UNDERSTANDING THE RISKS IN NEW ASSET CLASSES

Christopher Chappell, Parit Jakhria, Johann Marais, Andrew Smith

1. Introduction

The eternal search for alpha in benign financial markets has created increased pressure on investors to add new asset classes to their portfolios.

Historically, some life insurance and savings products have been lambasted as labyrinths of complex liabilities that lacked transparency with misunderstood guarantees being offered. Are we inventing financial instruments without learning the lessons from life?

As Barmecidal salesmen bombard board rooms with bavardage and bunkum, do we know what we are buying?

This paper reviews the mean-variance (M-V) framework and highlights some issues that investors should consider before adding the new, more exotic asset classes to their portfolios.

2. Executive summary

Invariably, investment houses use the M-V framework to present investors with new investment opportunities illustrating the potential enhancement in return for a given risk budget. The M-V framework is a useful tool; it is simple and easy to understand. However, it has a number of limitations that should be borne in mind when reviewing the results of the analysis.

Generally, these arise because of

- a lack of historic data on which to base the risk-return frontier for the new instrument,
- information asymmetry between buyers and sellers, and
- the simplified framework having limited ability to capture all the aspects that may matter to an investor, such as optionality and skewness, systematic or diversifiable risk.

The management of an insurance company involves balancing the competing objectives of the various stakeholders. These may give rise to issues that should be considered, which are not illustrated by the M-V framework. As part of the decision making process, these may provide a precursor to the risk-return evaluation using the framework. These considerations may include accounting constraints, ongoing management complexity, corporate responsibility and subjective views of the development of the market in this asset class.

In addition, it might be prudent to make allowance for these issues via the application of margins within the assumptions used as part of the M-V analysis.

These are discussed in more detail below.

3. Investment background

Traditionally, the major asset classes used by institutional investors are

- Equity
- Fixed income
- Property
- Money market instruments

Diversification within these categories is achieved through geographical, sector, credit rating, nominal and inflation based differentiation.

Additional asset classes exist that have been offered to insurance companies to provide enhanced returns, diversification or liability protection. Although some of these investments have existed for a number of years, it is only recently that major institutional investors have considered including these within their investment portfolios. Some of the instruments are listed below with more detail on these asset classes provided in Appendix C.

- Hedge funds
- Private equity
- Commodities
- Structured credit
- Commodities
- Infrastructure
- Variance or volatility swaps
- Insurance securitisations
- Foreign exchange
- Numerous derivatives of other asset classes

Appendix D contains some historical examples of new asset class launches that have seen success or failure. The reasons why some new instruments succeed where others fail are not always transparent – for example, why the markets for index-linked gilts and swaptions have developed, whilst those for zero dividend preference shares and some insurance securitisations have failed to gain traction. This results in insurance companies and pension funds facing the major question:

“How do we determine whether these are appropriate investments for our portfolios?”

4. Classical mean-variance framework

Mean and variance

The classical M-V framework characterises investment in assets (and portfolios of assets) in terms of risk and return. The different portfolios are summarised in the two dimensions with the use of the mean for the return axis[1] and standard deviation for the risk axis. Thus, modern portfolio theory (MPT) provides a method by which rational investors may use diversification to optimise the risk-return trade-off within their portfolios.

Mathematically,

Suppose there are N assets, $A_1 \ldots A_N$,
With mean (A_i) = μ_i, variance (A_i) = σ_i^2, correlation (A_i, A_j) = ρ_{ij}.
A portfolio of assets P, with weights $\omega_1,...,\omega_N$ in each asset, where $\omega_i > 0$ and $\sum \omega_i = 1$, has a return, R_p, that can be expressed in the form

$$\mathrm{E}[R_p] = \sum \omega_i \mu_i = \vec{\mu}\vec{\omega}^T$$
$$Var[R_p] = \sum_i \sum_j \omega_i \omega_j \rho_{ij} \sigma_i \sigma_j = \vec{\omega}\, \mathbb{C}\, \vec{\omega}^T$$

where

$$\vec{\mu} = (\mu_1,\ldots,\mu_N),$$
$$\vec{\omega} = (\omega_1,\ldots,\omega_N),$$
$$\mathbb{C} = (C_{ij})_{N\times N},\ C_{ij} = \mathrm{cov}(A_j, A_j) = \rho_{ij}\sigma_i\sigma_j$$

It is assumed that a rational investor prefers a higher return for the same level of risk and vice versa. Therefore, a portfolio strictly dominates another if it achieves a higher return for a lower level of risk.

