and optimum portfolios to reflect the changed economic conditions, in particular reducing yields on Government bonds.

Time Frame

EValue use 4, 8,13, 18 and 25 years as a proxy for a range of investment periods. These are applicable to investment periods of 3-5, 6-10, 11-15, 16–20 and 21+ years respectively. The model will be updated on a quarterly basis and portfolios are assumed to be rebalanced on a yearly basis.

EValue's model is based on the principle that the long run behavior of an asset class will be in line with its historic behaviour. These long run conditions revert to a fixed term, which is referred to as a "steady state". However, at any one time, returns can be quite different from those in the "steady state" and these depend heavily on market conditions. In general, the rate of return drifts back to the "steady state" but the rate at which it does so varies and sometimes it can be very slow. EValue will determine the "steady state" through empirical analysis and it will not change until it is revisited.

EValue commented that "there is a trend towards a steady state in the longer term but since the model is a real world economic scenario generator, the scenarios we model will not necessarily ever reach these long term assumptions. We see a trend over around 20 years where those longer term situations tend to settle down. You should note, however, that a unique feature of our asset model is that, unlike other economic scenario generators, we do not assume that normality will resume in the short term. For example, all UK pre-credit crunch ESG models will assume that low yields will revert within around 5 years to 'normality'. Given this not only underestimates but completely ignores the possibility of long term low yields such as in Japan, we have reviewed and revised our model to ensure that this is correctly taken into account."

Underlying Capital Market Assumptions

The structure of the model begins with the modelling of interest rates, as EValue believe they have a direct impact on cash and fixed income returns, while all other asset classes have some dependency on interest rates. For example when interest rates are high, it is expected that growth rates will be higher, which impacts equity dividend growth rates and property rent growth rates.

EValue employ as much historic data as possible, and many cases this will go back to the end of World War II. EValue will simulate scenarios, which are individually realistic.

The EValue asset model includes models of the term structure of UK, US, Eurozone and Japanese government bond yields. In order to provide realistic forecasts of the risks inherent within international government bond portfolios, EValue's asset model takes into account the international dependence structure of interest rates. This is achieved by modelling common factors driving the single-economy residuals.

The EValue model also incorporates price inflation, which is used to calculate returns on real asset and inflation-linked bonds. As a result, the model takes into account long-term expectations on inflation.

The EValue equity model describes the joint real-world dynamics of the major equity markets, which covers the UK, US, Eurozone, Japan, Asia-Pacific ex Japan and Emerging Markets. The equity model projects credible levels of risk, for instance by attaching a realistic probability of a large short-term loss, as well as modeling the realistic levels of future returns. These assumptions are derived from historic observations, so that after a period of rising equity valuations, future expected returns are lower. The model also produces asset allocations, which are counter-cyclical with respect to equity "bubbles". Therefore the optimal asset allocation will shift away from equity markets that have become overvalued and towards equity markets that are under-valued. To ensure that the reduction in risk due to international diversification is modelled accurately, the model will incorporate an international dependence between dividend yields, growth rates and volatility in different economies.

The model also considers unhedged investments in foreign assets, by providing realistic simulations of currencies, to ensure that the risk of investments denominated in other currencies is not understated. The model, which obeys uncovered interest rate parity, also incorporates a dependence structure between ifferent currencies, to ensure that the risk of internationally diversified portfolios can be accurately forecasted.

The EValue corporate bond model is designed to accurately reflect the properties of a typical corporate bond fund with a credit rating of "A". Commodities are modelled like an equity without a dividend yield. The property model assumes that for current interest rates, valuations in terms of rental yield will tend to revert to the steady-state level given by the current cost of mortgage finance.

Validation

The overall level of the equity risk premium is chosen to be consistent with a range of academic and market consensus estimates, including the PricewaterhouseCoopers report commissioned by the FCA.

Team

EValue currently employ 60 people, which includes a team of 6 actuaries and PhDs who work on updating and maintaining the model.

EValue operates on an independent basis as an associate company of Financial Express who acquired a significant equity stake in 2011 from Towers Watson. EValue commented that "strong relations remain in place between EValue and Towers Watson, with the same management team and EValue employees retained to drive the next stage of the ompany's development".

Asset Class

EValue have models for over 60 asset classes in 4 currencies and can extend that range systematically. For their standard allocations they have used the following asset classes:

- UK Money Market
- UK Government Bond
- UK Corporate Bond
- UK Index Linked Bond
- UK Equity

- US Equity
- European Equity
- Japanese Equity
- Emerging Market Equity
- UK Property

For practical purposes, EValue believe that it is sensible for asset allocation to be relatively stable over time and not to be unduly affected by small changes each quarter. Assets, which have similar properties and are strongly correlated, may prompt relatively large changes in the proposed portfolio. As a result, EValue group certain assets in order to reduce the sensitivity of the output and to reduce turnover in portfolios. For example for their standard allocations, developed market equities have been grouped together and assume the following static ratios: 65% US Equity, 20% European Equity and 15% Japanese Equity.

Portfolio Optimisation

Tax is not taken into account in the portfolio optimisation, but for the calculation of asset allocations, EValue include charges that are levied directly on each asset class but not charges that apply to the investment product as a whole. Therefore they represent fund charges but not product charges.

The result of a proposed asset allocation may not be desirable or achievable for practicable purposes. Hence, to ensure a portfolio has a reasonable level of liquidity and diversification, constraints to the portfolio can be imposed. For example, for each asset class the minimum weighting as a percentage of the portfolio can be set at zero, to avoid short selling. Alternatively, a maximum weighting of 10% can be applied to avoid high allocations to illiquid asset classes such as Property.

Funds Risk Assessor

EValue will map the risk profile of a fund or a portfolio of funds, and will do so by objectively assessing the degree of investment market risk by analyzing the underlying asset allocation. This ensures that no subjective judgment is made. EValue have adopted this approach as they want to look into the future and not the past. They believe that analysing a fund's past performance can be misleading. A fund that has a steady return is not necessarily low risk. EValue also claim to be able to map any number of risk categories or use any benchmark allocation.

Risk Targets

EValue use volatility based upon the standard deviation of the logarithm of the final portfolio value, to determine risk and set risk targets [see appendix for the rationale behind this approach]. The levels of risk targets are set at regular intervals on the volatility scale to provide a sensible range of outcomes to meet investor requirements. (Note that the risks targets will change with each quarterly calibration). The current benchmark portfolios state the lowest risk category is a portfolio of 100% cash while the highest risk category is a portfolio of 100% UK equities.

Moody's Analytics (MA) – Formerly known as Barrie & Hibbert

Who they are and what they offer

Moody's Analytics offer a number of services including Investment, Risk Management and Workforce Solutions. Within the Investment Solutions arena they are a leading provider of investment research and analytics for debt capital markets and risk management professionals. As the exclusive distributor of all content produced by Moody's Investors Service and developer of the market-leading EDFTM (Expected Default Frequency) credit measures, they provide the market with information and tools that support better decision making. The scope of their expertise ranges from credit research to macroeconomic forecasts and structured markets.

Moody's have relationships with a large number of financial institutions to provide risk management services for the business, as well as within their retail product area, this includes Standard Life and Lloyds. They offer a full end-to-end proposition for product providers, distributors and advisers to help develop investment propositions in line with new regulations. The service combines solutions for attitude to risk and financial projection within an investment governance framework that allows evaluation, monitoring and review of the risk and return of investment solutions. It does this by using a series of quantitative and independently validated risk metrics.

Moody's believe that investment solutions should be specifically tailored to meet the requirements of the client and their investment customers. They have developed an analytical framework that supports the design and governance of investment solutions, configured to the desired investment outcomes and risk targets for each client. Moody's do not believe it is appropriate to offer a standard set of "off the shelf" risk grades or SAAs. Once they have established the desired outcomes and risk targets, they use the cashflow projection engine, the Wealth Scenario Generator, to identify suitable investment solutions, and to illustrate investment outcomes in relation to client needs. Moody's Analytics economic and capital market modelling platform, or Economic Scenario Generator (ESG), sits at the core of all their products and services. Moody's employ a large team of specialists, built up over the last 20 years, which is dedicated to the research & development, maintenance and regular re-calibration of the ESG.

