Asset Allocation:
Analysis of Theory and Practice
in the Australian Investment Management Industry

Thesis submitted in fulfilment of the requirements
for the degree of Doctor of Philosophy

Lujer Santacruz
MFinPlan, MBusMgt, BScMEng

School of Commerce
Faculty of Business Education Law and Arts
University of Southern Queensland
Toowoomba Queensland 4350 Australia

2015

Table of contents

Abstract

Asset allocation is the decision on how much of the investment portfolio to place in each of the broad asset classes (e.g. cash, fixed interest securities, property, equities). It is a key decision area in the investment management industry, where professional investors manage pooled investments. The present research examined any dichotomy between theory and practice of asset allocation in the Australian investment management industry. It surveyed the available body of research on asset allocation consisting of Modern Portfolio Theory from the seminal Markowitz mean-variance formulation to subsequent research strands. It utilised a combination of qualitative and quantitative methods to examine the level of awareness and usage of asset allocation theories and theory-based methods among investment management industry practitioners. The present research established that while there is a high level of awareness, there is a low level of usage of asset allocation theory and theory-based methods in the industry. Structural Equation Modelling identified perceived usefulness as having the strongest influence on usage. Recommendations mostly revolving around improving the interaction between academe and industry are made that may help reduce the theory-practice dichotomy. Limitations of the present research are discussed as well as future areas for related research.

Certification of thesis

I certify that the work reported in this thesis are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

5 November 2015

Lujer Santacruz — Date

Supervisors' endorsement:

5 November 2015

Chandrasekhar Krishnamurti — Date

5 November 2015

Frank Elston — Date

Acknowledgements

I am very grateful to my wife Bella and daughter Maria who have served as both motivation and inspiration for me throughout my PhD undertaking.

I am thankful to my PhD supervisors Prof Chandrasekhar Krishnamurti and Dr Frank Elston for their guidance and constructive feedback. I am thankful to my USQ colleagues who reviewed and provided suggestions on my PhD research proposal as panellists: Associate Professor Peter Phillips who was also the one who suggested the research topic to me, Associate Professor Joseph Mula who also provided valuable comments on the first draft of the complete thesis and Professor Julie Cotter who also introduced me to Research Methods.

I am grateful to Nobel Laureate Prof Harry Markowitz, who was largely responsible for originating the body of knowledge on portfolio optimisation which is the subject of this thesis. I greatly admire his generosity in sharing his valuable time and his insights with me when I met with him over an extended lunch in San Diego on 15 November 2012.

List of figures

List of tables

Chapter 1: Introduction and aims

1.1 Background

An investor's portfolio is his or her collection of investment assets. Investors make two levels of decision in constructing their portfolios namely asset allocation and security selection. "Asset allocation is the choice among broad asset classes (e.g. cash, fixed interest securities, property, equities) and the decision on how much of the portfolio to place in each one. Security selection is the choice of specific securities to hold within each asset class" (Bodie, Kane & Marcus 2011 p. 36). The present research investigates asset allocation although as the literature review will show, asset allocation studies sometimes actually involve security selection in that they are allocating the total value of the portfolio among several securities under the same asset class.

The significance of asset allocation on portfolio performance has been established in the literature. Using US investment data, it was found that around 90 percent of the variability in returns across time of a typical portfolio is explained by asset allocation (Brinson, Hood & Beebower 1986). A similar study using data for an Australian fund manager arrived at the same conclusion (Santacruz 2013). A follow up study to Brinson et al. (1986) found that around 40 percent of the variation of returns across several portfolios is explained by asset allocation (Ibbotson & Kaplan 2000). A later study decomposed portfolio return into its components namely market return, asset allocation returns in excess of the market return and security selection return in excess of the market return, to control for the pervasive influence of the market and found the latter two components equally important (Xiong et al. 2010).

There is a wealth of academic literature on the topic of asset allocation for investment portfolios. Whether this body of theory is being put to practical use in the investment management industry is not readily apparent. Here, investment management is defined as the job of planning, implementing, and overseeing the funds of an individual investor or an institution (Fabozzi et al. 1999). The challenge for investment theory appears to be in putting a rich set of tools into practice, akin to a "tough engineering problem and not one of new science" (Merton 2003 p. 23).

1.2 Research objectives

The objective of the research is to examine any dichotomy between theory and practice of asset allocation in the Australian investment management industry. Studying asset allocation theory and practice in relation to one another may lead to finding ways of improving both. The research will: (1) identify any dichotomy between theory and practice and the reasons for their existence; and (2) make recommendations that may help reduce the dichotomy.

1.3 Main research question

The research addresses the following main question: to what extent are available theories and theory-based methods of asset allocation being applied to practice in the Australian investment management industry? Research sub-questions in support of this main research question are detailed in Chapter 4.

1.4 Motivation for the research

The motivation for the research is the importance of being able to put the body of theory on asset allocation to practical use, which importance also applies to other areas of research. The research may benefit both academe and industry by suggesting ways to help reduce the dichotomy between theory and practice. A possible result from this is the development of more optimal asset allocation strategies for institutional investors that will have flow-on benefits for individual investors as well. Investment industry realities, in turn, can also guide future research. There could also be implications for finance education in the area of portfolio construction and management. Furthermore, the research methodology and any conceptual models developed can be applied in examining similar theory-practice dichotomies in other areas.

1.5 Expected contribution of the research

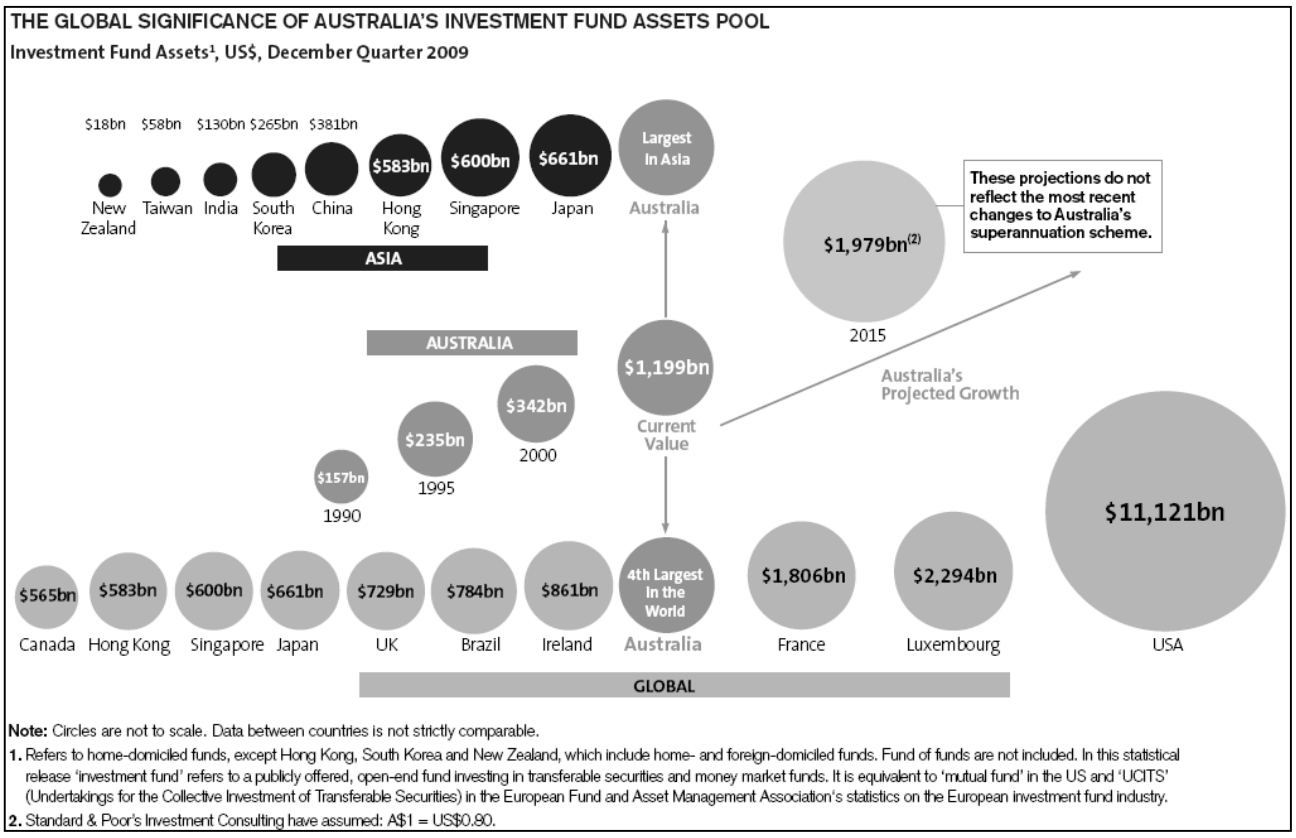
The research is underpinned by an extensive survey of extant literature on asset allocation theory and theory-based methods. The research therefore contributes to addressing the gap in literature that extensively surveys the wide range of research on the topic of asset allocation.

The research also contributes to the body of knowledge by specifically studying asset allocation theory and practice in the Australian context. As the literature review shows, there are previous similar studies on the theory-practice dichotomy but on other aspects of finance.

The only closely similar study looked at the evidence from Europe, but it was not based on a comprehensive survey of available asset allocation theories and did not probe the reasons for the dichotomy. Studying asset allocation theory and practice in the Australian context fills an apparent gap in the literature.

Focusing the study of asset allocation on the Australian investment management environment enhances the chances of the research recommendations becoming implementable, aside from the apparent advantage of access to primary and secondary data. It should also be pointed out that Australia's investment management industry is a major player, being the largest in Asia and the fourth largest in the world, as shown in figure 1.

Figure 1: Size and scale of Australia's investment management industry (Austrade 2010)



The key drivers in the sustained growth of Australia's investment management industry are the country's universal pension system known as superannuation, a strong insurance sector, growing high net worth and retail investor sectors and steady economic growth (Austrade 2010). As there are no drastic reversals expected in these drivers, Australia can be expected to remain a key player. While the research focuses on asset allocation practices of institutional

investors, it effectively covers individual investors as well because of the prevailing practice of financial planners recommending to their individual clients the same model portfolios as those of the institutional investors that they are affiliated with (Santacruz & Phillips 2009).

1.6 Structure of the thesis

Chapter 1 provides an introduction to the thesis in terms of background, research objectives, main research question, motivation and expected contribution.

Chapter 2 is a literature review surveying extant theories and theory-based methods of asset allocation. The review plays a major role in the research as the theories and methods surveyed are also the ones that will be assessed as to whether they are being applied in practice.

Chapter 3 is a literature review on asset allocation theory-practice dichotomy. It looks at previous research investigating the dichotomy and identifies any gaps in the literature.

Chapter 4 discusses the research questions and the proposed conceptual model and hypotheses that will be used to address these questions.

Chapter 5 discusses the research methodology employed to address the research questions using the proposed conceptual model.

Chapter 6 presents an overview of the investment management industry in Australia.

Chapter 7 details the methods and results of Study number 1 investigating the opinions of academics on the importance of asset allocation theories and theory-based methods.

Chapter 8 details the methods and results of Study number 2 investigating the process of asset allocation in the Australian investment management industry.

Chapter 9 details the methods and results of Study number 3 investigating the level of awareness and usage of asset allocation theories and theory-based methods among industry practitioners and the reasons behind these.

Chapter 10 discusses the conclusions of the research, lists some limitations and proposes possible future research areas.

Chapter 2: Literature review surveying asset allocation theories

This chapter of the thesis provides an extensive survey of available asset allocation theories and theory-based methods. It is more than just background information and will play a major role in the research as the asset allocation theories and theory-based methods surveyed are also the ones that will be assessed as to whether they are being applied in practice.

2.1 Modern Portfolio Theory (MPT)

2.1.1 Historical background

The formulation of portfolio asset allocation is an example of decision making under risk and uncertainty. To fully understand the theory behind it, it is essential to trace the origins of the theories on risk and uncertainty (Prigent 2007).

The original thinking in the academic community was that decision making is purely based on an assessment of expected values. However, the so-called St. Petersburg Paradox initially proposed in a 1713 letter by Nicholas Bernoulli showed that a hypothetical gamble resulting in a random variable with infinite expected value would nevertheless be considered worth only a small amount of money (Rubinstein 2006). Daniel Bernoulli in 1738 explained this paradox by pointing out that the single measure of expected value of a loss or gain in wealth is not adequate to explain human behaviour. He instead asserted that individuals will seek to maximise expected utility and suggested a utility function having properties such that the value of a gain in wealth is inversely proportional to wealth already possessed (Bernoulli 1954). Therefore, individuals with different utility functions and wealth situations will not have the same considerations in evaluating a gamble, or an investment in general.

Despite the ground breaking insight offered by the work of Bernoulli, there was little attempt to study the importance of risk and uncertainty on economic decisions for the next 200 years (Rubinstein 2006). One of the first to suggest that risk and uncertainty play a key role in economic theory was a book that came out much later (Knight 1921). Knight argued that in an economic system with perfect competition and perfect information, no profit would exist. In the real world, entrepreneurs would earn profits as returns for their putting up with uncertainties about information. Knight's use of probability theory in his analysis also led him to the belief that uncertainty could be reduced to a measurable degree through the use of a

well-diversified portfolio, foreshadowing investment theories that would be developed later on (Stabile 2005).

In a seminal book, an axiomatic analysis was provided justifying that rational individuals should make decisions under uncertainty by maximising their expected utilities (Von Neumann & Morgenstern 1947), as originally suggested by Daniel Bernoulli. Building on this Theory of Expected Utility, the concept of risk aversion was developed assuming utility as a concave function of wealth, similar to Bernoulli's. It was demonstrated that a risk averse agent will avoid a fair gamble, or will require an inducement to take it, as its expected utility will lie below his concave utility function (Friedman & Savage 1948).

2.1.2 Markowitz mean-variance model of asset allocation

The papers cited in the previous section and some other early works in financial economics provided the theoretical foundations for the ground breaking paper (Markowitz 1952) that originated the body of theory referred to as Modern Portfolio Theory (MPT). The Markowitz mean-variance formulation of MPT is the first mathematical exposition of the concept of diversification of investments although this has always been practiced on an ad hoc basis (Rubinstein 2006). In his paper which derives from his PhD dissertation, Markowitz specified two variables that impact the formulation of portfolio asset allocation namely expected portfolio return (now commonly represented by the vertical axis) and expected portfolio risk which he defined as the variance of expected returns (now commonly represented by the horizontal axis). He rejected deciding solely on the basis of maximising expected portfolio return as this will ignore the risk-averse investor's desire to minimise expected portfolio risk and will also contradict the pervasiveness of the practice of diversification. Markowitz demonstrated how the combination of asset classes or securities in a portfolio could minimise portfolio risk at a given level of expected return or maximise expected return at a given level of risk, thereby providing the theoretical rationale for diversification.

Given a portfolio consisting of n assets with w_i as the fraction of the total portfolio value held in asset i so that $\sum_{i=1}^{n} w_i = 1$, the portfolio expected return and risk respectively can be represented as follows:

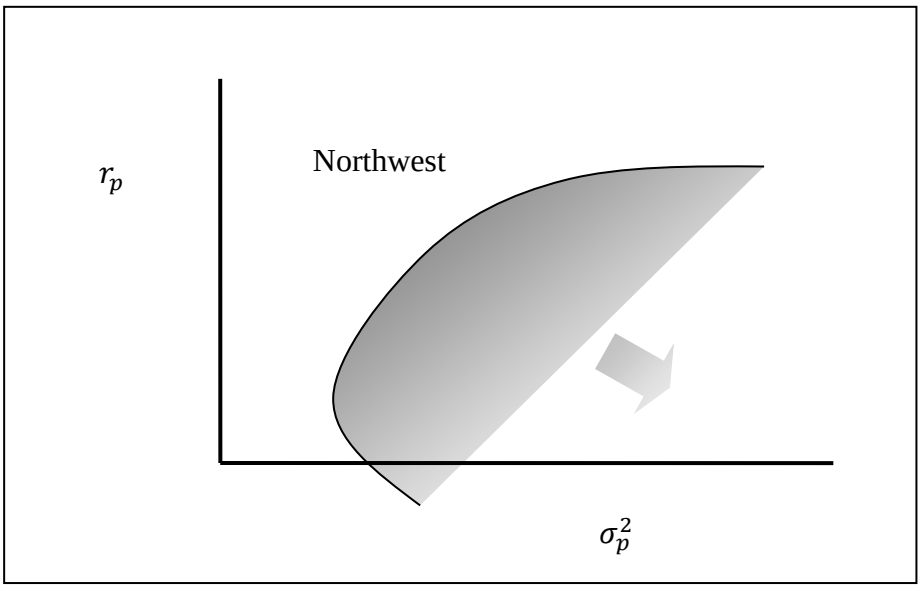
Equation 1: $r_p = \sum_{i=1}^{n} w_i r_i$

Equation 2: $\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \sigma_{ij}$

where r_i is the expected return of asset i and σ_{ij} is the covariance of the expected returns of assets i and j. From equation 1, portfolio return is just a simple weighted average of individual expected asset returns. Portfolio risk, on the other hand, is not just a simple weighted average of variances of expected returns. Equation 2 implies that what is important is not just the individual assets' variances but also their covariances with one another, thus highlighting the importance of diversification or holding assets with differing characteristics. The portfolio concept emphasises that individual assets should not be looked at in isolation.

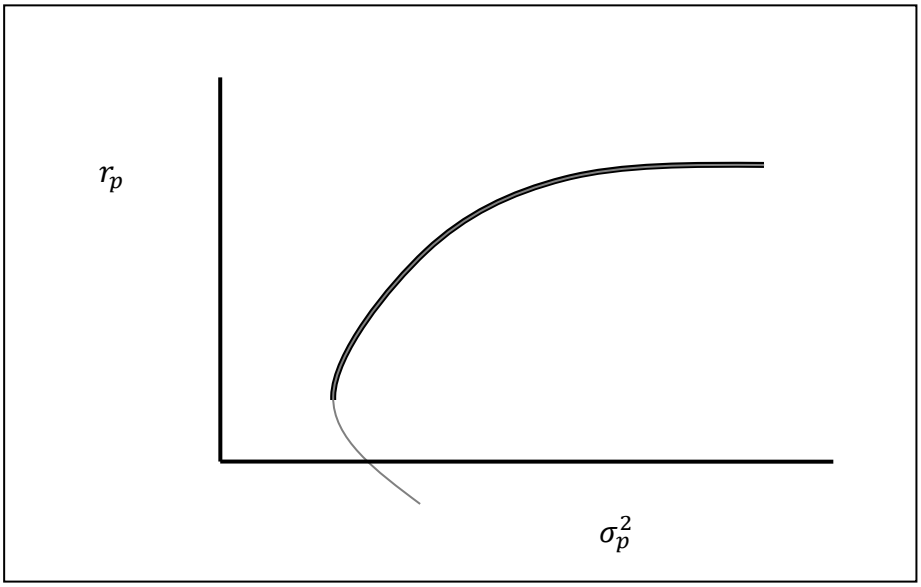
The complete set of portfolios from which investors may choose can be generated by calculating expected return and variance using the above equations for all possible combinations of investment assets in the economic system. The resulting envelope has been shown to be a parabola (Merton 1972) and can be represented schematically in figure 2.

Figure 2: The set of all risky portfolios from which an investor may choose



Some of the portfolios in the choice set are better than others in terms of both expected return and risk. Portfolios that are located on the northwest rim of the choice set have a higher expected return for each level of risk (or a lower risk for each level of expected return) than portfolios inside the envelope (Jobson & Korkie 1981). Risk-averse investors seeking to maximise utility as a function of return and risk will therefore prefer portfolios that are located on the northwest rim. These portfolios comprise the set of optimal portfolios referred to as the efficient frontier, as shown in figure 3.

Figure 3: The set of optimal portfolios or the efficient frontier



The efficient frontier can be derived mathematically using quadratic programming, by maximising r_p in equation 1 subject to constraining σ_p^2 to certain values in equation 2 or by minimising σ_p^2 subject to constraining r_p to certain values (Markowitz 1956). This calculation will also yield the corresponding optimal asset allocation for each value of risk or expected return. The actual choice of optimal asset allocation on the efficient frontier will then depend on the acceptable level of risk or the risk tolerance on the part of the investor. For this and subsequent work on MPT, Markowitz was awarded in 1990 The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel jointly with Merton Miller and William Sharpe for "pioneering work in the theory of financial economics" (Nobel Prize 2013).

2.1.3 Limitations and practical difficulties with the original mean-variance model

The original mean-variance formulation of MPT involves the following assumptions, some explicit and some implied by subsequent researchers, that have tended to limit its practical application. Bibliographic citations are given in the succeeding discussion around each item.

1. Investors' utility is a function of mean and variance of returns (i.e. they only seek return and avoid risk) and therefore portfolios can be constructed based on these two variables alone.
2. Expected return is normally distributed.
3. Risk is measured by the variance of expected returns.
4. There is a way to accurately establish *ex ante* the expected returns and variances of investment assets as well as the covariances among them.
5. The investor's expected utility is being maximised over a single investment period.
6. The investor has a quadratic utility function.

Several research strands have developed in the MPT literature as a result of attempts to address the perceived limitations resulting from the original model's above listed assumptions and unfavourable empirical test results (Baker & Filbeck 2013), as well as to extend its application to other areas. These research strands and some of the prominent associated papers will be discussed individually in the following sections. These papers can be seen as critiques of the original formulation of the mean-variance optimisation model as well as of each other.

2.2 Modern Portfolio Theory subsequent research strands

2.2.1 Use of additional parameters

The search for additional parameters to use in the original model other than the mean and variance in assumption 1 has centred on the non-normal distribution of asset returns contrary to assumption 2 of the original model. Empirical evidence suggests that asset returns are positively skewed and have heavier tails than implied by a normal distribution (Fama 1965; Kon 1984; Markowitz & Nilufer 1996; Peiro 1999). There is also experimental evidence of investor preference for positively skewed returns (Sortino & Price 1994). In an asset pricing context, skewness was found to be economically attractive and investors may be willing to

accept a negative expected return accompanied by a high positive skewness (Harvey & Siddique 2000). It should also be noted that if non-normality of returns is accepted, then variance of returns will be ineffective as the primary measure of risk (Sheikh & Hongtao 2009).

Early work suggested the use of a third moment, skewness of expected returns, in addition to the original two moments in the asset allocation model which are mean and variance of expected returns (Arditti & Levy 1975; Jean 1971; Simkowitz & Beedles 1978). It was later confirmed that including skewness as a parameter improves the mean-variance portfolio decision (Kane 1982). A mean-absolute deviation-skewness model has been proposed where the desirable positive skewness can be maximised under constraints on mean and absolute deviation (Konno, Shirakawa & Yamazaki 1993). Considering the three moments and allowing short sales, the computation of optimum portfolio weights was found to be possible in most cases (de Athayde & Flores 2004). Adding skewness, in combination with asymmetric dependence that recognises greater correlation among assets during market downturns, yielded economically better portfolio decision than the purely mean-variance model especially in the absence of short selling constraints (Patton 2004). It has been shown that return distributions of individual securities and portfolios can be characterised solely by their means, variances and skewness (Mencia & Sentana 2009). However, it is recognised that with the presence of skewness, asset allocation will involve competing objectives such as maximising portfolio expected returns and skewness and minimising portfolio variance. As it is unlikely to meet all these objectives simultaneously, asset allocation linear programming could be carried out only after establishing a preference among these objectives (Lai 1991). Such multi-objective optimisation technique has been generalised in a four-moment environment and when applied to a European equity database showed consistency with the mean-variance model (Maillet & Merlin 2009).

A Bayesian framework has been proposed that incorporates the same higher order moments in the original mean-variance model. The method was also found to result in higher expected utility for the investor compared to other methods that do not address parameter uncertainty (Harvey et al. 2010). Under large departures from a normal return distribution, optimal allocation of assets is affected and four-moment optimisation strategies are better able to approximate expected utility (Jondeau & Rockinger 2006). It has also been shown that with

the use of a return distribution model incorporating both kurtosis and skewness based on the extended Student-t distribution, expected utility maximisers will select portfolios on the mean-variance efficient frontier (Adcock 2010). Of more direct interest to investors is the finding that ignoring higher moments of the return distribution can result to portfolio overweighting in risky securities (Cvitanic, Polimenis & Zapatero 2008).

Another approach is to modify the variance and covariance formula to acknowledge the skewness in expected returns. An example is what the authors refer to as "skewness-aware deviation" (Low, Pachamanova & Sim 2012). The proposed formula for this yields the regular variances and covariances when the expected return distribution is perfectly normal. Computational experiments conducted in the study showed that the proposed parameter results in more intuitively appealing asset allocation.

One recent book summarises the discussion on the need for multi-moment portfolio theories (Jurczenko & Maillet 2006). Multi-moment asset allocation has only recently become popular among academics primarily because of growing concern for extreme risks. The authors aimed to put together previously scattered literature on the topic.

2.2.2 Use of risk measures other than variance of expected returns

It has been asserted that risk can be defined as the variance of expected returns only when expected returns are normally distributed and when investors have quadratic utility functions, both of which assumptions do not hold in practice (Feldstein 1969). To address the issue of non-normality, some have proposed tweaking the original mean-variance model by adding higher order moments as discussed in the previous section. The other school of thought involves using an alternative asymmetric parameter to variance that more accurately represents downside risk. It should be noted that variance is a symmetric measure that incorrectly treats above average returns just as negatively as below average returns. A more accurate parameter would focus on downside risk, as investors are primarily concerned with below target returns. The alternative parameters that have been proposed are semi-variance, lower partial moments (LPM), value at risk (VAR) and conditional value at risk (CVAR).

Semi-variance

A monograph follow-up to the seminal paper on MPT details the use of semi-variance instead of variance in the asset allocation model (Markowitz 1959). In this case, excess returns above

average are collapsed to zero so that they do not unnecessarily add to the variance, yielding intuitively better asset allocation. Semi-variance was shown to be a more accurate measure of risk not just for asset allocation but also for capital budgeting (Mao 1970a). Although the calculations are more complex than those with the mean-variance model, a viable method has been demonstrated for generating mean-semivariance efficient portfolios (Hogan & Warren 1972). With the use of a transforming variable, the mean-semivariance optimisation was also shown to reduce to a classical mean-variance optimisation problem that can be solved through quadratic programming (Markowitz et al. 1993). Contrary to some previous assertions, a mathematical proof has been provided showing that mean-semivariance efficient strategies can always be calculated for single periods (Hanqing, Markowitz & Xun Yu 2006). It should be noted that literature has offered two definitions of semi-variance namely below mean return semi-variance and below target return semi-variance, with the latter being more widely used (Nawrocki 1999).

Lower partial moments

The semi-variance measure discussed in the previous section belongs to the broader class of downside risk measures known as Lower Partial Moments or LPM. The seminal papers on LPM defined risk as the probability weighted function of the deviations below a target return (Bawa 1975; Fishburn 1977) and focused on LPM's consistency with the concept of ordering investments based on stochastic dominance. The computational formula for LPM is as follows:

Equation 3: $LPM = \frac{1}{k}\sum_{i=1}^{k}[\max(0, \bar{r} - r_i)]^n$

where k is the number of observations, $\bar{r}$ is the target return, r_i is the asset return during period i and n is the degree of the LPM. As the degree n increases, the investor becomes more averse to below target returns as a high value of n will penalise deviations more than low returns. Below target return semi-variance can be considered a special case of LPM, where the degree of the moment is assigned a value of two (Nawrocki 1991).

LPM-optimal portfolios were found to have realised returns with less downside risk exposures than optimal portfolios determined using variance (Harlow 1991). Experimental study also showed that investors' risk perception is closer to the LPM special case of probability of loss than to variance (Unser 2000). The LPM portfolio optimisation model was found to provide a

different set of asset class weightings compared to traditional models and exhibit a more efficient frontier (Kong 2006). An empirical study using US investment data showed mean-LPM optimisation yielding similar portfolio returns as mean-variance models but with the desirable feature of avoiding extreme allocation to particular assets (Wojt 2010).

Value at risk

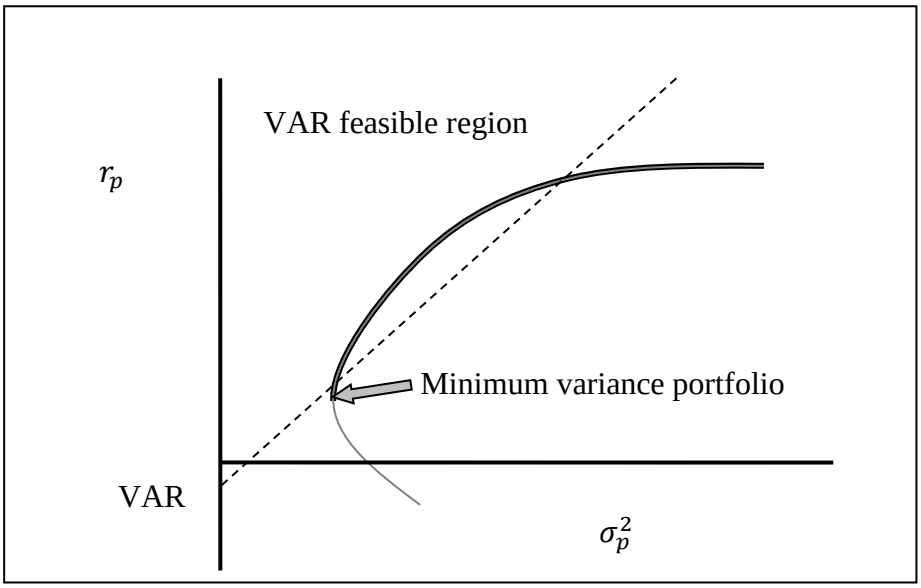
Another definition of risk put forward is the probability of occurrence of an adverse outcome. Roy suggested, at around the same time Markowitz published his seminal paper, that one objective of an investor is to minimise the probability of an adverse outcome and he referred to it as the Safety-First criterion (Roy 1952). He argued that investors are primarily concerned with conserving their principal through investment return r and would therefore assess risk as the probability of returns going below a predetermined level that he referred to as the disaster level d. Noting that r will have standard deviation s, the investor can obtain a portfolio with the lowest probability of returns going below d by maximising $(r - d)/s$, or what he referred to as reward to variability ratio. It has been shown that the Safety-First approach implies attitudes towards portfolio choices that are consistent with Expected Utility Theory (Arzac & Bawa 1977). More recently, Roy's original Safety-First approach has been improved by using semi-deviation and employing linear programming to construct the efficient frontier (Norkin & Boyko 2012).

The Safety-First approach served as precursor for the development of another risk measure referred to as Value at Risk or VAR, which measures the potential loss in value of a portfolio over a specified time horizon given a certain confidence level. For example, a portfolio having a VAR equal to $10 million for a time horizon of one month given a confidence level of 99% means the probability of the portfolio losing value in excess of $10 million in one month is less than 1%. Confidence levels of 95% or 99% are commonly used in practice.

A static asset allocation model has been proposed which maximizes the expected return subject to expected loss meeting VAR limits (Campbell, Huisman & Koedijk 2001). Applying a similar VAR constraint to the asset allocation problem, it has been shown that the minimum VAR portfolio is mean-variance efficient and therefore its frontier is a subset of the mean-variance efficient frontier (Alexander & Baptista 2002), as shown in figure 4. As figure 4

shows, applying a VAR constraint may result in the exclusion of the minimum variance portfolio.

Figure 4: The mean-variance efficient frontier with a VAR constraint



The mean-VAR optimisation strategy was tested and was found workable even during periods of severe market instability when returns exhibit significant deviation from normality assumptions (Consigli 2002). Portfolios on the efficient frontier that were constructed by applying the minimum VAR strategy were also found to yield performance closer to that expected compared to portfolios selected using the mean-variance model (Durand, Gould & Maller 2011). Using Genetic Algorithm to construct the mean-VAR efficient frontier for listed Taiwanese stocks, robust optimisation results were obtained (Lin & Ko 2009) and it was found that inefficient allocation of assets by investors is possible if the decision was based on the mean-variance model alone (Tsao 2010).

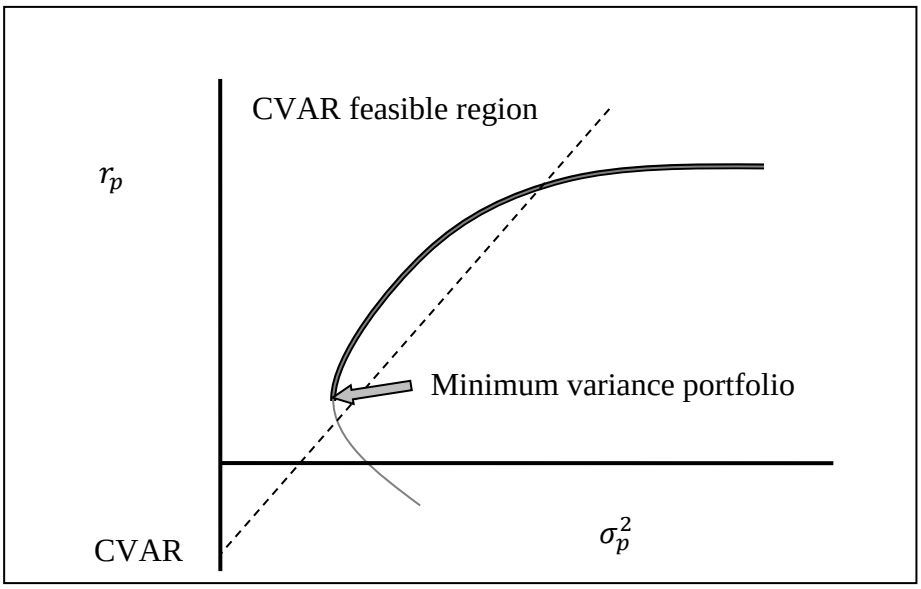
An improvement in VAR optimisation methodology has been suggested that considers competing objectives such as higher return and higher risk and uses polynomial goal programming instead of the conventional linear programming method (Chen 2008). The earlier static single period models have also been extended to forward looking dynamic stochastic asset allocation models in line with continuous time models (Atkinson & Papakokkinou 2005; Rengifo & Rombouts 2004; Wang et al. 2003; Ye & Li 2012).

Conditional value at risk

Although VAR is a popular measure of risk in the financial industry, it has mathematical shortcomings, ignores extreme losses beyond itself and is based on the standard deviation of normal distributions (Rockafellar & Uryasev 2000). It has also been found that VAR-optimal portfolios tend to have larger exposure to risky assets than non VAR-optimal portfolios and therefore would be subject to larger losses in the event of losses actually occuring (Basak & Shapiro 2001). Because of the shortcomings of VAR, another definition of risk has emerged based on the expectation of a loss: Conditional Value at Risk or CVAR. Also referred to as Expected Shortfall or ES, it is based on the conditional expectation of the loss of the portfolio at least exceeding VAR. Instead of looking at what could probably happen as in VAR, CVAR or ES takes stock of the worst possible outcome when things actually go bad. It looks at the conditional expectation and determines the expected portfolio loss when the loss turns out to be larger than the VAR threshold value.