Efficient frontier

A portfolio of specific assets into which an investment can be made today generates a point in the risk-return space. The collection of all such points from different possible portfolios of assets defines the investible region. This region is illustrated below with three asset classes.

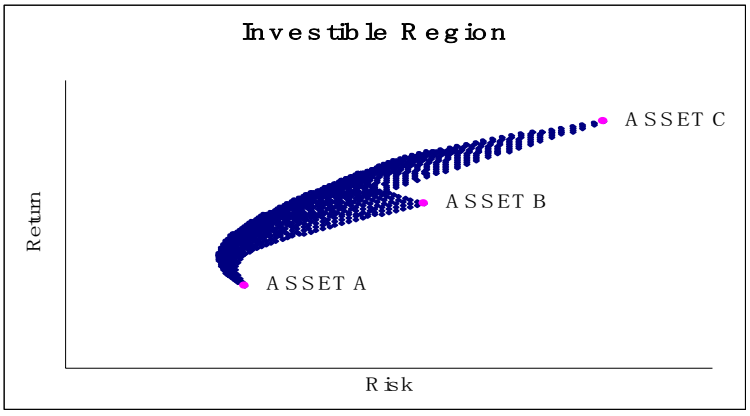

Fig 1

[1] The return of a single asset class is modelled as a random variable and that of a portfolio as a weighted combination of the returns from the mix of assets.

The efficient frontier is the collection of all the points in the investible region that cannot be dominated by any other point in the region. Practically, this is represented by a line along the upper outer edge of the investible region. Combinations along this line represent portfolios for which there is lowest risk for a given level of return. Conversely, for a given amount of risk, the portfolio lying on the efficient frontier represents the combination offering the best possible return.

If we relax the condition that the weights need to be non-negative (i.e. allow short selling of assets), we get a larger investible region.

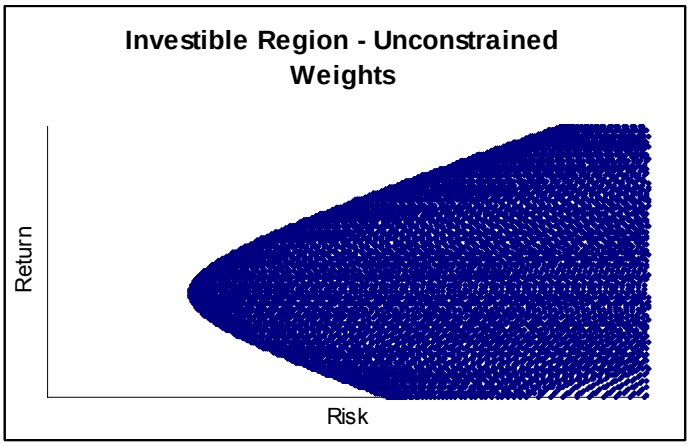

Fig 2

If the assets have non trivial pair wise correlations, the efficient frontier will be convex. This is because the portfolio return is a linear combination of the asset class returns, whereas the standard deviation is less than that implied by a linear combination, resulting in 'diversification'.

The classical theory goes on to define the risk-free return and derive the "capital market line".

Risk-free asset

The risk-free asset gives a certain return equal to the 'risk-free' rate for the chosen time horizon. This is measured in currency terms most easily, but some modellers prefer to measure all returns, including the risk-free return, on an inflation-adjusted basis. As a consequence of the zero variance (and hence covariance with other assets), when it is combined with other assets, the changes in return as well as risk are linear.

Market portfolio

The efficient frontier is a collection of portfolios; each portfolio is optimal for a given level of risk. The Sharpe ratio represents a measure of the amount of additional return (above the risk-free rate) a portfolio provides compared with the risk it carries (a risk-adjusted performance measure). The portfolio on the efficient frontier with the highest Sharpe ratio is known as the market portfolio.

Capital markets line

The properties of the risk-free asset and the market portfolio can be used to create a "capital markets line" (linear combination of risk as well as return with market

portfolio). Graphically, this line originates at the risk-free rate on the y-axis and forms a tangent to the efficient frontier at the market portfolio. Assuming it is possible to borrow and lend at the risk-free rate, and investors consider the Sharpe ratio to be a robust measure of risk-adjusted performance, rational investors will invest at a point along this capital market line that satisfies their risk appetite or return requirements.

The following provides an illustration of the concept above, derived using three risky assets along with a risk-free instrument as detailed in the table below.