History

Barrie & Hibbert (B&H) was acquired by the Moody's Corporation in 2011 and forms part of the Moody's Analytics Enterprise Risk Management solutions. The acquisition broadens Moody's Analytics suite of software solutions for the insurance and pension sectors.

The business dates back to 1995, when Andrew Barrie and John Hibbert started as consultants to help companies manage market risk. Over the next eight years, B&H undertook a wide range of client engagements and research supporting the development of a diverse array of models. Details of significant milestones are below:

1995	First client engagements informing model development and research
1996	Regime-switching equity model
1997	Full yield curve model for actuarial use
1998	FTSE option-implied distributions
1999	Stochastic volatility model
2000	Corporate bond model
2000	Launch of Decision Analyser Toolbox (DAT) cashflow engine for financial planning
2001	Stochastic mortality model, first clients using stochastic modelling in financial planning tools
2002	Equity mean-reversion model
2003	First standalone Economic Scenario Generator (ESG) launched
2004	Two Factor Black-Karasinski model for interest rates
2007	Extended Two-Factor Black-Karasinski model for interest rates
2008	Full Stochastic Volatility Jump Diffusion Equity model
2009	Time-varying term premium introduced to Two-Factor Black-Karasinski model for interest rates
2011	Second generation credit and corporate bond model
2012	Dynamic Equilibrium calibration designed for Strategic Asset Allocation and Optimisation
2013	Enhancement of standard multi-year "Best Views" calibration for asset portfolio projection
2014	Launch of Wealth Scenario Generator product and cashflow engine for retirement planning

With more than 150 customers around the world, the ESG is widely recognized as an industry standard for valuing insurance assets and liabilities. Based in Edinburgh, they expanded into America in 2007 with an office in New York and into Asia in 2009 with an office in Hong Kong.

MA has expanded beyond life insurance, applying its expertise to asset management, retail distribution, pensions, and Property & Casualty insurance. Their models are now integrated into enterprise risk management platforms, consumer advice tools and valuation processes around the world. It is estimated that in the UK alone, 70% of insurers rely on their models. Around 30 UK product providers and asset managers have risk-graded investment propositions, which are supported by Moody's investment governance services including Standard Life (Myfolio), Royal London (Global Multi Asset Portfolios) and Intrinsic (Cirilium Funds).

The Model

The model looks at 40 economies across various fundamentals including interest rates, inflation, currencies and asset price projections. The main changes are generally to interest rates and implied volatility. The model is updated quarterly, and after each update assumptions are tested before models go live to ensure they adequately reflect the views of the team. Any changes to the models, along with an explanation, are provided with clear rationale.

The model is integrated with asset price and economic risk factor dynamics. It captures fundamental financial economic dynamics and relationships and ensures economically coherent projections for paths of asset prices, inflation and interest rates. It provides forward-looking projections consistent with current economic conditions, in contrast to a number of models where simple distributions are fitted to historic asset return data

Importantly the model captures complex market features which impact client outcomes for example market fat tails, time-varying volatility, tail dependence, realistic yield curve behaviour impacting asset prices, cashflows and client outcomes. Their Stochastic Volatility Jump Diffusion model is designed specifically to incorporate scenarios where volatilities and correlations increase significantly above the 'average' levels.

Asset and Modeling Coverage

The MA Economic Scenario Generator can project a wide range of assets and risk factors, including:

- Equity indices
- Nominal and real interest rates
- Nominal and index-linked bonds
- Inflation (RPI, CPI, wages,)
- Exchange rates
- Real estate and alternative assets (hedge funds, private equity, commodities)
- Credit spreads and credit risky bonds (financial and non-financial corporate bonds, sovereign bonds)
- Municipal bonds
- Structured products (MBS etc)
- Derivatives (options, swaps, forwards)
- Implied volatilities
- Multi-asset portfolios (with a range of rebalancing options)

The MA Economic Scenario Generator includes a range of modeling options for the major risks and asset types. Typically they will run between 1000 and 5000 scenarios. They maintain standard calibration to interest rates, inflation, credit risk and a wide range of related asset prices (including equities, fixed income, real estate and a range of alternative assets) across 31 global economies.

Where a more bespoke calibration solution or additional assets are required, clients may choose the best model for their requirements considering the nature of their liabilities and the sophistication level of users. Examples of the various models include constant volatility; credit and equity mean reversion, amongst others.

Optimisation

They provide a standard multi-year real world calibration of asset models, specifically to support portfolio optimisation and strategic asset allocation exercises.

Strategic Asset Allocations are created for each client, according to specific client requirements in respect of: investment or cashflow objectives (e.g. wealth accumulation, retirement saving, decumulation), asset exposure preferences and asset allocation constraints. These standard calibrations are updated on a quarterly basis.

Validation

Moody's operate a quarterly Calibration Steering Group, which has responsibility for validating that, the model calibration and outputs are in line with expectations, given changes in market prices and economic indicators. They also assess the impact any model changes are likely to have on client's portfolios and liabilities.

Support

Clients are supplied with calibration reports that document the features of the calibration. This includes a range of information and validations of ESG outputs including:

- Parameter values
- Quality of fit vs. market or target data (tabular and graphical)
- Distribution and percentiles validations
- Summary methodologies for models and calibrations
- References to their knowledge base for in-depth documentation

Many clients use these calibration reports as the basis for discussions with their auditors and regulators. The output from Moody's analytic framework is typically used within the clients' own investment governance committees.

Time Frame

The MA model is multi period and simulations can be run over any timeframe. In their experience generally, retirement projections up to 50+ years have been required, but typically retail projections will be much shorter (e.g. 10 years).

Underlying Capital Market Assumptions (CMAs)

Moody's maintain a standard set of Capital Market Assumptions and use these to produce a standard model calibration, which they term their "Best Views Calibration". These assumptions and the associated model calibration are updated on a quarterly basis.

Risk Profilers

MA works with a number of risk profilers. They have a standard integration with A2Risk, the business where David Blake of Cass Business School is a Director. However, they have also developed asset allocations, which have been integrated with FinaMetrica, Oxford Risk and EValue, for specific clients.

Resources

In terms of staff directly involved in supporting the core modelling platform, and based in the groups Edinburgh and London offices, this totals 60 plus. This is reinforced by the wider resource of Moody's and the commitment to the continuous development of their core modelling capability. Further details of their strength and depth of resource is provided below.

Overview of Modelling Operations	Number
Staff responsible for ESG research, development, maintenance	63
Staff responsible for quarterly calibration update	15
Approx. quarterly operational effort (man-days per quarter) to deliver quarterly calibration updates	30 - 50
Specialist Employee Qualifications (relating to the 63 employees identified above)	
Actuaries (qualified)	11
Actuaries (trainee)	7
CFA (qualified)	7
CFA (trainee)	3
FRM (qualified)	5
FRM (trainee)	1
Quantitative PhDs: Maths, Physics	15
Economists (postgraduate economics qualification, including PhD)	9

Being part of the wider Moody's Analytics group helps the capital markets and risk management professionals worldwide respond to the evolving marketplace with confidence. Moody's Analytics provides unique tools and best practices for measuring and managing risk through expertise and experience in credit analysis, economic research and financial risk management. As part of this global analytics business, they benefit from access to a much broader group of risk modelling and economic research experts, which encompasses around 1600 credit analysts and 70 economists.

Morningstar – Formerly Ibbotson

Who they are and what they offer

Morningstar is a global independent investment research company based in Chicago, operating in 27 countries. It currently employs (as at 30th June 2016) over 4,000 people across North America, Europe, Australia and Asia. Many will know Morningstar as a data provider who provide data on approximately 530,000 investment offerings, including stocks, mutual funds and similar vehicles, along with real-time global market data on nearly 18 million equities, indexes, futures, options, commodities and precious metals, in addition to foreign exchange and Treasury markets.