Applying a CVAR constraint to the asset allocation problem, it has been shown that the minimum CVAR portfolio is mean-variance efficient and therefore its frontier is a subset of the mean-variance efficient frontier (Alexander & Baptista 2004), as shown in the figure 5. As figure 5 shows, applying a CVAR constraint will not result in the exclusion of the minimum variance portfolio.

Figure 5: The mean-variance efficient frontier with a CVAR constraint



A linear programming technique has been developed to optimise CVAR while simultaneously calculating VAR, recognising that portfolios with low CVAR consequently would also have low VAR (Rockafellar & Uryasev 2000). An alternative approach has been proposed using robust optimisation which considers the uncertainty in input parameters by finding a solution which is feasible for all possible data realizations (Quaranta & Zaffaroni 2008). A non-parametric estimation methodology to solve the mean-CVAR asset allocation problem has also been presented (Yao, Li & Lai 2013).

A comparative empirical study found that for the same level of expected return, a mean-CVAR optimal portfolio has lower risk than the corresponding mean-variance optimal portfolio (Benbachir, Gaboune & Alaoui 2012). Investments in risky assets are found reduced when using CVAR (Cheng & Chiung 2012). Using investment data during the credit crunch period in the US when volatilities were relatively higher, the CVAR method was found to generate portfolios with lower expected losses compared to the variance and VAR methods (Ho, Cadle & Theobald 2008).

Other measures of risk

Aside from those previously discussed, other definitions of risk have been put forward. One characterises it by the risk curve showing every severity level of the potential loss and the probabilities of these losses occurring. Optimisation is carried out by maximising the expected portfolio return and constraining the risk curve (Huang 2008).

The mean-absolute deviation (MAD) portfolio optimisation model uses the absolute deviation of returns instead of variance as a measure of risk. Although it is almost a mathematical equivalent, MAD has computational advantages over variance when it comes to large scale optimisation problems as it reduces them to a linear programming problem. It has also been demonstrated that MAD portfolio optimisation is more consistent with expected utility maximisation (Konno & Koshizuka 2005).

Most of the risk measures discussed in the previous sections and paragraphs are in agreement with the assertion that a risk definition has to take into account another component, exposure, in addition to uncertainty which has been measured with statistics (Holton 2004). There is subjectivity, therefore, as risk will depend on an individual's perception of uncertainty and exposure. It is acknowledged that there are two classes of risk measures proposed in investment portfolio literature: dispersion measures of which variance is an example and

safety risk measures of which VAR is an example (Fabozzi et al. 2005). Expounding on this, a paper examined the properties of an ideal risk measure for use in portfolio theory. Some of the desirable features of investment risk measures identified are asymmetry, non-linearity, relativity, multidimensionality, inter-temporal dependence and recognises the impact of economic factors on investors' preferences. Given the wide range of desirable features, it is acknowledged that there is not one risk measure that can meet all the requirements (Fabozzi et al. 2008). More importantly, whatever the risk measure utilised, its time-varying nature needs to be considered (Engle 2004).

2.2.3 Addressing parameter uncertainty

One key hindrance to widespread adoption by the industry of the mean-variance model is the fact that the portfolios generated by this optimisation model are extremely sensitive with a tendency to amplify the effects of the imprecise input variables, namely expected returns, variances and covariances (Ceria & Stubbs 2006; DeMiguel & Nogales 2009; Goldfarb & Iyengar 2003). These input variables are supposed to be determined ex ante but in the absence of other methods are usually estimated ex post using historical data. Because of the model's sensitivity to the inputs, the resulting optimal asset allocations often have extreme or counterintuitive weights for some assets, are unstable, fluctuate substantially over time and have poor test performance (Fabozzi, Huang & Zhou 2010; Michaud 1989; Tütüncü & Koenig 2004).

Errors in expected returns are found to have the most impact on optimal portfolio return, followed by variances and then covariances (Best & Grauer 1991; Chopra & Ziemba 1993). Several factor models for predicting asset covariance structure were tested and found not to have significant effects on optimal asset allocation (Chan, Karceski & Lakonishok 1999). However, there is an argument that extreme weights even in the absence of estimation errors are due to some assets dominating the covariance matrix (Green & Hollifield 1992). Related to this, it has been demonstrated that if investment managers are more productive in generating historical information for assets more familiar to them (e.g. domestic equities), then these assets will likely have a lower predictive variance of expected returns and will dominate the optimal portfolios thereby possibly explaining the equity home bias puzzle (Nocetti 2006). Similarly, predictability of equity returns arising from widely available information on

dividend-price ratios results in higher weighting for equities in a multi-period model (Campbell, Chan & Viceira 2003).

Uncertainty in input parameters is not the only concern but also the choice of investment interval (e.g. daily, weekly, monthly) as it is known that variance and skewness increases with longer intervals. It was found that the choice of investment interval significantly affects the optimal portfolio weightings (Chang, DuPoyet & Prakash 2008).

The mean-variance model makes the assumption that the covariances among expected returns of assets are stable, but in reality they fluctuate dramatically. Covariance among asset returns was found to increase during periods of volatility, which ironically diminishes the benefit of diversification during periods when it would have been most valued (Jacquier & Marcus 2001). This point was highlighted during the financial shocks of recent years. A time-varying estimation of the covariance matrix was found to result in more efficient portfolios that fits empirical data better (Ebner & Neumann 2008).

Several approaches have been suggested to address the problem of parameter uncertainty and these include imposing constraints on asset weights, Bayesian estimation, use of shrinkage estimators, robust optimisation, portfolio resampling and other methods.

Imposing constraints on asset weights

Small errors in parameters inputted into the mean-variance optimisation model can significantly alter the composition of the optimal portfolio and one suggestion to address this is to impose sensible constraints on the portfolio asset weights (Chopra 1993; Frost & Savarino 1988). One hindrance though is that an analytical study found that only a small proportion of the portfolios on the efficient frontier are positively weighted portfolios and the proportion further decreases as the number of assets in the portfolio increases (Best & Grauer 1992). Nevertheless, imposing non-negativity constraints on asset weights was found to result in better test-performing portfolios (Jagannathan & Ma 2003).

Bayesian estimation

Another method is Bayesian estimation which involves combining prior beliefs about the parameters with recently observed values to come up with better estimates of the parameters. An early work incorporated parameter uncertainty and the accompanying estimation risk into

the portfolio optimisation problem using Bayesian approach (Klein & Bawa 1976). A later suggested approach is the use of an "all stocks are identical" informative prior that assumes that all investment assets have identical expected returns, variances and covariances. This reduced estimation error by drawing the posterior parameter estimates toward the averages for all investment assets in the population and resulted in superior optimal portfolios (Frost & Savarino 1986). A Bayesian technique was tried for a portfolio selection problem where the number of possible portfolios is large relative to the historical data period and found that portfolios constructed from all equities comprising the Standard and Poor's Index outperform the index itself (Polson & Tew 2000). Another modification of the Bayesian approach considers investor aversion to ambiguity and therefore uses multiple priors that constrain expected return values within a confidence interval. Resulting portfolios were found to be more stable over time and deliver better test performance (Garlappi, Uppal & Tan 2007).

A variation of the Bayesian approach is the Black-Litterman model which combines the subjective views on the expected returns of portfolio assets with the implied views or the set of expected returns that would make an actual benchmark portfolio mean-variance optimal. The resulting mixed estimate of expected returns will then result in intuitive portfolios that have more sensible portfolio weights (Black & Litterman 1991).

Use of shrinkage estimators

Another approach that aims to reduce the impact of input estimation errors is the use of James-Stein shrinkage estimators (Jobson, Korkie & Ratti 1979). This is based on the assertion that the best estimate of asset returns is the grand mean of the historical returns on all assets. The idea behind this technique is that assets believed to be in the same basket should have properties (returns, variances and covariances) that behave similarly in the long term. The technique involves shrinking expected returns for assets belonging to the same class into a global expected return for that asset class. This need not be applied to the variances and covariances as studies have shown that their estimation errors do not affect portfolio performance as much as errors in means (Best & Grauer 1991). It has been found that mean-variance portfolios with James-Stein adjusted inputs outperformed portfolios with unadjusted inputs (Chopra 1993).

Robust optimisation

Robust portfolio optimisation is a fairly recent development. This approach recognises that the estimation process for input parameters will not yield point estimates but rather an uncertainty set which contains the actual mean and covariance matrix of asset returns within a certain level of confidence. A robust portfolio maximises the worst-case scenarios resulting from all possible values of the mean and covariance matrix within their respective uncertainty sets (Tütüncü & Koenig 2004). The apparent aim of robust optimisation is to ensure that asset allocation decisions are acceptable even if input parameters to the model cannot be accurately estimated or in other words are robust to parameter uncertainty (Ceria & Stubbs 2006). A computational method has been developed that requires an effort comparable to that required for solving convex quadratic programs (Goldfarb & Iyengar 2003). Using computational experiments, portfolios generated using robust optimisation were found to outperform portfolios generated using traditional mean-variance optimisation, generally less sensitive to input parameters (Ceria & Stubbs 2006) and are more stable over time which makes it suitable for long term investment strategies (Tütüncü & Koenig 2004).

Similar to a Bayesian approach, another version of robust optimisation involves combining the views of a group of expert advisors, each having a different outlook for expected returns, variances and covariances. A robust portfolio will be one that has the best performance under the worst case scenarios deriving from the views of the expert advisors. Simulations show that such robust portfolios exhibit stability and good diversification (Lutgens & Schotman 2010).

An alternative approach suggested is the use of robust estimators of the input variables in a portfolio model which minimises variance by relying solely on estimates of the covariance matrix and is therefore less sensitive to input variable estimation errors. Empirical evidence shows that portfolio asset allocations developed in this manner are less sensitive to departures from normality of asset returns and are more stable over time than those constructed using a traditional minimum variance method. The portfolios also perform better than traditional mean-variance optimal portfolios (DeMiguel & Nogales 2009).

A dissenting view on robust portfolio optimisation has been offered. Empirical calculations show that robust optimisation methods are equivalent to using shrinkage estimators and yield the same efficient set. This would appear to make the additional computational efforts unjustified (Scherer 2007).

Portfolio resampling

Portfolio resampling is a heuristic method of accounting for estimation errors. It involves repetitively sampling the historical returns data and generating minimum variance portfolios for each sample set. The optimal portfolio is then constructed by averaging the portfolio weights of all the simulated minimum variance portfolios (Michaud 1998). Portfolio resampling has been found to result in more diversified portfolios that outperform traditional mean-variance optimal portfolios (Scherer 2002).

Other methods of addressing parameter uncertainty

A single index model has been proposed which assumes that the returns on assets are related to each other through individual relationships with an underlying factor. This was more to make calculation involving large number of assets easier by collapsing the covariance matrix rather than to address parameter uncertainty (Sharpe 1963). This index has evolved into the measure β or *Beta* which is the sensitivity of asset returns relative to the market returns.

Another way to estimate expected returns is by applying the Capital Asset Pricing Model (CAPM). Optimal portfolios with expected returns estimated based on the CAPM method (to be discussed later in section 2.2.8) performed better than optimal portfolios derived using traditional sample means and using a shrinkage estimator (Jorion 1991).

Serial correlation of returns is another departure from one of the assumptions of asset allocation models, which is the independence of returns from those of previous periods. This has been found to be more pronounced for alternative asset classes such as hedge funds and private equity. Serial correlation would tend to understate risk estimates as it smooths asset class volatility. Application of Fisher-Geltner-Webb's unsmoothing methodology has been suggested to correct this (Sheikh & Hongtao 2009).

It is widely accepted that asset classes become more correlated during periods of market stress or volatility. Therefore, assuming linearity of correlations would underestimate joint negative returns during market downturns. Use of copula method is suggested that would differentiate between correlations during market stress and during normal periods (Sheikh & Hongtao 2009). Using a correlation matrix modelled by a suitable copula parameter in a CVAR minimisation model was found to outperform the traditional minimum variance approach

where the asset dependencies are represented by linear correlation coefficients (Sghaier & Boubaker 2013).

Another method suggested is to create a separate return covariance matrix using outliers as they provide a better representation of risk during periods of market turbulence. The inside-sample and outlier-sample covariance matrices can then be blended in a procedure that takes into consideration investors' views about the "quiet" and "turbulent" regimes represented by these covariance matrices (Chow et al. 1999). Similarly, parsing return projections into quiet and turbulent regimes has also been suggested. Two sets of optimal portfolios can then be developed, one for a quiet regime and one or more for a turbulent regime which can be used as overlay strategies to the former in case of market turbulence (Miccolis & Goodman 2012b). This is extended further by a study that presented evidence that four regimes, characterised as crash, slow growth, bull and recovery states are needed to capture asset returns (Guidolin & Timmermann 2007).

The estimation of the covariance matrix of asset returns for use in mean-variance optimisation can be improved through shrinkage. This involves calculating the optimally weighted average of two estimators: the sample covariance matrix and single-index covariance matrix. This is shown to generate portfolios with lower variances (Ledoit & Wolf 2003).

Another approach addressing the shortcomings of batch processing of historical data in providing the model's parameters is online processing of streamed financial data as they come in. This allows algorithmic or automatic trading of securities and portfolio asset allocation without human intervention. This approach was found to outperform traditional allocation techniques in both computational demand and financial performance (Tsagaris, Jasra & Adams 2012).

2.2.4 Multi-period models

The original mean-variance model is a single period model and therefore its static risk-reward criterion is difficult to apply to long term investors who are faced with changing investment conditions. The single period model is sometimes adapted for multi-period analysis with the assumption that parameters from period to period are independent of each other, which is not realistic (Çelikyurt & Özekici 2007).

The early works on multi-period asset allocation models are mainly based on expected utility theory having expected return as the main variable and with not as much emphasis on variances of returns (Merton 1969; Samuelson 1969). The former offers a continuous time model while the latter considers discrete time periods, but both suggest a constant allocation into risky and risk-free assets in the ideal case. Merton's model proved to be computationally intractable but an approximate solution based on simplifying assumptions has been offered (Campbell, Chan & Viceira 2003). Following on from a review of multi-period mean-variance approach based on scenario trees (Steinbach 2001), a more recent paper offers a discrete time multi-period model that considers expected return and variance from period to period described as a Markov chain. Dynamic programming using objective functions that depend on the expected return and variance of the final portfolio value is then used to determine optimal portfolios (Çelikyurt & Özekici 2007). Using a stochastic programming technique, a VAR constraint was found to be workable for a continuous time multi-period mean-variance model (Ye & Li 2012). A robust multi period portfolio selection model based on minimising a risk term and maximising the end-of-horizon value has been tested and found to reduce the variability of the final portfolio value while attaining acceptable end values (Pınar 2007).

Strategic asset allocation has been suggested as a way to handle the issues with multiple time periods. By adopting a long-term investment horizon, it is believed that portfolio returns can be better optimised as mean reversion in returns of different asset classes becomes more evident (Brennan & Schwartz 1997). However, differences in growth rates among various asset classes tend to move the portfolio away from the optimal allocation in the case of a buy and hold approach. It has been shown that even small changes in asset allocation weights are often statistically significant (Christie 2005). One way to keep the portfolio close to the efficient frontier in multi-period scenarios is by rebalancing whenever asset weights deviate from the optimal allocation by more than the pre-set thresholds. This involves trimming the high growing asset classes and investing the proceeds in the slow growing ones, which also has the advantage of selling assets high and buying them low (Miccolis & Goodman 2012a; Perold & Sharpe 1988). Multi-period strategies involving rebalancing has been found to outperform a buy and hold no-rebalancing strategy (Yu & Lee 2011). However, there is an observation that current rebalancing practices are characterised by suboptimal calendar rules

and other heuristics. An algorithm is proposed for determining when rebalancing is statistically desirable (Michaud, Esch & Michaud 2012).

The concept of rebalancing is further extended to an adaptive asset allocation approach where the asset allocation is varied through time in accordance with changes in market capitalisations of the underlying asset classes. This model proposes that portfolio rebalancing should be carried out in the context of shifts in the overall value of debt and equity in the market (Sharpe 2010). The diverse effect of market liquidity characteristics on various asset classes has been acknowledged and a model is suggested that adjusts the asset allocation in accordance with changing market liquidity. This dynamic asset allocation model will reduce exposure to assets that are sensitive to market liquidity in anticipation of a market downturn and increase exposure in an improving environment. Simulation shows that this improves portfolio performance (Xiong, Sullivan & Wang 2013).

Multi-horizon investing acknowledges that investors have multiple time horizons at any given time. The total portfolio is therefore an aggregate of multiple sub-portfolios with different time horizons. These sub-portfolios have different investment objectives and risk and return considerations and therefore have different optimal asset allocations (Jaeger, Rausch & Foley 2010). This appears to have been foreshadowed by a theoretical analysis of the effect of different investment horizons on the efficient set of constructed portfolios. It found that the efficient set for each group of investors should be constructed according to their investment horizon, although long horizon efficient sets was also found to be subsets of short horizon efficient sets (Levy 1973).

Lifecycle investing has become popular with target date retirement funds in recent years. These funds initially have a high allocation to equities but move towards safer asset classes as the target retirement date approaches. While this strategy may reduce uncertainty of fund balances closer to retirement, if done mechanistically, it may cause investors to miss out on the upside potential of wealth accumulation with a more aggressive investing stance. A more dynamic lifecycle strategy is suggested with regular changes in the asset allocation based on the actual accumulation in the retirement fund resulting from portfolio performance relative to the target amount at retirement. Simulation shows higher potential terminal balances with this strategy compared to mechanistic lifecycle investing (Basu, Byrne & Drew 2011).

2.2.5 Non-quadratic utility function models

It is asserted that the mean-variance model is the optimal selection rule only if the investor's utility function is quadratic (Tobin 1958). However, the assumption that the investor has a quadratic utility function is unappealing because it implies increasing absolute and relative risk aversion (Arrow 1971). Investors with such a utility function would require higher rewards for investment risk as their wealth increases, which is not consistent with intuition or common investor behaviour (Harlow 1991). The specific type of investor utility function would have been irrelevant if expected returns are normally distributed as portfolios maximising the expected utility of returns will always be located on the efficient frontier, but it is accepted that returns are not normally distributed (Adcock 2010; Unser 2000).

However, it was also shown empirically that for a finite population of portfolio returns, the ordering of portfolios by the mean-variance criterion was almost the same as that obtained by using expected utility regardless of utility function and return distribution (Levy & Markowitz 1979). This was also found true for the case of infinite population of portfolio returns (Kroll, Levy & Markowitz 1984). An algorithm for the alternative approach of maximising expected utility in an asset allocation problem has been suggested, which is shown to reduce to the traditional mean-variance method in the case of quadratic investor utility function (Sharpe 2007). It has also been shown that the use of a return distribution model incorporating both kurtosis and skewness based on the extended Student-t distribution will have a similar effect of reducing expected utility maximisation to mean-variance optimisation (Adcock 2010). An experimental study showed that expected utility optimisation represents a better approximation of subjects' preferences compared to mean variance optimisation (Morone 2008).

As investors do not necessarily have quadratic utility functions, traditional mean-variance optimisation will only approximate the true utility-maximising portfolio. Full-scale optimisation has been suggested that utilises computer algorithms to identify the utility-maximising portfolio for any type of return distribution and investor utility function. Empirical analysis shows that full-scale optimisation yields significantly higher investor utility compared to traditional mean-variance optimisation (Adler & Kritzman 2007).

2.2.6 Other asset allocation models

Around the introduction of MPT, heuristic approaches to asset allocation predominated. An early work outlined a series of steps based on protocols in the asset allocation process for the trust section of a bank (Clarkson & Meltzer 1960).

Prospect Theory was offered as an alternative to Expected Utility Theory, on which asset allocation models are based. Prospect Theory is based on the understanding that investors are averse to loss and not to risk, as rational belief asserts. Choice is explained by the assignment of values to gains and losses and considering probabilities rather than basing it on absolute wealth levels, thereby providing an explanation for behaviour that sometimes contradicts Expected Utility Theory and rational belief (Kahneman & Tversky 1979). Investors have been observed to be risk averse in the domain of gains but risk seeking in the domain of losses (Cremers, Kritzman & Page 2005). An algorithm has been developed to calculate optimal asset allocations based on Prospect Theory which differed significantly from the optimal mean-variance portfolio (De Giorgi, Hens & Mayer 2007). However, despite Prospect Theory's assumptions being in sharp contradiction to those with mean-variance optimisation, another study using stochastic dominance rules showed that efficient sets produced by the two models coincide thereby implying that mean-variance optimisation can be used to construct Prospect Theory efficient portfolios (Levy & Levy 2004). Prospect Theory's original two propositions are decisions based on change of wealth not total wealth and loss aversion giving more weight to losses than gains. Cumulative Prospect Theory adds a third proposition that individuals subjectively reweight probability assessments. While Prospect Theory lends itself to analysis of simple binary choices of alternatives, Cumulative Prospect Theory has been shown useful in multi-asset portfolio optimisation (Davies & Satchell 2004).

Stochastic Dominance criterion is another tool used for decision making under risk and uncertainty. Stochastic Dominance refers to situations where an investment represented by a return probability distribution is ranked as superior to another investment for the range of possible outcomes. The Stochastic Dominance criterion is not restrictive as it does not require a certain investor utility function or a normal distribution of returns. However, there is currently no method for identifying the stochastically dominant efficient set of all diversification strategies which was also the conclusion of a much earlier review article (Levy 1992). Towards this end, a series of operational tests have been developed for portfolio

optimality that are based on the general stochastic dominance criterion (Kuosmanen 2004). A robust approach has also been suggested consisting of maximising the worst case expected utility of portfolios over all possible distributions. Special conditions have been identified where this Stochastic Dominance approach reduces the problem to solving a parametric quadratic program (Popescu 2007).

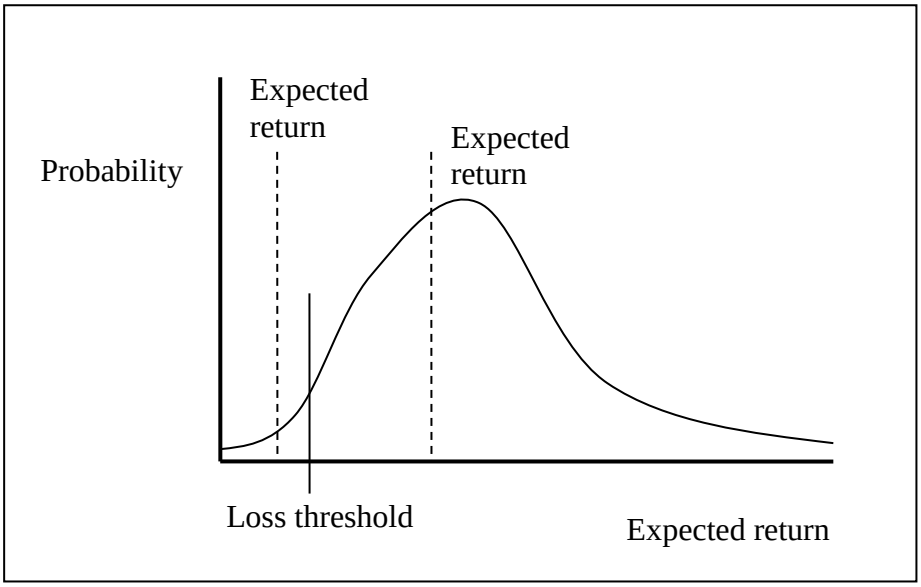
Another approach offered is factor-based asset allocation as opposed to asset-class-based asset allocation. This is based on identifying the underlying factors (e.g. risk exposures) that drive returns of various asset classes. By analysing these underlying risk exposures, a portfolio of asset classes can be constructed that has a good diversification of risk. The main limitation of the method is that it still requires making allocations among traditional asset classes and is therefore dependent on the risk-return characteristics of these asset classes. It has also been found that, using both an idealised mathematical model and optimisations based on empirical data, that neither factor-based nor asset-class-based asset allocation is inherently superior to the other (Idzorek & Kowara 2013). An approach using return-generating factors instead of underlying risk exposures have also been suggested (Asl & Etula 2012). Another factor suggested as a basis for asset allocation is underlying risk premia or the amount an investment is expected to earn for bearing investment style risk and strategy risk. Empirical analysis shows diversification benefits with investing in risk premia primarily because of their low correlations with traditional asset classes (Bender et al. 2010). Incorporating cross sectional global market factors with individual security factors have also been shown to provide diversification benefits, again due to their low correlations with systematic market risk factors (Clarke, de Silva & Murdock 2005).

Another alternative to the mean-variance method is offered which bases portfolio optimisation directly on asset characteristics. For instance, an equity has characteristics such as the firm's market capitalization, book-to-market ratio or lagged return that are implicitly related to the mean-variance model inputs (i.e. equity's expected return, variance and covariance with other equities). The proposed approach models the portfolio weights in each equity as a direct function of the equity's characteristics. The coefficients of this function are determined by maximizing the average utility the investor would have obtained in implementing the policy over the historical sample period. This approach addresses previously discussed parameter uncertainty problems with the mean-variance model (Brandt, Santa-Clara & Valkanov 2009).

Risk parity investing advocates diversifying by risk through more investment in low risk assets relative to high risk assets. Leveraging is then applied to the risk balanced portfolio to increase both its expected return and its risk to desired levels (Asness, Frazzini & Pedersen 2012).

Another method suggested is gain-loss analysis, particularly when the expected return deviations from normality are severe as is the case with hedge funds. Here, we wish to know what we stand to gain if there is a gain and what we stand to lose if there is a loss, with the reference point being a specified loss threshold (Bernardo & Ledoit 2000), as shown in figure 6. The attractiveness of an investment portfolio is measured by the gain-loss ratio which is the conditional expected return given gain divided by the conditional expected return given loss. This measure does not require returns to be normally distributed and captures all of the higher moments of the expected return distribution (Shadwick & Keating 2002). A study examined the diversification of hedge funds using gain-loss analysis and found that when deviations from normality are small, the mean-variance model provides a good approximation to the more robust gain-loss analysis, but when the deviations from normality are severe there is a need for gain-loss analysis (Agarwal & Naik 2000).

Figure 6: Gain-loss analysis



A two-phase modified MPT methodology has been suggested involving a first phase where the mean-variance efficient frontier is determined to provide a number of pre-selected efficient portfolios and a second phase where the future performance of these portfolios are simulated as a way to rank them using a multi-criteria performance index. Tested empirically using equities from the Frankfurt and Vienna stock exchanges, this approach avoids too much reliance on the predictive ability of input parameter historical data (Ballestero et al. 2007).

Because of the difficulty of estimating the expected returns, an alternative approach suggested has been to focus on obtaining the minimum variance portfolio. This model relies solely on estimates of the covariance matrix and is therefore less sensitive to input variable estimation errors. Empirical evidence also shows that minimum variance portfolios usually performs better than mean-variance optimal portfolios (Chan, Karceski & Lakonishok 1999; Jagannathan & Ma 2003).

Traditional mean-variance optimisation will only approximate the true utility-maximising portfolio when the utility function is not quadratic and the returns are not normally distributed. To address this, full-scale optimisation has been suggested that utilises computer algorithms to identify the utility-maximising portfolio given any type of investor utility function and return distribution. (Adler & Kritzman 2007). Under this method, the portfolio's utility is calculated for a wide range of asset allocation and given any utility function and return distribution in order to identify the weights that would maximise expected utility. Full-scale optimisation yielded significantly higher investor utility compared to traditional mean-variance optimisation for non-quadratic utility and non-normal return distributions (Cremers, Kritzman & Page 2005).

While the present research is focused on optimisation strategies, there is also a decision making strategy in economics where the aim is to meet some acceptability criteria instead of attempting to find the best option. Referred to as satisficing (blend of satisfy and suffice), it can also be optimal if the costs of the optimisation process are considered. Its originator argued that human beings lack the cognitive resources to optimise, and that this "bounded rationality" approach is more realistic (Simon 1959). An application of this approach in portfolio construction used returns being above the equity market index as the satisficing criterion, noting that it is more natural for investors to specify such a criterion as opposed to

mean-variance type parameters. Although it allowed easier portfolio construction, it was outperformed by a parallel CVAR optimisation methodology (Brown & Sim 2009).

2.2.7 Inclusion of alternative assets in the model

Up to this point, the research papers cited have limited their analysis to the traditional asset classes cash, fixed interest security and equity. Inclusion of other asset classes such as property, precious metals, derivative instruments, private equity and venture capital in the asset allocation problem involves additional considerations.

One problem with property portfolios is the large number of assets compared to the available historical return data. To address this, use of Mean Absolute Deviation that gives less weight to data outliers instead of standard deviation to characterise risk was tested and found to yield a usable efficient frontier (Byrne & Lee 1997). Use of a Bayes-Stein approach in addition to a minimum variance strategy shows an increased stability in portfolio allocation to international real estate securities as well as improvements in portfolio performance (Stevenson 2000). A Bayesian approach using LPM as a measure of risk was also found useful in constructing optimal property portfolios (Coleman & Mansour 2005). A study found that the inclusion of both public and private real estate in a mixed-asset portfolio can substantially improve the mean-variance efficient frontier (Mueller & Mueller 2003). Portfolios that include residential real estate show a higher expected return for the range of risk levels than portfolios without it most probably because of the relative stability of property returns and its low correlation with other asset classes (Peat & Wright 2012).

Using a mean-variance-skewness approach, it was found that precious metals specifically gold figured prominently in optimal portfolios constructed using various country equity indices (Lucey, Poti & Tully 2006).

It has been shown using rank dependent expected utility theory that derivative assets have to be included in portfolios to maximise the expected utility of investors (Prigent 2010). A theoretical basis for approximating the optimal derivative holding in a portfolio has been presented (Ilhan, Jonsson & Sircar 2004). An expected return maximising multi-period model with a VAR constraint has been tested in constructing an optimal portfolio of many options linked to a single index. Despite the large size of options included, near optimal solutions were obtained using mixed integer programming (Schyns, Crama & Hübner 2010).

Hedge funds have become a popular addition to investment portfolios. However, hedge funds have return characteristics different from traditional asset classes in that they exhibit return distributions with skewness and kurtosis that significantly deviate from those of a normal distribution. This renders it unsuitable for portfolio optimisation using mean-variance optimisation and requires less restrictive methods such as full-scale optimisation that has been described in a previous section (Cremers, Kritzman & Page 2005).

Another alternative asset class is what is referred to as equity collars. It involves a combination of put and call options on an underlying equity to the extent that the minimum and maximum returns that the collar will provide is known. Zero cost collars can be structured such that the cost of the put which provides protection against downturns is offset by the premium revenue generated by the sale of the call. Simulation using empirical data showed that during periods of volatility when asset classes exhibit high correlations, portfolios containing a zero cost collar in place of debt outperform traditional debt/equity portfolios (D'Antonio & Johnsen 2011).

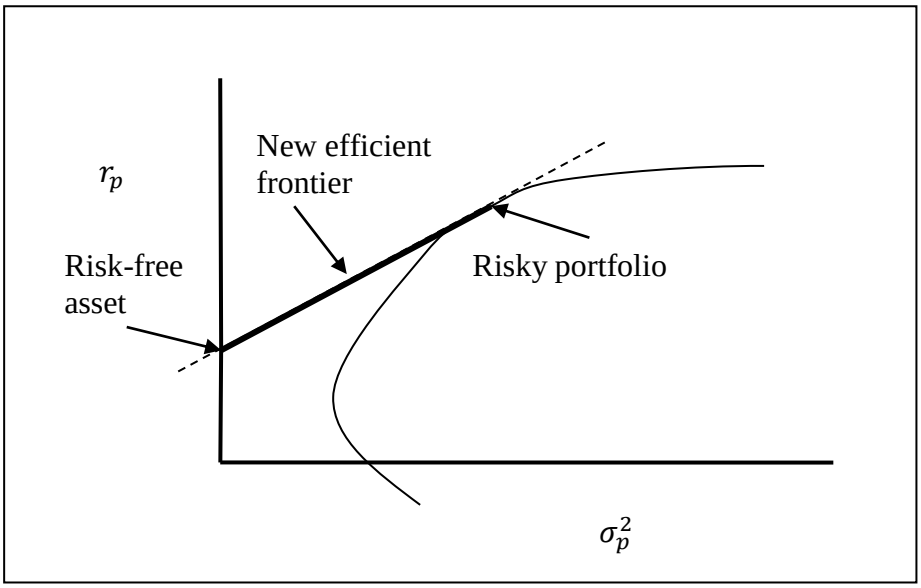
Private equity and venture capital are also categorised under alternative investments. Their relative higher returns in relation to volatility make them attractive for inclusion in optimal portfolios. However, illiquidity and the finding that they have significant exposure to the same risk factors that drive equity and bond volatility reduces this attractiveness (Pedersen, Page & Fei 2014).

2.2.8 Portfolio Separation Theorem and extension of MPT to asset pricing

Adding a risk-free asset to the original MPT formulation transforms the efficient frontier to a straight line connecting the risk-free return with the tangency portfolio of risky assets on the original efficient frontier (Tobin 1958), as shown in figure 7. Subsequently referred to as Portfolio Separation Theorem, it separates the portfolio decision into determining the optimal subportfolio of risky assets irrespective of an investor's risk tolerance and then allocating the investment between this subportfolio and the risk-free asset. An experimental study found that introduction of a riskless asset to a portfolio of three risky assets did not seem to have the effect predicted by Portfolio Separation Theorem (Kroll, Levy & Rapoport 1988a). However, with parameter uncertainty, it has been shown that holding a combination of the tangency

portfolio and the risk-free asset can never be optimal as an investor can improve the portfolio by including some other assets that would reduce the estimation risk (Kan & Zhou 2007).

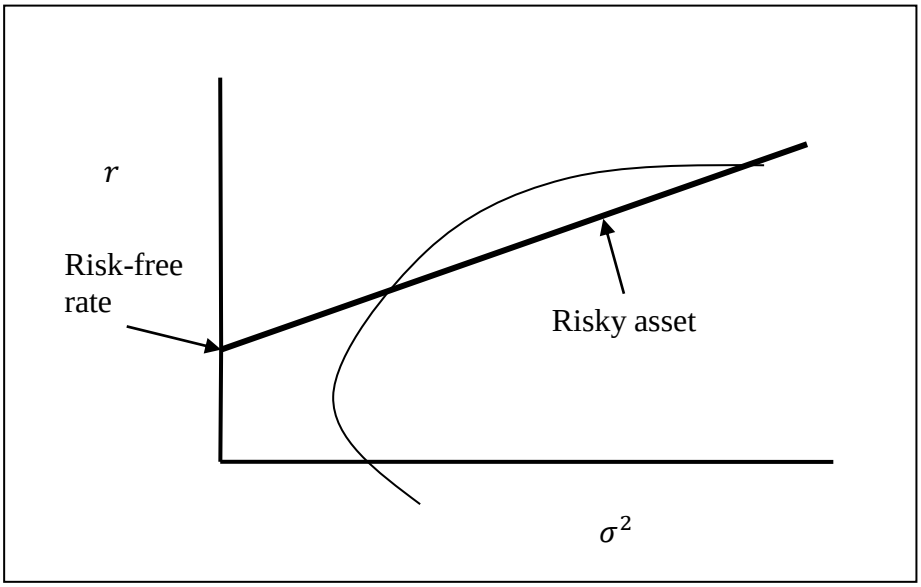
Figure 7: Portfolio Separation theory



This approach was further simplified by determining the risky sub-portfolio using a single index model which assumes that returns on assets are related to each other through individual relationships with an underlying factor (Sharpe 1963). As mentioned earlier, this made calculations involving a large number of assets easier by collapsing the covariance matrix. This index has evolved into the measure β or *Beta* which is the sensitivity of asset returns relative to the market returns. However, the condition under which portfolio separation is possible was studied and found to be restrictive, with similar requirements on the nature of the expected utility function as those for mean-variance portfolio optimisation (Cass & Stiglitz 1970).