	Return	Volatility	Proportion in market portfolio
ASSET A	5%	5%	44%
ASSET B	6%	10%	32%
ASSET C	7%	15%	24%
RISK FREE	4.5%	0%	
MARKET PORTFOLIO	5.8%	5.30%	

Illustration of the capital market line

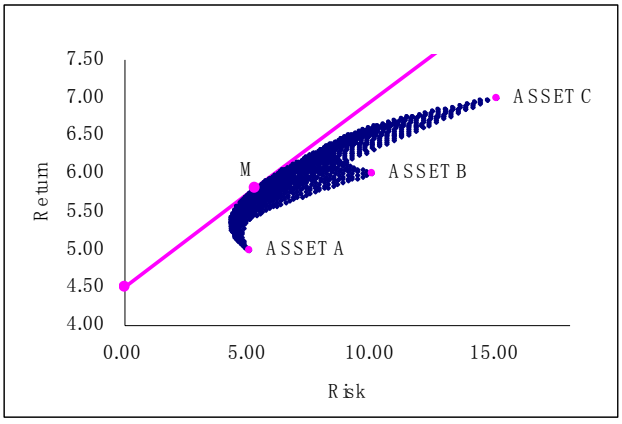

Fig 3

5. Considerations when using the classical mean-variance (M-V) framework

The M-V framework is simple and easy to understand; however, there are a number of considerations that should be made when using the framework. These relate to the three key assumptions – the mean, variance and correlations.

5.1 Parameter estimation

The use of models to support decision making requires the appropriate estimation of parameters to calibrate the model. As a result, projected risks and returns are contaminated with parameter uncertainty.

Whilst parameter error is not unique to investment problems, it is particularly acute where investment optimisation is involved. If all portfolios were truly of the same expected risk and return, and constant over time, statistical analysis would still highlight portfolios that were historically lucky, that is, performed well with low variability. Using realistic parameters, we find that the reward for a given level of risk is likely overestimated by a factor of three.

Mathematically, to see the effect of parameter estimation, we try a thought experiment to maximise the Sharpe ratio. Imagine there are N risky asset classes in addition to the risk-free asset. Suppose also that the returns over a one-year time horizon in excess of the risk free rate have mean μ and variance-covariance matrix *V*.

A portfolio with holdings *h* in each risky asset then has dollar gains with mean $h.\mu$ over the risk free rate, and variance $h^T Vh$. The Sharpe ratio is the return over the risk free rate divided by the standard deviation.

Sharpe ratio = $\dfrac{h.\mu}{\sqrt{h^T Vh}}$

From the Cauchy-Schwartz inequality, we can find an upper bound on the Sharpe ratio.

$$\frac{h.\mu}{\sqrt{h^T Vh}} \le \sqrt{\mu^T V^{-1} \mu}$$

The equality holds when *h* is a positive multiple of $V^{-1}\mu$. In classical mean-variance analysis, these values of *h* correspond to efficient portfolios, the return of which is as large as possible given the risk.

We denote the maximum Sharpe ratio by *S*, where

$$S = \sqrt{\mu^T V^{-1} \mu}$$

We now seek to investigate the effect of parameter uncertainty on the estimation of *S*. Suppose that μ and *V* are unknown, but to be estimated from *T* years of historic data, with $T > N$. We denote by X_t the vector of historic returns on each risky asset in excess of the risk-free rate. The estimated mean and variance-covariance matrices are given below.

$$\hat{\mu} = \frac{1}{T}\sum_{t=1}^{T} X_t$$

$$\hat{V} = \frac{1}{T-1}\sum_{t=1}^{T} (X_t - \hat{\mu})(X_t - \hat{\mu})'$$

We are interested in the sampling distribution of the estimated maximum Sharpe ratio, that is:

$$\hat{S} = \sqrt{\hat{\mu}^T \hat{V}^{-1} \hat{\mu}}$$

Using a theorem stated by Anderson (1957)[2], based on normal distributions, we can compute that:

$$\mathbf{E}\left[\hat{S}^2\right] = \frac{T-1}{T-N-2} S^2 + \frac{(T-1)N}{T(T-N-2)}$$

If we had an unbiased estimate, the right hand side would be simply S^2. The effect of the bias is startling. For example, suppose we take:

True Sharpe ratio S = 25%
Number of risky assets N = 10
Years of calibration data T = 30

We find that

Expected squared estimated Sharpe ratio $\mathbf{E}\left[\hat{S}^2\right]$ ~ (80%)^2. In other words, where an unbiased Sharpe ratio estimate should be 25%, historic data results in an estimate of 80%, overstating prospective returns by more than three times.