However the company's products and services also include a wide range of investment consulting services, such as risk tolerance questionnaires, asset class models, capital market assumptions; and fund-of-funds services. Its services include asset allocation, momentum strategies, active and passive strategies, and custom strategies, as well as income, tax-efficient, alternative, target maturity, and risk-based portfolios. They currently also offer asset allocation research and services to mutual fund firms, banks, financial advisers, insurance companies, asset managers, and retirement plan providers in the United States and internationally.

The origins of Morningstar's SAA approach go back to 1977 when Roger Ibbotson founded Ibbotson Associates. During the 1980s, Ibbotson Associates made numerous contributions to the financial industry through:

- The introduction of building blocks methodology to forecast asset class returns
- Asset allocation and business valuation consulting
- The introduction of the Mean-Variance Optimizer allowing institutional investors to examine risk and return trade-offs among asset classes
- Asset allocation training to investors

Over the next two decades, Ibbotson Associates continued to build its asset allocation expertise through various works including research in retirement income planning and mutual fund returns, the development of risk tolerance questionnaires and asset allocation model portfolios. As of 1st March 2006, Ibbotson Associates, Inc became a Morningstar company.

Resources and Asset Classes Covered

Morningstar claim that all of the 120-investment management team based in Chicago, London and Sydney contribute to the strategic asset allocation process. Morningstar has split the investment universe into 12 asset groups, with teams working individually on each group. There are six asset groups within equities, which are Americas, Europe, the Middle East and Africa (EMEA), Asia Pacific, Global Sectors, Emerging Markets and REITs/Infrastructure. The remaining six asset groups are referred to as Fixed Groups, which are Americas, EMEA, Asia Pacific, G5 & Global Credit, Emerging Market Debt and Currency.

Valuation Driven Investing

Compared to other SAA providers who anchor their capital market assumptions on the expectation of one or a few asset classes and then extrapolate out for other asset classes based on their risk premia. Morningstar has adopted a complete bottom-up approach with an independent view formed on each asset class.

Valuation driven investing is primarily focussed on setting assumptions as they seek out assets that are underpriced relative to the wider market and wait for them to return to fair value. Valuation driven investing is based on two clear principles. Firstly, the belief that an asset has a "fair value" that can be estimated through careful analysis. Secondly, an asset will return to its fair value over the long term, but in the short term an asset may deviate away from its fair value.

With the above in mind, Morningstar will form two sets of assumptions for each asset class; the fair returns, which are what an investor would expect to earn from an asset class over the long term, which is independent of current market prices; the valuation implied return, which is specific to the asset class' current valuation and could be expected to revert over the medium to long term, which they have defined as ten years.

How do they estimate an asset class' fair value?

Morningstar has developed different methodologies for calculating Equities and Fixed Income instruments.

Equities - Morningstar define the valuation implied return of an equity asset class by the following formula:

Valuation Implied Return = Change in valuation + Growth + Total Yield + Inflation

Change in valuation represents the asset class' expected return based on its reversion to fair value. So if an asset price were higher than fair value we would expect the price to fall over time. The fair value calculations are based on the following metrics:

- **Profit margin normalisation.** Profit margins are known to be a mean reverting series, which creates opportunities. So when profit margins are abnormally low an investor may look to be overweight that asset class and vice versa when profit margins are abnormally high.
- **Return to book-equity normalisation.** Similar to profit margins, opportunities are created when ROE is abnormally high or low. Morningstar are aware for both ROE and profit margins, the "normal" level can structurally change depending on the market in question and so it requires continual investigation.
- **Cyclically adjusted price to earnings ratio (CAPE).** Many investors believe that the price to earnings ratio is helpful in assessing whether a price is abnormally high or low. However real-time earnings are too volatile to assess, so a long-term earnings figure that is adjusted for inflation can be more reliable.

Morningstar determine their long run growth expectations on forecasts for both long-run productivity growth and equity sector cash flow growth. This is based on academic research, which showed that long-run corporate fundamental growth is in line with economic productivity.

The yield is calculated as the expected shareholder distributions from dividends and share buy backs. Whilst Morningstar determines inflation as the expected increase in consumer prices which will be reflected in future equity prices. The long-term inflation expectations are based on several long-term inflation forecasts, as well as Central Bank's medium to long-term explicit inflation targets.

Fixed Income - Morningstar defines the valuation implied return of a fixed income asset class by the following formula:

Valuation Implied Return = Income Return + Shift Return + Roll Return + Credit Migration Cost + Default Loss

Morningstar define income return as the expected income to be received over a 10-year period. Which is the starting yield along with an expectation for yields to normalise over time to "fair" yield. The fair yield is calculated by forecasting inflation, the real rate of return, term spread and credit spread.

Shift return is the price change that would be required for the yield to revert to normal levels over a 10-year period. So if yields were currently below fair value, then over the long-term yields would be expected to rise causing the price of the bond to fall.

The price impact of a bond getting closer to their maturity and moving from longer term rates to shorter term rates is the roll return. The default loss will be a drag on the expected return and is based on the estimated default risk. Finally, the credit migration cost is the return attributable to the impact of rating upgrades and downgrades on credit bond prices.

Morningstar believes that determining the fair value of currency is considerably harder than for equities and fixed income, however they don't believe that it's impossible. The methodology employed is based on the theory that in the long run, the inflation differential is the sole driver of changes in the spot rate. Therefore the currency valuation implied return is based on the inflation differential between the local currency and the reference currency, as well as the reversion of real exchange rates to fair value.

Forming an SAA

The SAA that is constructed by Morningstar is not the output from a highly sophisticated machine but the ranking of their convictions and risk management. They seek to gain the largest exposure to their best ideas that are most underpriced, while building asset allocations designed to stand up to challenging investment environments.

Morningstar are aware that a simple approach to diversification may not always be the most effective method in reducing capital loss as the majority of assets could be overvalued at the same time. Therefore, during certain periods asset classes that are historically uncorrelated may have a correlation that converges to 1. Therefore, Morningstar look into future risks, not just historic. So by understanding forward looking risk drivers, Morningstar can build portfolios which they believe are diversified for the future rather than the past.

In addition to valuation, which forms a major part of the SAA, Morningstar look to also understand market sentiment between differing assets. This allows them to see how the market consensus views an investment idea they are considering. They would like to go against the consensus as that is the only way they believe they can outperform the market.

An important thing to note about Morningstar's SAA is that it's a slow evolving process and is unlikely to considerably change. Given the long-term time horizon they do not believe in constantly changing the asset allocation, even if a significant market change takes place. For instance, after Brexit, the SAA changed slightly with a reduction in the portfolio's gilt allocation. However, across the board this was by approximately 1-2%.