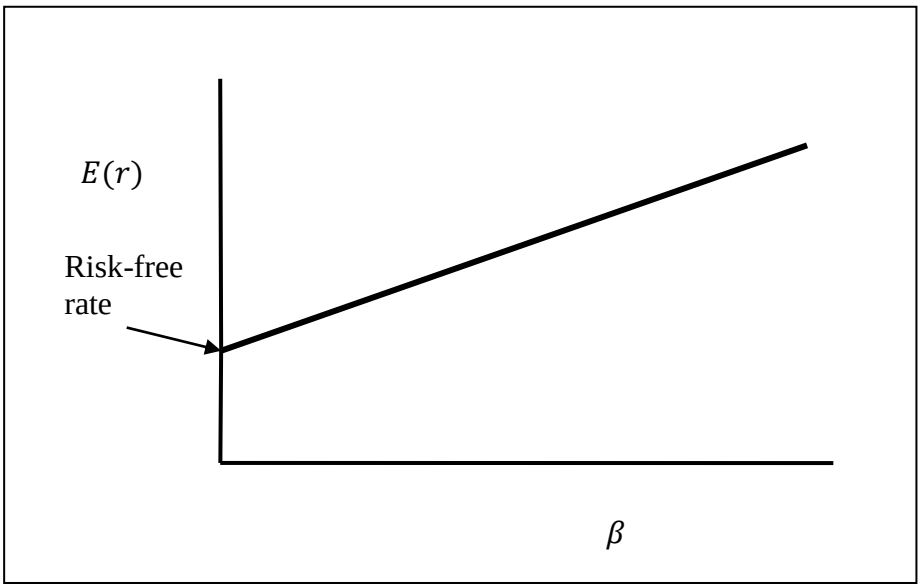
The Portfolio Separation Theorem was subsequently expanded to cover the pricing of individual assets. A line can be constructed in figure 7 to show the risk-reward trade-off, where an investor may obtain a higher expected return from an asset only by incurring additional risk (Sharpe 1964), as shown in figure 8.

Figure 8: The risk-reward trade-off



Subsequent papers further developed this concept into what is now known as the Capital Asset Pricing Model or CAPM (Lintner 1965; Mossin 1966). In the model, the risk measure is replaced by β and the line is referred to as the Security Market Line, as shown in figure 9.

Figure 9: The Security Market Line



CAPM is represented in the following equation:

Equation 4: $E(r) = r_f + \beta[E(r_m) - r_f]$

where $E(r)$ is the expected return of the asset, r_f is the risk-free rate of return and $E(r_m)$ is the expected return of the market. Asset price is assessed on the basis of how actual returns compare with expected returns.

2.2.9 Non-finance applications of Modern Portfolio Theory

Modern Portfolio Theory has also found application in areas other than finance and investments. Some of the published works are shown in table 1, which all involve finding the optimal allocation into various methodologies of doing things. Although this is not directly relevant to the present research, it is nevertheless worth noting that MPT is being applied in other areas. It is also worth noting that all these papers used the original mean-variance formulation of MPT in their analysis.

Table 1: Studies applying MPT to other areas

Title of paper	Author/s
Applying Modern Portfolio Theory to the analysis of terrorism	Phillips 2009
Water planning in a changing climate: joint application of cost utility analysis and Modern Portfolio Theory	Marinoni, Adkins & Hajkowicz 2011
Comparing water options for irrigation farmers using Modern Portfolio Theory	Gaydon et al. 2012
Using portfolio theory to guide reforestation and restoration under climate change scenarios	Crowe & Parker 2008
The optimal tree species composition for a private forest enterprise – applying the theory of portfolio selection	Neuner, Beinhofer & Knoke 2013
Applying modern portfolio techniques to agriculture	Coleman 2007

Chapter 3: Literature review on asset allocation theory-practice dichotomy

Research in economics and finance has produced a large number of innovations that have become widely used in industry and government. Some of these innovations include marginal analysis, the use of net present value in capital budgeting, peak load pricing, econometric forecasting, portfolio selection models and the options pricing model. Other theories did not end up as widely used or are still going through the process of adoption, the speed of which is influenced by the following factors: usefulness in dealing with uncertainties in the future, competitive pressure to adopt, additional benefits such as signalling, fairness issues in the case of governmental adoption and capacity to serve ancillary goals. However, even after adoption, some concepts may be understood imperfectly by users and therefore sub-optimally employed (Faulhaber & Baumol 1988).

Asset allocation theories may be one of these innovations that have not reached their full practical potential. Despite the original mean-variance model's elegance, mathematical rigour and intuitive appeal and the availability of computing power, there appears to be some evidence that MPT is not being fully utilised in the investment environment (Michaud 1989). In an early work, the aggregate market values of the major asset classes in the US namely common stocks, fixed corporate securities, real estate, government bonds and municipal bonds were estimated over the years to get a picture of the total market portfolio (Ibbotson & Fall 1979). Later analysis of the data extended to more recent times showed that the evident asset allocation was inconsistent with what would have been recommended by the original mean-variance model (Baker & Filbeck 2013). Using a mean-variance model that acknowledges the time varying nature of the covariances of asset returns improves the model's fit with US stock market data although Tobin's portfolio balance model which relies on the trade-off between liquidity and forgone interest still showed a better fit (Engel et al. 1995).

An experimental test where statistically knowledgeable students were asked to construct portfolios using two risky assets showed a high percentage of mean-variance inefficient portfolios which did not decrease with practice (Kroll, Levy & Rapoport 1988b), probably indicating the use of heuristics. One of the common diversification heuristics is the naïve diversification strategy of assigning equal weights to the assets in the portfolio. An experimental study on how participants would invest in defined contribution savings plans

showed that some people spread their contributions evenly across the investment options, with the allocation to equities increasing as the number of equity options is increased (Benartzi & Thaler 2001). Some support for this heuristic is provided by a study that found the performance of portfolios based on the mean-variance model and enhancements designed to reduce estimation error to be not superior compared to the naïve diversification strategy of equally weighted portfolios (DeMiguel, Garlappi & Uppal 2009).

Acknowledging their significant influence on the aggregate market portfolio, there have been studies on how financial advisers' recommended asset allocations stack up against the original mean-variance model. A study undertaken in the US context found that adviser-recommended asset allocations are suboptimal and achieve on average only 80% to 98% of the theoretically optimal portfolio returns (Huber & Kaiser 2003). Another study showed that the benchmark asset allocations recommended by financial planning groups for Australian private investors are also significantly sub-optimal. For each recommended asset allocation, a superior portfolio having a higher expected return for the same level of risk could be obtained by adjusting the recommended asset allocations (Santacruz & Phillips 2009).

Financial advisers' recommended asset allocations were also assessed against Tobin's extension of the original mean-variance model, the Portfolio Separation Theorem, which simplified asset allocation into the choice of the mix of a risk free asset and a risky portfolio that is uniform for all investors (Tobin 1958). Inconsistent with this theorem which implies that all investors should hold the same allocation of risky assets, US financial advisers were found to be recommending that conservative investors hold a higher ratio of bonds to stocks than aggressive investors (Canner, Mankiw & Weil 1997). However, further analysis of the same data showed that advisors' recommendations are consistent with MPT under reasonable assumptions (Elton & Gruber 2000). It was also shown that MPT supports advisors' recommendation that the ratio of bonds to stocks should vary directly with risk aversion when there are complete markets and when an investor's horizon exceeds the maturity of cash as this allows investors to synthesise risk-free and risky assets (Bajeux-Besnainou, Jordan & Portait 2001). Inter-temporal hedging was tested as an explanation for the "asset allocation puzzle" identified by Canner et al. (1997) but was found insufficient (Lioui 2007).

The present research aims to obtain a clearer picture of the apparent dichotomy between asset allocation theory and practice through a survey methodology. Similar survey studies have

been completed on other areas of finance as shown in table 2. Significant dichotomy between theory and practice have been identified and future directions recommended in these studies. However, these studies are mostly descriptive and did not attempt to examine the reasons for the non-usage of finance theories in practice. For this reason, and as they covered areas distinct from asset allocation, a detailed review of these studies was not carried out. However, some aspects of the methodologies that they employed will be adopted in this research.

Table 2: Survey studies on theory and practice in various areas of Finance

Title of paper	Author/s
Distribution of incomes of corporations among dividends, retained earnings and taxes	Lintner 1956
Investment decision under uncertainty: theory and practice	Mao & Helliwell 1969
Survey of capital budgeting theory and practice	Mao 1970b
The theory and practice of corporate finance: evidence from the field	Graham & Harvey 2001
Initial public offerings: an analysis of theory and practice	Brau & Fawcett 2006
Capital structure policies in Europe: survey evidence	Brounen, de Jong & Koedijk 2006
Corporate portfolio management: theory and practice	Pidun et al. 2011

A survey study on the use of general investment theory by fund managers on four continents found low usage in practice. The reasons cited were lack of availability of data, perception that theory does not work in practice, preference for a qualitative approach, external constraints and mechanical use of theory undermining managers' mystique (Coleman 2013). The study sought explanation from another paper that paints finance theory as a house without windows, where the research community acts as if all important insights are already contained within the existing body of theory and does not attempt to engage with the practitioner environment (Keasey & Hudson 2007). An earlier survey study among investment analysis managers in the US also showed low levels of usage of theory-based techniques and strategies in securities analysis and portfolio management, with larger firms having relatively higher

usage. No change in usage rate was observed before and after the stock market crash of 1987 (Carter & Van Auken 1990).

The only previous study identified which is closely similar to the present research is one that involves a survey of 229 Europe based institutions on their portfolio construction and performance measurement practices (Amenc, Goltz & Lioui 2011). The study found that while most investment management practitioners in Europe are aware of the main theories in portfolio construction, many still resort to ad hoc methods when constructing portfolios. Firm size was found to be a contributing variable in the use of sophisticated portfolio construction methods. Respondents were not directly asked their use of specific theories but were asked instead to choose from lists the method that they used for certain tasks. It may have been for this reason that the study was not able to shed much light on the role of mean-variance optimisation in their portfolio construction activities. Furthermore, the study is also mostly descriptive and did not attempt to examine the reasons for non-usage of asset allocation theories in practice. The present research will address these apparent gaps in the literature. The present research involves an extensive review of MPT and subsequent research strands and utilises a questionnaire survey that probes industry awareness and usage of theory and theory-based methods.

Chapter 4: Research questions and proposed conceptual model

4.1 Research question and sub-questions

The present research addresses the following main question: To what extent are available theories and theory-based methods of asset allocation being applied to practice in the Australian investment management industry?

As shown in the literature review, there have been no previous research focused specifically on probing the dichotomy between theory and practice of asset allocation. The present research aims to address this literature gap through the following research sub-questions:

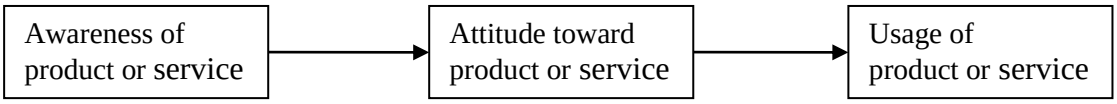
1. What is the level of awareness of asset allocation theories and theory-based methods among Australian investment management industry practitioners?
2. What are the factors that influence the level of awareness of asset allocation theories among practitioners?
3. What is the level of usage of asset allocation theories and theory-based methods that they are aware of among Australian investment management industry practitioners?
4. What are the factors that influence the level of usage of asset allocation theories among practitioners?

4.2 Conceptual model

To answer the above research questions, the present research proposes a conceptual model. This conceptual model is a combination of some theories and models widely used in marketing and information systems research.

In adopting a particular product or service, it is established that an individual goes through several levels, as shown in figure 10. Awareness of a product or service leads to attitude towards them which in turn influences usage of the product or service by the individual (Morrison & Gluck 1970). Similarly, the proposed research will decompose any dichotomy between theory and practice into awareness of and actual usage among those who are aware of available theories and theory-based methods on asset allocation.

Figure 10: The Marketing Model

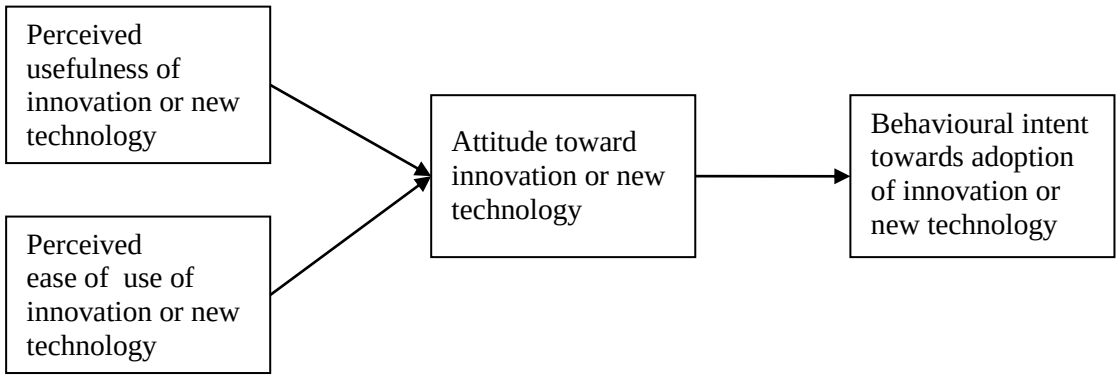


The conversion of attitude developed through awareness into actual usage of available asset allocation theories and theory-based methods will be further analysed using theories and models commonly used to examine adoption of an innovation or a new technology. These are the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB) which are widely used in information systems research. While the researcher is not aware of any previous study applying TAM and TPB to the use of finance theory in practice, it is asserted that use of an asset allocation theory or theory-based method by a previous non-user is similar to adoption of an innovation or a new technology as defined in literature.

"Innovation is defined as an idea, practice or object that is perceived as new by an individual or other unit of adoption, regardless of whether or not an idea is new as measured by the lapse of time since its first use or discovery. Technology is defined as a design for instrumental action that reduces the uncertainty in the cause-effect relationship involved in achieving a desired outcome" (Rogers 2003 p. 12-13). Use of an asset allocation theory or theory-based method can be considered an innovation as it involves a "change in behaviour of participants in the market or regulatory arena, acting from self-interest" (Faulhaber & Baumol 1988, p. 597).

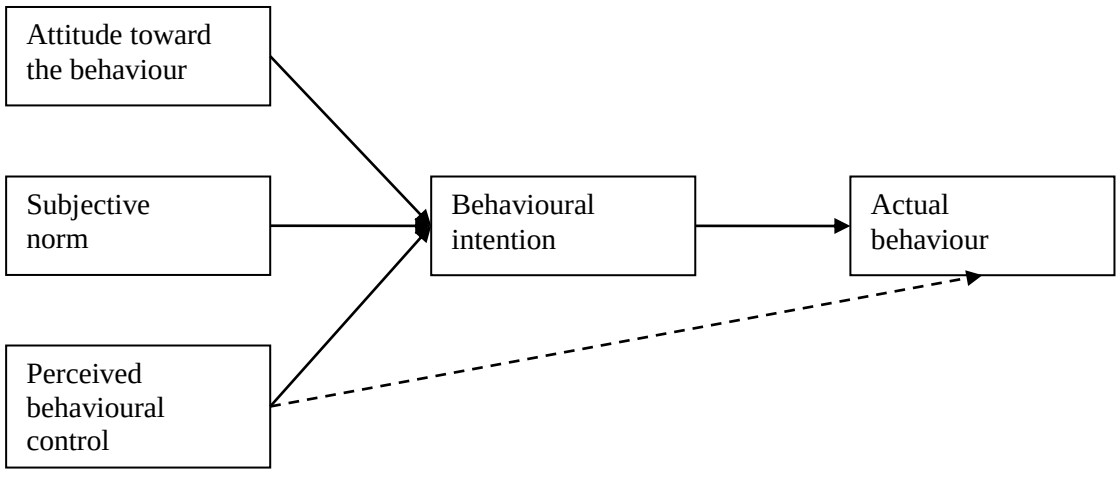
The first model, TAM, posits that an individual's perception of its usefulness and ease of use influences attitude and behavioural intent towards volitional adoption of an innovation or a new technology, as shown in figure 11. Perceived usefulness is defined as the degree to which the individual believes that adopting an innovation or new technology will enhance his or her job performance. Perceived ease of use is defined as the degree to which the individual believes that adopting an innovation or new technology will not require much effort (Davis 1989). Meta analytic reviews have found TAM to be a robust model for explaining acceptance of an innovation or new technology (King & He 2006; Qingxiong Ma & Liping 2004).

Figure 11: The Technology Acceptance Model



The second model, TPB, posits that an individual's attitude toward the behaviour, the subjective norm surrounding the behaviour and perceived behavioural control are determinants of behavioural intention which in turn drives actual behaviour by the individual, as shown in figure 12. TPB presents a more complete and general explanation of individual behaviour than that offered by TAM.

Figure 12: The Theory of Planned Behaviour



An individual's attitude towards the behaviour is defined as the degree to which the person has a favourable or unfavourable evaluation of the act of carrying out the behaviour. Subjective norm is defined as the perceived social pressure to carry out or not carry out the behaviour emanating from an individual's referent group or peers. Perceived behavioural control is

defined as the degree to which the individual believes they have control over or is able to carry out the behaviour without impediment. Behavioural intention is defined as the degree to which the individual is motivated or is willing to carry out the behaviour (Ajzen 1991).

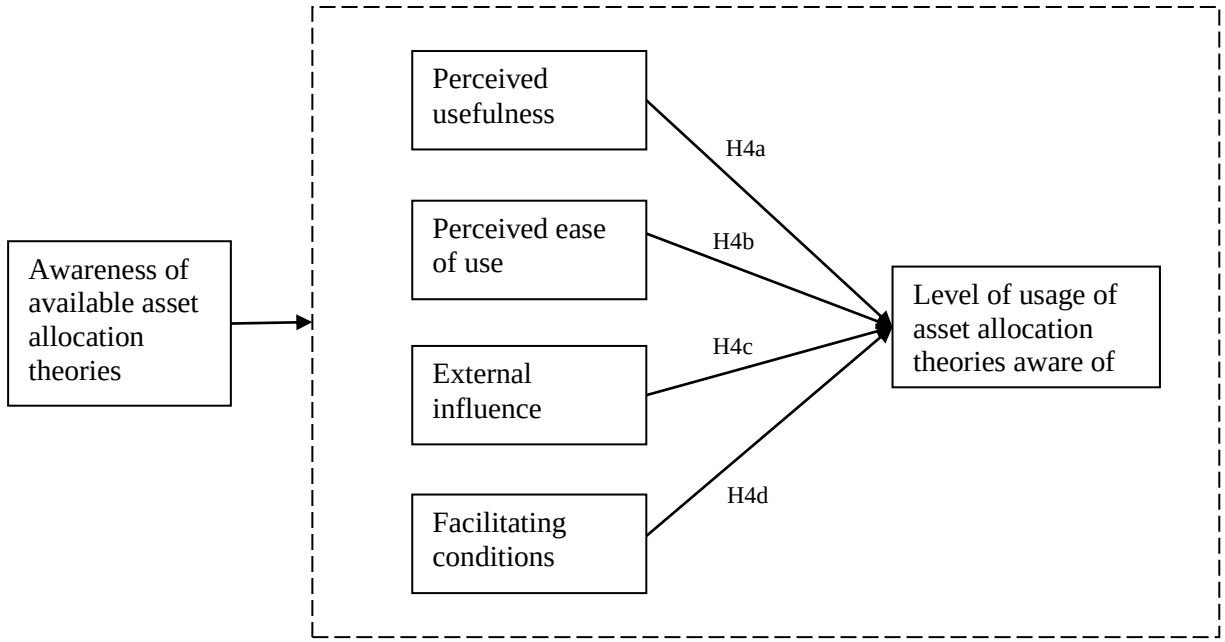
TPB suggests that behavioural intention is the most influential predictor of actual behaviour. However, intentions may not effectively predict behaviour if the individual does not have perceived control over the behaviour, hence the dotted line in figure 12. Perceived behavioural control captures non-motivational factors such as ability, availability of resources, cooperation of others and perceived absence of impediment in general (Ajzen 1991). Applied to the case of making socially responsible investments, these impediments could be institutional, organisational or individual impediments (Juravle & Lewis 2008).

TPB has shown wide application in research fields such as purchase prediction, adoption of innovation or new technology, voting behaviour and other diverse areas. An example in the area of finance is the use of TPB to explain the decision of individuals to invest in equities, which was found to be related to attitude, subjective norm and perceived behavioural control (East 1993). Meta analytic reviews have found TPB to be a robust model for explaining behaviour (Armitage & Conner 2001; Notani 1998; Sutton 1998). A review article categorised the criticisms of TPB into insufficient account of social factors, absence of a construct for past behaviour, clarity of perceived behavioural control construct, affective factors and moderation and interaction effects among the constructs (Manstead 2011). Other criticisms of TPB include concerns on the causality between perceived behavioural control and intention, sufficiency of the constructs in predicting behaviour, lack of distinction between behavioural intentions and expectations that may not influence behaviour directly and lack of detail on how intentions are implemented. Notwithstanding these criticisms, TPB was found to be appropriate in predicting people's intentions to seek the advice of a financial adviser (Johnson 2003) and other areas as shown by the wealth of literature that employs it as the theoretical framework. TPB has been utilised to analyse not only individual but organisational behaviour as well (Chen & Liu 2011; Hsiu-Fen Lin & Lee 2004; Zhang, Yang & Bi 2013).

In the proposed conceptual model, the elements of TAM have been incorporated into TPB as antecedent constructs influencing attitude toward the use of asset allocation theories and theory-based methods, as was applied in a study on student usage of online learning tools (Saade, Tan & Kira 2008). However, it has been found that the relationship between attitude

and behavioural intention is insignificant when perceived usefulness and perceived ease of use are included in the model. These two antecedent constructs were seen to work directly on behavioural intention and therefore can take the place of attitude in the model (Venkatesh et al. 2003). In the same spirit, behavioural intention is subsumed in the proposed conceptual model by the resulting four antecedent constructs that are theorised to directly influence usage of asset allocation theories and theory-based methods. This is consistent with the focus of the present research which is on actual usage of asset allocation theories and theory-based methods instead of intended usage. While meta-analysis has indicated that behavioural intentions explain only 28% of the variance in actual future behaviour and that therefore the gap between intentions and behaviour is not negligible (Sheeran 2002), the proposed conceptual model incorporates a moderating construct (i.e. facilitating conditions) that should have narrowed this gap significantly. The proposed conceptual model as shown in figure 13 is very similar to the Unified Theory of Acceptance and Use of Technology (UTAUT) presented in Venkatesh et al. (2003). UTAUT examined eight of the most common models used to understand the adoption of an innovation or new technology. The individual models were empirically compared by applying them to subjects in four work-based environments. The key elements of the eight models were brought together in the form of UTAUT, which identifies four key determinants and four moderators of usage behaviour. UTAUT posits that performance expectancy, effort expectancy, social influence and facilitating conditions predict behavioural intention, moderated by gender, age, experience, and the perception of voluntariness of usage. The conceptual model proposed in the present research has also adopted some of the construct terminologies in UTAUT. Hence, the TPB Subjective Norm construct is referred to as External Influence and Perceived Behavioural Control is referred to as Facilitating Conditions.

Figure 13: The proposed conceptual model



The marketing model has also been incorporated in the proposed conceptual model by acknowledging that awareness of available asset allocation theories and theory-based methods is a pre-requisite to the operation of the proposed combined TAM/TPB/UTAUT model. Lack of awareness of their availability would naturally preclude development of perceptions about the use of asset allocation theories and theory-based methods in practice. To be consistent with this, the dependent construct in the proposed model will be defined as the level of usage of asset allocation theories and theory-based methods that they are aware of among Australian investment management industry practitioners. This will be measured directly from the survey results as the percentage of theories and theory-based methods practitioners are aware of that they are actually using in practice, possibly with weighting factors based on the relative importance of each theory or method as discussed in Chapter 7.

It is noted that the above conceptual model, with the constructs contextualised for finance, may be addressing a current methodology gap in trying to explain the level of usage of general finance theories in practice. Extending it further, the model may be used to explain the level of usage of any academic body of theories in practice.

4.3 Research hypotheses

Consistent with the proposed conceptual model and based on the general findings of research on theory-practice dichotomy in similar areas, the following hypotheses are offered as responses to research sub-questions 1 to 4 respectively and will be validated in the present research:

H1: There is a high level of awareness of asset allocation theories and theory-based methods among Australian investment management industry practitioners.

H2: There are various avenues through which Australian investment management industry practitioners are able to achieve awareness of asset allocation theories and theory-based methods.

H3: There is a low level of usage of asset allocation theories and theory-based methods that they are aware of among Australian investment management industry practitioners.

H4: The proposed conceptual model shown in figure 13 can explain the low level of usage of asset allocation theories and theory-based methods that they are aware of among Australian investment management industry practitioners.

The survey instruments used in the present research have questions that directly address and provide support to the first three hypotheses. The fourth hypothesis will be tested through the following sub-hypotheses pertaining to the constructs defined in the proposed conceptual model:

H4a: Perceived usefulness has a significant influence on the use of asset allocation theories and theory-based methods.

H4b: Perceived ease of use has a significant influence on the use of asset allocation theories and theory-based methods.

H4c: External influence has a significant influence on the use of asset allocation theories and theory-based methods.

H4d: Facilitating conditions has a significant influence on the use of asset allocation theories and theory-based methods.

Measures to operationalise the above constructs in the proposed conceptual model have been sourced from the literature and contextualised to the case of usage of asset allocation theories and theory-based methods, in order to flesh out the factors influencing the level of usage.

Chapter 5: Research methodology

5.1 Dimensions of the present research

The present research is an applied research that seeks to improve the understanding of phenomena which in this case is the dichotomy between theory and practice of asset allocation. Its purpose is explanatory in that it will build on exploratory and descriptive research to identify the reason something occurs. It is a cross-sectional study as it involves observations at one point in time (Neuman 2011). The present research primarily utilises survey methodology.

5.2 Use of survey research methodology in finance

A majority of the studies seeking to explain decision making by finance practitioners utilise empirical methods relying on secondary data such as share prices and financial statements. However, there is also a significant body of knowledge based on primary data gathered though surveys and interviews with decision makers themselves (Neuhauser 2007). Some of these survey-based studies are widely cited such as Lintner (1956) and Graham and Harvey (2001) that were both mentioned in table 2 in Chapter 3.

There are arguments in support of the survey method in finance. It has been suggested that academics should not focus on how practitioners are expected to behave under finance theories but rather study how they actually behave and why (Percival 1993). Towards this end, finance practitioners should be surveyed more often as their preferences are major factors in organisational decision making. This is also one way of bridging the dichotomy between finance theory and practice (Weaver 1993). However, although survey studies contribute significantly to understanding the state of practice in finance, there are limitations that researchers should be aware of in over-relying on practitioners' insights without proper theoretical underpinning. First, practitioners may not be willing to divulge details of their actions and the reasons for them. Second, practitioners may not be fully aware of all the reasons for their organisation's actions. Third, researchers may be unable to gain access to practitioners who are significant decision makers in their organisations. Fourth, the constantly changing nature of financial systems would require frequent updating of surveys which would not be economical. Finally, interpretation of survey data requires the application of an

appropriate theoretical framework (Aggarwal 1993). The present research is aware of these limitations and has addressed them during the data gathering process.

The views of editors of finance journals regarding survey research have been gathered (Baker & Mukherjee 2006). Journals were found not to have specific policies on publication of survey-based research and these generally go through the same review process as other types of research such as empirical studies. Editors appear to view survey research as either equal to or complimentary to other types of research. Surveys produce data that cannot be obtained from other sources but there can be difficulties in generalizing results because of possible non-response bias. Examination of journal issues over a 21 year period found that 37% of journals have not published a single survey-based article with an average of around 0.27 survey-based articles per year for those who have. Editors generally appear receptive to survey-based research as long as they are carried out with the same rigour as other types of research (Baker & Mukherjee 2006).

Even in the field of health services, an important part of the implementation process is exploring barriers to adoption of research based recommendations, as what the present research is aiming to do. A common method to identify barriers is the use of theory-informed interviews and surveys (Hanbury et al. 2012). The present research likewise utilises a survey methodology as it is the most appropriate way to address the research questions that have been posed. In doing so, it is cognisant of the possible shortcomings of the survey methodology adopted and aims to address them sufficiently.

5.3 Survey structure

The present research involves three data gathering studies. Study number 1 obtains the opinion of the research community on the relative importance of the various asset allocation theories and theory-based methods through a survey. Study number 2 involves structured interviews of a small number of investment management industry practitioners to obtain an initial understanding of their awareness and usage of asset allocation theories and theory-based methods and to obtain a picture of the asset allocation process in financial institutions. Study number 1 and Study number 2 inform the design and implementation of Study number 3 which involves a quantitative survey that probes awareness and usage of the asset allocation theories and theory-based methods discussed in the literature review among investment management industry practitioners who have a role in asset allocation decisions. Study

number 3 directly addresses the research sub-questions posed earlier through an online survey conducted using the service provided by www.qualtrics.com.

The data gathering studies utilise a combination of qualitative and quantitative methods. Use of multiple methods to study the same phenomenon under investigation is referred to as methodological triangulation. It offers the potential to provide a wider and deeper understanding of the study phenomenon thereby increasing study credibility (Hussein 2009). In the present research, qualitative methods are used as preliminary inquiries for a quantitative study and the results from the former are used to inform the instruments used in the latter. The qualitative instruments allow a more flexible investigation with more depth while the quantitative survey provides a larger sample size and database for objective and statistical analysis (Smith & Goudzwaard 1970).

While Study number 1 and Study number 2 inform the design and implementation of the research instrument in Study number 3, there was on a higher level an iterative process among the literature review, research methodology and data gathering. For instance, the literature review of available theories and theory-based methods initially guided the set of questions asked of academics in Study number 1. In turn, the responses gathered from academics identified areas of literature that needed to be discussed further and also influenced the design of the research instrument for Study number 3.

Chapter 6: Overview of the Australian investment management industry

6.1 Introduction

As discussed in Chapter 1, the Australian investment management industry is one of the largest in the world. This chapter provides an overview of the investment management industry in Australia by discussing the various participants in the industry. An understanding of the industry structure is essential in carrying out the data gathering studies in this research and analysing the results. For instance, the practitioner survey carried out in Study number 3 utilised a respondent set sourced from among these industry participants to the extent that the contact details of target relevant executives are publicly available.

As stated in Chapter 1, investment management is defined as the job of planning, implementing, and overseeing the funds of an individual investor or an institution (Fabozzi et al. 1999). The major participants in the investment management industry are superannuation or pension funds, fund managers, asset consultants to institutional investors, personal financial planning groups, insurance companies, savings or investment banks and other entities. All the information in this chapter are sourced from Austrade (2010) unless otherwise stated.

6.2 Superannuation or pension funds

Superannuation or pension funds are the major contributors to the growth of, and currently the largest player in the Australian investment management industry, accounting for around 70% of the industry's investment assets. The growth of the superannuation segment is expected to continue into the future as legislation has continued to be favourable towards it. The major superannuation or pension funds are shown in table 3.

Table 3: The 50 largest superannuation funds in terms of assets (Australian Bureau of Statistics 2013 data)

AMP Superannuation Savings Trust	Commonwealth Bank Group Super
Australian Super	Local Government Superannuation Scheme
Colonial First State First Choice Super	Auscoal Superannuation Fund
State Public Sector Superannuation Scheme	Australia Post Superannuation Scheme
Retirement Wrap	MTAA Superannuation Fund

The Universal Super Scheme	Qantas Superannuation Plan
First State Superannuation Scheme	Suncorp Master Trust
Unisuper	Westpac Mastertrust Superanuation Division
One Path Masterfund	The Portfolio Service Retirement Fund
Retail Employees Superannuation Trust	Russell Supersolution Master Trust
Sunsuper Superannuation Fund	Equipsuper
Health Employees Superannuation Trust	Care Super
Construction and Building Unions Super	Local Authorities Superannuation Fund
Asgard Independence Plan	Aust Catholic Super and Retirement Fund
Mercer Super Trust	NGS Super
Wealth Personal Superannuation and Pension	Catholic Superannuation Fund
MLC Superannuation Fund	Oasis Superannuation Master Trust
Public Sector Superannuation Scheme	CSS Fund
IOOF Portfolio Service Super Fund	Military Superannuation and Benefits Fund
Telstra Superannuation Scheme	Energy Super
Plum Superannuation Fund	Local Government Superannuation Scheme
Hostplus Superannuation Fund	Public Sector Super Accumulation Plan
State Super Retirement Fund	Rio Tinto Staff Superannuation Fund
Macquarie Superannuation Plan	The Retirement Plan
Victorian Superannuation Fund	Maritime Super

It should be noted that in addition to approximately 500 institutional pension funds, there are close to half a million smaller self-managed superannuation or pension funds accounting for around 30% of total superannuation assets. These are entities that self-manage the retirement funds of at most four individuals, usually members of a family. The present research will only cover institutional pension funds although the asset allocation practices of self-managed funds can be identified as an area for future research.

6.3 Fund managers

Fund managers of non-superannuation or non-pension monies consist of local firms and local offices of offshore-based investment management firms. Some of these fund managers also belong to the same groups that operate a publicly-available superannuation or pension fund.

The major fund managers that account for around 85% of the funds under management in this segment are shown in table 4.

Table 4: The 30 largest fund managers in terms of funds under management

Commonwealth/Colonial Group	Aberdeen Asset Management Ltd
Macquarie Bank Group	BNP Paribas Asset Management Ltd
State Street Global Advisors	Platinum Asset Management
Vanguard Investments Limited	Lazard Asset Management
AMP Group	Dimensional Fund Advisors
BlackRock	UBS
ING/ANZ Group	Schroder Investment Mgt Australia Ltd
BT Financial Group	Goldman Sachs-JBWere Asset Mgt
AXA Australia/AllianceBernstein	National/MLC Group
PIMCO	Tyndall Investment Management Group
Perpetual Limited	Suncorp
IOOF Group	GMO Australia
BNY Mellon Asset Management Australia	Ausbil Dexia Ltd
Industry Funds Management Ltd	Australian Unity
Challenger Financial Services Group	Balanced Equity Management

In addition to the large fund managers, there are also smaller and numerous boutique fund managers. They are typically established by experienced managers who focus on a particular strategy or niche. The largest boutique fund managers include Perennial Investment Management, Platinum Asset Management and Maple Brown Abbot and are increasingly being regarded as large fund managers.