As more years are added the problem does abate. For example, using 500 years of data, we are likely to reduce the estimate of S to 30% from 80%. It is worth noting that a significant volume of historic data is required to materially reduce the amount of over estimation.

Smith (2003)[3] shows a number of possible solutions to reduce the bias. However, the bigger part of the solution is to use other knowledge of the world to prevent the bias occurring in the first place. This means using economic theory to explain returns and risks. For example, if one equity market appears to have higher predicted returns and lower risks relative to another market, users should seek an economic explanation before relying on such a pattern persisting.

[2] Anderson (1957) An Introduction to Multivariate Statistical Analysis. 3rd Edition, Wiley. Page 176.

[3] Smith (2003). Fools Gold -Beating the Bias, http://www.actuaries.org.uk/files/finance_invest/foolsgold20030217.ppt

5.2 Data

Using historical data

The use of historical data for the return and risk parameters may result in the reward not being earned for taking risks. The rewards and risks may reflect the rewards that would have been achieved if we had perfect hindsight, or the assumed risk profile may not reflect the future interactions resulting in the buyer not receiving the protection believed to be purchased (for example, if the correlations and variance do not hold in the future).

Lack of data

It is in the nature of new investments that historic data is limited. Therefore, parameter estimates are uncertain. As far as possible, to mitigate this uncertainty, estimates may be based on other investments with similar characteristics, or the history of simpler component assets that underlie the new structure.

For example, consider the modelling of a CDO (collateralised debt obligation). These instruments have become popular over the last 10 years. Indices have only recently emerged, including the iBoxx and iTraxx series, but there was little hope of getting useful historic data on CDO's before CDO's existed. Many CDO's are rated, so one way to model them would be to assume they behave in a similar manner to other instruments with similar credit ratings, for example, corporate bonds. An alternative approach is to model each of the individual bonds underlying the CDO, where more relevant historic data is available, feeding the modelled bond performance through the CDO structure.

The changing future environment

The familiar mantra about the past not being a guide to the future, is especially relevant for new financial instruments. Whilst the insurance industry changes continuously, periods of rapid change are generally accompanied by rapid product innovation. Thus, new product evaluations are particularly likely to occur during these times of change. In some cases, the change is external and the product is a response to that change – new products emerge to exploit tax or regulatory arbitrage opportunities - in other occasions, the existence of the product may change the market itself.

In the latter, the emergence of new instruments may change the shape of the data and interactions resulting in the assumptions being invalid even if the investment banks undertake reasonable methods fore the derivation of the assumptions.

For example, there is a one-off effect of information becoming available after a product launch. Most new products are illiquid and initially seen as risky because their future performance is unknown. Over time, products either join the mainstream, in which case the initial risk premium is reduced, or the product fails to catch on in which case the existing issues sit forgotten, illiquid in buy-to-hold portfolios. In either scenario, the performance in the early months and years is not typical of subsequent behaviour, nor truly reflected in the historic assumptions derived from similar assets used to set the parameters for the new asset class.

Selective marketing

It is possible that hindsight may provide the view that investment bank marketing departments have been opportunistic and selective with aspects of product marketing. At any point in time, an investment bank may have dozens of products under development. However, some of these will look more impressive than others on a past performance basis. As you would expect, marketing departments may focus their efforts on the more impressive products; thus, potential investors need to consider whether the statistics for these products are an adequate guide to the value offered by the product issuer. On occasions, the reverse may apply, that structured products are offered to investors when they appear cheap on a historic basis.

To make an allowance for these issues, it may be possible to make an adjustment to the expected return to allow for the bias caused by the opportunistic and selective aspects to product marketing.

5.3 Correct parameters

The M-V framework provides a two dimensional analysis. It assumes that the expected return and the volatility only (i.e. mean return and standard deviation) matter to the investor. This assumption may not fully capture characteristics that are important to the client. For example

- The standard deviation risk measure results in positive and negative returns receiving equal weighting. As seen in many papers and submissions to the FSA, assumptions in the tail of distributions could be significantly different from those applicable for small fluctuations around current market positions.
- The framework captures first order linear moments and thus, it is difficult to reflect liability optionality - a characteristic highly prevalent in life insurance.
- The framework assumes the investor is indifferent to other characteristics of the distribution of returns, such as skew. Real world attitudes to risk may lead to high levels of skewness. Therefore, in mean-variance terms, an investor can improve performance by "selling" skewness, i.e. by accepting negatively skewed returns in return for improvements in mean and/or variance. The implication of this is that portfolios which contain fairly-priced option positions (or follow equivalent dynamic strategies) will have their performance mis-measured.
- The framework is more controversial in an institutional context, especially when risk and return for a portfolio does not translate easily into risk and return for an end-user investor. For example, to consider the attractiveness of a with-profits savings policy, account should be taken of guarantees and charges, not only the underlying investments. Furthermore, from a shareholder perspective the risk and return must be measured in aggregate across a business, or indeed across an investor's portfolio, which may not correspond directly to risks and returns measured for one fund in isolation.