Optimisation

As discussed in the appendix of this report, asset class returns are not normally distributed due to the existence of fat tails. Therefore Morningstar incorporate Skewness and Kurtosis into the asset allocation process. Also given the weaknesses in assuming that asset class returns are normally distributed, Morningstar believe that the Truncated Levy Flight (TLF) distribution is particularly well suited for financial modelling because it has a finite variance, fat tails that empirically better fit the data and it scales appropriately over time.
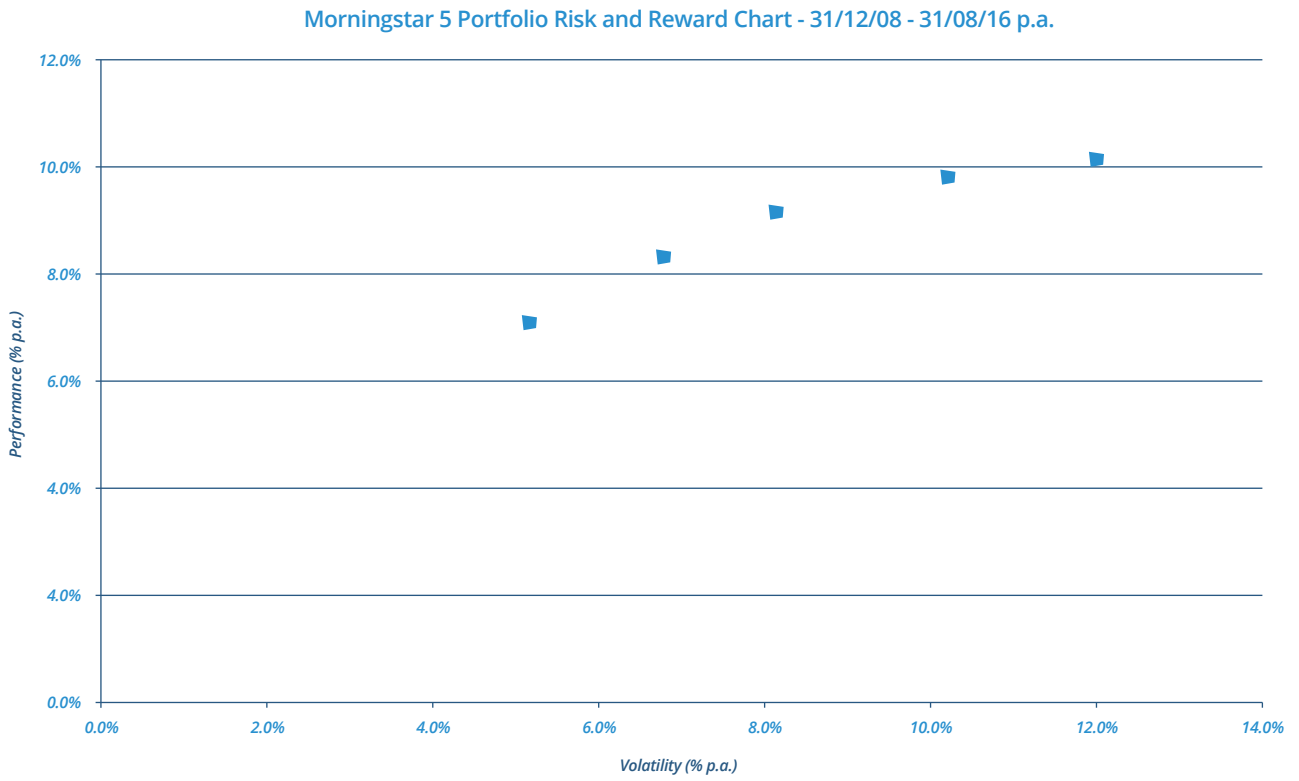
Validation

Morningstar have formed a number of working groups and sub-committees to ensure that the asset allocation process is being adhered to and evolving. The committees include:

- Global Investment Policy Committee - This over-arching committee ensures the group is producing outcomes that are aligned with the company's principles and are in line with regulatory standards.
- Regional Asset Allocation Committee - This committee utilises the information from the working groups and sector analysis research to ensure full alignment of the asset allocation process.
- Global Capital Market and Asset Allocation Working Group - The group comprises of senior investment professionals across North America, Europe and Asia. The group is responsible for the ongoing review of the firms capital market assumptions and developing new forecasting methodologies.
- Regional Risk Committees - This is chaired by the regional managing director and the intention is to ensure adherence to risk standards and the regulatory framework for that region.
- Regional Portfolio Committee - The final committee will provide a peer review and approval forum for the proposed changes to portfolios.

Performance

Morningstar has provided us with the return and volatility figures of five of their portfolios which are purely based on asset allocation (see chart on next page).

Morningstar 5 Portfolio Risk and Reward Chart - 31/12/08 - 31/08/16 p.a.

Source: Morningstar

Returns are annualised from 31st December 2008 to 31st August 2016.

Willis Towers Watson (WTW)

Who they are and what they offer

Willis Towers Watson (WTW) is a US-listed global professional services company that helps organisations improve performance through effective people, risk and financial management. The origins of the firm's legacy organisations date back to the 19th century. WTW as an entity was formed following the merger of Willis Group Holdings and Towers Watson in June 2015. While in 2010, Towers Watson was formed, as Towers Perin and Watson Wyatt merged. Globally WTW employs 39,000 associates and 900 within their investment business. The business advises more than 1,200 pension funds and institutional investors which amounts to over $2.3 trillion of assets under advisory (as at 1 January 2015). WTW is also responsible for over $78.2 billion of delegated and fiduciary assets worldwide (as at June 2016).

A large proportion of the WTW client base is pension funds, while it also has endowments, sovereign wealth funds and insurance companies as clients. WTW currently provides strategic asset allocation to Old Mutual Wealth, which in turn is used by its multi-asset team as well as its wealth select platform. WTW has previously designed model portfolios for retail customers of a UK Building Society.

Their Model

WTW's solutions are based on a stochastic model called Star ESG*, which models a range of possible outcomes for an investment portfolio. WTW has adopted an economic scenario generator (ESG) model, which reflects both short and long-term forecasts in its outputs.

Star ESG is a fully coherent and integrated stochastic Monte-Carlo generator covering a wide array of economic and financial risk metrics including interest rates, credit spreads, equities, property, foreign exchange and many alternative series. Monte Carlo methods are a broad class of computational algorithms that rely on repeated random sampling to obtain numerical results. These metrics are then used to determine the full distribution of returns at one-year and multi-year projections for a wide range of assets (and at both aggregate and/or individual security level detail). The assumptions that go into building the model are formed using current market information, historical data, views from other industry participants and an element of economic overlay.

The WTW model includes "fat-tailed" distributions. This feature attempts to ensure that periods of severe negative returns are not underestimated. The WTW now also allows for the possibility of negative cash rates and bond yields.

*Currently WTW's clients use output from 3 stochastic economic models that come from legacy consulting organisations. WTW is in the process of combining these models into the STAR ESG platform.

Time Frame

WTW's model is a multi-period model, which can model returns for long-term time horizons, for example 50 years plus. From year 20 onwards, WTW adopts a normative long-term assumption. The normative assumptions represent WTW expectations for asset class returns when markets are priced at "equilibrium" levels or, the returns WTW would expect, on average, over a full market cycle (over which they would expect over/under pricing relative to equilibrium to "balance out"). WTW's best estimates in the earlier years of the projections differ from their views of longer-term central outcomes in a number of areas. The transition from shorter-term to longer-term assumptions operates over different periods for different variables.

WTW is also able to provide dynamic asset allocation advice based on views over a three to five year time horizon.

Underlying Capital Market Assumptions

The starting point for WTW's standard assumptions is current market expectations. The extent to how much they depend on this information varies from asset class, but it's an important input into the process. WTW also uses historic market data, mainly to determine volatility and correlation assumptions for each asset class. Judgment is used to decide if the drivers of historical performance will recur.

WTW also incorporates the views of other market participants by using information from central banks and government guides for regional expectations on future inflation and economic growth. They will also sense check their assumptions by surveying return expectations of many investment managers.

These inputs are then used to frame the Global Investment Committee (GIC) capital market assumptions. The GIC are made up of nine Investment professionals with an average of 17 years of investment experience.

- **Robert Brown** - Managing Director and Chairman of the GIC. Robert joined WTW in 2002 having previously spent 7 years at First Quadrant where he was involved in managing equity market neutral and GTAA strategies, and latterly heading its European operations. Prior to that he spent eleven years at NatWest Investment Management (Gartmore) where he was a director in charge of their structured equities group.

- **Alasdair Macdonald** - Head of Advisory Portfolio Management. Alasdair joined WTW in 1999. A particular area of Alasdair's specialisation is in stochastic modelling and has been heavily involved in the development of the WTW Investment Model and the use of risk budgeting statistics for institutional investors.