The boutique fund sector is supported by incubation firms in the areas of business operations and sales and marketing in exchange for an equity stake thereby allowing the boutique funds to concentrate solely on investing. The major fund incubators include Ascalon, Bennelong, Challenger, Grant Samuel, Magellan, Pengana and Pinnacle.

Platform administrators who operate master trusts or wrap accounts enable retail investors to access several wholesale managed funds in a convenient administrative arrangement. Like the

managed fund sector, this area is dominated by large financial institutions. The five largest platform administrators are BT Financial Group, NAB/MLC Group, AMP Group, ING/ANZ Group and Commonwealth/Colonial Group.

6.4 Asset consultants to institutional investors

Asset consultants are firms that provide advice on investment strategies, asset allocation and selection of investment managers to institutional investors such as superannuation fund trustees and therefore serve as gatekeepers between institutional investors and investment managers. As such, they play a major role in influencing the asset allocation of the investment management industry. The major asset consultants are shown in table 5.

Table 5: The major asset consultants

JANA Investment Advisers
Frontier Investment Consulting
Towers Watson
Mercer
Russell Investments
Ibbotson Associates
Quentin Ayers
Access Capital Advisers
CPG Research and Advisory
Sovereign Investment Research

6.5 Personal financial planning groups

Personal financial planners, as part of their holistic advice, recommend investment products to their clients. These include managed investments which make financial planners one of the industry's distribution channels. However, as far as asset allocation is concerned, financial planning groups usually recommend to their clients the same model portfolios as those of investment management firms that they are affiliated with (Santacruz & Phillips 2009). The major personal financial planning groups are shown in table 6.

Table 6: The 30 largest personal financial planning groups in terms of number of advisers

Professional Investment Services	Wealthsure Financial Services
AMP Financial Planning Pty Ltd	Hillross Financial Services Ltd
Count Financial Ltd	Lonsdale Financial Group
Millenium3 Financial Services	Australian Financial Services
Commonwealth Financial Planning	Financial Services Partners
NAB Financial Planning	RetireInvest
ABN AMRO Morgans Ltd	Godfrey Pembroke Financial Consultants
Charter Financial Planning	Bridges Financial Services Pty Ltd
MLC/Garvan Financial Planning	AFG Financial Planning Pty Ltd
Financial Wisdom Ltd	WHK Group Ltd
Securitor	AAA Financial Intelligence
Westpac Financial Planning	Apogee Financial Planning
AXA Financial Planning Ltd	Guardian Financial Planning
Genesys Wealth Advisers	Aon Financial Planning
ANZ Financial Planning	Synchron

6.6 Insurance companies

Insurance companies provide insurance products directly to businesses and individuals or indirectly through superannuation or pension funds. They also provide superannuation products through affiliated entities. Insurance companies are one of the largest investors in the investment management industry. The major insurance companies are shown in table 7.

Table 7: The 20 largest insurance companies in terms of market share

AMP Group	Macquarie Life
NAB/MLC Group	MBF Life
ING Australia Group	Zurich Group
AXA Australia Group	Metlife Insurance
Comminsure Group	Hallmark Group
BT/Westpac Group	Allianz Australia Life
Suncorp Group	HCF Life

Tower Group	Cuna Mutual
AIA Australia	IOOF Life
Challenger Financial Group	Combined Life

6.7 Savings or investment banks

Savings and investment banks are also major investors in the investment management industry. As can be seen in the previous sections, banks and their affiliates operate in various sectors of the investment management industry.

Chapter 7: Data gathering study number 1 – survey of academics

7.1 Introduction

Study number 1 aims to determine through a survey how academics and researchers perceive the importance of the various theories and theory-based methods in making the correct asset allocation decision. The categorisation of the body of research is based on the literature review of asset allocation theories and theory-based methods that has been discussed in Chapter 2.

A more quantitative method of assessing the importance of the various theories and theory-based methods would have been to conduct a meta-analysis of studies that quantify their impact on optimising asset allocation. A meta-analysis would integrate the findings of these studies numerically rather than verbally (Leedy & Ormrod 2005). Often used as a synonym for research synthesis, meta-analysis involves quantitative procedures to statistically combine the results of previous empirical studies about a specific phenomenon (Cooper 2009). However, it would be difficult to do this with the body of asset allocation research as there is a wide range of methodologies and datasets used, and it would not be possible to reduce this rich set of data to a common denominator.

In this study, an email survey was carried out among academics and researchers who have published papers on the topic of asset allocation. Emails were sent out to 208 authors cited in the literature review undertaken for the present research. As the literature review was quite extensive, the views that can be extracted from this respondent selection set should be representative of the views of academics who have undertaken research on asset allocation. This is further reinforced by the relatively high response rate of 20% with 41 academics responding to the survey.

One might question why only academics who have undertaken research on asset allocation were surveyed as this might have provided biased results. Ideally, the respondent selection set should be all academics that are aware of the concept of asset allocation. However, the main consideration is a solid understanding and not just awareness of the various theories and theory-based methods as the study aims to obtain a picture of their relative importance. It is expected anyway that academics would be naturally biased in favour of theory. It is also worth noting that most of the published research of the academics surveyed started out as

critiques of the existing body of knowledge and therefore the respondent set is not really a homogeneous group in terms of their perception of asset allocation theory.

7.2 Research instrument

The email survey instrument used in this study is shown in table 8.

Table 8: Survey instrument for Study number 1

Dear Prof _____,

I am doing a PhD research entitled "Asset Allocation: Analysis of Theory and Practice in the Australian Investment Management Industry". The aim of the research is to examine any dichotomy between theory and practice of asset allocation. Studying asset allocation theory and practice in relation to one another may lead to finding ways to improve both, which would be beneficial to academe and industry.

My research involves doing a comprehensive survey of available theories and theory-based methods of asset allocation, which I have mostly completed and where I cited your paper entitled "_____".

One of the studies I am conducting in my research aims to obtain a general picture of the importance of this body of knowledge on asset allocation decision from the point of view of academics. As you have done research work on this area, I would greatly appreciate if you can put in your informed opinion on the table below which should not take more than 5 minutes and email it back to me. Also, please feel free to indicate on the spaces provided any theory-based methods that I may have overlooked as well as provide any comments on asset allocation or this research in general using the bottom box.

Major categories of theory or theory-based method of asset allocation (with some examples)	How important is each major category in making the correct asset allocation decision? 1 - Unimportant 2 - Of little importance 3 - Moderately important 4 - Important 5 - Very important
Markowitz's original mean-variance model	
Use of additional parameters - higher moments such as skewness of returns - Bayesian framework incorporating skewness - others such as: _____	
Use of risk measures other than variance - semivariance - lower partial moments - VAR	

- conditional VAR - others such as: _____	
Addressing problems of parameter uncertainty - imposing weight constraints - Bayesian estimation - use of shrinkage estimators - robust optimisation - portfolio resampling - others such as: _____	
Multi-period models - discrete time multi period models - continuous time multi period models - others such as: _____	
Non-quadratic utility function models	
Other (alternative) asset allocation models - heuristic approach - qualitative approach backed by simulation - factor based asset allocation - risk parity investing - Prospect Theory based models - Stochastic Dominance criterion - gain loss analysis - inclusion of non-traditional asset classes - Portfolio Separation Theorem - others such as: _____	
Please indicate also what you think are the two most important among the given examples of other (alternative) asset allocation models above: (1) (2)	
Other comments on asset allocation or this research in general:	

Your email response will be treated confidentially and the resulting PhD paper and journal publications will not identify the survey respondents. Participation is entirely voluntary and completion of the survey will be taken as tacit consent to be surveyed. If you decide to take part and later change your mind, you are free to withdraw from the research at any stage. Any information already obtained from you will be destroyed.

Should you have any queries regarding this research, you can contact myself as the principal researcher through my details below. If you have any ethical concerns with how the research is being conducted or any queries about your rights as a participant please feel free to contact: Ethics and Research Integrity Officer, Office of Research and Higher Degrees, University of Southern Queensland, Toowoomba QLD 4350, Ph: 07 4631 2690, Email: ethics@usq.edu.au.

Thank you and regards,

Lujer Santacruz
Lecturer and PhD Candidate

7.3 Analysis of respondent profile

Before looking at the results, the actual respondents were analysed for possible non-response bias to check if they are representative of the respondent selection set. Three identifiable parameters were used for this purpose, namely country, research focus and Scopus h-index of the respondents. Chi-square tests comparing frequency distributions were utilised for the first two parameters while t-tests comparing means were utilised for the third parameter.

In order to carry out a chi-square test, the actual frequency distribution of respondents by country is summarised in table 9 along with the expected frequencies if the observed distribution in the respondent selection set were applied to the actual number of respondents and the corresponding differences or residuals.

Table 9: Distribution of respondents by country

Country of respondent	Actual frequency	Expected frequency	Residual
Australia	4	1.8	2.2
Belgium	1	0.6	0.4
Canada	3	2.0	1.0
China	2	2.2	-0.2
France	1	2.2	-1.2
Italy	1	1.0	0.0
Morocco	1	0.6	0.4
Spain	2	1.2	0.8
Turkey	1	0.6	0.4
UK	4	3.2	0.8
US	20	18.3	1.7
Others	1	7.3	-6.3
Total	41	41.0	0.0

The chi-square value of 10.99 calculated from the above comparative frequency table is not significant at 95% confidence ($p = 0.44 > 0.05$). Therefore, it can be concluded that there is no significant difference in terms of frequency distribution by country between the respondent selection set and the actual respondents.

In order to carry out a chi-square test, the actual frequency distribution of respondents by research focus is summarised in table 10 along with the expected frequencies if the observed distribution in the respondent selection set were applied to the actual number of respondents and the corresponding differences or residuals.

Table 10: Distribution of respondents by research focus

Research focus	Actual frequency	Expected frequency	Residual
General asset allocation research	3	3.6	-0.6
Markowitz' original mean-variance model	7	2.7	4.3
Use of additional parameters	4	5.3	-1.3
Use of risk measures other than variance	7	10.6	-3.6
Addressing parameter uncertainty	7	7.1	-0.1
Multi-period models	4	2.6	1.4
Non-quadratic utility function models	3	2.2	0.8
Other asset allocation models	6	6.9	-0.9
Total	41	41.0	0.0

The chi-square value of 9.65 calculated from the above comparative frequency table is not significant at 95% confidence ($p = 0.21 > 0.05$). Therefore, it can be concluded that there is no significant difference in terms of frequency distribution by research focus between the respondent selection set and the actual respondents.

As mentioned, the third parameter is Scopus h-index of the respondents. The h-index attempts to measure both the quantity and quality of an academic's published work. The way it is calculated, an academic with an index of h has published h papers each of which has been cited in other papers h times (Hirsch 2005). The h-indices used in this study are those sourced from citation database Scopus. The researcher did a comparison of the h-indices of those who responded with those who did not respond to discount the possibility that less prominent academics are more likely to respond therefore clouding the opinions gathered. However, the comparison is made only for those who have h-indices available on Scopus.

The descriptive statistics are summarised in table 11. It is worth noting that the London School of Economics found that full professors in the field of economics, which includes the finance discipline, have an average h-index of 7.60 (LSE 2014) which is around the mean for the respondent selection set in this study.

Table 11: Comparison of h-indices of respondents and non-respondents

	Total number	**Scopus h-index available**	**% h-index available**	**Mean h-index**	**Standard deviation**
Respondents	41	33	80%	6.85	5.75
Non-respondents	167	130	78%	7.64	6.64

The percentages having h-index available on Scopus are almost the same for both respondents and non-respondents, eliminating it as a confounding variable. The value for the Levene's test for equality of variances of 1.74 is not significant at 95% confidence ($p = 0.19 > 0.05$). Therefore, there are no significant differences between the variances of the two groups and the t-test for equality of means can be carried out with the homogeneous variance assumption (Coakes, Steed & Dzidic 2006). The subsequent value for the t-test for equality of means of 0.63 is not significant at 95% confidence ($p = 0.53 > 0.05$). Therefore, it can be concluded that there is no significant difference in terms of Scopus h-index between the actual respondents and the non-respondents among the respondent selection set.

To conclude this section, on the basis of the three parameters namely country, research focus and Scopus h-index of the respondents, there do not appear to be any non-response bias and therefore the actual respondents are representative of the respondent selection set. Given the extensiveness of the literature review carried out, from which the authors were selected to be part of the respondent selection set, the subsequent survey results would appear to have external validity.

7.4 Results and discussion

The descriptive statistics and distribution of responses to the question on importance of each category of asset allocation theory and theory-based method in making the correct asset allocation decision are shown in table 12. While the survey instrument used a 1 to 5 coding

for the importance rating, the researcher has decided to transpose the responses to a 0 to 4 coding in the analysis as a 0 rating will more accurately represent an "unimportant" view. Of course, any analysis will have to acknowledge that Likert ratings are not really scalar measures.

Table 12: Responses to question on importance of theory categories

Category of theory and theory-based method	**n**	**μ**	**σ**	**Importance in making correct asset allocation decision Unimportant<->Very important**				
				0	**1**	**2**	**3**	**4**
Markowitz' original mean-variance model	41	3.22	1.01	0	5	2	13	21
Use of additional parameters	40	2.43	1.01	0	10	8	17	5
Use of risk measures other than variance	40	2.28	1.13	3	7	11	14	5
Addressing parameter uncertainty	41	3.10	0.83	1	0	6	21	13
Multi-period models	41	2.41	1.07	1	9	9	16	6
Non-quadratic utility function models	37	2.05	1.39	8	5	6	13	5
Other asset allocation models	37	2.73	0.99	1	4	6	19	7

The above results confirm a common thread in asset allocation literature. The original mean-variance model (mean importance of 3.22) is perceived as a robust model but the problems with parameter uncertainty need to be addressed (mean importance of 3.10) for the model to maximise its usefulness in asset allocation practice. There is also a lot of theoretical discussion on the other research categories but the relatively low importance (i.e. less than 3.00) attributed to these categories suggest that their impact on portfolio optimisation is not as significant, something that a meta-analysis might be able to confirm. Among these research categories, other asset allocation models that present a departure from the original mean-variance model are attributed the highest importance (mean importance of 2.73). This is reflective of the growing body of literature on newer asset allocation models such as factor-based and Prospect Theory based models.

In answering the survey, academics may have a more favourable view of the category where their research efforts are focused. Possible bias is tested by comparing the views on the importance in making the correct asset allocation decision of various research categories of

academics whose research is focused on the particular category with those of the rest. The results are shown in table 13.

Table 13: Testing responses to question on importance of theory categories for bias

Category of theory and theory-based method	Focus is on the same category			Focus is not on the same category			1	2	3
	n	μ	σ	n	μ	σ			
Markowitz' original mean-variance model	7	3.71	0.49	34	3.12	1.07	0.10	0.16	no
Use of additional parameters	3	2.67	0.58	36	2.36	1.02	0.10	0.61	no
Use of risk measures other than variance	7	3.29	0.76	33	2.06	1.09	0.33	0.01	yes
Addressing parameter uncertainty	7	3.43	0.79	34	3.03	0.83	0.59	0.25	no
Multi-period models	4	3.75	0.50	37	2.27	1.02	0.06	0.01	yes
Non-quadratic utility function models	3	3.33	0.58	34	1.94	1.39	0.07	0.10	no
Other asset allocation models	5	3.00	0.00	31	2.65	1.05	0.00	0.07	no

1 – p value for Levene's test for equality of variances (which directs subsequent t-tests), at 95% confidence $p > 0.05$ indicates equality

2 – p value for t-test for equality of means, at 95% confidence $p > 0.05$ indicates equality

3 – based on the t-test, are respondents possibly biased in their responses because of their research focus?

The means are expectedly higher for those whose research focus is on the same category but the significance will be confirmed through t-tests. For each research category, the variances are tested for equality using Levene's test. Subsequent t-tests for equality of means are carried out based on either a homogeneous or a non-homogeneous variance assumption (Coakes, Steed & Dzidic 2006). As table 13 shows, there is possible research focus bias in the responses to two research categories namely 'use of risk measures others than variance' and 'multi-period models'. However, despite possible bias, the aggregate mean importance of these two research categories are still the second and third lowest. Therefore, we can accept the aggregate importance rating data in table 12 and proceed with any further analysis on their basis.

The respondents were also asked to name the two most important among other asset allocation models and provide comments about asset allocation in general. The responses are summarised in table 14 and table 15.

Table 14: Top mentions among other asset allocation models

Other asset allocation models	Number of mentions
Factor-based asset allocation	18
Prospect Theory based models	6
Qualitative approach backed by simulation	5
Stochastic Dominance criterion	4
Risk parity investing	4
Heuristic approach	4
Non-variance risk measures	3
Inclusion of non-traditional asset classes	3
Multi-period models	1
Portfolio separation theorem	1
Gain-loss analysis	1
Bayesian framework	1
Expected utility models	1
Liquidity as a shadow allocation	1
Scenario dependent correlation matrix	1
Equal weighted asset allocation	1

Among other asset allocation models, the factor-based model is the clear front runner as perceived by academics. It is worth noting that the model is also based on the same principle as the original mean-variance model which is diversification of risk. As discussed earlier in Chapter 2, instead of attempting to directly measure the risk characteristics of each asset class (e.g. using variance of returns), this model looks at the underlying factors that drive the various assets and aims to diversify these optimally. The next rated models (Prospect Theory, qualitative with simulation, Stochastic Dominance, risk parity investing and heuristic approach) share the common principle of acknowledging that actual investor behaviour may be different from that traditionally predicted by theory, possibly explaining any dichotomy.

Table 15: Comments about asset allocation in general

Analytical modelling of the asset allocation process is an important factor but needs to include the dynamics of the underlying drivers and consider behavioural impacts.
Very important to treat asset class interdependencies in a manner that is more dynamic than simple one-dimensional correlation coefficients. I favour copula dependency functions.
The original model is overly simplistic, however it is the breakthrough that introduced mathematical rigour to asset allocation. In investing, need to remember that this is not a stable system like other areas of science - assumptions can change and relationships can change. Therefore, (1) always start with objective qualitative analysis – what is going on in the economy and the markets and what is coming on the horizon? (2) go back to assumptions made and relationships used and test them periodically (3) do not get so enamoured with your own quantitative sophistication that you do not pay proper attention to common sense. The most important part of asset allocation is how to get return assumptions - this is the area that needs research.
Estimation error is the single most important factor for enhancing investment value. Michaud resampling is the only technology with provable enhanced value. Bayesian and shrinkage methods are important in data management but the other issues are all unproven.
Within real estate investments, looking at the economic base industries of cities invested in is very important as they drive demand for real estate in each city.
Asset allocation is insufficient - need to add sector rotation and security analysis. VAR and CVAR are worthless as they do not measure risk. Advanced utility theory using both Prospect Theory S-Shaped and Friedman-Savage-Markowitz Reverse S-Shaped utility functions are important. Use of upper partial moment instead of the mean is an important development in applying utility theory.
In modelling the dynamics of prices and returns of assets, time series model is needed. Copula is also a good tool to explain dependencies. Also, high frequency finance seems to be the future.
Multi-period modelling is very important, but not well developed in the literature.
Trending in asset return is often overlooked but it contributes to higher than forecast risk experience.
I believe that for doing any choice, we should account for the temporal horizon and using the right definition of returns for that choice. Moreover we should account that any choice has to be done consistently to a given investor's stochastic dominance criterion.
See several well-known papers about Stein's lemma to see why Markowitz's model is so important. Kurtosis is not generally important as it is often a monotonic function of variance. Non-variance risk measures may result in some differences but it is unlikely that these will be statistically significantly different from an equivalent mean-variance optimisation and some of these functions can sometimes result in a non-convex objective function. Not convinced that continuous time models are that useful in practice, even though they may be powerful in theory.

The comments summarised in table 15 reinforce the findings discussed earlier. The original mean-variance model is still perceived as relevant but the determination of inputs to the model needs to be refined and should also consider their time-varying nature. The underlying risk factors also need to be considered as well as actual investor behaviour and preferences. Models need to be applied dynamically and assumptions reviewed and validated.

7.5 Chapter summary

The opinions of a representative respondent set of academics and researchers from among the authors cited who have undertaken research on asset allocation were gathered through an email survey. The original mean-variance optimisation model was rated important in making the correct asset allocation decision along with the research strand addressing the problems of the model with parameter uncertainty. Other research strands emanating from the original mean-variance model were rated not as important suggesting that their impact on portfolio optimisation is not as significant. Other asset allocation models, such as factor-based asset allocation and other models that represent a departure from the original mean-variance model, were rated highly reflecting the growing body of literature in this area. Possible bias in the responses because of research focus was analysed and found to be not material as far as the overall results are concerned.

The importance attributed by academics to asset allocation theory and theory-based methods indicate the relevance of studying how they are being used in practice and how they can be put to better use. This is particularly significant given the negative press that Modern Portfolio Theory has been getting since the Global Financial Crisis (GFC) of 2007-08.

The importance ratings for each category of theory and theory-based method of asset allocation give an indication of their relative impact on portfolio optimisation. Therefore, they can also be used as a possible weighting factor in Study number 3 where the level of awareness and usage of each one by practitioners is surveyed. The results of Study number 1 also provided insights that informed the design of the survey instrument and the target respondents in Study number 3.

The survey carried out in this study provided the academics' views on the relative importance of the original mean-variance optimisation model and subsequent research strands that aim to address its perceived limitations. A more quantitative method of assessing the importance of various theories and theory-based methods would have been to conduct a meta-analysis of studies that quantify their impact on optimising asset allocation. However, it would be difficult to do this with the body of asset allocation research as there is a wide range of methodologies and datasets used and it would not be possible to reduce the rich set of data to a common denominator. Nevertheless, a meta-analysis of asset allocation theories and theory-based methods could be a future area of study.

Chapter 8: Data gathering study number 2 – interviews of practitioners

8.1 Introduction

Study number 2 involves structured interviews with a small number of investment management industry practitioners who have a role in asset allocation decisions. Respondents were obtained primarily from among attendees at two industry conferences: Fund Executives Association Limited National Conference on 8 August 2013 and CFA Society Australia Investment Conference on 24 October 2013 both in Melbourne. There were a total of 13 interviewees.

The first objective of the interviews is to obtain a general picture of the asset allocation process in financial institutions. In the US context (Sharpe 2007 p. 18), the process typically involves the following steps:

1. Select desired asset classes and representative benchmark indices.
2. Choose a representative historical period and obtains returns for the asset classes.
3. Compute historical asset average returns, standard deviations, and correlations.
4. Estimate future expected returns, standard deviations, and correlations. Historical data are typically used, with possible modifications, for standard deviations and correlations. Expected returns are often based more on current market conditions and/or typical relationships in capital markets.
5. Find several mean-variance-efficient asset mixes for alternative levels of risk tolerance.
6. Project future outcomes for the selected asset mixes, often over many years.
7. Present to the board relevant summary measures of future outcomes for each of the selected asset mixes.
8. Finally, ask the board to choose, based on its views concerning the relevant measures of future outcomes, one of the candidate asset mixes to be the asset allocation policy.

As the above steps are for the US context, they will be verified if applicable to the Australian context during the interviews with practitioners. The research methodology for Study number 3 will then be based on the actual steps in the asset allocation process.

The second objective of the interviews is to obtain an initial understanding of the awareness and usage of asset allocation theories and theory-based methods among practitioners. The insights obtained in this study and Study number 1 will inform the design and implementation of the quantitative survey in Study number 3.

8.2 Research instrument

The list of open ended questions asked during the interviews are shown in table 16.

Table 16: Interview questions used in Study number 2

1	William Sharpe, in a 2007 paper, outlined the typical steps in the asset allocation process in the US as follows: (a) Select desired asset classes and representative benchmark indices. (b) Choose a representative historical period and obtains returns for the asset classes. (c) Compute historical asset average returns, standard deviations, and correlations. (d) Estimate future expected returns, standard deviations, and correlations. Historical data are typically used, with possible modifications, for standard deviations and correlations. Expected returns are often based more on current market conditions and/or typical relationships in capital markets. (e) Find several mean-variance-efficient asset mixes for alternative levels of risk tolerance. (f) Project future outcomes for the selected asset mixes, often over many years. (g) Present to the board relevant summary measures of future outcomes for each of the selected asset mixes. (h) Finally, ask the board to choose, based on its views concerning the relevant measures of future outcomes, one of the candidate asset mixes to be the asset allocation policy. How similar, or different, is the process here in Australia?
2	Do investment management entities (e.g. managed funds, super funds) decide in-house on strategic asset allocations or do they rely on outside parties? Please detail.
3	How often are strategic or long-term asset allocations determined?
4	Who carries out the analysis leading to asset allocation recommendations?
5	Who decides on what method of analysis to use to come up with asset allocation recommendations?
6	Who evaluates and approves the asset allocation recommendations?
7	The major academic theory on asset allocation revolves around Markowitz's mean-variance optimisation model. Subsequent enhancements to theory include the use of additional parameters, use of risk measures other than variance, addressing problems of parameter uncertainty, multi period models, non-quadratic utility function models and other asset allocation models. Approximately what percentage of this body of academic theories and theory-based methods of asset allocation do you think analysts are aware of?
8	What do you think are the reasons that contribute to this level of awareness?
9	Approximately what percentage of asset allocation theories and theory-based methods that they are aware of do you think analysts actually use?

10	What do you think are the reasons that contribute to this level of usage?
11	What other questions relevant to my research do you think should I be asking in this interview?
12	Could you kindly provide your name, email address, job title, qualifications, name of organisation and nature of business?

8.3 Analysis of respondent profile

The interviewees are fairly representative and range from investment analysts to senior executives from six superannuation funds, five asset consultants, one non-superannuation managed fund and one financial planning firm. Superannuation or pension funds manage the retirement funds of individuals and are major investors in domestic and global financial markets. Asset consultants are firms that provide advice on investment strategies, asset allocation and selection of investment managers to institutional investors such as superannuation fund trustees and fund managers and therefore serve as gatekeepers between institutional investors and investment managers (Austrade 2010). Though modest, the number of interviewees was sufficient to meet the objectives of Study number 2.

8.4 Results and discussion

The interview responses to the various questions are summarised in the following tables. The first six responses are from superannuation funds (shaded), the next five from asset consultants, the next one from a non-super managed fund (shaded) and the last one from a financial planning firm. The responses are presented in their entirety to have a full appreciation of the answers provided, with a summary after each table.

Table 17: Responses to interview question 1 on the asset allocation process in practice

Sharpe outlines a typical Markowitz mean-variance optimisation (MVO) process. Given that we do not believe the covariances and mean are stationary and that MVO gives non-sensible portfolios heavy with unlisted assets due to its Sharpe ratio optimisation, we avoid MVO. Instead, we decide on an asset allocation and test it using Monte Carlo simulation.
There are a range of theories in applying asset allocation. No one standard is uniformly applied. The main difference I would identify in the given steps is with the rigidity it suggests in the asset allocation process. It implies a level of science which, While done for informative purposes, in practice is heavily overlayed with more subjective analysis. Such rigour is typically used in stress testing various portfolios to identify how they would have performed in historic events. If I had to isolate a general theme, it would be the focus on historical data in step (c) and then using this as a basis going forwards. We attempt to generate forward looking return assumptions and to a lesser

degree modify correlations where there is a valid thesis for it. Typically correlations are historic as it is challenging and risky to make forward looking correlation assumptions. Additionally, steps (g) and (h) are a matter of the individual governance structures in place. The set of steps provided is consistent with Australia, although there is a common practice to delegate this authority to an investments sub-committee.
Our process uses some elements of this, but is different in a number of respects. We start with (a) and on (b), (c) and (d) we do not use historical data as a guide to future returns although it is used more so for standard deviations and correlations. Returns for assets classes are estimated on a forward looking basis, having regard to a range of factors that include likely future economic growth and earnings growth and valuations of asset classes. With (e) we do not use mean-variance optimisation, with (f) we do projections and with (g) the summary measures are presented to our internal investment team and debated, then to our investment committee and board for approval.
Asset allocation evaluation in Australian starts with setting up the objectives of the investments (risk/return profiles). From then on flows the asset class, correlation, liquidity considerations, etc.
Our process follows that structure broadly except for steps (b) to (d). For those steps we use the Barrie & Hibbert Economic Scenario Generator, a software package which implements a library of Monte-Carlo models for the projection of capital market scenarios and another software package to generate asset class assumptions. The simulation-based model generates thousands of capital market scenarios which are used to simulate potential portfolio outcomes for over multiple time periods, across many asset classes and geographies. Critically, the process does not assume normally distributed returns.
The process here in Australia is similar to that described, noting that this process is how a board decides its strategic asset allocation (i.e. its long term benchmark or reference portfolio).
We largely follow the same procedure except that the final decision is based on the entire investment team's collective view rather than requiring a board decision.
If we were determining asset allocations, we would start with a lot of stuff that comes before (a). Define objectives, which may include an assessment of the liability profile that is dual to the assets. Decide how peer-aware or constrained you are. Assess the asset owner's risk tolerance. You cannot leave that to steps (e) and (h), because you need to know that information, before you can select desired asset classes. Assess the asset owner's governance structure, and see what that tells you about what you can and cannot hold. Assess the legal constraints with holding certain asset classes such as derivatives. Decide whether benchmarks make sense. You need to know your liquidity budget. You need to know your fee budget. With (b), we would be mindful of the Efficient Market Hypothesis and random walks. Not so sure if there is such a thing as a representative historical period. However, we do a lot of forward-looking Monte Carlo simulations and we have to seed that with something. So implicitly, yes we might use the last few decades of data. With (c), yes I guess we do that but there cannot imaginably be an average correlation because asset correlations are phase-specific. You cannot just correlate through the historical cycle and we would need to think about whether volatility was time-variant in an ARCH and GARCH sense. With (d), Sharpe is not all that clear about what his timeframe is. We would have different asset allocations, for different timeframes. We would take current conditions into account for tactical asset allocation, maybe up to a year. And we would think about a strategic timeframe, say 2-5 years, and we would have some strategic asset allocation model as well that takes a timeless view and does not take current conditions or valuations into account at all. At this stage, we would consider robustifying the covariance matrix. With (e), sometimes depending on what software we are using, we might simply enter a risk aversion parameter at this stage and only estimate one portfolio. With (f), yes, we go out to 50 years plus. With (g), no as often the Board will not be involved. You put out a product disclosure statement and that tells you what weighting bands for various asset classes that product will stay within, and you stay within that. If the Board does get involved, they set strategy bands. The portfolio managers work within that, the Board only sets the broad ranges. That said, it may well be that the overall ranges they set, have been determined originally in the context of an MPT model. With (h), no probably not in that format.

The process is similar to what has been described, with a tracking error overlay (i.e. let us not be too different from everyone else).
The process is very similar to what has been described.
Somewhat similar, but the optimisation implied in (e) is rarely done, or if done not taken seriously. Steps (f) to (h) are done at the investment team level, Boards are not given a set of different candidate strategies to choose from.
It is very similar.
Of limited relevance. To construct 8 starting point balanced portfolios, we use projected returns (which flow from a common long term assumption for nominal GDP growth), projected standard deviations and historic correlations. Each private client adviser will use one of these portfolios as a starting point after assessing a client's investment objectives and then tailor the asset allocation.

The above responses from a small sample are summarised as follows. Investment management firms that use mean-variance optimisation generally follow a similar process, but rely less on historical data and instead generate forward looking return and variance assumptions. If ever historical data are used, it would be for generating correlation matrices but with market adjustments incorporated. Some superannuation funds that do not carry out mean-variance optimisation decide on an asset allocation and then simulate future results. The asset allocation process generally starts with the additional step of setting out risk and return objectives for investors. Also, in addition to strategic asset allocation, there are additional levels such as tactical asset allocation which consider market developments. Instead of Boards, investment teams generally make decisions and this has particular relevance in determining the target respondents for the survey in Study number 3.

Table 18: Responses to interview question 2 on whether asset allocation is decided in-house or by outside parties

Typically superannuation funds are supported by an asset consultant (e.g. Mercer, Russell, Jana, Frontier) to support the asset allocation process. The extent to how much the consultant determines asset allocation is each fund's decision, but tends to be inversely correlated to the number of internal staff.
Different approaches are used, often depending on the scale of the funds being managed. We utilise the expertise of a specialist asset consultant as part of all investment decisions relating to asset allocation and manager/investment selection. The asset consultant works closely with the internal team and will typically do most of the in-depth quantitative analysis.
We mainly decide in-house but use some input from asset consultants (e.g. Jana, Frontier).
Strategic asset allocation is decided in-house, but rely on outside parties such as asset consultants for recommendations and discussions.

We decide in-house. We don't have a strategic asset allocation as such. We have a Reference Portfolio which is an easily implemented, low cost portfolio of assets that is expected to deliver the Board's return and risk expectations. Separate from the Reference Portfolio, we run the Target Portfolio which introduces other assets with better beta and active strategies with alpha.
As a superannuation fund, the Board is responsible for the strategic asset allocation decision, noting that external expertise and consultants are used in the complete asset allocation process.
I cannot speak for all other houses, but we determine our own in-house asset allocation as we see this as a repeatable source of alpha generation.
It varies. There would be lots of examples of each. Increasingly, asset owners and large superannuation funds are doing this themselves. But historically, asset consultants have been the outside parties doing that strategic asset allocation modelling.
Combination of both. Managed funds use own analysis but superannuation funds more often guided by asset consultants.
Outside consultants and/or external research is almost always used.
Depends on size and resources. Large industry funds and large retail houses generally do the work internally. Maybe an asset consultant is involved. Small to mid-sized funds rely on asset consultants.
Not really applicable to us but in-house if we need to respond.
We provide top-down strategic asset allocation benchmarks and a tactical overlay. Our advisers take this guidance and apply it to individual client circumstances.

The above responses from a small sample are summarised as follows. Superannuation funds rely on analytical inputs from asset consultants to make decisions on strategic asset allocation. Asset consultants, by the nature of their business, have their own investment analysts. Non-superannuation managed funds may decide based on their own analysis. The wide range of decision makers as far as asset allocation is concerned indicates a need to be exhaustive in identifying target respondents for Study number 3.

Table 19: Responses to interview question 3 on how often asset allocation is determined

For us, quarterly.
Again, depends on the fund. Typically asset allocations are set, then reviewed on a quarterly or annual basis. Our regulator requires at least annual review. Depending on the fund, asset allocations are rarely changed in a wholesale way, they might be modified to adjust for perceived discrepancies in markets on a risk adjusted basis.
We reset strategic allocations annually, and make adjustment to long-term plans using any new insights.
Once, but reviewed every year or three years. Some may also implement medium term asset allocation, dynamic asset allocation for short terms.