In summary, return and variance may not completely describe the risk and return properties of an asset class, especially for the new asset classes with a non-standard distribution (e.g. CDOs). The framework has two dimensions, limiting the analysis to the best two metrics with which to characterise the assets and the liabilities.

5.4 Taking the liabilities into account

The risk and return should be considered after taking into account the nature of the liabilities for the particular investor being considered. This is because the liabilities of an institutional investor are usually inter-related with the assets. Thus, different definition of risk and return may result relative to the unconstrained investor as illustrated in the mean-variance analysis earlier. The following example illustrates how the framework could be applied to a life insurance company.

Life insurance company example

> *Return* – It may be assumed that the expected return on the assets should have a 1-1 relationship with the return measure that is most important to the company and hence be a simple and reasonable proxy for the return metric. Alternative metrics could be profit measures (e.g. European Embedded Value)
>
> *Risk* – Standard deviation is no longer a good measure, because the owners are more concerned about downside risk than upside risk – hence a Value at Risk (VaR) measure would be more suitable. The Pillar II capital regime fits this concept nicely and the Individual Capital Assessment (ICA) capital requirement would be natural proxy for the risk metric.
>
> Thus we can compare different investment strategies by mapping each investment strategy onto the two dimensional space of risk and return. We can then investigate which investment strategies lie on the efficient frontier and use the company's risk appetite to choose the appropriate point on that frontier.

6. Process for decision making

The decision making process encompasses consideration for the various stakeholders in a company.

- Shareholders and policyholders
- Regulators and rating agencies
- Management and staff

The following table provides an overview of a qualitative selection process under which the investment opportunity may be rejected or passed to consideration as part of a strategic review process. This process may be used prior to undertaking analysis using a M-V framework. Appendix A contains a more detailed breakdown of the questions.

Stakeholders	Rejection	Strategic review
Policyholders and shareholders	Treating customers fairly	PPFM and illustrations
	Risk appetite constraints	Brand/reputational damage
	Understanding of principle risks	
Regulators and rating agencies	Solvency of dependent entities	Investment admissibility
	Management conflict of interest	Regulatory reporting
	Product disclosed to regulators for approval	
Management and staff	Credibility/track record of party offering opportunity	System requirements
	Openness and transparency of disclosures	Management time and cost
	Ability to audit process and controls of company	

7. Making adjustments within the M-V framework

If you are theoretically satisfied with the investment forming part of the overall portfolio, the benefit may be further evaluated using the M-V framework. In establishing the M-V framework for analysis, we must ensure that the two metrics of risk and return are the most appropriate.

It is possible to review the results without adjustment and make a subjective call as to the reasonableness of any solution. An alternative approach is to consider margins for uncertainty or sensitivity scenarios to increase comfort in the call being made.

There are three basic parameters to be considered.

- The mean return
- The variance
- The correlation

The following proposes adjustments that could be made to each, depending on the answers to certain questions. Further detail is shown in Appendix B.

Issue		Mean	Variance	Correlation
Parameter estimation	Issuer experience	Subtract 50bp	Add 5%	Add 20%
	Number of market makers		Add 10%/N where N is the number of market makers	
Data quality	Own data available	Subtract 50 bp	Add 3%	Add 20%
	Historic data available			
	Reputable independent source			
Selective marketing	Favourable recent history	Subtract 50 bp	Add 3%	Add 25%
	Advantageous product construction			
	Geared return			
Environmental	Taxation treatment	Subtract 25bp		
	Exposed to consumer behaviour		Add 3%	
Source of enhanced return	Based on key personnel		Add 3%	
Liquidity	Prospects for secondary market or future issuance			
	Ability to unwind or roll position easily	Assume bank makes max{1% spread on the implied volatility or 0.5% of notional} on each rollover.		