- **Peter Ryan Kane** – Head of Portfolio Advisory Asia Pacific. Peter has more than 25 years of experience in financial markets as an adviser, investor, borrower and risk manager. Prior to WTW, Peter held positions including Global Chief Investment Officer, Head of Interest Rate Risk Management, Capital Markets researcher, and Financial Markets Trader.

- **Matt Stroud** – Head of Investment Strategy, North America. Matt is responsible for all aspects of investment strategy advice in the Americas including developing and maintaining model portfolios for delegated accounts, complete with managers and weights, and overseeing application of model portfolios to client context. Prior to working at WTW, Matt developed and assessed the NASD's first formal action against a NASDAQ market maker for trading ahead of customer limit orders and was also a Financial Consultant at Merrill Lynch & Co.

- **Craig Baker** – Global Chief Investment Officer. Craig is ultimately responsible for all aspects of WTW's investment philosophy and process. Prior to the CIO role Craig spent three years as Head of Investment Research and 15 years leading the Manager Research team at WTW.

- **David Hoile** – Head of the Asset Research Team. David is responsible for the firm's capital markets research and developing medium-term and strategic asset class views. Prior to joining WTW, David was Head of Investment Research at Aon Consulting.

- **Luba Nikulina** – Global Head of Manager Research. Prior to assuming this role, Luba led the global private markets team at WTW and has over 18 years' industry experience. Luba attended the Advanced Management Program at Harvard Business School and holds an MBA degree from London Business School, MS in Finance from the Finance Academy in Russian and a BA in Linguistics.

- **Chris Mansi** – Global Delegated CIO. In this role Chris is responsible for the investment process, structure and resources WTW put in place to build portfolios designed to meet delegated clients' objectives. Chris joined WTW in 1999 and has over 20 years' industry experience.

- **Chris Hemmer** – Chris joined WTW in 1993 an is a Director and Senior Consultant in the Chicago office. Chris serves as the lead consultant for a number of clients providing both advisory and delegated services. Prior to his current role he managed the Chicago investment practice for five years

Over the last 12 months, Chris Redmond and Tim Hodgson have left the GIC and Craig Baker, David Hoile, Luba Nikulina, Chris Mansi and Chris Hemmer have all joined.

The GIC has overall responsibility for setting WTW's investment return assumptions, which they review on a quarterly basis to reflect any changes to market conditions. A more extensive review is conducted on a yearly basis. The production of quarterly model calibrations is delegated to the ESG Technical Committee (TC), which reports in to the GIC.

Asset Allocation

The ESG TC also determines model portfolios under two differing risk levels that reflect WTW's best investment ideas under an unconstrained mandate. They will use their return, volatility and correlation assumptions as a validation check to ensure they have designed an optimised portfolio.

Using the GIC's model portfolios as a starting point, WTW is able to apply client specific constraints to arrive at bespoke asset allocations using their in-house modelling systems. WTW's assumptions can also be used in conjunction with its client's own optimisation models where appropriate and necessary. Sensitivity analysis is typically conducted to test the robustness of portfolio analysis.

Resources

The GIC compromises nine investment professional who are backed by the asset research team which compromises 10 global consultants and a 140 strong modelling team who work on the asset modelling and development of the model.

Validation

WTW conducts an annual sense check of assumptions by surveying many investment managers and other industry participants.

Asset Classes

The asset classes that TW are able to model are shown in the table below:

Fixed Income	Derivatives	Equities	Alternative Beta	Others
Government Bond	MBS (Mortgage Backed Securities)	Large Cap	Reinsurance	Hedge Funds
Corporate Bond	CMBS (Commercial Mortgage Backed Securities)	Small Cap	Commodities	Private Equity
FRN (Floating Rate Notes)	Swap	Emerging Market	Loans	Global Property
Index Linked Gilts	Equity Derivatives		High Yield	Infrastructure
Municipal Bonds			EMD (Emerging Market Debt)	Gold
			EM Currency	

Optimisation

WTW is able to overlay their standard assumptions with factors specific to clients and is able to conduct the following:

- Mapping of WTW asset assumptions to each client's asset class categories
- Include the expected alpha and fees for researched managers
- Provide different risk measures such as standard deviation, tail VaR (Value at Risk) and probability of loss.

WTW's work with Old Mutual Wealth

WTW has been working with Old Mutual since 2000 and it currently provides them with asset allocation for Old Mutual's wealth select platform and their Spectrum funds.

WTW provides Old Mutual with risk/return/correlation assumptions for the following asset categories:

- UK Equities
- Global Equities
- UK Cash
- UK Fixed Income
- International Fixed Income
- UK Property

Property exposure is constrained to a maximum of 15% and the International equity weights are calculated based on regional GDP weighting (except for a 15% sub component in Global Specialist).
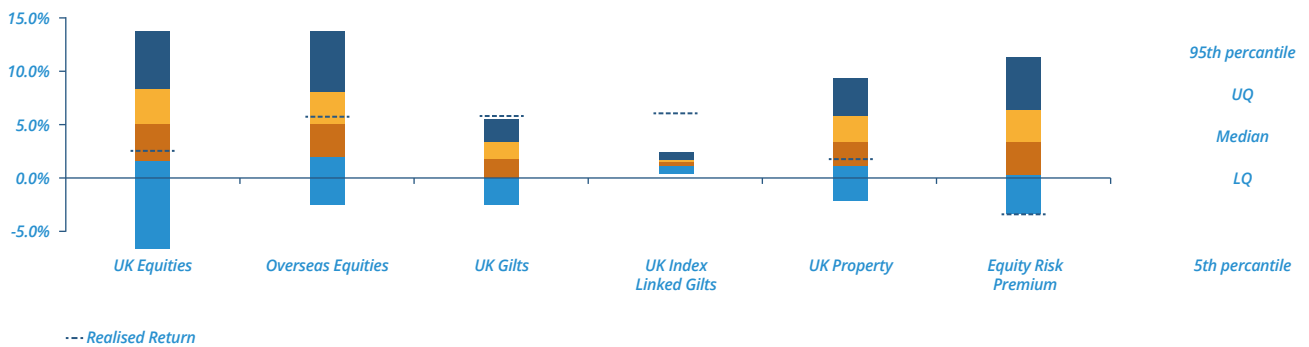
WTW then runs the asset assumptions though Old Mutual Wealth's mean variance optimisation tool and provides Old Mutual with a set of optimised asset allocations.

Historic assumptions vs actual outcomes

The chart below looks at the assumed real returns relative to the actual outcomes for five major asset classes. Of particular importance is the equity risk premium (UK equities relative to ILG) and this is also shown on the chart.

UK Equity returns were between the lower quartile and the median expected level reflecting the relatively high starting point of markets as at 30 June 2006, followed by the significant bear market seen in 2007-9, and the subsequent recovery.

ILG returns benefited as Bank of England independence and a focus on liability matching by UK pension schemes caused real yields to decline. This has resulted in a realised risk premium at the low end of the range that was expected in 2006. UK fixed interest gilts also benefitted, but to a smaller extent, from falling yields over the period.

Source: WTW

AKG

Although AKG are involved in this market, their activities are limited in the retail space. Therefore we have not reviewed their product in detail.

Who they are and what they offer

AKG is an actuarially based organisation specialising in the provision of information, ratings and consultancy to the financial services industry. This actuarial skill, set together with market experience, has meant AKG can provide an asset allocation component and assistance for intermediary firms, system providers, publishers and other third parties involved in the creation of client investment solutions and support. Their clients include O&M Systems, Defaqto and Capita.

AKG have confirmed that their asset allocation offering is not a core part of their business. They are not overly proactive in seeking clients, but are happy to assist existing clients who require their expertise in this area.

AKG continue to provide services to Citywire, Networks and Wealth Wizards.

Approach to Strategic Asset Allocation

AKG do not have a one size fits all model and instead tailor their offering to each individual client. The process starts with reviewing the client's existing set of assumptions. AKG will then look at the markets' recent performance to determine whether the current assumptions for volatilities, correlations and returns need to be adjusted. The adjusted assumptions are then used to model the client's current portfolio to check their robustness to meet the needs of investors based on their attitude to risk. Analysis of whether the volatilities are starting to rise or fall is then considered with consideration of adjustment to higher or lower values in the modelling.