We review our Reference Portfolio formally with the Board every three years but it is monitored against updated assumptions annually.
Infrequently, but reviewed annually.
Quarterly.
It used to be done every 3 to 5 years, then when the global financial crisis hit, funds started determining strategic asset allocation more often. One point to think about is that the risk-free rate is the basis of asset valuation. If within 24 months, the risk free rate changes from 5 to 0, as happened in the US, then everything changes. You cannot wait 3 to 5 years. Now, we re-run the strategic asset allocation every year and we re-estimate the inputs every 3 to 6 months. But the long-term numbers do not usually change a lot in 6 months.
3 to 5 years.
Analysis of the liability profile and expected asset returns. Managed funds tend to use the latter while superannuation funds use the former more.
Cursory review every year, but deep studies less often.
Strategic asset allocation for portfolios is reviewed formally once a year. Our research department conducts research year round on asset classes and investment strategies that eventually get incorporated in the formal strategic asset allocation review.
We review our assumptions and portfolio weights once a year.

The above responses from a small sample are summarised as follows. Strategic asset allocation is set generally once a year, although some firms would do it less often every 3 to 5 years. They are reviewed more frequently (e.g. quarterly) and sometimes adjusted slightly on a tactical basis to account for market factors. Recent instability in the financial markets has caused firms to set and review their strategic asset allocations more frequently than they have in the past. This indicates a need for a question in Study number 3 to probe changes in attitudes before and after the global financial crisis.

Table 20: Responses to interview question 4 on who carries out the analysis leading to asset allocation recommendations

Internal staff in the asset allocation team.
The internal investment team utilising the resources of an asset consultant.
Mostly the internal investment team, with some input from asset consultants.
Mostly asset consultants.
Asset consultant forms the asset return and risk assumptions. Portfolio design and preliminary modelling is done in-house. Asset consultant undertakes scenario testing on the candidate portfolios.
External investment consultants together with the internal investment team.

Part of the investment team.
A global team calculates capital market assumptions and runs the optimisation and local portfolio specialists take that output and make sure that it is fit-for-purpose on particular portfolios.
Combination of both. Managed funds use own analysis but superannuation funds more often guided by asset consultants.
In house research.
Depends on size and resources. Large industry funds and large retail houses generally do the work internally. Maybe an asset consultant is involved. Small to mid-sized funds rely on asset consultants.
Our Investment Strategy Group and research department.
The Chief Investment Officer.

The above responses from a small sample are summarised as follows. Superannuation funds have internal investment teams that carry out analysis with inputs from asset consultants. This indicates the large role played by asset consultants as far as asset allocation is concerned. Investment teams of non-super managed funds may do their own analysis entirely.

Table 21: Responses to interview question 5 on who decides on what method of analysis to use to come up with asset allocation recommendations

The asset allocation framework is ultimately owned by the person in charge of asset allocation.
The internal investment team utilising the resources of an asset consultant.
The chief investment officer and other senior members of the investment team.
Mostly asset consultants.
In-house management in consultation with the asset consultant.
Generally the external investment consultants, subject to consultation regarding assumptions used with the internal investment team.
Determined in the investment process.
Portfolio optimization team, but any subsequent tailoring or prior specification (e.g. particular constraints or objectives) done by a local portfolio specialist.
Combination of both. Managed funds use own analysis but superannuation funds more often guided by asset consultants.
Research department but also approved by the Board.
Whoever is doing the analysis.
Senior investment analysts and principals in the investment strategy group.
The Chief Investment Officer.

The above responses from a small sample are summarised as follows. The investment team or senior analyst decides on the method of analysis to use, with inputs from asset consultants. Financial analysts significantly influence the choice of methods used.

Table 22: Responses to interview question 6 on who evaluates and approves the asset allocation recommendations

The Chief Investment Officer. We operate under a structure where the trustees approve a strategy and we have the discretion to move within the limits of that strategy (e.g. +/- 5% asset allocation tilts).
A three pillar structure exists where there is peer review between the internal investment team and the asset consultant. The results are ultimately approved by the Investment Committee or Board.
Our internal investment committee and investment committee.
Investment committee evaluates, the Board approves.
The Board.
Trustee board.
The investment team as a collective body.
Peer review, asset owner, trustee boards.
Evaluate - no one, approve asset allocation - committee or Board.
Usually external consultants are used.
Board in the case of industry superannuation funds. Investment team and senior management in the case of retail investment houses.
Senior leaders and the global strategic asset allocation committee.
The Chief Investment Officer, but ultimately the execution lies with the adviser and client.

The above responses from a small sample are summarised as follows. An investment committee, senior executive or Board approves the strategic asset allocation recommendations by internal financial analysts and/or external asset consultants.

Table 23: Responses to interview question 7 on the percentage of the body of asset allocation theories that analysts are aware of

This is a vague question. Does aware mean having heard of the names or actually tested them in practice. I have heard of most of them but not back-tested most of them.
It would be surprising if analysts were not aware of the academic theory. There are a number of pitfalls with relying solely on a mean-variance optimisation model and as such it would be to varying degrees that the application of the theory would influence asset allocation decisions.
We are aware of a fair amount of the theory, but the key issue is how to keep any changes practical, action oriented and simple.

Asset consultants are the best people to ask this question. I suspect academic thinking is used in broad terms, but not in a specific way.
I think most asset allocation analysts are aware of that academic research. I think Black-Litterman, non-traditional assets and risk measures other than variance are probably the most used in practice.
Analysts undertaking asset allocation analysis are generally aware of some of the enhancements outlined above. From my experience, areas such as VAR, CVAR, non-traditional asset classes and skewness have been used for many years by asset consultants and have been generally required by clients. There are a number of theory outlined above, which have not been discussed during asset allocation discussions, so I can only assume consultant analysts may not be incorporating these into analysis.
Most if not all, however not all methods are applied equally.
All of the above are familiar fairly widely across the relevant staff in our organisation.
About 90%.
Nearly all use non-traditional asset classes but the others, not much if at all.
90 to 100%.
Our researchers are aware of almost all of these theories (95% plus).
I suspect around 25%. In reality, it is of little practical use. Our goal is to take what is often a very unsophisticated private investor and move them up the quality curve from both an asset allocation and portfolio design perspective. We can do that very successfully using a qualitative approach. The marginal value added from applying a highly academic approach is limited and for most clients would be a source of confusion and unease. Private investors need to trust their advisers and will not do so unless they understand what is happening.

The above responses from a small sample are summarised as follows. Analysts are aware of almost all of the theories and theory-based methods of asset allocation. There is a general appreciation that proper analysis is not possible without the knowledge of theories. The first response indicates that the term awareness needs to be defined properly. For this research, awareness will mean having heard of the theory without necessarily having tested it in practice.

Table 24: Responses to interview question 8 on the reasons that contribute to the level of awareness

There is much time spent on enchancing one's own body of knowledge and reading on current events, including academic papers, when doing research in order to try to derive an edge to produce the best outcomes for the clients.
The awareness of these academic theories comes through these being explored at the university level. The absence of their prevalence in the practical asset allocation decisions in Australia probably lessens the awareness/development of this thought.

Having analysts and graduate research capacity to assess new ideas, access to fund managers and industry experts who are researching new asset allocation techniques.
Practitioner publications such as JPM, FAJ, CFA, SSRN, collaboration and interaction among institutional investors, though sharing between asset managers and institutional investors.
Mixture of research papers as well as increased awareness and sophistication of investors.
Far greater attention has been paid toward this area of input into the investment decision making process over the recent past.
It's our job to know about all this stuff. Also we are all a bit geeky, so we play around with it anyway. Thirdly, MVO is pretty finely balanced and often knife-edge stuff and for a whole bunch of reasons you often get answers that someone is not happy with. So you have to do something - Black-Litterman, partitioned matrices, robustification, jump-diffusion processes, etc.
They read the literature.
Real-world applicability of the theories, technical knowledge.
Academic and professional training, technical industry conferences
Academic background and graduate degree of most members (e.g. PhD, CFA, MBA, Master in Finance, etc.). Our research department's semi-academic approach, long term focus and not being product/marketing driven.
Applying such detail would not make a meaningful difference to investment outcomes for our clients. If we were to adopt such an approach, it may even prove detrimental to the performance of the firm.

The above responses from a small sample are summarised as follows. The high level of awareness of asset allocation theories and theory-based methods can be attributed to the university training of analysts (undergraduate and postgraduate degrees) and the continual search for improvement probably driven by competitive forces in the industry. Other sources of awareness are journals and publications as well as conferences and other interactions among practitioners. There is also greater attention to theories with the growing sophistication of the investment market. However, possible lack of usage of theories in practice may lessen the motivation among financial analysts to be aware of them.

Table 25: Responses to interview question 9 on the percentage of theories they are aware of that analysts actually use

Many have been put to practice by the world's leading investment management and hedge funds (Black-Litterman, risk factors, risk parity).
Difficult question, it depends on the rationale for review. This would be better addressed by the asset consultant. In practice, I believe that analysts are aware of theories and might utilise them to test theories but they are rarely used as the basis for determining asset allocations.

We know a simple long-term static asset allocation based on mean variance does not work, so we spend a lot of time research how to improve it. I don't think we use a lot of the theory straight out. We start with the theory as an idea, and then test it internally using our analysts.
Not much, except the general concept of the benefits of diversification.
Guessing 20 to 30%. As noted above, our process uses returns and risks derived from simulations in a non-normal environment which I think addresses the same issues the theory based methods address.
I would suggest that around 10 to 30% of these are discussed and used for client asset allocation analysis. However, my optimistic expectation would be that asset consultants consider at least 50 to 80% of these in practice, however do not necessarily communicate how they are incorporated into analysis with clients.
Generally I believe that most firms use some (around 30%) of these measures selectively based on their own experience as to their usefulness in the process. Firms' analysts are generally aware of most of these methods though.
Maybe 95% or even 100%.
About 10%.
Unsure.
20%.
About 80% on a regular basis, and 95% plus on some specific projects.
In part resources dependent, the larger global investment banks have the resources to build a more academic asset allocation solution for private clients. I suspect they do this more as a marketing approach than a desire to actually drive better investment outcomes. Smaller firms such as ours do not see the need to over-engineer - understand the correlation characteristics of each asset class and ensure each individual portfolio is constructed in a way that does not compromise these diversification benefits.

The above responses from a small sample are summarised as follows. A significant percentage is being used in practice but mainly to provide general guidance (e.g. the benefits of diversification), to test/fine tune analysis or probably as a marketing tool but not often to directly determine strategic asset allocation. However, the range of responses in terms of percentage usage is quite wide, pointing to a need to establish this in Study number 3.

Table 26: Responses to interview question 10 on the reasons that contribute to the level of usage

Rather than being picked on their merits, I believe the frameworks are chosen to fit into the philosophy and acceptance by internal stakeholders of the organisation. Also, consider that everyone has an existing process from fully qualitative to fully quantitative, and you are exploring one facet - the quantitative side of asset allocation.
The practical limitations from actually deriving insights from the theory and the heavy reliance on assumptions and historic data.

Many can be impractical to implement (due to cost and trading constraints) and regulation (such as preventing leverage).
Funds do not start with a blank sheet of paper, too risky to rely on one or two theories. The knowledge, experience and assumptions used by those managing the assets may be different from those used by those who developed the theory.
I think the reason the usage percentage is low is that the concepts behind the methods are complex and difficult to implement without specialist software. The reason the methods themselves are gaining in use is the realisation that returns are non-normal, fat-tails are more common than expected and the parameters (e.g. correlation) can be unstable.
I would have a high expectation that asset consultants are required to maintain an up-to-date understanding of the latest thinking in regards to asset allocation.
Greater level of academic depth required within the members of investment teams.
Most of these theories were created to solve a problem, so there is not much that at least some analysts do not use, at least some of the time. Here is one example – one reason we use non-quadratic utility functions arises in managing multi-asset portfolios for post-retirees. This group is highly risk averse and they care more about shortfall risk, risk of ruin, etc. So we look around for more suitable utility functions. Here's another recent example, about why we moved to Black-Litterman models. We would previously (pre-financial crisis) have used an unconditional mean-variance-covariance approach, and started with a risk-free rate, and estimated return premia for risk, and added those various risk return premia to the expected returns of the various assets such as shares over cash returns. But when the financial crisis hit, we had a problem. If we are estimating future equity returns, we were adding a fixed percentage-point risk return premium, to a risk free rate that in the dark days of pessimism had fallen close to zero. Equity prices were very depressed at that time so we were getting the counter-intuitive result, that just after equity prices had gone down, their expected future returns also had gone down and not up. So we introduced Black-Litterman as a way of introducing a prior view based on a Dividend Discount Model equity valuation.
They know most of them are close to useless in practice.
Unsure.
Most of it is useless. Key risk is performing differently to everyone else, so funds stick with the herd.
Our research uses semi-academic approach.
As noted above, optimal for both clients (relative to where they have come from) and our business.

The above responses from a small sample are summarised as follows. Some of the reasons cited for the low level of usage of asset allocation theories and theory-based methods are the qualitative philosophy of some organisations and impractical results of purely quantitative analysis that are reliant on unrealistic assumptions and historical data. It is worth noting that the latter is also a common view among academics. It is also mentioned that practitioners may have assumptions and knowledge different from those of academics who developed the theories. The comments appear consistent with the factors affecting usage of theory as defined in the conceptual model for this research.

Table 27: Responses to interview question 11 on what other questions relevant to the research should be asked in the interview

What type of fund/objectives are you investing for? Is it maximum long term risk adjusted performance? What are your liquidity constraints? What liability matching are your investment decisions constrained by?
How do investors use tactical asset allocation relative to their use of long-term (static) strategic allocations, and has this changed over time?
Perhaps something about a set and forget approach of asset allocation versus a more dynamic approach. For example, do managers adjust their strategic asset allocation in light of a material change to the equity risk premium or is that only addressed at the formal review? What role does current asset valuation levels have in the strategic asset allocation setting process?
What do you believe are the limitations of strategic asset allocation construction? Based on these limitations (if any), is the role of strategic asset allocation construction still relevant? Apart from strategic asset allocation, what other forms of asset allocation do you consider?
You could ask value chain type questions. In your organisation/process, what is your total return expectation, and what is your total value-added expectation, and what is your risk budget? Of the value-add you expect from your process, how much comes from your theoretical model itself and how much comes from superior inputs to the model and how much comes from pragmatic ad hoc adjustments to your model? And how much from your implementation? You could also ask how similar or different organisations' actual portfolios were, to the outputs of the theoretical model. Also, about reverse optimisation also known as implied alpha, how many organisations conduct implied alpha analysis?
Ask about the unit itself rather than opinion of what the industry is doing.
Is asset allocation being matched to the specific liabilities of the investor body? Is tax taken into account (e.g. franking)?
What agency issues exist in the process of asset allocation? Are funds getting enough diversity of insight in the way they do asset allocation? Is the typical governance approach used by funds likely to result in good asset allocations?
Look into the use of research as a way to push marketing agenda and sell specific products. Also and related to the latter, look at the problem of data mining and back testing in practical implementations of theories.
Asset allocation outcomes from an Australian perspective - are the more academic approaches being discounted because they are devised in the US and Europe and do not take account of Australia's home biases, franking credits, love affair with property, limited corporate bond market, high currency volatility etc?

The above responses from a small sample are summarised as follows. Several questions have been suggested that would be considered for inclusion in the survey instrument for Study

number 3. What are the investment objectives and what is the perceived value-added with theory-based portfolio optimisation? How is tactical and dynamic asset allocation used relative to strategic asset allocation? What are the limitations of strategic asset allocation construction? Is liability matching relevant to asset allocation? What are the governance and agency issues with asset allocation? What are the marketing implications of theory in asset allocation? Are there any context issues with the use of asset allocation theories in the Australian environment?

8.5 Chapter summary

A structured interview was conducted among some practitioners to document the asset allocation process in the industry. The asset allocation process used by Australian investment management firms that practice mean-variance optimisation generally follow the one described in Sharpe (2007), but with less reliance on historical data for determining the inputs to the model. Firms that do not practice mean-variance optimisation usually decide on an asset allocation and then conduct simulation of future results to validate them.

Asset consultants play a major role in asset allocation decision making as they usually provide advice to superannuation funds on this area, although some investment managers make the decisions in-house with their investment team. The investment team or financial analysts (both in-house and those of external consultants) decide on the asset allocation method to use and make the asset allocation recommendations that are approved by the investment team, senior executives or the Board. This insight informs the choice of survey respondents in Study number 3. Strategic asset allocation is set generally once a year and reviewed quarterly, now generally more often than before because of the GFC.

There is a high level of awareness of asset allocation theory and theory-based methods, attributed to the university training of investment practitioners, the continual search for improvement, availability of publications, conferences and other interactions among practitioners. There is a wide range of opinion on the percentage of theories actually being used in practice, but a significant level is currently being used mainly to provide general guidance and not to directly determine asset allocation. Perceived low level of usage of theories is attributed to the qualitative philosophy of some organisations and the impractical results of purely quantitative analysis.

Based on the interview responses and an understanding of the industry participants, the major targets for Study number 3 would be superannuation or pension funds, fund managers and asset consultants to institutional investors. Minor targets would be personal financial planning groups, insurance companies and savings or investment banks. It has been noted that these latter entities largely rely on the model asset allocations of investment management firms that they are affiliated with.

The interview results have provided several insights that informed the design of the survey instrument and the target respondents in Study number 3 as well as additional questions that needed to be probed. They have also suggested possible answers to the research sub-questions that will be validated in Study number 3.

Chapter 9: Data gathering study number 3 – survey of practitioners

8.1 Introduction

Study number 3 directly addresses the research questions posed by validating the following hypotheses:

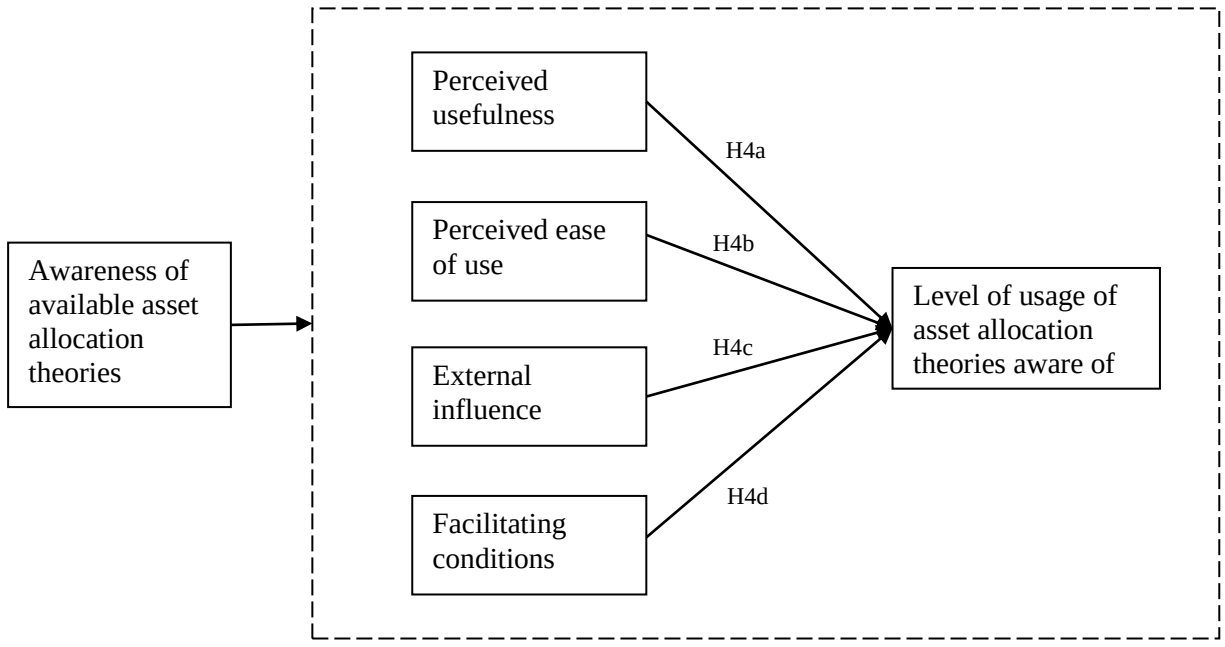
H1: There is a high level of awareness of asset allocation theories and theory-based methods among Australian investment management industry practitioners.

H2: There are various avenues through which Australian investment management industry practitioners are able to achieve awareness of asset allocation theories and theory-based methods.

H3: There is a low level of usage of asset allocation theories and theory-based methods that they are aware of among Australian investment management industry practitioners.

H4: The conceptual model re-shown in figure 14 below can explain the low level of usage of asset allocation theories and theory-based methods that they are aware of among Australian investment management industry practitioners.

Figure 14: The conceptual model



Measures to operationalise the above constructs in the conceptual model have been sourced from the literature and contextualised to the case of usage of asset allocation theories and theory-based methods, in order to flesh out the factors influencing the level of usage through the following sub-hypotheses:

H4a: Perceived usefulness has a significant influence on the use of asset allocation theories and theory-based methods.

H4b: Perceived ease of use has a significant influence on the use of asset allocation theories and theory-based methods.

H4c: External influence has a significant influence on the use of asset allocation theories and theory-based methods.

H4d: Facilitating conditions has a significant influence on the use of asset allocation theories and theory-based methods.

9.2 Operationalisation of constructs used in the conceptual model

In order to ensure the validity of the measures used to operationalise the constructs, only those that are based on extant theories and have been tested in previous research are utilised. As previous research studies were undertaken for other contexts, appropriate modifications of the measures were carried out to adapt them to the present research and to ensure that they more accurately represent the constructs being examined. The measures for each construct were developed from previous studies where measures for similar constructs were defined and validated. These are summarised in the following tables.

Table 28: Perceived Usefulness - similar constructs, definitions and measures used in previous studies

Construct	Definition	Measures used
Perceived usefulness (Davis 1989)	The degree to which a person believes that using a particular system would enhance their job performance.	Using the system in my job would enable me to accomplish tasks more quickly.
		Using the system would improve my job performance.
		Using the system in my job would improve my job productivity.
		Using the system would enhance my effectiveness on the job.
		Using the system would make it easier to do my job.
		I would find the system useful in my job.
Near term consequences: job fit (Thompson & Higgins 1991)	The extent to which an individual believes that using a particular system can enhance the performance of their job.	Use of the system will have no effect on the performance of my job (reverse scored).
		Use of the system can decrease the time needed for my important job responsibilities.
		Use of the system can significantly increase the quality of output of my job.
		Use of the system can increase the effectiveness of performing job tasks.
		Use of the system can increase the quantity of output for same amount of effort.
		Considering all tasks, the general extent to which use of the system could assist on job (different scale used).
Relative advantage (Moore & Benbasat 1991)	The degree to which an innovation is perceived as being better than its precursor.	Using the system enables me to accomplish tasks more quickly.
		Using the system improves the quality of work I do.
		Using the system makes it easier to do my job.
		Using the system enhances my effectiveness on the job.
		Using the system gives me greater control over my work.

Performance outcome expectations (Compeau, Higgins & Huff 1999; Compeau & Higgins 1995)	Perceived likely consequences of using a particular system.	Use of the system will increase the quality of output of my job.
		Use of the system will increase my effectiveness on the job.
		Use of the system will increase the quantity of output for the same amount of effort.
		Use of the system will decrease the time on routine job tasks.
		Use of the system will make me better organised.
		Use of the system will decrease reliance on clerical support staff.

Based on the information presented in table 28, the following definition is adopted for the construct "Perceived Usefulness" of asset allocation theories and theory-based methods: "the degree to which the use of asset allocation theories and theory-based methods is perceived to enhance performance in attaining the organisation's objectives".

Combining the shaded measures in table 28, this construct is operationalised through the following measures, all referring and adapted to asset allocation theories and theory-based methods in general:

1. Their use enhances our effectiveness in meeting clients' needs.
2. Their use makes it easier and quicker to accomplish our tasks.
3. Their use improves our job performance.
4. Their use increases our productivity.
5. Their use increases the quality of our output.

Table 29: Perceived Ease of Use - similar constructs, definitions and measures used in previous studies

Construct	Definition	Measures used
Perceived ease of use (Davis 1989)	The degree to which a person believes that using a particular system would be free of effort.	Learning to use the system would be easy for me.
		I would find it easy to get the system to do what I want it to do.
		My interaction with the system would be clear and understandable.
		I would find the system to be flexible to interact with.
		It would be easy for me to become skilful at using the system.
		I would find the system easy to use.
Near term consequences: complexity (Thompson & Higgins 1991)	The degree to which a system is perceived as relatively difficult to understand and use.	Using the system takes too much time from my normal duties.
		Working with the system is so complicated, it is difficult to understand what is going on.
		Using the system involves too much time doing mechanical operations.
		It takes too long to learn how to use the system to make it worth the effort.
Ease of use (Moore & Benbasat 1991)	The degree to which an innovation is perceived as being easy to use.	My interaction with the system is clear and understandable.
		I believe that it is easy to get the system to do what I want it to do.
		Overall, I believe that the system is easy to use.
		Learning to operate the system is easy for me.

Based on the information presented in table 29, the following definition is adopted for the construct "Perceived Ease of Use" of asset allocation theories and theory-based methods: "the degree to which the use of asset allocation theories and theory-based methods is perceived as being easy to understand and use".

Combining the shaded measures in table 29, this construct is operationalised through the following measures, all referring and adapted to asset allocation theories and theory-based methods in general:

1. It is easy to learn how to use them.
2. It is easy to get them to do what is needed.
3. They are flexible to work with.
4. It is easy to become skillful at using them.
5. It is easy to use them.

Table 30: External Influence - similar constructs, definitions and measures used in previous studies

Construct	Definition	Measures used
Subjective norm (Ajzen 1991; Mathieson 1991; Taylor & Todd 1995)	Perceived opinions of referent persons or groups whose beliefs are important about the performance of a particular behaviour.	People who are important to me would support my using the system.
		People who are important to me would want me to use the system.
		People whose opinions I value would prefer me to use the system.
		People who influence my behaviour think that I should use the system.
Social factors (Thompson & Higgins 1991)	The individual's internalisation of the reference groups' subjective culture and specific interpersonal agreements that the individual has made with others	I use the system because of the proportion of co-workers who use the system.
		Senior management has been helpful in introducing the system.
		My supervisor is very supportive of the use of the system for my job.
		In general, the organisation has supported the introduction of the system.
Image (Moore & Benbasat 1991)	The degree to which use of an innovation is perceived to enhance one's image or status in one's social system.	People in my organisation who use the system have more prestige than those who do not.
		People in my organisation who use the system have a high profile.
		Having the system is a status symbol in my organisation.

Based on the information presented in table 30, the following definition is adopted for the construct "External Influence" in the use of asset allocation theories and theory-based methods: "the degree to which the use of asset allocation theories and theory-based methods is perceived as favourable by important external entities".

Combining the shaded measures in table 30, this construct is operationalised through the following measures, all referring and adapted to asset allocation theories and theory-based methods in general:

1. Clients think that we should use them.
2. The industry thinks that we should use them.
3. A large proportion of the industry uses them.
4. The regulators think that we should use them.
5. Those who use them are perceived highly.

Table 31: Facilitating Conditions - similar constructs, definitions and measures used in previous studies

Construct	Definition	Measures used
Perceived behavioural control (Ajzen 1991; Mathieson 1991; Taylor & Todd 1995)	Reflects perceptions of internal and external constraints on behaviour.	I have control over using the system.
		I have the resources necessary to use the system.
		I have the knowledge necessary to use the system.
		I have the ability necessary to use the system.
		Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system.
Facilitating conditions (Thompson & Higgins 1991)	Objective factors in the environment that observers agree make an act easy to carry out.	Guidance is available to me in the selection of the system.
		A specific person or group is available for assistance with system difficulties.
		Specialised instruction concerning the system is available to me.

Compatibility (Moore & Benbasat 1991)	The degree to which an innovation is perceived as being consistent with the existing values, needs and past experiences of potential adopters.	Using the system is compatible with all aspects of my work.
		Using the system is completely compatible with my current situation.
		I think that using the system fits well with the way I like to work.
		Using the system fits into my work style.

Based on the information presented in table 31, the following definition is adopted for the construct "Facilitating Conditions" in the use of asset allocation theories and theory-based methods: "the degree to which the use of asset allocation theories and theory-based methods is perceived as having no constraints or impediments".

Combining the shaded measures in table 31, this construct is operationalised through the following measures, all referring and adapted to asset allocation theories and theory-based methods in general:

1. We have control over using them.
2. We have the resources necessary to use them.
3. We have the knowledge and ability necessary to use them.
4. They are compatible with our systems.
5. There are entities that can assist us in using them.

9.3 Research instrument

Aside from measuring the constructs discussed in the previous section, the research instrument for Study number 3 gathered other information as well. Question 1 is a screening question in order to obtain respondents who are qualified to complete the survey. Question 2 directly asks the respondent's level of awareness and usage of the various categories of asset allocation theories and theory-based methods. Question 3 asks the level of importance attributed to the various categories of asset allocation theories and theory-based methods, which was also asked of academics in Study number 1. Question 4 probes whether the importance ratings were affected by the occurrence of the Global Financial Crisis of 2007-08. Question 5 probes the source of awareness of asset allocation theories and theory-based methods. Question 6 probes

the reasons for non-usage of asset allocation theories and theory-based methods. Question 7 identifies the actual asset allocation methods being used. Question 8 measures the level of agreement with the measures operationalising the model constructs as defined in the previous section. The sequence of presenting the measures for the four constructs were randomised in order to avoid the tendency to just replicate answers to similar items and therefore ensure that subsequent reliability tests are objective. The last item in question 8 measures the level of agreement with use of asset allocation theory. Question 9 expounds on the answers to Question 8. Questions 10 to 14 are respondent classification questions.

The online survey for Study number 3 which was conducted using the service provided by www.qualtrics.com is shown in table 32.

Table 32: Survey instrument for Study number 3

Dear Respondent,

I am doing a PhD research entitled "Asset Allocation: Analysis of Theory and Practice in the Australian Investment Management Industry". The aim of the research is to examine any dichotomy between theory and practice of asset allocation. Studying asset allocation theory and practice in relation to one another may lead to finding ways to improve both, which would be beneficial to academe and industry.

As part of my research, I am studying the awareness and usage of asset allocation theories and theory-based methods in the investment management industry. I would greatly appreciate if you can answer the following set of questions which should take only around 15 minutes. Please note that some of the questions may not display properly on mobile phones in which case we request that you try it again on a computer.

If you would like to enter the draw for two AU$ 300 fuel/grocery vouchers to be won, kindly provide your name and email address at the end of the survey (these information will be dissociated from your responses and will not be passed on to external parties). Alternatively, you can nominate a charity organisation that you would like to receive the cash equivalent of the prize. The winners will be drawn randomly between 1 and 31 October 2014 (subject to change) and they will be notified by email. The prizes must be claimed within 15 days of notification.

Your responses will be treated confidentially and the resulting PhD paper and journal publications will not identify the survey respondents. Participation is entirely voluntary and completion of the survey will be taken as tacit consent to be surveyed. If you decide to take part and later change your mind, you are free to withdraw from the research at any stage. Any information already obtained from you will be destroyed.

Should you have any queries regarding this research, you can contact myself as the principal researcher through my details below. If you have any ethical concerns with how the research is being conducted or any queries about your rights as a participant please feel free to contact: Ethics and Research

Integrity Officer, Office of Research and Higher Degrees, University of Southern Queensland, Toowoomba QLD 4350, Phone: 617 4631 2690, Email: ethics@usq.edu.au.

Thank you and best regards,

Lujer Santacruz
Lecturer and PhD Candidate
School of Commerce, Faculty of Business Education Law and Arts
University of Southern Queensland, Toowoomba QLD 4350 Australia
Phone: 617 4631 1574, Email: santacru@usq.edu.au

Question 1. What is your level of involvement with the asset allocation process in your organisation?

( ) I am involved in making decisions on how it is done
( ) I am involved in making recommendations on how it is done
( ) I am familiar with how it is done in our organisation
( ) None of the above, therefore I am not able to proceed with this survey

Question 2. Please indicate your awareness and usage of the following categories of asset allocation theories and theory-based methods.

	Aware of?		Actually use?	
	Yes	No	Yes	No
Markowitz' original mean-variance model	( )	( )	( )	( )
Use of additional parameters (e.g. higher order moments such as skewness and kurtosis)	( )	( )	( )	( )
Use of risk measures other than variance (e.g. semi-variance, partial moments, VAR, CVAR)	( )	( )	( )	( )
Addressing problems of parameter uncertainty (e.g. imposing weight constraints, Bayesian estimation, shrinkage estimators, robust optimisation, portfolio resampling)	( )	( )	( )	( )
Multi-period models	( )	( )	( )	( )
Non-quadratic utility function models	( )	( )	( )	( )
Other asset allocation models (e.g. factor based, Prospect Theory, qualitative with simulation, Stochastic Dominance, risk parity investing, heuristic approach)	( )	( )	( )	( )

Question 3. For those categories of theories and theory-based methods aware of as answered in Question 2, how important do you think is each one in making the correct asset allocation decision?

	Unimportant	Of little importance	Moderately important	Important	Very important
	0	1	2	3	4
Markowitz' original mean-variance model	( )	( )	( )	( )	( )
Use of additional parameters	( )	( )	( )	( )	( )
Use of risk measures other than variance	( )	( )	( )	( )	( )
Addressing problems of parameter uncertainty	( )	( )	( )	( )	( )
Multi-period models	( )	( )	( )	( )	( )
Non-quadratic utility function models	( )	( )	( )	( )	( )
Other asset allocation models	( )	( )	( )	( )	( )

Question 4. Following on from the last question, how would you have rated the importance of each one before the Global Financial Crisis of 2007-08 happened?

	Unimportant	Of little importance	Moderately important	Important	Very important
	0	1	2	3	4
Markowitz' original mean-variance model	( )	( )	( )	( )	( )
Use of additional parameters	( )	( )	( )	( )	( )
Use of risk measures other than variance	( )	( )	( )	( )	( )
Addressing problems of parameter uncertainty	( )	( )	( )	( )	( )
Multi-period models	( )	( )	( )	( )	( )
Non-quadratic utility function models	( )	( )	( )	( )	( )
Other asset allocation models	( )	( )	( )	( )	( )

Question 5. What is/are your main source/s of awareness of above asset allocation theories and theory-based methods?

[ ] In-house training or professional development
[ ] External non-university training
[ ] University training
[ ] Practitioner journals
[ ] Academic journals
[ ] Books and other publications
[ ] Conferences
[ ] Interaction with other practitioners

Question 6. For those categories of theories and theory-based methods aware of but not actually being used as answered in Question 2, please indicate the reason/s why each one is not being used.

	Reason/s why not being used:
Markowitz' original mean-variance model	_____
Use of additional parameters	_____
Use of risk measures other than variance	_____
Addressing problems of parameter uncertainty	_____
Multi-period models	_____
Non-quadratic utility function models	_____
Other asset allocation models	_____

Question 7. For those categories of theories and theory-based methods actually being used as answered in Question 2, please detail the specific method/s being used.