8. Conclusion

The ideal world would enable objective assessment of parameters, where the estimates were well founded and accurate, and significant appropriate volumes of data existed on which to base assumptions. This may be viewed as the Sarbanes Oxley world.

However, reality in the field of new assets and innovations does not lend itself to such an environment. It is not feasible to adjust parameters to zero for elements we can't assess objectively. There is a requirement to apply common sense and a structured approach to deriving educated adjustments to parameters to understand the sensitivity of the underlying assumptions on which we make our decisions.

In evaluating new asset classes, it may not be appropriate to pick a strategy located on the efficient frontier but to invest in one which shows least sensitivity to appropriate scenarios that reflect elements where the robustness of the M-V framework may be questioned.

This paper highlights the difficulties in deriving appropriate objective sensitivities and attempts to provide a basis for discussion at the Finance, Investment and Risk Management conference. The discussion is to leverage the opinions of an experienced actuarial community from diverse backgrounds to assist the profession in deriving a mapping of reasonable consideration in a highly subjective arena.

Appendix A

The following details questions that may form part of pre-discussions about investment in a new asset class.

Shareholders and policyholders

Alignment with representations

Question	Thought
Does the investment fit with TCF and PPFM considerations?	Representations would have been made that suggest a certain risk exposure
Where does the asset fit – policyholder fund or shareholder fund	Policyholders should not pay for shareholder benefit
How will the investment impact our projections/illustrations?	If the impact is significantly adverse it might be difficult to market and could create a significant impact on persistency and new business volumes

Risk aggregation and exposure

Question	Thought
How does the investment impact our risk appetite/tolerance?	We might already be at the limit of our tolerance
Do we understand the principle risks and threats inherent in this investment?	Market, credit, correlation, gearing, new market failure, driver of the enhanced return, reliance on key investment gurus

Corporate Responsibility

Question	Thought
Does it involve exposure to tobacco, armaments or any investment that may not meet our social responsibility or ethical investment requirements?	Damage to brand and thus business
Does this investment require actions (aggressive debt collection, asset stripping) which could harm our brand?	Damage to brand in addition to adverse publicity

Regulators and rating agencies

Corporate Structure

Question	Thought
What legal entity issues this structure?	The structure may lead to admissibility issues
Is the product dependent on the solvency of any other entity?	Care should be taken if there is a chance of default or collapse
Who are the end shareholders? Is there scope for conflict of interest?	
Could the structure be used for money laundering?	

Reporting

Question	Thought
Has the proposition been shared with the regulators/tax authorities for review?	If not, do this first before expending time on a wasted initiative.
Is there a material adverse impact on GAAP reporting?	
Is there a material adverse impact on the treatment of other assets and liabilities	
Is there access to timely data that we can use for appropriate valuation purposes? Are we reliant on certain key sources for data?	

Management and staff

Ongoing Management

Question	Thought
Do we have a good understanding of how this product is likely to behave?	If we can't grasp this, then it is probably best to leave it alone
How much management time will be taken to monitor this investment?	
Do we have systems to support the data management or will significant investment be required?	

Biases

Question	Thought
What is the history of the company offering the new instrument?	Care should be taken if they have a poor track record of honesty and integrity
How open and transparent are they being?	If we have questions on transparency we should ask ourselves whether it is the result of them not understanding the proposed opportunity fully, or whether something is being hidden
Can we audit their processes and controls?	It may be that operational issues are important. If managers are crucial to deriving enhanced return, we need to review freedoms and controls in place and develop relationship such that we know the key individuals.
Are we being offered a theoretical free lunch?	Theoretical free lunches don't exist, so consider whether risks are being missed, or whether the opportunity is not being priced correctly
Does the investment bank appear to understand the risks it is taking?	If not, don't touch it
Is the investment bank open as to how it is mitigating/managing these risks?	May be exposed to excessive risk taking you do not intend to take. You want to know it has its risks under control.
How much expertise do we have in	If we don't have experience we need to

relation to the investment?	understand whether we need to develop the expertise.
Does the seller have greater expertise than we do?	If they do, we may want to reconsider spending time to develop knowledge before taking this further. This may tie with how much we trust the seller
Do we understand the principles on which the pricing model is based?	If we don't understand the principles we need to spend time to understand the pricing, which will give us some feel for how the value is going to move under market conditions.
How pushy is the sales person?	Consider whether the sale creates a conflict/self interest

Appendix B

The following provides an overview of issues that may lead to adjustment to the assumptions within a M-V framework or proposed sensitivities.