The process used by AKG is a simple deterministic quantitative driven approach with some qualitative overlay. AKG's offering is purely strategic in nature with no tactical asset allocation overlay provided. Generally they update their Capital Market Assumptions on a semiannual basis and these are peer reviewed by an external actuarial business.

The "Traditional Approach"

Prior to the introduction of quantitative models, investment professionals constructed private client portfolios in a manner that was consistent with the principals backing modern portfolio theory. It is assumed that a sensibly diversified portfolio would approximate a position close to the efficient frontier. Portfolios were constructed across a number of asset classes and portfolio's risk gradations were often determined in a qualitative fashion. Labels such as 'cautious' and 'balanced' are commonly applied to describe the portfolio mix.

Typically portfolios would be constructed using arbitrary allocations, which approximated clients' risk bandings. Hence a "balanced risk" portfolio may be constructed using a base allocation of 60% equities, 30% bonds and 10% cash. The portfolio may be managed within tolerances around these bands to ensure that the portfolio met the clients' expectations of risk and returns.

Pros

- The static base portfolio can act as a benchmark
- The investment manager retains full flexibility over the investment strategy
- Precise capital market assumptions are not required
- Clients may assume false levels of comfort from more complex and seemingly more rigorous approaches

Cons

- It may require an experienced adviser to match the client's risk tolerance with an appropriate portfolio.
- The portfolios are not optimised for risk and return
- Risk/return characteristics of the portfolio may be difficult to determine
- Risk/return characteristics of other assets held outside of the portfolio may be difficult to incorporate into the overall exposure of the client.
- Portfolio labels were applied inconsistently across the industry – one firm's "cautious" portfolio may be another's "balanced". (This problem may still remain within different risk targeted ranges but at least there is some underlying consistency in the approach)

6.
Common Limitations of Models

1. Use of Historic Volatility to Gauge Future Risk

a) The models use some form of volatility measure to denote risk. Investors might consider risk as being more asymmetrical in nature, with a specific concern being a permanent loss of capital.

b) Volatility changes over time. Markets can be calm or they can be extremely agitated. Most of the models use long-term average volatility to gauge future risk. Use of long time series of data ensures that the models are not unduly influenced by short-term trends in markets.
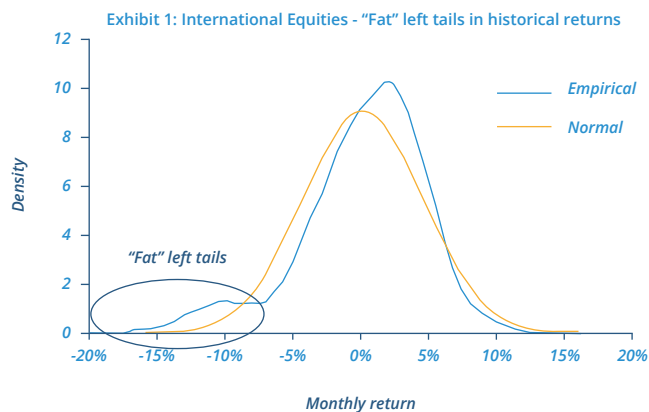
More sophisticated models (eg Moody's Analytics "volatility jump diffusion model") factor in both calm and agitated markets into their stochastic assumptions. In addition to the different volatility assumptions in each 'regime', different return assumptions can be applied. Such an approach diminishes the impact of sequencing in the models outputs.

2. Tail Risks

Many statistical techniques based on probability theory assume that observations are drawn independently to form a normal distribution. Evidence in financial literature demonstrates that return observations in financial markets only approximate a normal distribution. Extreme events are more common than the normal distribution curve would suggest, examples of these would include:

- May 2010 'flash crash' when the Dow Jones index lost 1,000 points in minutes
- 2008 financial crisis and the collapse in credit markets
- 2000-2001 collapse in TMT stocks
- 1998 LTCM hedge fund crisis
- Asian financial crisis in 1997
- Stock market collapse in 1987

The presence of events such as these produces a bell curve that has "fat" tails. As are typically negative events for financial markets, fat tails tend not to be symmetrical and feature on the left hand side. Below is a stylised chart illustrating the phenomenon.

Source: J.P. Morgan Asset Management. For illustrative purposes only.

Put another way, the annualised volatility (SD) of the UK equity market over the Twentieth Century was approximately 18%. If we assume a normal distribution, we might expect to observe a single instance of a monthly return in excess of 15% over the 100-year period. In fact there were 7-recorded instances.

Deterministic models assuming that distributions are 'normal', fail to fully factor in the likelihood of extreme events. As a result, the risks described by these models are probably understated.

A stochastic approach is likely to better model how financial markets behave in practice. Such a modelling approach can consider historical events such as the 1987 stockmarket crash as part of their scenario analysis. This should more accurately model the risk-return expectations of a particular asset allocation.

3. Breakdowns in Correlations

A well-diversified portfolio of assets is constructed using a diverse mix of assets, which have independent performance drivers. The greater the diversity in the mix of performance drivers, the greater the diversification benefits the portfolio provides.

Historic correlation analysis is usually employed as a proxy to describe the interdependence of different assets. If the historic correlation relationship breaks down, the volatility of the returns from a portfolio could rise.

Financial markets are interrelated. During periods of market stress, assets that are seemingly unrelated can begin to perform in unison. As a result diversification benefits can melt away as assets become increasingly correlated.

Some of the more sophisticated stochastic models (such as Barrie & Hibbert) can factor in changing 'regimes' or 'market states'. During calm stable markets, volatility of individual asset classes is low, as are correlations between them. During turbulent, stressed markets, the volatility of returns from individual asset classes rise, as will correlations between them. A stochastic approach permits the use of two (or more) volatility tables and correlation matrices. For example, a model can be generated which assumes that 80% of the time markets are in a calm state, and 20% in a stressed state.

Models that ignore such changes to the market dynamics may underestimate the risks within the proposed asset allocations.

4. Assumptions of Positive Nominal Interest Rates

Over the last year, we have seen interest rates across the western world turn negative and in markets where rates where expected to rise, they have remained at historically low levels. In the case of the UK, interest rates have actually fallen from 0.50% to 0.25% (As at 4th August 2016) and many market analysts expect further falls. However only twelve months ago, there were adverts on the radio warning consumers about the impact of rising interest rates.

Most retail investors in western economies will not have to pay to hold their money in a basis current account and it is unlikely that that this will happen. However over the last year, the likelihood of this happening has increased. Therefore we questioned the providers in this report to see how they would deal with negative interest rates.

Many of the providers have had to recalibrate their models in order to address a negative interest rate regime, however all of the providers are able to deal with a negative rates environment.

5. Sequencing Risks in Drawdown

It is not just long-term average returns that impact the financial well being of investors. The timing of how those returns arise is critical. When retirees begin withdrawing money from their investments, the returns during the first few years can have a major impact on their wealth.

Two retirees with identical wealth can have entirely different financial outcomes, depending on when they start retirement. A retiree starting out an retirement plan at the bottom of a bear market will have a far happier financial experience than another starting out at a market peak, even if the long-term averages returns may be the same.

Deterministic models do not factor such timing factors and stochastic models provide a more effective solution.

7.
Summary Table Detailing Some Differences Between the Main Providers

Question	DT	EValue	MA	Morningstar	WTW
Is the model stochastic or deterministic?	Deterministic	Stochastic	Stochastic	n/a	Stochastic
Is a qualitative overlay in place post model results?	Yes	No	No	Yes	Yes
How many scenarios are run in the ESG Model	N/A	10,000 scenarios will be run for the main asset allocation. A subset of 1,000 is used in the calculation of planning tools.	From 1000 to 5000	n/a	From 10,000 to 20,000
Size of Team	Ben Gross is the CEO and is supported by four directors. One of which is Chris Fleming who leads the analytics team. A team of 6 analysts supports Chris.	EValue employ approximately 60 people. This includes a team of six actuaries and PHD's who update and maintain the model.	60 plus employees are responsible for ESG research, development and maintenance. Of these 15 are also responsible for the quarterly calibration update.	The 120 strong investment management team all contribute with varying levels of input into the strategic asset allocation process.	The global investment committee consists of nine investment professionals who are backed by 10 global consultants and a 140 plus strong investment strategy team.