	Specific method/s being used:
Markowitz' original mean-variance model	_____
Use of additional parameters	_____
Use of risk measures other than variance	_____
Addressing problems of parameter uncertainty	_____
Multi-period models	_____
Non-quadratic utility function models	_____
Other asset allocation models	_____

Question 8. Please indicate your level of agreement or disagreement with each of the following statements referring to asset allocation theories and theory-based methods in general (randomised).

	Strongly disagree 0	Disagree 1	Neither agree nor disagree 2	Agree 3	Strongly agree 4
Their use enhances effectiveness in meeting clients' needs	( )	( )	( )	( )	( )
Their use makes it easier and quicker to accomplish tasks	( )	( )	( )	( )	( )
Their use improves our job performance	( )	( )	( )	( )	( )
Their use increases our productivity	( )	( )	( )	( )	( )
Their use increases the quality of our output	( )	( )	( )	( )	( )
It is easy to learn how to use them	( )	( )	( )	( )	( )
It is easy to get them to do what is needed	( )	( )	( )	( )	( )
They are flexible to work with	( )	( )	( )	( )	( )
It is easy to become skilful at using them	( )	( )	( )	( )	( )
It is easy to use them	( )	( )	( )	( )	( )
Clients think that we should use them	( )	( )	( )	( )	( )
The industry thinks that we should use them	( )	( )	( )	( )	( )
A large proportion of the industry uses them	( )	( )	( )	( )	( )
The regulators think that we should use them	( )	( )	( )	( )	( )
Those who use them are perceived highly	( )	( )	( )	( )	( )
We have control over using them	( )	( )	( )	( )	( )
We have the resources necessary to use them	( )	( )	( )	( )	( )
We have the knowledge and ability necessary to use them	( )	( )	( )	( )	( )
They are compatible with our systems	( )	( )	( )	( )	( )
There are entities that can assist us in using them	( )	( )	( )	( )	( )
I think our organisation should use/continue using asset allocation theories and theory-based methods	( )	( )	( )	( )	( )

Question 9. Kindly expound on your choices in the previous question by providing your opinions on the following topics in relation to asset allocation theories and theory-based methods:

	Your opinions:
Usefulness of theories	_____
Ease of use of theories	_____
External influences favouring use of theories (e.g. market and industry practice)	_____
Facilitating conditions favouring use of theories (e.g. knowledge, ability and resources)	_____

Question 10. Please indicate the primary nature of your organisation.

( ) Superannuation or pension fund
( ) Fund manager
( ) Asset consultant to institutional investors
( ) Personal financial planning group
( ) Insurance company
( ) Savings or investment bank
( ) Other, please specify: _____

Question 11. Please indicate which one best describes your position in your organisation.

( ) Board member
( ) Chief executive officer
( ) Chief investment or financial officer
( ) Head of section, please specify: _____
( ) Analyst
( ) Other, please specify: _____

Question 12. Please indicate the size of assets under management by your organisation.

( ) Less than AU$ 500m
( ) AU$ 500m to less than AU$ 1b
( ) AU$ 1b to less than AU$ 10b
( ) AU$ 10b to less than AU$ 50b
( ) AU$ 50b to less than AU$ 100b
( ) AU$ 100b to less than AU$ 200b
( ) AU$ 200b or more

Question 13. How long has your organisation been operating?

( ) Less than 5 yrs
( ) 5 yrs to less than 10 yrs
( ) 10 yrs to less than 20 yrs
( ) 20 yrs to less than 50 yrs
( ) 50 yrs to less than 100 yrs
( ) 100 yrs or more

Question 14. Location (automatically determined)

( ) Sydney
( ) Melbourne
( ) Brisbane
( ) Perth
( ) Canberra
( ) Adelaide
( ) Other, please specify: _____

Optional. Feel free to put in any comments or suggestions about this online survey or the research topic in general, in the space below.

_____
_____
_____

Optional. Finally, if you want yourself or your charity to be entered in the prize draw, please provide the details below and then click NEXT to close the survey.

Contact details:

Your full name or name of nominated charity organisation _____
Email address _____

Thank you for your time.

The survey design utilised the principles of Tailored Design Method to increase the response rate by developing perceptions of reduced cost and increased rewards of being a respondent and creating respondent trust (Dillman, Smyth & Christian 2014). The survey questionnaire was designed in a physically appealing and easy-to-answer manner, of an appropriate length and the questions asked in a logical manner in order to reduce the perceived cost of being a respondent. Perceived reward of being a respondent is reinforced by explaining that the research will be beneficial to both academe and industry. As literature has shown that offering incentives can improve the survey response rate (Deutskens et al. 2004) respondents are also given the choice to enter a draw for two AU$ 300 fuel/grocery vouchers to be won. However, the Tailored Design Method suggests that knowledge of the survey population must be considered in order to develop the most effective means of providing incentives (Dillman, Smyth & Christian 2014). In the case of the target respondents for this study, investment practitioners who are successful professionals and who are generally conscious about transparency, some may actually prefer not to be included in the draw and therefore the option of nominating a charity organisation is provided.

The online survey was programmed to accept only one response from an IP address in order to prevent "ballot box stuffing". The questionnaire was pre-tested among academics and practitioners before being finalised for dissemination. As is required for all research, clearance was obtained from the USQ Research Ethics Committee before the survey was administered. A message with a link to the online survey was sent out to target respondents.

9.4 Sample design and data collection

Respondents were obtained through a two-pronged approach. This involved directly writing to relevant investment management industry practitioners and mass mail-outs to practitioner members through relevant industry associations.

Survey invitations were directly sent to companies involved in investment management as listed in Chapter 6. Relevant executives and analysts of companies were identified through their websites or through Linkedin. The survey invitations were sent through regular email or through Linkedin inmail. Whenever possible, messages were personally addressed as studies have shown that doing so significantly improves the response rate (Dillman, Smyth & Christian 2014). Emails and Linkedin inmails with an invitation to the survey were sent out generally on Tuesdays, Wednesdays and Thursdays as studies have shown that opening rates

and click-through rates are higher on these days. On Mondays, people are starting the workweek and would generally start deleting messages that seem unimportant. On Fridays, people are gearing up for the weekend and are not as interested in messages coming into their mailbox (Zipursky 2013). The survey invitations were generally sent out before 8am as studies have shown that those who received survey invitations midday were significantly less likely to respond than those who received them before working hours. A likely explanation is that emails received first thing in the morning can be read before one starts facing the demands of the day while an email received midday will be competing with the ongoing demands of the day (Dillman, Smyth & Christian 2014).

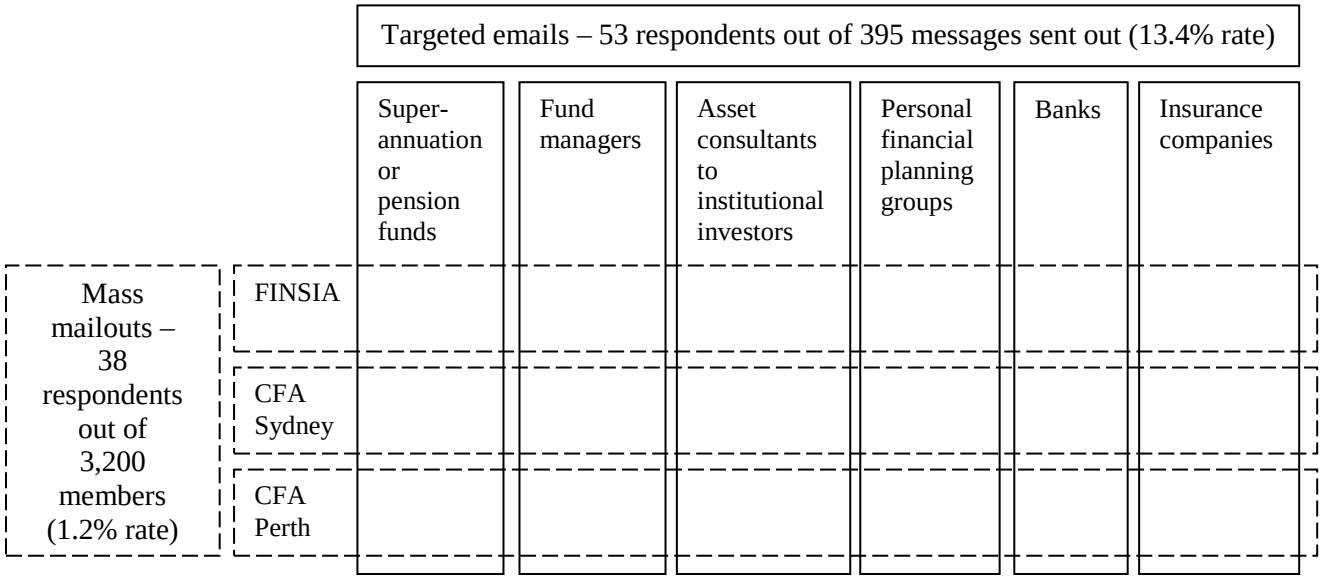
The survey invitations were also disseminated to practitioner members through relevant industry associations. This provides the advantage of numbers and reaches a broader base of potential respondents including those from lesser known companies and practitioners who were not identifiable through the company websites and other publicly available information sources such as Linkedin. Sponsorship by legitimate authority is also suggested as one way of creating respondent trust and therefore obtaining a good response rate (Dillman, Smyth & Christian 2014). Consequently, the support of key industry associations was sought. Table 33 lists the associations that were formally approached, with those actually participating highlighted.

Table 33: Key investment management industry associations

Name	Website
Funds Executives Association Limited	http://www.feal.asn.au
Association of Superannuation Funds of Australia	http://www.superannuation.asn.au
Financial Services Institute of Australasia	http://www.finsia.com
Australian Institute of Superannuation Trustees	http://www.aist.asn.au
Investment Management Consultants Association	http://www.imca.org.au
SMSF Professionals Association of Australia	http://www.spaa.asn.au
CFA Society Sydney (includes Brisbane)	http://www.cfasociety.org/sydney
CFA Society Melbourne	http://cfa-melbourne.com.au/
CFA Society Perth	http://www.cfasociety.org/perth

Figure 15 summarises the two-pronged approach that was utilised. The generally low response rates reflect the fact that a very small percentage of practitioners are actually directly involved in asset allocation. There were 305 surveys started to be answered but only 123 were completed and only 91 were valid responses. The response rates could have been improved if the survey software had a facility to remind respondents that the survey they started is about to be closed after a certain number of days. This has been suggested to the software provider as a possible feature enhancement.

Figure 15: The sampling approach utilised and the valid response rates



9.5 Analysis of respondent profile

The following tables summarise the responses to the classification questions in the survey.

Table 34: Distribution of respondents by level of involvement with the asset allocation process in their organisation

Level of involvement	Frequency	Percentage
Makes decisions on how it is done	57	62.6
Makes recommendations on how it is done	25	27.5
Familiar with how it is done	9	9.9
Total	91	100.0

Looking at the distribution by position of respondents who are familiar with how asset allocation is done as shown in table 35 below, we can see that they can also be potentially deciders or influencers. Therefore, all 91 respondents will be included in the analysis.

Table 35: Distribution of respondents who are familiar with how asset allocation is done by position in their organisation

Position	Frequency	Percentage
Board member	1	11.1
Chief executive officer	1	11.1
Chief investment or financial officer	1	11.1
Head of an asset class market	1	11.1
Head of research	1	11.1
Client relationship manager	3	33.4
Other	1	11.1
Total	9	100.0

Table 36: Distribution of respondents by the primary nature of their organisation

Primary nature of organisation	Frequency	Percentage
Superannuation or pension fund	15	16.5
Fund manager	36	39.6
Asset consultant to institutional investors	16	17.5
Personal financial planning group	10	11.0
Insurance company	7	7.7
Savings or investment bank	3	3.3
Other	4	4.4
Total	91	100.0

The above distribution reflects the investment management industry participants that were identified as priority targets for data gathering in chapters 6 and 8, with some representation from other industry participants.

Table 37: Distribution of respondents by position in their organisation

Position	Frequency	Percentage
Board member	9	9.9
Chief executive officer	11	12.1
Chief investment or financial officer	16	17.5
Head of investment strategy	7	7.7
Head of asset allocation	4	4.4
Head of an asset class market	7	7.7
Head of risk management	2	2.2
Head of research	4	4.4
Analyst	12	13.2
Portfolio manager	7	7.7
Client relationship manager	6	6.6
Personal financial adviser	3	3.3
Other	3	3.3
Total	91	100.0

The respondents are all decision makers or influencers in their respective organisations as far as asset allocation is concerned.

Table 38: Distribution of respondents by size of assets managed by their organisation

Size of assets under management	Frequency	Percentage
Less than AU$ 500m	25	27.5
AU$ 500m to less than AU$ 1b	5	5.5
AU$ 1b to less than AU$ 10b	18	19.8
AU$ 10b to less than AU$ 50b	16	17.5
AU$ 50b to less than AU$ 100b	5	5.5
AU$ 100b to less than AU$ 200b	9	9.9
AU$ 200b or more	13	14.3
Total	91	100.0

Table 39: Distribution of respondents by age of their organisation

Length of time operating	Frequency	Percentage
Less than 5 yrs	9	9.9
5 yrs to less than 10 yrs	12	13.2
10 yrs to less than 20 yrs	20	22.0
20 yrs to less than 50 yrs	31	34.0
50 yrs to less than 100 yrs	5	5.5
100 yrs or more	14	15.4
Total	91	100.0

Table 40: Distribution of respondents by their location

Location	Frequency	Percentage
Sydney	43	47.2
Melbourne	24	26.4
Brisbane	9	9.9
Perth	3	3.3
Canberra	3	3.3
Adelaide	2	2.2
Other	7	7.7
Total	91	100.0

Table 40 shows a good number of respondents from Melbourne despite the non-participation of CFA Society Melbourne in disseminating the survey among its members. Looking at the profile of respondents overall as shown in tables 36 to 40, there appears to be a good distribution. However, quantitative conclusions cannot be made on the representativeness of the respondent set as there are no data on the profile of asset allocation practitioners for the entire industry. Suffice to say that the responses gathered from this set of respondents can be utilised to achieve the objectives of this research.

9.6 Results and discussion

The responses gathered with the closed-ended online survey questions were entered into SPSS to generate the following summary tables. The summary tables for the open-ended survey questions were generated using content analysis of the responses.

Table 41: Awareness and usage of asset allocation theories and theory-based methods

Category of theory and theory-based method	n	Aware of	%	Actually use if aware of	%
Markowitz' original mean-variance model	91	87	95.6	44	50.6
Use of additional parameters	91	80	87.9	33	41.3
Use of risk measures other than variance	91	81	89.0	47	58.0
Addressing parameter uncertainty	91	76	83.5	39	51.3
Multi-period models	91	76	83.5	35	46.1
Non-quadratic utility function models	91	46	50.5	8	17.4
Other asset allocation models	91	79	86.8	49	62.0

The above descriptive statistics confirm hypotheses H1 and H3, respectively, that there is a high level of awareness but a low level of usage of asset allocation theories and theory-based methods among Australian investment management industry practitioners.

Table 42: Source of awareness of asset allocation theories and theory-based methods

Source of awareness	n	Number of respondents mentioning	% of respondents mentioning
Interaction with other practitioners	91	48	52.7
In-house training or professional development	91	48	52.7
Academic journals	91	47	51.6
Practitioner journals	91	46	50.5
University training	91	43	47.3
Conferences	91	40	44.0
External non-university training	91	35	38.5
Books and other publications	91	34	37.4

The above results confirm hypothesis H2 that there are various sources of awareness of asset allocation theories and theory-based methods. It is worth noting that university training is not the primary source of awareness of asset allocation theories and theory-based methods. The fairly even distribution indicates that no single source of awareness dominates the others and therefore it is important that knowledge is disseminated through various channels.

Table 43: Top mentions on specific methods being used for those categories of theories actually being used

Theory categories and specific methods being used for each one	Number of mentions
Markowitz' original mean-variance model	
Standard mean-variance optimisation (MVO)	14
Standard MVO as a first cut form of analysis for storytelling	3
Standard MVO with a qualitative overlay	2
Risk budgeting approach	2
MVO with volatility analysis	2
MVO with Monte Carlo simulation	1
Use of additional parameters	
Adjusted return and risk measures	5
Stochastic scenario modelling	5
Higher moments	2
Industry peer comparison	1
Use of risk measures other than variance	
VAR	10
CVAR	8
Probability of loss	7
Semi-variance	4
Qualitative measures	3
Drawdown analysis	3
Non-gaussian risk measure	2
Addressing parameter uncertainty	
Scenario modelling	9
Qualitative overlay	6

Robust estimation	5
Bayesian estimation	3
Stress testing	3
Black-Litterman model	2
Imposing asset weighting constraints	2
Portfolio resampling	1
Multi-period models	
Time-varying forecast scenarios	8
Regime or cycle-based analysis	5
Dynamic asset allocation	3
Time series analysis	3
Stress testing	2
Non-quadratic utility function models	
Generic algorithm for non-quadratic optimisation	1
Linear models	1
Optimal loss models	1
Retirement modelling	1
Other asset allocation models	
Risk parity model	7
Factor-based asset allocation	6
Qualitative overlay	5
Scenario simulation	4
Asset-liability risk matching	3
Heuristic approach	2

The range of specific methods being used in the industry are generally consistent with those surveyed in the literature review. However, there appears to be some differences in how they are ranked in terms of usage and how they are ranked by academics in terms of importance. This could be an initial indication of asset allocation theory-practice dichotomy.

Table 44: Responses to question on importance of theory categories

Category of theory and theory-based method	n	μ	σ	Importance in making correct asset allocation decision Unimportant<->Very important				
				0	1	2	3	4
Markowitz' original mean-variance model	87	1.92	1.06	12	13	35	24	3
Use of additional parameters	80	2.25	1.13	6	13	28	21	12
Use of risk measures other than variance	81	2.90	1.04	4	2	18	31	26
Addressing parameter uncertainty	76	2.53	1.19	6	11	11	33	15
Multi-period models	76	2.24	1.15	6	13	26	19	12
Non-quadratic utility function models	46	1.67	1.14	5	20	10	7	4
Other asset allocation models	79	2.56	1.02	2	8	30	22	17
Asset allocation theories in general	91	2.56	1.01	3	10	27	35	16

Table 45: Responses to question on importance of theory categories before GFC

Category of theory and theory-based method	n	μ	σ	Importance in making correct asset allocation decision Unimportant<->Very important				
				0	1	2	3	4
Markowitz' original mean-variance model	87	1.98	1.11	11	17	26	29	4
Use of additional parameters	80	2.19	1.03	5	13	32	22	8
Use of risk measures other than variance	81	2.72	1.06	3	8	18	32	20
Addressing parameter uncertainty	76	2.32	1.18	7	11	21	25	12
Multi-period models	76	2.20	1.14	6	15	23	22	10
Non-quadratic utility function models	46	1.52	1.15	9	16	12	6	3
Other asset allocation models	79	2.39	1.03	3	10	32	21	13
Asset allocation theories in general	91	2.46	0.99	2	13	31	31	14

Table 46: Comparison of responses to question on importance before GFC and now

Category of theory and theory-based method	n	Before GFC		Now		1	2
		μ	σ	μ	σ		
Markowitz' original mean-variance model	87	1.98	1.11	1.92	1.06	0.36	no
Use of additional parameters	80	2.19	1.03	2.25	1.13	0.32	no
Use of risk measures other than variance	81	2.72	1.06	2.90	1.04	0.01	yes
Addressing parameter uncertainty	76	2.32	1.18	2.53	1.19	0.02	yes
Multi-period models	76	2.20	1.14	2.24	1.15	0.59	no
Non-quadratic utility function models	46	1.52	1.15	1.67	1.14	0.23	no
Other asset allocation models	79	2.39	1.03	2.56	1.02	0.12	no
Asset allocation theories in general	91	2.46	0.99	2.56	1.01	0.17	no

1 – *p* value for t-test for equality of means, at 95% confidence $p > 0.05$ indicates equality

2 – based on the t-test, is there a change in perception of importance before GFC and now?

Looking at tables 44, 45 and 46, there appears to be no significant changes in the perception of the importance of the various categories of theory before and after the GFC despite the overwhelmingly negative press that Modern Portfolio Theory has received, except for two categories. The events of the GFC have strengthened the importance of using risk measures other than variance and addressing the problems with parameter uncertainty.

Table 47: Comparison of responses to question on importance between academics and practitioners

Category of theory and theory-based method	Academics (from Ch. 7)			Practitioners		
	n	μ	σ	n	μ	σ
Markowitz' original mean-variance model	41	3.22	1.01	87	1.92	1.06
Use of additional parameters	40	2.43	1.01	80	2.25	1.13
Use of risk measures other than variance	40	2.28	1.13	81	2.90	1.04
Addressing parameter uncertainty	41	3.10	0.83	76	2.53	1.19
Multi-period models	41	2.41	1.07	76	2.24	1.15
Non-quadratic utility function models	37	2.05	1.39	46	1.67	1.14
Other asset allocation models	37	2.73	0.99	79	2.56	1.02
Asset allocation theories in general	-	-	-	91	2.56	1.01

The most glaring difference between academics and practitioners in the perception of importance seems to be with Markowitz' original mean-variance model. While it is rated highest (mean importance of 3.22) by academics, it is rated second lowest (mean importance of 1.92) by practitioners. Other asset allocation models that represent a departure from the original mean-variance models are rated much higher by practitioners than the original mean-variance model (mean importance of 2.56). However, in terms of actual usage as shown in table 41, other asset allocation models do not completely dominate Markowitz' original mean-variance models and the associated theory strands, with a significant percentage still using the latter. Use of risk measures other than variance are rated much higher while addressing the problems with parameter uncertainty are rated much lower by practitioners compared to academics. This appears counterintuitive as research on the problems with parameter uncertainty is supposed to address the main dissatisfaction among practitioners which is impractical model outputs.

While the previous discussions centred on the awareness, usage and importance ratings of asset allocation theories and theory-based methods, the following discussions are on the underlying reasons, thereby addressing hypothesis H4. The conceptual model defined previously is utilised and Structural Equation Modelling (SEM) is carried out using the data obtained through the online survey. SEM is used to validate the fit with the conceptual model of data obtained through the survey. SEM allowed estimation of the strength of the hypothesised relationships (H4a, H4b, H4c and H4d) in the conceptual model between the four exogenous latent constructs and the endogenous variable namely level of usage of theories. It therefore provided information about relationships, both directly from one variable to another and via any mediating variables (Byrne 2010). The use of multiple measures to represent the latent constructs lent the conceptual model to SEM instead of the usual simple regression analysis. While SEM generally requires sample sizes greater than 300, simple conceptual models containing five or fewer constructs each with more than three measures can be analysed with as little as 100 responses (Hair et al. 2006).

Before carrying out SEM on the conceptual model, Confirmatory Factor Analysis (CFA) is performed to assess the convergent validity of the five measures used for each of the four constructs and the discriminant validity of the four constructs. Convergent validity is the extent to which a set of measures consistently reflects the construct they are designed to

measure. Before proceeding with the CFA, an initial indication of convergent validity is obtained by looking at the reliability of the measures used for each construct as measured by Crombach's alpha.

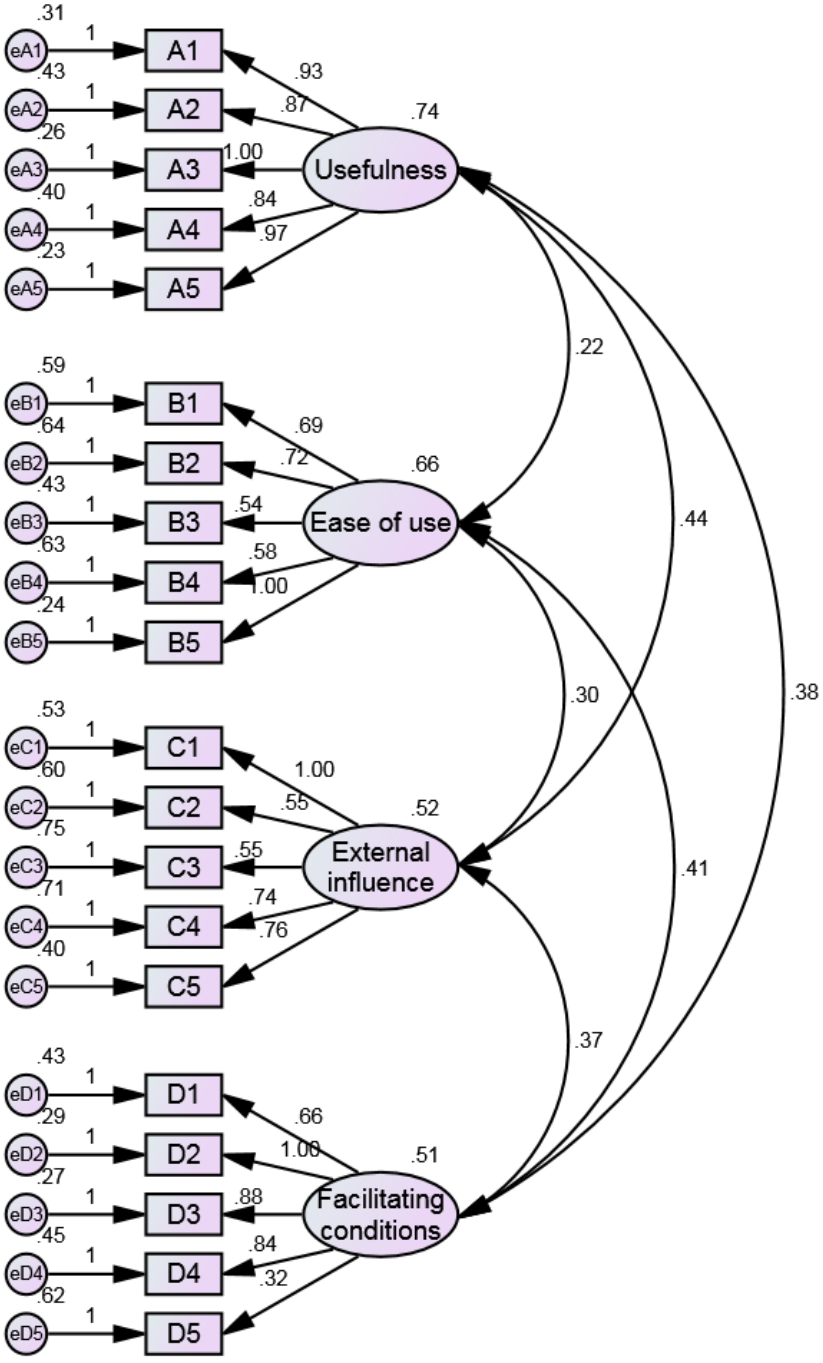
Table 48: Reliability of measures used for each construct as indicated by Crombach's alpha

Model constructs and measures	Crombach's alpha
A. Perceived usefulness of theories 1. Their use enhances our effectiveness in meeting clients' needs 2. Their use makes it easier and quicker to accomplish our tasks 3. Their use improves our job performance 4. Their use increases our productivity 5. Their use increases the quality of our output	0.906
B. Perceived ease of use of theories 1. It is easy to learn how to use them 2. It is easy to get them to do what is needed 3. They are flexible to work with 4. It is easy to become skillful at using them 5. It is easy to use them	0.774
C. External influences favouring use of theories 1. Clients think that we should use them 2. The industry thinks that we should use them 3. A large proportion of the industry uses them 4. The regulators think that we should use them 5. Those who use them are perceived highly	0.704
D. Facilitating conditions favouring use of theories 1. We have control over using them 2. We have the resources necessary to use them 3. We have the knowledge and ability necessary to use them 4. They are compatible with our systems 5. There are entities that can assist us in using them	0.738

The Crombach's alphas for the four constructs are all above the minimum 0.7 guideline (Hair et al. 2006). The high construct reliability values are noteworthy given that the twenty measures were presented in a random sequence and not together. They indicate that the measures all consistently represent the same latent construct.

Discriminant validity is the extent to which a construct is truly distinct from other constructs and captures some phenomena other constructs do not. The results of the CFA to confirm convergent validity and assess discriminant validity are shown in figure 16.

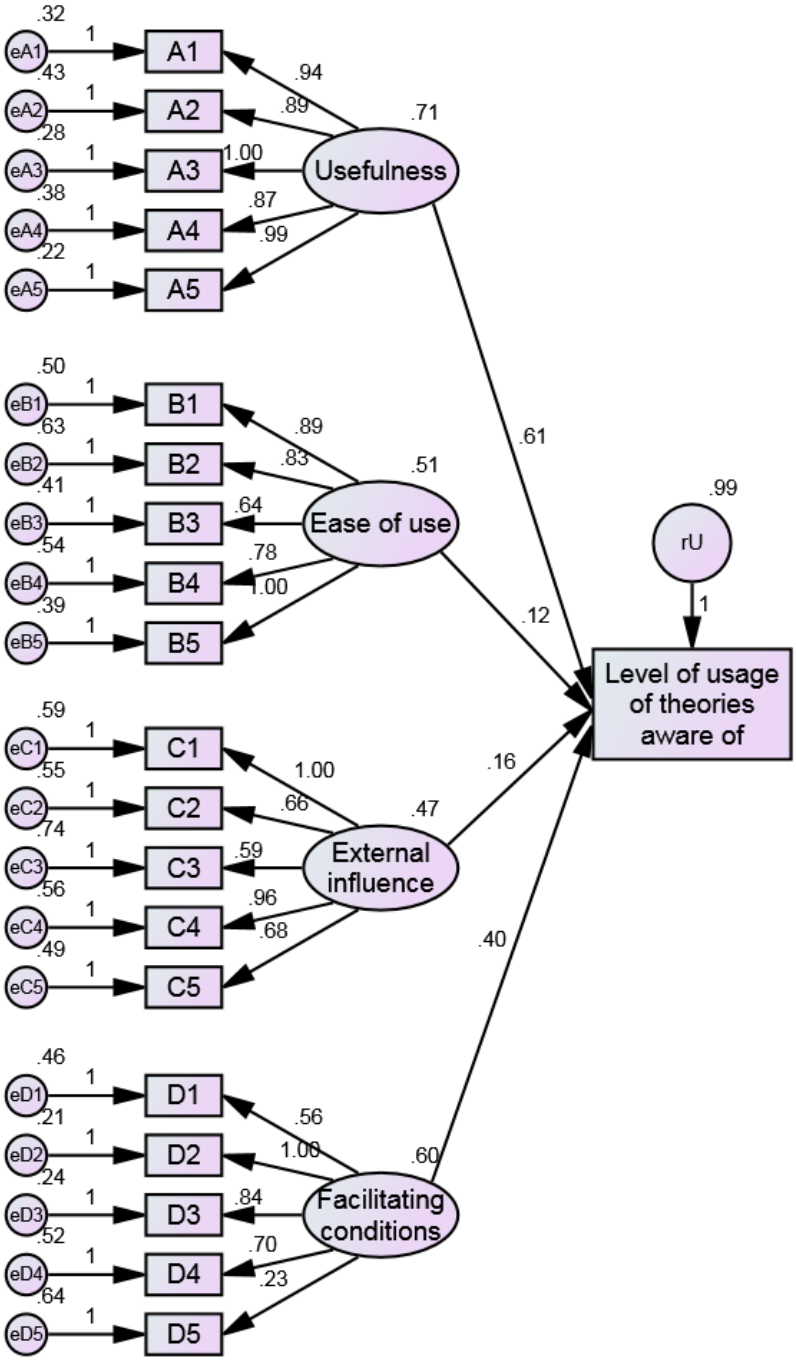
Figure 16: Results of Confirmatory Factor Analysis



The factor loadings (all significant at $p<0.001$) for the measures represented by rectangles are all above the minimum 0.5 guideline (Hair et al. 2006) except for D5, thus confirming convergent validity. The factor loadings (all significant at $p<0.001$) between the constructs represented by the ovals are all below the maximum 0.5 guideline (Hair et al. 2006) indicating low correlations and therefore discriminant validity.

The results of SEM using the research conceptual model are shown in figure 17. In the model, the level of usage of theories is the percentage of theory categories aware of that a respondent is actually using weighted based on the importance of each theory category as rated by academics in Chapter 7. The percentages are normalised to a 0.0-4.0 scale for consistency.

Figure 17: Results of SEM using the conceptual model

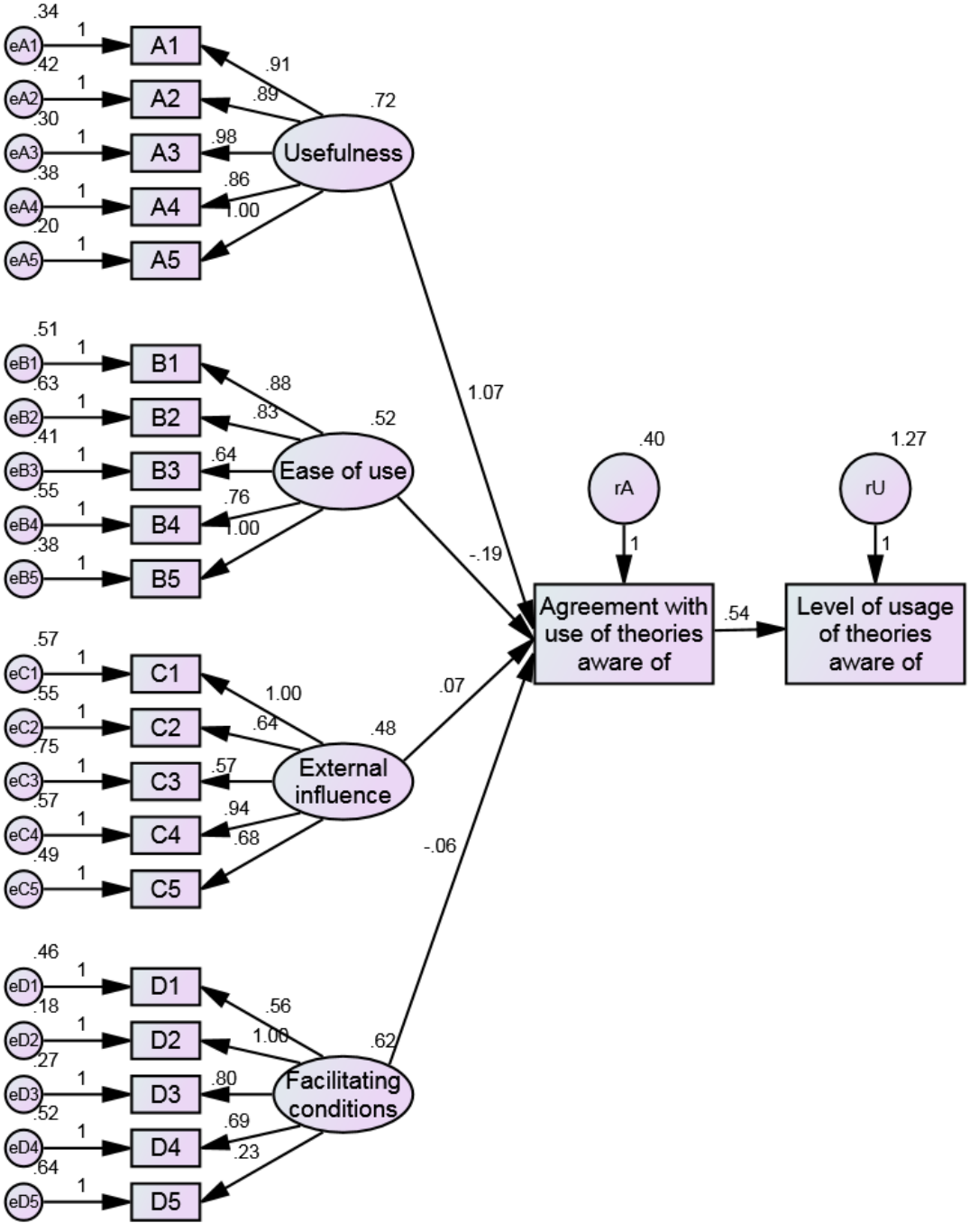


To evaluate the fit of the conceptual model with the data, two widely used goodness of fit measures are used namely Root Mean Square Error of Approximation (RMSEA) and Comparative Fit Index (CFI). The values obtained are RMSEA = 0.101 which is just around the maximum 0.10 guideline and CFI = 0.775 which is below the minimum 0.90 guideline (Hair et al. 2006). This implies rather inconclusively that the conceptual model may explain the level of usage of asset allocation theories. The measure D5 that was found in the CFA to have a low and insignificant factor loading has been retained in the SEM as the improvement in goodness of fit without it is negligible.