Question	Adjust mean	Adjust standard deviation	Adjust correlation
Parameter estimation errors			
Does the issuer have experience of this type of transaction?	Subtract 50bp	Add 5%	Add 20%
How many market makers contributed to the historic performance data?		Add 10%/N where N is the number of market makers	
Historic data/credibility of data/source of data			
Is the source of the information on which our understanding of the behaviour of the new asset class based our own?	Subtract 50bp	Add 3%	Add 20%
Are there comparable investments whose history we can examine?			
Can we verify the data (eg from Datastream, Reuters, Bloomberg)?			
Are the correlations based on historic experience of the constituent assets?			Add 20%
Selective marketing			
Is it a fashionable push on diversification under which historic returns look good because of timing of money flows into investment, gearing, point in cycle (e.g. technology bubble)?	Subtract 50bp		
Can we explain aspects of the data (mean return, volatilities, and correlations) in terms of what we know about the way the product is put together?	Subtract 50bp	Add 3%	Add 25%
Is the investment geared?		Add 3%	
Change in future environment			
How does it change our tax position (if at all)?	Subtract 25bp		
Does the product rely on benign overseas tax or regulatory treatment?			

Question	Adjust mean	Adjust standard deviation	Adjust correlation
What are the risks of challenge from tax authorities?			
What is the current tax treatment? If it is new, is the tax treatment likely to change as a result of its introduction (ie assets based on arbitrage)? Does a tax treatment history exist?			
Is the investment exposed to social trends or consumer behaviour?		Add 3%	
Source of enhanced return			
What derives the enhanced return? If its quality of management, what is their track record? What would happen if they moved banks?		Add 3%	
What "peso effect" rare events threaten this product but are absent from the historic data?	If peso effects, reduce expected return by spread on a bond of similar credit rating		
Can we replicate the pricing model?		Add 3%	
Does this investment contain risks correlated to others in our portfolio?			Adjust accordingly
Liquidity			
What is the prospect for future issuance? How many of our peers has this been shown to? How many of them have invested, and how much?			
Can it be easily mimicked by other institutions such that it would catch on? Is the investment transparent?			
How liquid is the secondary market for this product?			
How can we unwind our position?	If difficult, assume transaction costs incurred		

Question	Adjust mean	Adjust standard deviation	Adjust correlation
	over 5 years as reduction in return		
If there is expiry of options and they need rolling, will we be at a competitive disadvantage (ie bank can charge more than a fair price to roll a complex structure)?	If yes, assume bank makes max{1% spread on the implied vol or 0.5% of notional} on each rollover.		
Additional risks introduced			
Does it increase our credit exposure to an existing counterparty?	Appropriate adjustment		
Where is the legal entity located? Do we understand the reasons for the chosen legal structure?		Add 3%	
Under what legal jurisdiction is the instrument constructed? What is the political stability of countries involved?			
Does the country have a stable regulatory framework, up to international standards?			
What other risks do we introduce e.g. operational risk?	Appropriate adjustment for risk	Appropriate adjustment for volatility	

Appendix C

ALTERNATIVE ASSET CLASSES

Hedge funds

Defined as a pooled investment vehicle that is privately organised, administered by professional investment managers and is not restricted to a long-only, non-geared investment strategy

Characterised by:

- Placing of many large bets on different assets
- A high level of borrowing given the limited size of the capital
- A mix of investments for which price movements would be expected mostly to cancel each other out, except for the positive effect the fund is looking for.
- A willingness to trade in derivatives, commodities and non-income bearing securities

Private equity

The provision of equity capital where there is no immediate exit mechanism through a secondary market.

Characterised by:

- Unlisted and therefore relatively illiquid
- Difficult to place a value on the holding
- Often difficult to obtain management information.
- Invest, build and optimise, sell!
- Higher returns than in equity market, but higher risk as well

Commodities

A commodity is something that is relatively easily traded, that can be physically delivered, and that can be stored for a reasonable period of time. It is a characteristic of commodities that prices are determined on the basis of an active market, rather than by the supplier (or other seller) on a "cost-plus" basis. Examples of commodities include not only minerals and agricultural products such as iron ore, crude oil, ethanol, sugar, coffee, aluminium, rice, wheat, gold, diamonds, or silver, but also so-called "commoditised" products such as personal computers. When they are traded on an exchange, commodities must also meet specified minimum standards, also known as a basis grade.