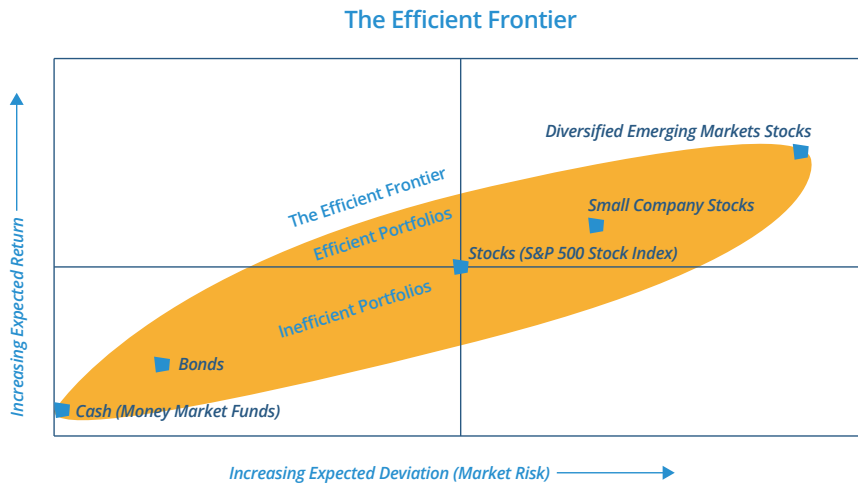| Question	DT	EValue	MA	Morningstar	WTW
How many asset classes are modelled?	Cash Corporate Bond Index Linked Gilt UK Gilts Global High Yield Bonds Global Equities Property Commodities Hedge Funds Inflation	Cash Government Bond Corporate Bond Index Linked Gilt Global Equities Commodities Property	Cash Government Bonds Corporate Bonds Index Linked Gilt Global Equities Property Emerging Market Debt Commodities Hedge Funds Private Equity Infrastructure Where clients require additional/ bespoke asset classes, MA provides a custom calibration service.	Cash Government Bonds Corporate Bonds Index Linked Gilt Global High Yield Bond Emerging Market Debt Global Equities Property Hedge Funds Commodities Real Estate Infrastructure	Cash Government Bond Corporate Bond FRN (Floating Rate Notes) Index Linked Gilt Municipal Bonds MBS (Mortgage Backed Securities) CMBS (Commercial Mortgage Backed Securities) Swaption Equity Derivatives Global Equities Reinsuarnce Commodities Loans High Yield Emerging Market Debt EM currency Hedge Funds Private Equity Global Property Infrastructure Gold
Over what time horizons are investment periods modelled?	DT's CMA's are based on a long-term outlook though they do not specify precisely the time frame.	EValue use 4,8,13, 18 and 21+ years as a proxy for a range of investment periods. The proposed portfolios are applicable to investment periods of 3-5, 6-10, 11-15, 16-20 and 21+.	The MA model is multi period that uses multiple time frames.	Assumptions are typically based on a 10-year time horizon. However they do have the ability to form SAA's based on a 20 year horizon.	WTW is a multi period model, which can model returns for long-term time horizons, for example 50 years plus.

Question	DT	EValue	MA	Morningstar	WTW
Does the model assume a steady state? If so, over what time period is the steady state assumed?	The model always assumes that returns, volatilities and correlations are always in a steady state.	Yes. EValue tend to see a trend over 20 years when longer-term situations tend to settle down.	Yes. MA's model assumes that interest rates revert towards a long-term average level. The term over which asset price behaviour would be expected to revert towards this equilibrium state will depend on the current level of rates, the assumed long term reversion level and their assumptions regarding the rate of mean reversion.	n/a	Yes. After twenty years WTW assume a normative long-term assumption.
Does the model assume tail risk	No	Yes	Yes	Yes	Yes
Did the events in 2008, fall within the models predicted range?	Yes	Nearly all outcomes were within the 95% confidence level.	Yes	n/a	Yes
How do the models accommodate for a market crisis where the correlation of asset classes tend to move to 1.	They don't. DT model assumes that the correlation between asset classes remains constant throughout.	Conditional correlation factors are used within the model to allow for these situations. This helps overcome the issues that fixed correlation factors used by an MVC model suffer in the event of a major market upset.	Specific model, called stochastic volatility diffusion equity model. The model is used to incorporate scenarios where volatility and correlations increase significantly above market levels.	Yes. Morningstar take a forward-looking approach to risk and understand that the majority of asset classes can be over or undervalued at the same time.	WTW use scenario analysis and sensitivity testing extensively to provide a picture of asset class / portfolio returns under market stress scenarios.

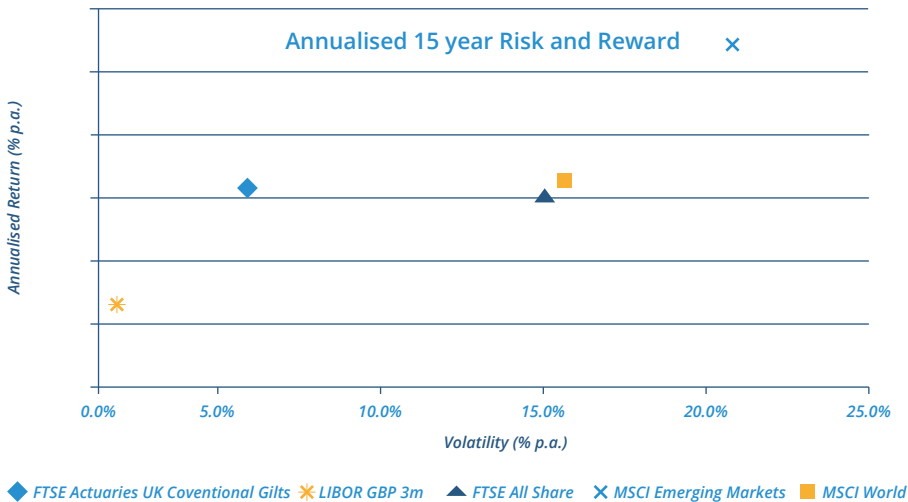| Question	DT	EValue	MA	Morningstar	WTW
Are they willing to provide long term examples of historic performance information?	Yes. Please see DT's section of the report.	No. EValue are looking into providing fair and consistent performance measures of their portfolios.	As the SAA that MA provide is specific to each of their clients in line with client-specific asset allocation constraints, investment objectives or asset exposure preferences. MA will only provide performance information to their clients.	Yes. Please see Morningstar's section of the report.	Yes. WTW have not provided us with historic performance of their portfolios. However they have provided how their historic capital market assumptions have differed to the actual outcomes for five major asset classes.
Does the model consider negative interest rates into their scenarios?	Yes. DT does not conduct scenario analysis, however their model can assume the interest rates are negative.	Yes. In late 2015, EValue allowed the possibility of negative interest rates into their scenarios.	Yes. Post the 2008 financial crisis MA added a volatility displacement factor into their model. This was to ensure that the model was capable of simulating negative nominal rates.	Yes	Yes. The WTW model now allows for the possibility of negative cash rates and bond yields.

8.
Evaluating Model Performance Records

The SAA models are designed to place the investors' portfolios on or close to the efficient frontier.

The Efficient Frontier

In theory it should be possible to examine the risk adjusted performance track record of a model.