Among the four constructs, only perceived usefulness has a path coefficient above the minimum 0.5 guideline (Hair et al. 2006) with a value of 0.61 (significant at $p<0.001$). Facilitating conditions has a path coefficient of 0.40 (significant at $p<0.01$) while ease of use and external influence both have much lower and insignificant path coefficients. The underlying reasons for these findings will be probed later when analysis of the responses to the open ended questions in the survey is conducted.

To see if the fit of the model with the data can still be improved, an intervening variable, the level of agreement with use of asset allocation theory, is introduced. This variable is represented by the responses to the last item in question 8 asking the level of agreement with the statement “I think our organisation should use/continue using asset allocation theories and theory-based methods”. The results of SEM using such an expanded conceptual model are shown in figure 18.

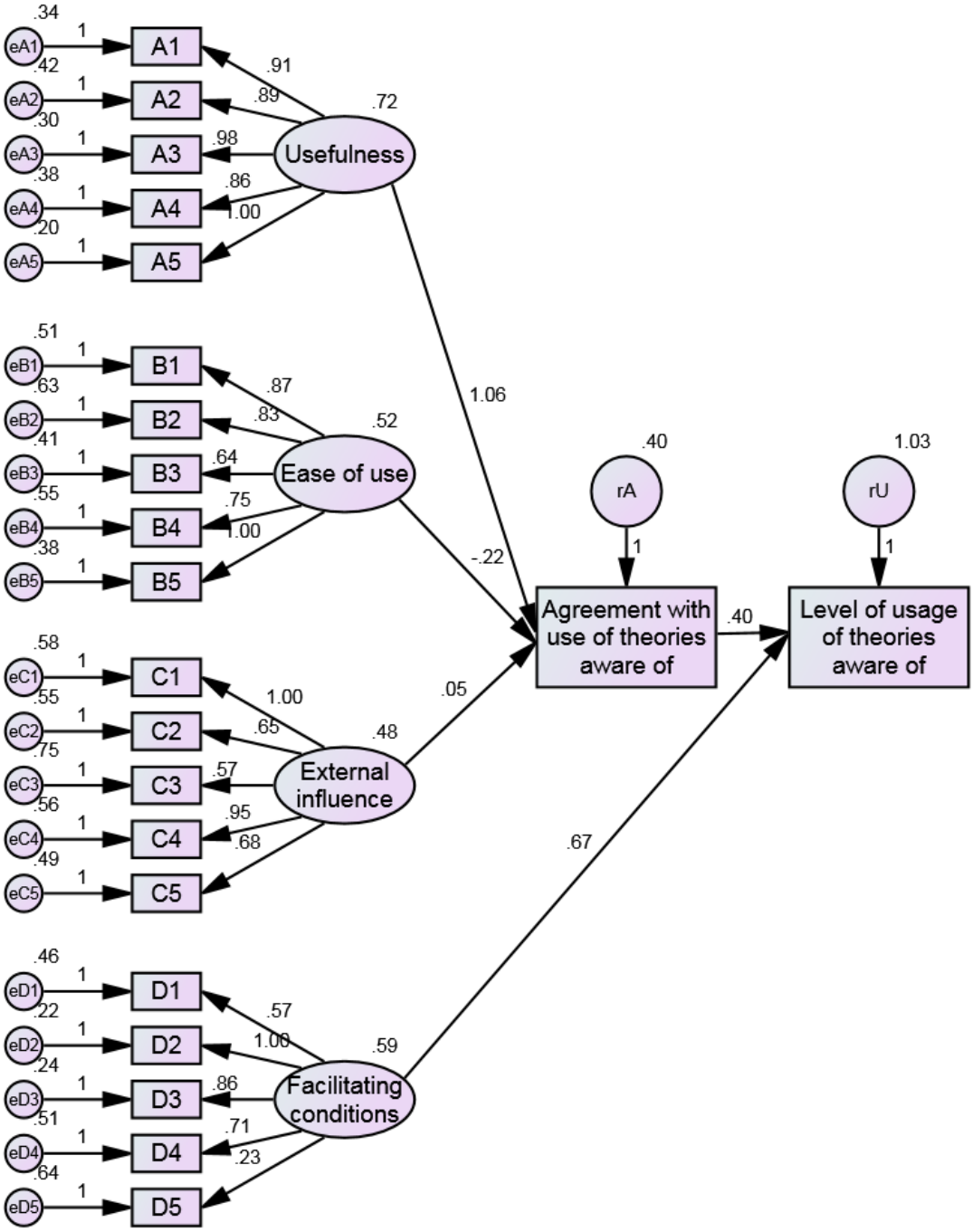
Figure 18: Results of SEM using the expanded conceptual model



The goodness of fit values have not changed much from the original model (RMSEA = 0.102 and CFI = 0.772). The path coefficient for perceived usefulness has greatly improved to 1.07 (significant at $p<0.001$) but those for the other three constructs are now much lower and insignificant.

A final modification to the conceptual model is redirecting the path from facilitating conditions to level of usage of theories. This would make sense as facilitating conditions is expected to influence usage more than attitude towards asset allocation theories. This is consistent with how perceived behavioural control directly influences actual behaviour in the TPB model discussed in chapter 4. The SEM results are shown in figure 19.

Figure 19: Results of SEM using the modified conceptual model



The goodness of fit values have improved from the original model (RMSEA = 0.098 and CFI = 0.790). The path coefficient for perceived usefulness has still improved to 1.06 (significant at $p<0.001$) and the path coefficient for facilitating conditions has greatly improved to 0.67 (significant at $p<0.001$) confirming hypotheses H4a and H4d. The path coefficients for ease of use and external influence are still low and insignificant providing little support for hypotheses H4b and H4c. The low path coefficient of 0.40 (significant at $p<0.001$) between agreement with use of theories and level of usage of theories is expected as it is acknowledged that the actual decision to use theory is decided by the organisation and not the individual.

Additional insight into the above quantitative findings can be obtained from the responses to the open ended questions in the survey, consistent with the triangulation approach discussed in Chapter 5. Table 49 summarises the reasons mentioned by respondents for not using the various categories of asset allocation theories.

Table 49: Top mentions on reasons why each category of theories is not actually being used

Theory categories and reasons why not being used	Number of mentions
Markowitz' original mean-variance model	
Not practical or relevant	7
Too theoretical or simplistic	8
Not consistent with business framework	5
Too complex	0
Small or simple investment or organisation	7
Not effective or does not add value	7
Difficulty with inputs to the model	4
Using another approach	3
Use of additional parameters	
Not practical or relevant	6
Too theoretical or simplistic	2
Not consistent with business framework	5
Too complex	6
Small or simple investment or organisation	4
Not effective or does not add value	7

Difficulty with inputs to the model	1
Using another approach	13
Use of risk measures other than variance	
Not practical or relevant	9
Too theoretical or simplistic	1
Not consistent with business framework	3
Too complex	3
Small or simple investment or organisation	3
Not effective or does not add value	3
Difficulty with inputs to the model	1
Using another approach	9
Addressing parameter uncertainty	
Not practical or relevant	7
Too theoretical or simplistic	3
Not consistent with business framework	3
Too complex	7
Small or simple investment or organisation	4
Not effective or does not add value	4
Difficulty with inputs to the model	3
Using another approach	5
Multi-period models	
Not practical or relevant	10
Too theoretical or simplistic	3
Not consistent with business framework	2
Too complex	10
Small or simple investment or organisation	3
Not effective or does not add value	3
Difficulty with inputs to the model	2
Using another approach	9
Non-quadratic utility function models	
Not practical or relevant	14
Too theoretical or simplistic	5
Not consistent with business framework	5

Too complex	12
Small or simple investment or organisation	4
Not effective or does not add value	5
Difficulty with inputs to the model	2
Using another approach	8
Other asset allocation models	
Not practical or relevant	5
Too theoretical or simplistic	1
Not consistent with business framework	4
Too complex	2
Small or simple investment or organisation	3
Not effective or does not add value	6
Difficulty with inputs to the model	2
Using another approach	6

Table 49 confirms the dominant influence of perceived usefulness on level of usage of theories, with the following reasons for non-usage being most commonly mentioned: not practical or relevant, too theoretical or simplistic, not effective or does not add value. Facilitating conditions can be associated with the following reasons: not consistent with business framework, small or simple organisation. Consistency with an existing business framework would reflect the previously identified political reasons when use of an optimiser requires significant changes in the structure of the organisation and the management of the investment process (Michaud 1989). Perceived ease of use can be associated with the following reasons: too complex, difficulty with inputs to the model. There were no reasons for non-usage mentioned that can be associated with external influence. Overall, the findings are consistent with the interview responses discussed in Chapter 8.

Table 50 summarises the opinions mentioned by respondents about each of the constructs in the conceptual model and supplements the insights from table 49.

Table 50: Top mentions on opinions about each of the constructs in the conceptual model impacting usage of theories

Model constructs and opinions on each one	Number of mentions
Usefulness of theories	
Good starting point for discussion but not to actually build portfolios	20
Of limited usefulness or not relevant/practical at all	19
Good framework for analysis but must understand limiting assumptions	10
Useful but must be overlaid with qualitative and other considerations	8
Theories need to prove themselves in practice	6
Good for explaining what has happened in the past	5
Theory relevant and improves the quality of any given portfolio	4
Ease of use of theories	
Ranges from easy to hard, depending on particular theory	20
Easy to use theory but difficult to apply results in practice	17
Theory easy enough to use and articulate	15
The mathematics is complex and getting them to work is hard	5
Easy if they are explainable to stakeholders	5
Depends on organisational structure and processes	2
External influences favouring use of theories	
The market expects it and there is a need to project expertise or quality	23
It is industry practice and regulators expect it	22
External influence not relevant or becoming not relevant	15
Herd mentality or doing what is popular	4
Relevance of external influence varies	2
Facilitating conditions favouring use of theories	
Needs people with the knowledge and training to run the process	18
Resources and systems important	14
Data important	5
Depends on company size and policies	5
Not relevant as theories can be learnt	5
Communicating theory is important	3

Under usefulness of theories, there are favourable opinions about theories but they are largely qualified (e.g. good starting point, must understand limitations, must be overlaid with qualitative considerations, good for explaining history). There are also opinions on the irrelevance of theories, most probably coming from those who are not using them in practice thereby reinforcing the significance of the model construct perceived usefulness of theories in influencing level of usage.

Under ease of use of theories, the prevailing opinion seems to be that asset allocation theory is easy enough to use. However, the contradictory finding that there is actually a low usage of theories reinforces the insignificance of the model construct perceived ease of use of theories.

Under external influences, the prevailing opinion seems to be that the market, industry and regulators expect the use of asset allocation theories. However, the contradictory finding that there is actually a low usage of theories reinforces the insignificance of the model construct external influences. In fact, several respondents directly expressed the opinion that external influence is not relevant.

Under facilitating conditions, the opinions expressed the importance of expertise, resources, systems and data with only a few saying that they are not relevant. This reinforces the significance of the model construct facilitating conditions in influencing level of usage.

It should be noted that the range of opinions expressed appear to be wider than the measures used to represent each model construct. Future similar research can incorporate these opinions in order to refine the measures for each construct.

9.7 Chapter summary

To directly address the research questions and hypotheses, an online survey to probe awareness, usage and perception of importance of asset allocation theories and theory-based methods was carried out among investment management industry practitioners. Emails with a link to the survey were sent directly to officers of companies involved in investment management as well as through relevant industry associations and 91 valid responses from decision makers and/or influencers were obtained. There was a healthy distribution among the respondents in terms of position in their organisation, size of assets managed, age of their organisation and their city location.

The results confirm research hypotheses H1 and H3, respectively, that there is a high level of awareness but a low level of usage of asset allocation theories and theory-based methods among Australian investment management industry practitioners. Looking at the range of specific methods being used in the industry, this appears to be consistent with the range of methods from the literature review in chapter 3 and mentioned by academics surveyed in chapter 7, albeit ranked differently. This would seem to be an initial indication of the asset allocation theory-practice dichotomy. The survey results also confirm hypothesis H2 that there are various sources of awareness of asset allocation theories and theory-based methods and that these sources are all equally important.

Comparing practitioners' perceptions of importance of the various categories of theory before and after the GFC, there appears to be no significant changes despite the overwhelmingly negative press that Modern Portfolio Theory has received, except for two categories. The events of the GFC have strengthened the importance of using risk measures other than variance and addressing the problems with parameter uncertainty.

The most glaring difference between academics and practitioners in the perception of importance seems to be with Markowitz' original mean-variance model. While it is rated highest by academics, it is rated second lowest by practitioners. Other asset allocation models that represent a departure from the original mean-variance models are rated much higher by practitioners. However, other asset allocation models do not completely dominate Markowitz' original mean-variance models and the associated theory strands in terms of actual usage, with a significant percentage still using them. Use of risk measures other than variance are rated much higher while addressing the problems with parameter uncertainty are counterintuitively rated much lower by practitioners compared to academics.

Structural Equation Modelling was carried out on the conceptual model using the data obtained through the online survey to identify the underlying reasons for the level of usage thereby addressing hypotheses H4a, H4b, H4c and H4d. Among the four constructs, only perceived usefulness and facilitating conditions seem to have a significant influence on level of usage, but the original conceptual model did not have a conclusive fit with the data. After expanding and modifying the original conceptual model by adding an intervening variable agreement with usage of theories and redirecting the path from facilitating conditions to level of usage, the goodness of fit is improved. However, still only the same two constructs appear

significant. Therefore, H4a and H4d are confirmed but there appears to be little support for H4b and H4c. The responses gathered for the open-ended questions in the survey are consistent with the quantitative conclusions.

Awareness of theories is not an issue as awareness is generally high across the categories of asset allocation theories. Among the possible factors contributing to low usage of theories aware of, perception of non-usefulness is the main barrier to adoption of asset allocation theories. The other factors, perception of ease of use and external influences do not have significant impact. Facilitating conditions may directly impact adoption, but its influence would depend on the main barrier being overcome. Therefore, as further areas of research, there is a need to probe the reasons for the general perception of non-usefulness of asset allocation theories perhaps through the Expected Utility Theory lens. It would also be insightful to talk to former users as it is known that some investment practitioners have experimented with optimising models only to abandon them when forward looking inputs proved difficult to generate and outputs turned out to be counterintuitive and without practical value (Michaud 1989).

The conceptual model can still be improved to better identify the factors influencing the level of usage of theories. Future research could explore different ways of identifying the factors as well as defining the measures for each factor.

Chapter 10: Conclusions

The present research sought to examine any dichotomy between theory and practice of asset allocation in the Australian investment management industry. The research established that there is a dichotomy between theory and practice after studying the extent to which available theories and theory-based methods of asset allocation are being applied to practice in the industry and identified the potential reasons for this. On this basis, recommendations are made that may help reduce the dichotomy.

Before studying how they are being put to use in practice, the present research first established that academics believe that theories and theory-based methods are still important in making the correct asset allocation decision. If this were not the case, then it would not have been relevant to proceed with research that examines their level of usage and aims to contribute to putting them to better use.

There appears to be a consensus among academics and practitioners that the original mean-variance optimisation model would be an ideal model if the problems with parameter uncertainty can be fully addressed. This is consistent with a research finding that while practitioners know that the original mean-variance model has its limits, it is still the industry workhorse (Amenc, Goltz & Lioui 2011). Many shortcomings with the model have been identified but the researcher concurs that "the operating principle should be that, to the extent that reliable information is available, it should be included as part of the definition of the optimisation procedure" (Michaud 1989 p. 31). In fact, if one looks at the mathematics behind the optimisation procedure, it is clearly on solid ground. The problem lies with the lack of integrity of the inputs to the model resulting in asset allocation recommendations that are counterintuitive and impractical. Practitioners therefore should embrace and support research aimed at addressing the problems of the original mean-variance model with parameter uncertainty, a research category that seems to have low levels of both awareness and usage among practitioners. This can be done at the same time that other asset allocation models representing a departure from the original mean-variance model are gaining ground in both academe and practice, so that an exhaustive solution to the optimisation problem can be achieved.

The survey results confirm that there is a low level of usage of asset allocation theories and theory-based methods. Among the theorised factors, perceived usefulness appears to have the strongest influence on usage followed by facilitating conditions. The two other factors, perceived ease of use and external influence, appeared insignificant. These findings indicate that there is an opportunity for widespread adoption of asset allocation theories and theory-based methods if the perception of lack of usefulness can be overcome. Ease of use not being a factor indicates that industry practitioners would be willing triers of asset allocation theories and methods. External influence not being a factor is indicative of entities that will make a decision on the use of asset allocation theories and methods based mainly on its merit.

The prevailing opinion among practitioners is that the outputs generated by the models are impractical and therefore the models are not relevant. These findings reflect the general dichotomy between theory and practice as written about in the literature. One explanation offered is that there is a fundamental difference between academics who look backward seeking to explain (e.g. through empirical research) while practitioners look forward seeking to forecast (e.g. expecting theoretical models to be black boxes). The obvious but not always easy solution is for academics and practitioners to listen to each other and help each other understand phenomena backward and forward (Nawrocki 1999). Academics also seem to be too focussed on a theory and instead of revisiting and validating it, often expand it beyond reasonable dimensions (Weaver 1993) perhaps explaining the prevalence of esoteric research. The dichotomy is also a manifestation of the rigour-relevance debate. From having a strong focus on managerial relevance at the expense of academic rigour, research has evolved into a more rigorous discipline that includes sophisticated data collection methods and quantitative analyses but is perceived as detached from management practice. Academic journals appear to be written by researchers for researchers and do not make an effort to reach practitioners and vice versa. The self-referential nature of both spheres prevents cross-pollination of ideas and has resulted in two communities that are dissociated from each other and that seemingly adhere to their own respective logic (Flickinger et al. 2014). This is consistent with the reference to finance theory as a house without windows in Chapter 3. However, an arm's length distance between theory and practice may still have to be maintained as theory must be developed at the frontiers of the field while practice is concerned with its central core (Aggarwal 1993). Otherwise there will be stagnation and none of the historical innovations would have occurred.

An early work (Smith & Goudzwaard 1970) identified the need for more communication between academics and practitioners in the field of investment management and offered some suggestions. Practitioners should make a greater effort to understand and contribute to academic research and should assume some responsibility for educating potential investment managers through internship. Academics should understand the operations and problems of investment managers, should familiarise themselves and their students with the kind of research being done by industry, must not overemphasise theory over application, should orient some of their research toward current problems of practitioners, should enlist the help of guest speakers from industry and should use practical case studies in teaching. Perhaps one way to summarise this is to encourage mutual appreciation of each other's work and research and acknowledge that everything falls under the same umbrella (e.g. investment management).

The researcher offers some specific suggestions and examples, as follows:

1. More of articles like (Evensky, Clark & Boscaljon 2010) which is a review of recent papers and books on asset allocation written for practitioners and published in a trade journal. Explaining theories and academic studies in practical language would encourage the industry to explore these theories and academic findings in more detail.
2. More of specific topical conferences such as Asset Allocation Summits and online forums such as LinkedIn groups on the topic of asset allocation.
3. Encourage cross pollination of ideas by having industry presentations during academic conferences and academic presentations during industry conferences. Furthermore, encourage cross attendance by reciprocal arrangements. For instance, the largest industry association Finsia can offer free annual conference registration to a few academic members of the Asian Finance Association and the latter can also offer free annual conference registration to the same number of Finsia practitioner members.
4. Combined practitioner/academic approach to running an investment management business. An example of this is Dimensional, a global asset management firm with an office in Australia who "help investors pursue dimensions of higher expected returns through advanced portfolio design management and trading underpinned by a deep working relationship with the academic community" (Dimensional 2015). It counts among its Board members leading finance academics including Nobel Prize winners and incorporates their research into its investment decision making. Another example is Finametrica, an

Australian company involved in risk profiling which is a preliminary step to formulating asset allocation recommendations. Finametrica allows the academic community to access its extensive database for research aimed at improving the understanding of investor risk tolerance and risk profiling.

As determined through the survey, there appears to be a high level of awareness among practitioners of asset allocation theories and theory-based methods but there appears to be a need to strengthen the role of university training in generating this awareness. University textbooks are known to focus on the idealised asset allocation model without extensive discussion of the limitations and refinements. As such, university graduates may have the tendency to set aside their learnings when they realise the shortcomings of theory when being applied in the real world. Finance teaching should not stop at idealised theories, but also should present critiques and papers that address shortcomings, so that graduates would know how to cope with them in practice. Most modern finance textbooks consider the original mean-variance model as the primary technique for optimising asset allocation and for rationalising the value of diversification (Michaud 1989) but as the present research has shown, it is not the case with industry. This seems to support that "the academic focus on modelling has resulted in an emphasis on abstract economic and statistical analysis that is effectively divorced from the real world of business" (London & Bradshaw 2005 p. 11). An early survey study on investment management teaching and practice found that universities do not have an appreciation of the problems faced by investment management practitioners and that industry does not understand the role of investment education (Smith & Goudzwaard 1970). While universities need to address these deficiencies in introducing theories to students, the other channels identified through which practitioners are made aware of asset allocation theories and methods also need to be strengthened.

The present research has answered the call that future research should address ways to better apply investment theories and tools to practice (Merton 2003). In fact, the motivation for the research lies on the importance of being able to put the body of theory on asset allocation to practical use, which importance also applies to other areas of research. The findings of the research may lead to the development of more practical optimal asset allocation strategies for institutional investors that will have flow-on benefits for individual investors as well. Investment industry realities can also guide future research.

An extensive survey of extant literature on asset allocation theory and theory-based methods underpinned the research, which is a contribution by itself given the paucity in literature that extensively surveys the wide range of research on the topic of asset allocation. The research also fills the gap in literature that looks at asset allocation theory and practice in the Australian context.

The present research also has a meaningful contribution to theory-practice dichotomy literature as it is focussed on a particular body of theory unlike other studies which covered a broad body of theory and were therefore mainly descriptive and did not allow detailed probing of reasons for the dichotomy. It also showed how models from other disciplines can be adopted to study the phenomenon. Furthermore, the research methodology and the conceptual models developed can be applied in examining theory-practice dichotomies in other areas.

However, the present research also has some limitations that at the same time indicate possible areas for future research. The research focussed on the Australian investment management industry. While the Australian industry is of significant size being the fourth largest in the world, future research should cover the US investment management industry which is the largest in the world being approximately six times the size of Australia's. This would address one other limitation of the research which is the relatively small sample size of the survey. This would also acknowledge that there may be contextual issues with regards to the dichotomy between theory-based methods and industry practice.

The present research relied on academics' subjective appraisals of asset allocation theory to establish their relative importance. A future area of research could assess the importance of the various theories and theory-based methods by carrying out a meta-analysis of studies that quantify their impact on optimising asset allocation.

The conceptual model can still be improved to better identity the factors influencing the level of usage of theories. Future research could explore different ways of identifying the factors as well as defining the measures for each factor. The main factor influencing the level of usage was found to be perceived usefulness of theory. Specific reasons why theory is perceived as not being useful can be probed further perhaps through the lens of Expected Utility Theory. Academics need to be aware of these reasons so that they can address them and therefore

improve theory. The actual level of usage of theories by practitioners could also be measured more specifically to allow a higher level of quantitative analysis of the survey results.

A related future area of research would be agency issues with asset allocation decision making. Asset consultants would be the agents and institutional investors would be the principals. Possible agency issues seem to be indicated by comments gathered that asset consultants prefer to use theory to project quality or expertise and that investors have their own risk/return objectives which might be different from theirs. The compensation structure for asset consultants could also be a significant factor. This research can also look at the implications of asset allocation decision making being carried out organisationally and not individually.

It has been mentioned that another area for research is asset allocation practices of self-managed superannuation or pension funds and other non-institutional investment managers. This is an area where some of the behavioural finance issues identified in the present research can be further studied.

While this research has focused on establishing the dichotomy between theory and practice of asset allocation, there is a need to take a broader view on theory-practice dichotomy in general. It is suggested that there are three ways in which the theory-practice dichotomy has been framed namely as a knowledge transfer problem, as a case of two distinct kinds of knowledge and as a knowledge production problem (Van De Ven & Johnson 2006).

The theory-practice dichotomy has been framed as a knowledge transfer problem in that practitioners are not able to fully apply theoretical knowledge because they are not in a form that can be readily used to address actual problems (Van De Ven & Johnson 2006). This could be ironic because a lot of theories are just generalised representations of industry practices and therefore should be readily applicable. Instead of stopping at identifying the dichotomy, future research can look at studying this underlying relationship to be able to address the dichotomy.

The theory-practice dichotomy has been framed as a case of two distinct kinds of knowledge in that academics are primarily concerned with generalising phenomena through models while practitioners are primarily concerned with directly addressing specific contextual issues. The intellectual focus of theory and the deliberate operational focus of practice often clash with

each other (Reed 2009). While each one uses a different methodology to achieve different objectives, they should not be exclusive of each other but rather complimentary (Van De Ven & Johnson 2006). For instance, investment management utilises theory-based quantitative methods but the theories governing them are mainly idealised models and therefore should not be expected to be applied rigidly. However, this does not mean that theory should not influence practice as understanding its deficiency could actually lead to a theory-based method that could be useful for a specific purpose. Theory-practice dichotomy should not be taken face value as lack of influence of theory in practice.

Lastly, the theory-practice dichotomy has been framed as a knowledge production problem in that academics have a "disinterested intellectual" attitude and are preoccupied with the demands of the scientific community to the detriment of practitioners who should be benefiting from their output (Reed 2009). This ivory tower approach is demonstrated in some finance theory where academics, instead of engaging practitioners, cherry-pick empirical data from practice in order to come up models that may not really be realistic (Keasey & Hudson 2007). To address this, engaged scholarship is suggested as opposed to the traditional linear production line approach of academic research (Reed 2009). Dichotomy between theory and practice is unavoidable but it is healthy if a constructive viewpoint is adopted where the two sides can actually nourish each other. Keeping the focus on the differences would keep both parties from exploring opportunities for co-production (Van De Ven & Johnson 2006). Academics, for their part, should recognise practice as the stage where ideas are created (Roth, Mavin & Dekker 2014).

To conclude, the present research has established that a dichotomy exists between theory and practice of asset allocation. To quote the eminent Professor Albert Einstein, "in theory, theory and practice are the same, in practice they are not". To determine the reasons why the dichotomy exists and what its implications are, the researcher has relied on interviews and surveys with academics and practitioners. Further research is needed to complete the picture, but hopefully the results from the present research will contribute as a starting point for narrowing the dichotomy between theory and practice of asset allocation.

List of references

Adcock, CJ 2010, 'Asset pricing and portfolio selection based on the multivariate extended skew-student- t distribution', *Annals of Operations Research*, vol. 176, no. 1.

Adler, T & Kritzman, M 2007, 'Mean–variance versus full-scale optimisation: in and out of sample', *Journal of Asset Management*, vol. 7, no. 5.

Agarwal, V & Naik, N 2000, Does gain-loss analysis outperform mean-variance analysis?, London Business School.

Aggarwal, R 1993, 'Theory and practice in finance education: or why we shouldn't just ask them', *Financial Practice and Education*, vol. 3, no. 2.

Ajzen, I 1991, 'The Theory of Planned Behavior', *Organizational Behavior & Human Decision Processes*, vol. 50, no. 2.

Alexander, GJ & Baptista, AM 2002, 'Economic implications of using a mean-VAR model for portfolio selection: a comparison with mean-variance analysis', *Journal of Economic Dynamics and Control*, vol. 26, no. 7-8.

Alexander, GJ & Baptista, AM 2004, 'A Comparison of VAR and CVAR constraints on portfolio selection with the mean-variance model', *Management Science*, vol. 50, no. 9.

Amenc, N, Goltz, F & Lioui, A 2011, 'Practitioner portfolio construction and performance measurement: evidence from Europe', *Financial Analysts Journal*, vol. 67, no. 3.

Arditti, FD & Levy, H 1975, 'Portfolio efficiency analysis in three moments: the multiperiod case', *Journal of Finance*, vol. 30, no. 3.

Armitage, CJ & Conner, M 2001, 'Efficacy of the Theory of Planned Behaviour: a meta-analytic review', *British Journal of Social Psychology*, vol. 40, no. 4.

Arrow, KJ 1971, *Essays in the Theory of Risk-bearing*, Markham Pub. Co., Chicago.

Arzac, ER & Bawa, VS 1977, 'Portfolio choice and equilibrium in capital markets with safety-first investors', *Journal of Financial Economics*, vol. 4, no. 3.

Asl, FM & Etula, E 2012, 'Advancing strategic asset allocation in a multi-factor world', *Journal of Portfolio Management*, vol. 39, no. 1.

Asness, CS, Frazzini, A & Pedersen, LH 2012, 'Leverage aversion and risk parity', *Financial Analysts Journal*, vol. 68, no. 1.

Atkinson, C & Papakokkinou, M 2005, 'Theory of optimal consumption and portfolio selection under a Capital-at-Risk and a Value-at-Risk constraint', *IMA Journal of Management Mathematics*, vol. 16, no. 1.

Austrade 2010, *Investment Management Industry in Australia*, Australian Trade Commission, Sydney.

Bajeux-Besnainou, I, Jordan, JV & Portait, R 2001, 'An asset allocation puzzle: comment', *American Economic Review*, vol. 91, no. 4.

Baker, HK & Mukherjee, T 2006, 'Survey research in finance: views from journal editors', *International Journal of Managerial Finance*, vol. 3.

Baker, HK & Filbeck, G 2013, *Portfolio Theory and Management*, Oxford University Press, New York.

Ballestero, E, Günther, M, Pla-Santamaria, D & Stummer, C 2007, 'Portfolio selection under strict uncertainty: a multi-criteria methodology and its application to the Frankfurt and Vienna Stock Exchanges', *European Journal of Operational Research*, vol. 181, no. 3.

Basak, S & Shapiro, A 2001, 'Value-at-Risk-based risk management: optimal policies and asset prices', *Review of Financial Studies*, vol. 14, no. 2.

Basu, AK, Byrne, A & Drew, ME 2011, 'Dynamic lifecycle strategies for target date retirement funds', *Journal of Portfolio Management*, vol. 37, no. 2.

Bawa, VS 1975, 'Optimal rules for ordering uncertain prospects', *Journal of Financial Economics*, vol. 2, no. 1.

Benartzi, S & Thaler, RH 2001, 'Naive diversification strategies in defined contribution saving plans', *American Economic Review*, vol. 91, no. 1.

Benbachir, S, Gaboune, B & Alaoui, ME 2012, 'Comparing portfolio selection using CVAR and mean-variance approach', *International Research Journal of Finance & Economics*, no. 88.

Bender, J, Briand, R, Nielsen, F & Stefek, D 2010, 'Portfolio of risk premia: a new approach to diversification', *Journal of Portfolio Management*, vol. 36, no. 2.

Bernardo, AE & Ledoit, O 2000, 'Gain, loss and asset pricing', *Journal of Political Economy*, vol. 108, no. 1.

Bernoulli, D 1954, 'Exposition of a new theory on the measurement of risk (translated from the 1738 original)', *Econometrica*, vol. 22, no. 1.

Best, MJ & Grauer, RR 1991, 'On the sensitivity of mean-variance-efficient portfolios to changes in asset means: some analytical and computational results', *Review of Financial Studies*, vol. 4, no. 2.

Best, MJ & Grauer, RR 1992, 'Positively weighted minimum-variance portfolios and the structure of asset expected returns', *Journal of Financial & Quantitative Analysis*, vol. 27, no. 4.

Black, F & Litterman, R 1991, 'Asset allocation: combining investor views with market equilibrium', *The Journal of Fixed Income*, vol. 1, no. 2.

Bodie, Z, Kane, A & Marcus, AJ 2011, *Investments and Portfolio Management*, 9th edn, McGraw-Hill/Irwin, New York.

Brandt, MW, Santa-Clara, P & Valkanov, R 2009, 'Parametric portfolio policies: exploiting characteristics in the cross-section of equity returns', *Review of Financial Studies*, vol. 22, no. 9.

Brau, JC & Fawcett, SE 2006, 'Initial public offerings: an analysis of theory and practice', *Journal of Finance*, vol. 61, no. 1.

Brennan, MJ & Schwartz, ES 1997, 'Strategic asset allocation', *Journal of Economic Dynamics & Control*, vol. 21, no. 8/9.

Brinson, GP, Hood, LR & Beebower, GL 1986, 'Determinants of portfolio performance', *Financial Analysts Journal*, vol. 42, no. 4.

Brounen, D, de Jong, A & Koedijk, K 2006, 'Capital structure policies in Europe: survey evidence', *Journal of Banking & Finance*, vol. 30, no. 5.

Brown, DB & Sim, M 2009, 'Satisficing measures for analysis of risky positions', *Management Science*, vol. 55, no. 1.

Byrne, BM 2010, *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*, 2nd edn, Routledge, New York.

Byrne, P & Lee, S 1997, 'Real estate portfolio analysis under conditions of non-normality: the case of NCREIF', *Journal of Real Estate Portfolio Management*, vol. 3, no. 1.

Campbell, JY, Chan, YL & Viceira, LM 2003, 'A multivariate model of strategic asset allocation', *Journal of Financial Economics*, vol. 67, no. 1.

Campbell, R, Huisman, R & Koedijk, K 2001, 'Optimal portfolio selection in a Value-at-Risk framework', *Journal of Banking and Finance*, vol. 25, no. 9.

Canner, N, Mankiw, NG & Weil, DN 1997, 'An asset allocation puzzle', *American Economic Review*, vol. 87, no. 1.

Carter, RB & Van Auken, HE 1990, 'Security analysis and portfolio management: a survey and analysis', *Journal of Portfolio Management*, vol. 16, no. 3.