Structured credit (e.g. CDOs, Leveraged Loans)

Structured assets resulting from the securitisation of revenue generating assets held by the borrower

The underlying assets for this type of investment are credit instruments, eg bank loans, bonds etc

Infrastructure

The financing of long-term infrastructure, industrial projects and public services based upon a non-recourse or limited recourse financial structure where project debt and equity used to finance the project are paid back from the cash flow generated by the project.

Variance swaps
A type of volatility swap where the payout is linear to variance rather than volatility. Therefore, the payout will rise at a higher rate than volatility

Insurance securitisations
This is a type of securitisation where a financial security is created that is backed by the receivables arising from an insurance book.

Foreign exchange
The foreign exchange (currency or forex or FX) market exists wherever one currency is traded for another. It is by far the largest market in the world, in terms of cash value traded, and includes trading between large banks, central banks, currency speculators, multinational corporations, governments, and other financial markets and institutions. Retail traders (individuals) are currently a very small part of this market and may only participate indirectly through brokers or banks.

Appendix D

EXAMPLES OF HISTORIC SUCCESSES AND FAILURES

The following list provides examples of historic “successes and failures”.

(a) The emergence of CDOs as a major asset class accompanied the Basel capital accord, which had a profound effect on the way banks priced corporate lending. The emergence of CDOs accompanied a step change in the behaviour of the underlying debt instruments.
(b) There remains a debate on the effect of the euro on volatility of other assets. For example, some argue that it is now less risky for a Frenchman to invest in a Greek bank because the currency risk has been eliminated by the Euro. Others argue that fluctuations in the relative fortunes of the French and Greek economies continue, but these now transmit into share price volatility rather than exchange rates.
(c) The UK was one of the earlier countries to issue index linked gilts in the early 1980’s. They initially enjoyed substantial yields of over 4%, levels which have never been achieved since. Many interpret this as a risk premium on a new instrument which was no longer required as the index linked market became mainstream.
(d) In addition, other interest rate markets were affected, as the issuance of index linked gilts is read as a signal from the government of a greater determination to tackle inflation.
(e) The spread between swaps and gilts has narrowed from over 50bp in the early 90s to around 20bp currently. This has happened during a period when swap volumes have grown exponentially, liquidity has improved dramatically and more sophisticated collateral arrangements mitigate the severity of swap counterparty exposure.
(f) The market in central European swaptions (Zloty, Korun, Forint) is now developing, at as time when likely euro convergence has reduced the volatility of these interest rates. As a result, the price of swaptions appears cheap relative to historic volatilities, leading to greater interest from purchasers of interest rate protection.
(g) The promotion of commodity funds as diversifying investments reached its nadir in the early 2000’s, following a period where equities had fallen in value and commodities had shown strong price growth. This was likely an opportunistic development from the sellers of these funds, as other data periods would not necessarily support the diversification or high return claims.
(h) Geared investment trusts provided very high returns during the late 90's. Problems in the sector were largely caused by the high level of borrowing run by some trusts, and the practice of 'cross-holdings', where trusts held shares in other split capital trusts. Borrowing (gearing) magnified returns in good times, but worsened them when the stock markets fell.

Appendix E

GLOSSARY OF USEFUL TERMS

Sharpe ratio
A ratio developed by Bill Sharpe to measure risk-adjusted performance. It is calculated by subtracting the risk free rate from the rate of return for a portfolio and dividing the result by the standard deviation of the portfolio returns.

$$S = \frac{\bar{r}_p - r_f}{\sigma_p}$$

Where

$\bar{r}_p$ = expected portfolio return
r_f = risk free rate
σ_p = portfolio standard deviation

Notes:
The Sharpe ratio tells us whether the returns of a portfolio are because of smart investment decisions or a result of excess risk. The Sortino ratio is a variation of this.

Sortino ratio
Similar to the "Sharpe ratio," except it uses downside deviation for the denominator, whereas Sharpe uses standard deviation.

Notes:
This ratio was developed to differentiate between good and bad volatility in the Sharpe ratio.

Treynor ratio
Also similar to the Sharpe ration, except that it uses portfolio beta rather than standard deviation

$$T = \frac{r_p - r_f}{\beta_p}$$

Where β_p is the systematic risk of the portfolio.

Information ratio
This is used to combine risk and historical return (relative to a benchmark). The information ratio is the ratio between the relative return and the historical tracking error.

$$IR = \frac{\text{Mean (relative return)}}{\text{Std deviation (relative return)}}$$

The relative return is defined as the difference between the actual portfolio return and the benchmark return over the same period. The historical tracking error is the standard deviation of the difference in returns over the same period.