We acknowledge that any performance comparison is fraught with difficulty.

a) There are two outcome variables to consider – both the risk and return
b) The models may not have consistent time horizons
c) Consideration should also be made to the model calibration and constraints used
d) Capital markets have not performed as theory suggests over the last 15 years. Certain high-risk assets such as developed market equity have been outshone by the performance of lower risk gilts.

9.
Appendix

Risk Profilers

FinaMetrica

The FinaMetrica Risk Tolerance Toolkit was launched in 1998. It was developed and trailed in Australia over four years with the assistance of the University of New South Wales. Its now maintained with expertise from the London School of Economics and has gained international recognition as world's best practice. The Toolkit's reliability and validity is backed by over a million uses by thousands of financial advisors in over 20 countries.

The system provides a scientific assessment of an individual's personal financial risk tolerance in plain English. The system uses psychometrics to ensure validity and reliability. FinaMetrica offer a 12 and 25 question risk tolerance questionnaire that can be completed in 15-20 minutes. The 25-question questionnaire measures financial risk tolerance, while the 12-question questionnaire only asks investment questions. A risk profile report is available after the questionnaire is taken and provides a scoring scale from 0 to 100.

FinaMetrica has regional alliances with firms involved in the financial services industry in various countries. FinaMetrica's UK alliance is with Ideals Lab who offers support for UK advisers seeking more information on the FinaMetrica risk profiling system.

Mapping Services

FinaMetrica map a number of risk rated funds provided by asset managers including 7IM, Archita, Santander, SEI, Legal & General and Standard Life.

FinaMetrica will map each of an asset manger's risk rated funds to the appropriate range of FinaMetrica risk tolerance scores. FinaMetrica asset allocation mapping links risk tolerance scores to investment portfolios enabling an apples-to-apples comparison between risk tolerance and portfolio risk. FinaMetrica monitors the strategic allocation of each fund on a regular basis to ensure that the mappings are still appropriate.

Oxford Risk

Oxford Risk (OR) is a spinout company of the University of Oxford, who has retained a significant shareholding in the company. OR was founded by Professor Lord John Krebs, Professor Alex Kacelnik and Dr. Edward Mitchell who have published hundreds of scientific research papers in behavioural ecology, behavioural economics, risk psychology and decision-making.

The Oxford Risk Rating (ORR) Personal Investor assesses the risk tolerances of retail customers when considering the purchase of investment products. ORR Personal Investor provides a scientifically defensible measure to aid the advice process, and is currently available to 40,000 advisers. Their clients include Sesame Bankhall Group, Personal Touch Financial Services, Standard Life, Clarendon, HSBC, RBS, Brewin Dolphin, Rathbones and Legal & General.

OR believe that there are other factors apart from risk tolerance that can help discriminate between investor and customer types. These include:

- Composure – The degree of short-term anxiety than an individual will feel.
- Fear of Catastrophic Loss
- Perceived Financial Expertise
- Delegation
- Belief in skill
- The effect of circumstances

OR have created a risk tolerance assessment specifically for the UK market, which was established through a list of 140 questions. Statistical analysis was then conducted to see how the questions perform and to identify poorly understood or confusing questions. A component analysis was then completed to reduce the number of questions to the minimum set that meets their performance criteria. This led to 18 questions, which equally compromise an assessment of the following factors:

- Risk focus
- Reward focus
- Composure

All 18 questions are regularly reviewed to ensure they are still reliable and valid. A five-point answer option scale is used for most questions. The scale is called the Likert scale, and looks like the following:

(1) Strongly Disagree
(2)
(3)
(4)
(5) Strongly Agree

Therefore higher scores from the questionnaire represent higher levels of risk tolerance and lower scores represent lower risk tolerance.

In OR's methodology document they also mentioned the following:

· Measures of asset risk are based on probability rather than deterministic.
· Volatility treats outcomes that are better than expected as being just as risky as outcomes that are worse than expected.
· Risk tolerance should been seen in the context of the investment objectives, not obscured by them.
· Research shows that attitudes to risk in domains other than financial investing, such as health risks and gambling are unrelated to financial risk attitudes.
· Neither knowledge of finance nor mathematical ability should feature in risk tolerance.
· Risk tolerance should reflect a deep seated and stable aspect of personality.
· A sensible question can fail a statistical test because it doesn't elicit sufficient disagreement amongst respondents.
· Higher wealth normally means higher risk tolerance.
· Older individuals tend to have a lower risk tolerance, as loss aversion becomes a more pressing concern at or approaching the age of retirement.

Risk Profile Boundaries

This paper briefly discusses the two commonly applied approaches to determining volatility bands for risk profiles. Both methods assume that volatility is measured though a portfolios standard deviation and each corresponding investment risk profile has been given its own prescribed level of expected volatility deemed appropriate for a typical investor.

Uniform Volatility Bands

The first method divides the efficient frontier asset strategy into a specific amount of uniform volatility bands. Under the uniform volatility band method an increase or decrease in risk profile just means an increase or decrease in volatility by a uniform amount.

Non-Linear Volatility Bands

This method also considers time, based on the assumption that an investor's willingness to accept risk is dependent upon their time horizon.

Illustrative Example

Assuming that an investor holds £100,000 and that the returns of his investments follow a normal distribution, we can calculate the investor's maximum loss with a 95% confidence level using the following formula:

(1.96 x 100,000 x volatility)

While the % Increase in maximum loss is just the maximum loss of the new risk profile divided by the maximum loss of the previous risk profile.

Below is a table showing the lower and upper risk bands for the uniform method, as well as the maximum loss from the upper volatility band.

Risk Profile	Lower Band	Upper Band	Maximum Loss	% Increase in Maximum Loss
1	0%	2%	£3,920	n/a
2	2%	4%	£7,840	100.0%
3	4%	6%	£11,760	50.0%
4	6%	8%	£15,680	33.3%
5	8%	10%	£19,600	25.0%
6	10%	12%	£23,520	20.0%
7	12%	14%	£27,440	16.7%
8	14%	16%	£31,360	14.3%
9	16%	18%	£35,280	12.5%
10	18%	20%	£39,200	11.1%

The example shows for a lower risk profile investor, moving up a risk profile is significantly greater than a higher risk profile investor moving up a risk profile. So even though the volatility bands are uniforms the difference in risk profiles are not uniform.

Below is a table showing the lower and upper risk bands for a four year time period under the non-linear method, as well as the maximum loss from the upper volatility band.

This example shows for a lower risk profile investor, moving up a risk profile is similar to a higher risk profile investor moving up a risk profile. So even though the volatility bands are not uniform the uniformity in risk profiles is greater than for the uniform volatility band method.

Risk Profile	Lower Band	Upper Band	Maximum Loss	% Increase in Maximum Loss
1	0.0%	3.9%	£7,644	n/a
2	3.9%	4.5%	£8,820	15.4%
3	4.5%	5.3%	£10,388	17.8%
4	5.3%	6.3%	£12,348	18.9%
5	6.3%	7.6%	£14,896	20.6%
6	7.6%	9.1%	£17,836	19.7%
7	9.1%	10.9%	£21,364	19.8%
8	10.9%	12.8%	£25,088	17.4%
9	12.8%	15.3%	£29,988	19.5%
10	15.3%	18.0%	£35,280	17.6%

Platforms and the Tools Embedded Within Them

Platform	Risk Profiling Tool	Asset Allocation Tools
CoFunds	Oxford Risk	DT
FundsNetwork		Ibbottson
Old Mutual Wealth	In house	Towers
Standard Life	Oxford Risk	MA
Transact		
SEI		N/A
James Hay		n/a
AJ Bell Investment		
Zurich		EValue
Elevate	EValue	EValue
Ascentric		
Nucleus	FinaMetrica	
Seven IM		Ibbottson
Aviva		
Raymond James		
Novia	In house	EValue
Aegon		EValue
Parmenion	In house/Edgecumbe Consulting	In house
Alliance Trust Savings		
James Brearley & Sons		
Wealthtime		
Praemium	Oxford Risk	MA
Avalon		
HSBC Private Bank	Oxford Risk	

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