Cass, D & Stiglitz, JE 1970, 'The structure of investor preferences and asset returns, and separability in portfolio allocation', *Journal of Economic Theory*, vol. 2, no. 2.

Çelikyurt, U & Özekici, S 2007, 'Multiperiod portfolio optimization models in stochastic markets using the mean–variance approach', *European Journal of Operational Research*, vol. 179, no. 1.

Ceria, S & Stubbs, RA 2006, 'Incorporating estimation errors into portfolio selection: robust portfolio construction', *Journal of Asset Management*, vol. 7, no. 2.

Chan, LKC, Karceski, J & Lakonishok, J 1999, 'On portfolio optimization: forecasting covariances and choosing the risk model', *Review of Financial Studies*, vol. 12, no. 5.

Chang, C-H, DuPoyet, B & Prakash, A 2008, 'Optimum allocation of weights to assets in a portfolio: the case of nominal annualization versus effective annualization of returns', *Applied Financial Economics*, vol. 18, no. 19-21.

Chen, H-H 2008, 'Value-at-Risk efficient portfolio selection using goal programming', *Review of Pacific Basin Financial Markets and Policies*, vol. 11, no. 2.

Chen, S & Liu, X 2011, 'Utilizing the Theory of Planned Behaviour to lead change in manufacturing organizations', in International Conference on E-business Management and Economics, Singapore.

Cheng, HC & Chiung, CT 2012, 'Optimal portfolios under a Conditional Value-at-Risk constraint', *International Research Journal of Finance & Economics*, no. 89.

Chopra, VK 1993, 'Improving optimization', *The Journal of Investing*, vol. 2, no. 3.

Chopra, VK & Ziemba, WT 1993, 'The effect of errors in means, variances, and covariances on optimal portfolio choice', *Journal of Portfolio Management*, vol. 19, no. 2.

Chow, G, Jacquier, E, Kitzman, M & Lowry, K 1999, 'Optimal portfolios in good times and bad', *Financial Analysts Journal*, vol. 55, no. 3.

Christie, S 2005, 'Strategic and tactical asset allocation in the presence of sampling error', *MAFC Research Papers*, vol. 30.

Clarke, RG, de Silva, H & Murdock, R 2005, 'A factor approach to asset allocation: exposure to global market factors', *Journal of Portfolio Management*, vol. 32, no. 1.

Clarkson, GP & Meltzer, AH 1960, 'Portfolio selection: a heuristic approach', *Journal of Finance*, vol. 15, no. 4.

Coakes, SJ, Steed, L & Dzidic, P 2006, *SPSS: Analysis Without Anguish: Version 13.0 for Windows*, Version 13.0. edn, John Wiley & Sons Australia, Milton.

Coleman, L 2007, 'Applying modern portfolio techniques to agriculture', *JASSA*, no. 4.

Coleman, L 2013, 'Why finance theory fails to survive contact with the real world: a fund manager perspective', *Critical Perspectives on Accounting*.

Coleman, MS & Mansour, A 2005, 'Real estate in the real world: dealing with non-normality and risk in an asset allocation model', *Journal of Real Estate Portfolio Management*, vol. 11, no. 1.

Compeau, D, Higgins, CA & Huff, S 1999, 'Social cognitive theory and individual reactions to computing technology: a longitudinal study', *MIS Quarterly*, vol. 23, no. 2.

Compeau, DR & Higgins, CA 1995, 'Computer self-efficacy: development of a measure and initial test', *MIS Quarterly*, vol. 19, no. 2.

Consigli, G 2002, 'Tail estimation and Mean-VaR portfolio selection in markets subject to financial instability', *Journal of Banking and Finance*, vol. 26, no. 7.

Cooper, HM 2009, *Research Synthesis and Meta-analysis : a Step-by-step Approach*, 4th ed. edn, Sage Publications, London.

Cremers, J-H, Kritzman, M & Page, S 2005, 'Optimal hedge fund allocations: do higher moments matter?', *Journal of Portfolio Management*, vol. 31, no. 3.

Crowe, K & Parker, W 2008, 'Using portfolio theory to guide reforestation and restoration under climate change scenarios', *Climatic Change*, vol. 89, no. 3-4.

Cvitanic, J, Polimenis, V & Zapatero, F 2008, 'Optimal portfolio allocation with higher moments', *Annals of Finance*, vol. 4, no. 1.

D'Antonio, L & Johnsen, T 2011, 'Equity collars as an alternative to debt in traditional asset allocation', *Journal of Financial Service Professionals*, vol. 65, no. 4.

Davies, GB & Satchell, SE 2004, 'Continuous cumulative prospect theory and individual asset allocation', *Conference on Subjective Probability, Utility, and Decision Making*, Zurich.

Davis, FD 1989, 'Perceived usefulness, perceived ease of use, and user acceptance of information technology', *MIS Quarterly*, vol. 13, no. 3.

de Athayde, GM & Flores, RG 2004, 'Finding a maximum skewness portfolio - a general solution to three-moments portfolio choice', *Journal of Economic Dynamics and Control*, vol. 28, no. 7.

De Giorgi, E, Hens, T & Mayer, J 2007, 'Computational aspects of Prospect Theory with asset pricing applications', *Computational Economics*, vol. 29, no. 3-4.

DeMiguel, V & Nogales, FJ 2009, 'Portfolio selection with robust estimation', *Operations Research*, vol. 57, no. 3.

DeMiguel, V, Garlappi, L & Uppal, R 2009, 'Optimal versus naive diversification: how inefficient is the 1/N portfolio strategy?', *Review of Financial Studies*, vol. 22, no. 5.

Deutskens, E, Ruyter, KD, Wetzels, M & Oosterveld, P 2004, 'Response rate and response quality of internet-based surveys: an experimental study', *Marketing Letters*, vol. 15, no. 1.

Dillman, DA, Smyth, J & Christian, LM 2014, *Internet Phone Mail and Mixed Mode Surveys The Tailored Design Method*, John Wiley and Sons, New Jersey.

Dimensional 2015, *Dimensional in Australia*, viewed 9 January 2015, <http://au.dimensional.com/>.

Durand, RB, Gould, J & Maller, R 2011, 'On the performance of the minimum VaR portfolio', *European Journal of Finance*, vol. 17, no. 7/8.

East, R 1993, 'Investment decisions and the Theory of Planned Behaviour', *Journal of Economic Psychology*, vol. 14, no. 2.

Ebner, M & Neumann, T 2008, 'Time-varying factor models for equity portfolio construction', *The European Journal of Finance*, vol. 14, no. 5.

Elton, EJ & Gruber, MJ 2000, 'The rationality of asset allocation recommendations', *Journal of Financial & Quantitative Analysis*, vol. 35, no. 1.

Engel, C, Frankel, JA, Froot, KA & Rodrigues, AP 1995, 'Tests of conditional mean-variance efficiency of the U.S. stock market', *Journal of Empirical Finance*, vol. 2, no. 1.

Engle, R 2004, 'Risk and volatility: econometric models and financial practice', *American Economic Review*, vol. 94, no. 3.

Evensky, H, Clark, J & Boscaljon, B 2010, 'Asset allocation - new and improved?', *Journal of Financial Planning*, vol. 23, no. 9.

Fabozzi, FJ, Huang, D & Zhou, G 2010, 'Robust portfolios: contributions from operations research and finance', *Annals of Operations Research*, vol. 176, no. 1.

Fabozzi, FJ, Ritchie, J, Collins, B & Coggin, D 1999, *Investment Management*, Prentice Hall, Upper Saddle River, NJ.

Fabozzi, FJ, Ortobelli, S, Rachev, ST, Stoyanov, S & Biglova, A 2005, 'The proper use of risk measures in portfolio theory', *International Journal of Theoretical and Applied Finance*, vol. 8, no. 8.

Fabozzi, FJ, Rachev, S, Ortobelli, S, Stoyanov, S & Biglova, A 2008, 'Desirable properties of an ideal risk measure in portfolio theory', *International Journal of Theoretical and Applied Finance*, vol. 11, no. 1.

Fama, EF 1965, 'The behavior of stock market prices', *Journal of Business*, vol. 38, no. 1.

Faulhaber, GR & Baumol, WJ 1988, 'Economists as innovators: practical products of theoretical research', *Journal of Economic Literature*, vol. 26, no. 2.

Feldstein, MS 1969, 'Mean-variance analysis in the theory of liquidity preference and portfolio selection', *Review of Economic Studies*, vol. 36, no. 105.

Fishburn, PC 1977, 'Mean-risk analysis with risk associated with below-target returns', *American Economic Review*, vol. 67, no. 2.

Flickinger, M, Tuschke, A, Gruber-Muecke, T & Fiedler, M 2014, 'In search of rigor, relevance, and legitimacy: what drives the impact of publications?', *Journal of Business Economics*, vol. 84, no. 1.

Friedman, M & Savage, LJ 1948, 'The utility analysis of choices involving risk', *Journal of Political Economy*, vol. 56, no. 4.

Frost, PA & Savarino, JE 1986, 'An empirical Bayes approach to efficient portfolio selection', *Journal of Financial and Quantitative Analysis*, vol. 21, no. 3.

Frost, PA & Savarino, JE 1988, 'For better performance: constrain portfolio weights', *Journal of Portfolio Management*, vol. 15, no. 1.

Garlappi, L, Uppal, R & Tan, W 2007, 'Portfolio selection with parameter and model uncertainty: a multi-prior approach', *Review of Financial Studies*, vol. 20, no. 1.

Gaydon, DS, Meinke, H, Rodriguez, D & McGrath, DJ 2012, 'Comparing water options for irrigation farmers using Modern Portfolio Theory', *Agricultural Water Management*, vol. 115.

Goldfarb, D & Iyengar, G 2003, 'Robust portfolio selection problems', *Mathematics of Operations Research*, vol. 28, no. 1.

Graham, JR & Harvey, CR 2001, 'The theory and practice of corporate finance: evidence from the field', *Journal of Financial Economics*, vol. 60, no. 2/3.

Green, RC & Hollifield, B 1992, 'When will mean-variance efficient portfolios be well diversified?', *Journal of Finance*, vol. 47, no. 5.

Guidolin, M & Timmermann, A 2007, 'Asset allocation under multivariate regime switching', *Journal of Economic Dynamics and Control*, vol. 31, no. 11.

Hair, JF, Black, WC, Babin, BJ, Anderson, RE & Tatham, RL 2006, *Multivariate Data Analysis*, 6th edn, Pearson Prentice Hall, Upper Saddle River, NJ.

Hanbury, A, Farley, K, Thompson, C, Wilson, P & Chambers, D 2012, 'Challenges in identifying barriers to adoption in a theory-based implementation study: lessons for future implementation studies', *BMC Health Services Research*, vol. 12, no. 1.

Hanqing, J, Markowitz, H & Xun Yu, Z 2006, 'A note on semivariance', *Mathematical Finance*, vol. 16, no. 1.

Harlow, WV 1991, 'Asset allocation in a downside-risk framework', *Financial Analysts Journal*, vol. 47, no. 5.

Harvey, CR & Siddique, A 2000, 'Conditional skewness in asset pricing tests', *Journal of Finance*, vol. 55, no. 3.

Harvey, CR, Liechty, JC, Liechty, MW & Muller, P 2010, 'Portfolio selection with higher moments', *Quantitative Finance*, vol. 10, no. 5.

Hirsch, JE 2005, 'An index to quantify an individual's scientific research output', in Proceedings of the National Academy of Sciences of the USA: *proceedings of theProceedings of the National Academy of Sciences of the USA*.

Ho, L, Cadle, J & Theobald, M 2008, 'Portfolio selection in an Expected Shortfall framework during the recent 'credit crunch' period', *Journal of Asset Management*, vol. 9, no. 2.

Hogan, WW & Warren, JM 1972, 'Computation of the efficient boundary in the E-S portfolio selection model', *Journal of Financial & Quantitative Analysis*, vol. 7, no. 4.

Holton, GA 2004, 'Defining risk', *Financial Analysts Journal*, vol. 60, no. 6.

Hsiu-Fen Lin, E & Lee, G 2004, 'Perceptions of senior managers toward knowledge-sharing behaviour', *Management Decision*, vol. 42, no. 1.

Huang, X 2008, 'Portfolio selection with a new definition of risk', *European Journal of Operational Research*, vol. 186, no. 1.

Huber, C & Kaiser, H 2003, 'Asset allocation recommendations of financial advisors: are they risk/return optimal?', *Journal of Wealth Management*, vol. 6, no. 2.

Hussein, A 2009, 'The use of triangulation in social sciences research: can qualitative and quantitative methods be combined', *Journal of Comparative Social Work*.

Ibbotson, RG & Fall, CL 1979, 'The United States market wealth portfolio', *Journal of Portfolio Management*, vol. 6, no. 1.

Ibbotson, RG & Kaplan, PD 2000, 'Does asset allocation policy explain 40, 90, or 100 percent of performance?', *Financial Analysts Journal*, vol. 56, no. 1.

Idzorek, TM & Kowara, M 2013, 'Factor-based asset allocation vs. asset-class-based asset allocation', *Financial Analysts Journal*, vol. 69, no. 3.

Ilhan, A, Jonsson, M & Sircar, R 2004, Portfolio optimization with derivatives and indifference pricing, Princeton University.

Jacquier, E & Marcus, AJ 2001, 'Asset allocation models and market volatility', *Financial Analysts Journal*, vol. 57, no. 2.

Jaeger, RA, Rausch, MA & Foley, M 2010, 'Multi-horizon investing: a new paradigm for endowments and other long-term investors', *Journal of Wealth Management*, vol. 13, no. 1.

Jagannathan, R & Ma, T 2003, 'Risk reduction in large portfolios: why imposing the wrong constraints helps', *Journal of Finance*, vol. 58, no. 4.

Jean, WH 1971, 'The extension of portfolio analysis to three or more parameters', *Journal of Financial and Quantitative Analysis*, vol. 6, no. 1.

Jobson, JD & Korkie, B 1981, 'Putting Markowitz theory to work', *Journal of Portfolio Management*, vol. 7, no. 4.

Jobson, JD, Korkie, B & Ratti, V 1979, 'Improved estimation for Markowitz portfolios using James-Stein type estimators', *Proceedings of the American Statistical Association*.

Johnson, M 2003, 'Prediction of Baby-Boomer Intentions to Seek Financial Planning Advice', The University of Queensland, Brisbane, QLD, Australia.

Jondeau, E & Rockinger, M 2006, 'Optimal portfolio allocation under higher moments', *European Financial Management*, vol. 12, no. 1.

Jorion, P 1991, 'Bayesian and CAPM estimators of the means: implications for portfolio selection', *Journal of Banking and Finance*, vol. 15, no. 3.

Juravle, C & Lewis, A 2008, 'Identifying impediments to SRI in Europe: a review of the practitioner and academic literature', *Business Ethics: A European Review*, vol. 17, no. 3.

Jurczenko, E & Maillet, B 2006, *Multi-moment asset allocation and pricing models*, John Wiley & Sons, Hoboken, NJ.

Kahneman, D & Tversky, A 1979, 'Prospect Theory: an analysis of decision under risk', *Econometrica*, vol. 47, no. 2.

Kan, R & Zhou, G 2007, 'Optimal portfolio choice with parameter uncertainty', *Journal of Financial & Quantitative Analysis*, vol. 42, no. 3.

Kane, A 1982, 'Skewness preference and portfolio choice', *Journal of Financial & Quantitative Analysis*, vol. 17, no. 1.

Keasey, K & Hudson, R 2007, 'Finance theory: a house without windows', *Critical Perspectives on Accounting*, vol. 18, no. 8.

King, WR & He, J 2006, 'A meta-analysis of the Technology Acceptance Model', *Information & Management*, vol. 43, no. 6.

Klein, RW & Bawa, VS 1976, 'The effect of estimation risk on optimal portfolio choice', *Journal of Financial Economics*, vol. 3, no. 3.

Knight, FH 1921, *Risk, Uncertainty and Profit*, A. M. Kelly, New York.

Kon, SJ 1984, 'Models of stock returns - a comparison', *Journal of Finance*, vol. 39, no. 1.

Kong, L 2006, 'The UPM/LPM Framework on Portfolio Performance Measurement and Optimization', Uppsala University.

Konno, H & Koshizuka, T 2005, 'Mean-absolute deviation model', *IIE Transactions*, vol. 37, no. 10.

Konno, H, Shirakawa, H & Yamazaki, H 1993, 'A mean-absolute deviation-skewness portfolio optimization model', *Annals of Operations Research*, vol. 45, no. 1-4.

Kroll, Y, Levy, H & Markowitz, HM 1984, 'Mean-variance versus direct utility maximization', *Journal of Finance*, vol. 39, no. 1.

Kroll, Y, Levy, H & Rapoport, A 1988a, 'Experimental tests of the Separation Theorem and the Capital Asset Pricing Model', *American Economic Review*, vol. 78, no. 3.

Kroll, Y, Levy, H & Rapoport, A 1988b, 'Experimental tests of the mean-variance model for portfolio selection', *Organizational Behavior & Human Decision Processes*, vol. 42, no. 3.

Kuosmanen, T 2004, 'Efficient diversification according to Stochastic Dominance criteria', *Management Science*, vol. 50, no. 10.

Lai, T 1991, 'Portfolio selection with skewness: a multiple-objective approach', *Review of Quantitative Finance & Accounting*, vol. 1, no. 3.

Ledoit, O & Wolf, M 2003, 'Improved estimation of the covariance matrix of stock returns with an application to portfolio selection', *Journal of Empirical Finance*, vol. 10, no. 5.

Leedy, PD & Ormrod, JE 2005, *Practical Research: Planning and Design*, 8th edn, Pearson/Merrill Prentice Hall, Upper Saddle River, NJ.

Levy, H 1973, 'Stochastic dominance, efficiency criteria, and efficient portfolios: the multi-period case', *American Economic Review*, vol. 63, no. 5.

Levy, H 1992, 'Stochastic dominance and expected utility: survey and analysis', *Management Science*, vol. 38, no. 4.

Levy, H & Markowitz, HM 1979, 'Approximating expected utility by a function of mean and variance', *American Economic Review*, vol. 69, no. 3.

Levy, H & Levy, M 2004, 'Prospect Theory and mean-variance analysis', *Review of Financial Studies*, vol. 17, no. 4.

Lin, P & Ko, P 2009, 'Portfolio value-at-risk forecasting with GA-based extreme value theory', *Expert Systems with Applications*, vol. 36, no. 2.

Lintner, J 1956, 'Distribution of incomes of corporations among dividends, retained earnings and taxes', *American Economic Review*, vol. 46.

Lintner, J 1965, 'Security prices, risk and maximal gains from diversification', *Journal of Finance*, vol. 20, no. 4.

Lioui, A 2007, 'The asset allocation puzzle is still a puzzle', *Journal of Economic Dynamics & Control*, vol. 31, no. 4.

London, S & Bradshaw, D 2005, 'Shredded credibility: the MBA industry may be facing a shake-out', *Financial Times*, April 29.

Low, C, Pachamanova, D & Sim, M 2012, 'Skewness-aware asset allocation: a new theoretical framework and empirical evidence', *Mathematical Finance*, vol. 22, no. 2.

LSE 2014, 'Key Measures of Academic Influence', <http://blogs.lse.ac.uk/impactofsocialsciences/the-handbook/chapter-3-key-measures-of-academic-influence/>.

Lucey, BM, Poti, V & Tully, E 2006, 'International portfolio formation, skewness and the role of gold', *Frontiers in Finance and Economics*, vol. 3, no. 1.

Lutgens, F & Schotman, PC 2010, 'Robust portfolio optimisation with multiple experts', *Review of Finance*, vol. 14, no. 2.

Maillet, B & Merlin, P 2009, *Robust higher-order moments and efficient portfolio selection*, SSRN.

Manstead, ASR 2011, 'The benefits of a critical stance: a reflection on past papers on the theories of reasoned action and planned behaviour', *British Journal of Social Psychology*, vol. 50, no. 3.

Mao, JCT 1970a, 'Models of capital budgeting, E-V vs E-S', *Journal of Financial & Quantitative Analysis*, vol. 4, no. 5.

Mao, JCT 1970b, 'Survey of capital budgeting: theory and practice', *Journal of Finance*, vol. 25, no. 2.

Mao, JCT & Helliwell, JF 1969, 'Investment decision under uncertainty: theory and practice', *Journal of Finance*, vol. 24, no. 2.

Marinoni, O, Adkins, P & Hajkowicz, S 2011, 'Water planning in a changing climate: joint application of cost utility analysis and Modern Portfolio Theory', *Environmental Modelling & Software*, vol. 26, no. 1.

Markowitz, H 1952, 'Portfolio selection', *Journal of Finance*, vol. 7, no. 1.

Markowitz, H 1956, 'The optimization of a quadratic function subject to linear constraints', *Naval Research Logistics Quarterly*, vol. 3, no. 1-2.

Markowitz, H 1959, *Portfolio Selection, Efficient Diversification of Investments*, Wiley, New York.

Markowitz, H & Nilufer, U 1996, 'The likelihood of various stock market return distributions, part 2: empirical results', *Journal of Risk & Uncertainty*, vol. 13, no. 3.

Markowitz, H, Todd, P, Ganlin, X & Yamane, Y 1993, 'Computation of mean-semivariance efficient sets by the Critical Line Algorithm', *Annals of Operations Research*, vol. 45, no. 1-4.

Mathieson, K 1991, 'Predicting user intentions: comparing the Technology Acceptance Model with the Theory of Planned Behavior', *Information Systems Research*, vol. 2, no. 3.

Mencia, J & Sentana, E 2009, 'Multivariate location-scale mixtures of normals and mean-variance-skewness portfolio allocation', *Journal of Econometrics*, vol. 153, no. 2.

Merton, RC 1969, 'Lifetime portfolio selection under uncertainty: the continuous-time case', *The Review of Economics and Statistics*, vol. 51, no. 3.

Merton, RC 1972, 'An analytic derivation of the efficient portfolio frontier', *Journal of Financial and Quantitative Analysis*, vol. 7, no. 4.

Merton, RC 2003, 'Thoughts on the future: theory and practice in investment management', *Financial Analysts Journal*, vol. 59, no. 1.

Miccolis, JA & Goodman, M 2012a, 'Dynamic asset allocation: using momentum to enhance portfolio risk management', *Journal of Financial Planning*, vol. 25, no. 2.

Miccolis, JA & Goodman, M 2012b, 'Next generation investment risk management: putting the 'modern' back in Modern Portfolio Theory', *Journal of Financial Planning*, vol. 25, no. 1.

Michaud, RO 1989, 'The Markowitz optimization enigma: is ‘optimized’ optimal?', *Financial Analysts Journal*, vol. 45, no. 1.

Michaud, RO 1998, *Efficient Asset Management*, Harvard Business School Press, Boston.

Michaud, RO, Esch, DN & Michaud, RO 2012, 'Portfolio monitoring in theory and practice', *Journal of Investment Management*, vol. 10, no. 4.

Moore, GC & Benbasat, I 1991, 'Development of an instrument to measure the perceptions of adopting an information technology innovation', *Information Systems Research*, vol. 2, no. 3.

Morone, A 2008, 'Comparison of mean-variance theory and expected-utility theory through a laboratory experiment', *Economics Bulletin*, vol. 3, no. 40.

Morrison, DG & Gluck, DJ 1970, 'Spurious correlations that result from 'awareness vs. usage' type regressions', *Journal of Marketing Research*, vol. 7, no. 3.

Mossin, J 1966, 'Equilibrium in a capital asset market', *Econometrica*, vol. 34, no. 4.

Mueller, AG & Mueller, GR 2003, 'Public and private real estate in a mixed-asset portfolio', *Journal of Real Estate Portfolio Management*, vol. 9, no. 3.

Nawrocki, DN 1991, 'Optimal algorithms and lower partial moment: ex post results', *Applied Economics*, vol. 23, no. 3.

Nawrocki, DN 1999, 'A brief history of downside risk measures', *Journal of Investing*, vol. 8, no. 3.

Neuhauser, K 2007, 'Survey research in finance', *International Journal of Managerial Finance*, vol. 3, no. 1.

Neuman, WL 2011, *Social Research Methods: Qualitative and Quantitative Approaches*, 7th edition, Boston.

Neuner, S, Beinhofer, B & Knoke, T 2013, 'The optimal tree species composition for a private forest enterprise – applying the theory of portfolio selection', *Scandinavian Journal of Forest Research*, vol. 28, no. 1.

Nobel Prize 2013, *The Sveriges Riksbank Prize in Economic Sciences 1990*, viewed 25 March 2013, <http://www.nobelprize.org/nobel_prizes/economics/laureates/1990/index.html>.

Nocetti, D 2006, 'Markowitz meets Kahneman: portfolio selection under divided attention', *Finance Research Letters*, vol. 3, no. 2.

Norkin, V & Boyko, S 2012, 'Safety-First portfolio selection', *Cybernetics & Systems Analysis*, vol. 48, no. 2.

Notani, AS 1998, 'Moderators of perceived behavioral control's predictiveness in the Theory of Planned Behavior: a meta-analysis', *Journal of Consumer Psychology*, vol. 7, no. 3.

Patton, AJ 2004, 'On the out-of-sample importance of skewness and asymmetric dependence for asset allocation', *Journal of Financial Econometrics*, vol. 2, no. 1.

Peat, M & Wright, D 2012, 'The impact of residential property investment on portfolio performance', *JASSA: The Finsia Journal of Applied Finance*, no. 2.

Pedersen, N, Page, S & Fei, H 2014, 'Asset allocation: risk models for alternative investments', *Financial Analysts Journal*, vol. 70, no. 3.

Peiro, A 1999, 'Skewness in financial returns', *Journal of Banking and Finance*, vol. 23, no. 6.

Percival, J 1993, 'Why don't we just ask them?', *Financial Practice & Education*, vol. 3, no. 2.

Perold, AF & Sharpe, WF 1988, 'Dynamic strategies for asset allocation', *Financial Analysts Journal*, vol. 44, no. 1.

Phillips, PJ 2009, 'Applying Modern Portfolio Theory to the analysis of terrorism', *Defence and Peace Economics*, vol. 20, no. 3.

Pidun, U, Rubner, H, Krühler, M, Untiedt, R & Nippa, M 2011, 'Corporate portfolio management: theory and practice', *Journal of Applied Corporate Finance*, vol. 23, no. 1.

Pınar, M 2007, 'Robust scenario optimization based on downside-risk measure for multi-period portfolio selection', *OR Spectrum*, vol. 29, no. 2.

Polson, NG & Tew, BV 2000, 'Bayesian portfolio selection: an empirical analysis of the S&P 500 index 1970-1996', *Journal of Business and Economic Statistics*, vol. 18, no. 2.

Popescu, I 2007, 'Robust mean-covariance solutions for stochastic optimization', *Operations Research*, vol. 55, no. 1.

Prigent, JL 2007, *Portfolio Optimization and Performance Analysis*, Chapman & Hall/CRC, Boca Raton.

Prigent, JL 2010, 'Portfolio optimization and rank dependent expected utility', in World Congress of the Econometric Society, Shanghai.

Qingxiong Ma, T & Liping, L 2004, 'The Technology Acceptance Model: a meta-analysis of empirical findings', *Journal of Organizational & End User Computing*, vol. 16, no. 1.

Quaranta, AG & Zaffaroni, A 2008, 'Robust optimization of Conditional Value at Risk and portfolio selection', *Journal of Banking and Finance*, vol. 32, no. 10.

Reed, MI 2009, 'The theory/practice gap: a problem for research in business schools?', *Journal of Management Development*, vol. 28, no. 8.

Rengifo, E & Rombouts, J 2004, Dynamic optimal portfolio selection in a VAR framework, Universite catholique de Louvain, Center for Operations Research and Econometrics (CORE), CORE Discussion Papers: 2004057.

Rockafellar, RT & Uryasev, S 2000, 'Optimization of Conditional Value-at-Risk', *Journal of Risk*, vol. 2, no. 3.

Rogers, EM 2003, *Diffusion of Innovations*, 5th edn, Free Press, New York.

Roth, W-M, Mavin, T & Dekker, S 2014, 'The theory-practice gap: epistemology, identity, and education', *Education + Training*, vol. 56, no. 6.

Roy, AD 1952, 'Safety first and the holding of assets', *Econometrica*, vol. 20.

Rubinstein, M 2006, *A History of the Theory of Investments: My Annotated Bibliography*, John Wiley & Sons, Hoboken, NJ.

Saade, R, Tan, W & Kira, D 2008, 'Is usage predictable using belief-attitude-intention paradigm?', *Issues in Informing Science and Information Technology*, vol. 5.

Samuelson, PA 1969, 'Lifetime portfolio selection by dynamic stochastic programming', *The Review of Economics and Statistics*, vol. 51, no. 3.

Santacruz, L 2013, 'The importance of strategic asset allocation', *Journal of Business and Economics*, vol. 4, no. 3.

Santacruz, L & Phillips, PJ 2009, 'Are benchmark asset allocations for Australian private investors optimal?', *Journal of Wealth Management*, vol. 12, no. 2.

Scherer, B 2002, 'Portfolio resampling: review and critique', *Financial Analysts Journal*, vol. 58, no. 6.

Scherer, B 2007, 'Can robust portfolio optimisation help to build better portfolios?', *Journal of Asset Management*, vol. 7, no. 6.

Schyns, M, Crama, Y & Hübner, G 2010, 'Optimal selection of a portfolio of options under Value-at-Risk constraints: a scenario approach', *Annals of Operations Research*, vol. 181, no. 1.

Sghaier, N & Boubaker, H 2013, 'Portfolio optimization in the presence of dependent financial returns with long memory: a copula based approach', *Journal of Banking and Finance*, vol. 37, no. 2.

Shadwick, W & Keating, C 2002, 'A universal performance measure', *Journal of Performance Measurement*, vol. 6.

Sharpe, WF 1963, 'A simplified model for portfolio analysis', *Management Science*, vol. 9, no. 2.

Sharpe, WF 1964, 'Capital asset prices: a theory of market equilibrium under conditions of risk', *Journal of Finance*, vol. 19, no. 3.

Sharpe, WF 2007, 'Expected utility asset allocation', *Financial Analysts Journal*, vol. 63, no. 5.

Sharpe, WF 2010, 'Adaptive asset allocation policies', *Financial Analysts Journal*, vol. 66, no. 3.

Sheeran, P 2002, 'Intention behavior relations: a conceptual and empirical review', *European Review of Social Psychology*, vol. 12, no. 1.

Sheikh, AZ & Hongtao, Q 2009, 'Non-normality of market returns: a framework for asset allocation decision making', *Journal of Alternative Investments*, vol. 12, no. 3.

Simkowitz, MA & Beedles, WL 1978, 'Diversification in a three-moment world', *Journal of Financial and Quantitative Analysis*, vol. 13, no. 5.

Simon, HA 1959, 'Theories of decision-making in economics and behavioral science', *American Economic Review*, vol. 49, no. 3.

Smith, KV & Goudzwaard, MB 1970, 'Survey of investment management: teaching versus practice', *Journal of Finance*, vol. 25, no. 2.

Sortino, F & Price, L 1994, 'Performance measurement in a downside risk framework', *The Journal of Investing*, vol. 3, no. 3.

Stabile, D 2005, *Forerunners of Modern Financial Economics: a Random Walk in the History of Economic Thought*, Edward Elgar, Cheltenham Northampton.

Steinbach, MC 2001, 'Markowitz revisited: mean-variance models in financial portfolio analysis', *SIAM Review*, vol. 43, no. 1.

Stevenson, S 2000, 'Bayes Stein estimators and international real estate allocation', in Pacific Rim Real Estate Society Conference, Sydney.

Sutton, S 1998, 'Predicting and explaining intentions and behavior: how well are we doing?', *Journal of Applied Social Psychology*, vol. 28, no. 15.

Taylor, S & Todd, PA 1995, 'Understanding information technology usage: a test of competing models', *Information Systems Research*, vol. 6, no. 2.

Thompson, RL & Higgins, CA 1991, 'Personal computing: toward a conceptual model of utilization', *MIS Quarterly*, vol. 15, no. 1.

Tobin, J 1958, 'Liquidity preference as behavior towards risk', *The Review of Economic Studies*, vol. 25, no. 2.

Tsagaris, T, Jasra, A & Adams, N 2012, 'Robust and adaptive algorithms for online portfolio selection', *Quantitative Finance*, vol. 12, no. 11.

Tsao, CY 2010, 'Portfolio selection based on the mean-VAR efficient frontier', *Quantitative Finance*, vol. 10, no. 8.

Tütüncü, RH & Koenig, M 2004, 'Robust asset allocation', *Annals of Operations Research*, vol. 132, no. 1-4.

Unser, M 2000, 'Lower partial moments as measures of perceived risk: an experimental study', *Journal of Economic Psychology*, vol. 21, no. 3.

Van De Ven, AH & Johnson, PE 2006, 'Knowledge for theory and practice', *Academy of Management Review*, vol. 31, no. 4.

Venkatesh, V, Morris, MG, Davis, GB & Davis, FD 2003, 'User acceptance of information technology: toward a unified view', *MIS Quarterly*, vol. 27, no. 3.

Von Neumann, J & Morgenstern, O 1947, *Theory of Games and Economic Behavior*, 2d edn, Princeton University Press, Princeton.

Wang, CP, Shyu, D, Liao, YC, Chen, MC & Chen, ML 2003, 'A model of optimal dynamic asset allocation in a value-at-risk framework', *International Journal of Risk Assessment and Management*, vol. 4, no. 4.

Weaver, SC 1993, 'Why don't we just ask them?', *Financial Practice and Education*, vol. 3, no. 2.

Wojt, A 2010, 'Portfolio Selection and Lower Partial Moments', Royal Institute of Technology, Stockholm.

Xiong, JX, Sullivan, RN & Wang, P 2013, 'Liquidity-driven dynamic asset allocation', *Journal of Portfolio Management*, vol. 39, no. 3.

Xiong, JX, Ibbotson, RG, Idzorek, TM & Chen, P 2010, 'The equal importance of asset allocation and active management', *Financial Analysts Journal*, vol. 66, no. 2.

Yao, H, Li, Z & Lai, Y 2013, 'Mean–CVaR portfolio selection: a nonparametric estimation framework', *Computers & Operations Research*, vol. 40, no. 4.

Ye, J & Li, T 2012, 'The optimal mean-variance investment strategy under Value-at-Risk constraints', *Insurance: Mathematics and Economics*, vol. 51, no. 2.

Yu, J-R & Lee, W-Y 2011, 'Portfolio rebalancing model using multiple criteria', *European Journal of Operational Research*, vol. 209, no. 2.

Zhang, B, Yang, S & Bi, J 2013, 'Enterprises' willingness to adopt/develop cleaner production technologies: an empirical study in Changshu, China', *Journal of Cleaner Production*, vol. 40.

Zipursky, M, 2013, 'The best day and time to send your email marketing messages', *Rightmix Marketing*, viewed 15 December 2013, <http://www.rightmixmarketing.com/email-marketing/best-time-day-to-send-email/>.