

The asset allocation puzzle with special reference to the asset
allocations of financial advisors in South Africa

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Abstract

The asset allocation puzzle refers to the inexplicable phenomenon that professional investment advice tends to be inconsistent with Markowitz's Modern Portfolio Theory (MPT). Many attempts have been made to resolve the puzzle within the framework of portfolio theory, but consensus on a solution has still not been reached. This dissertation is a case study of the asset allocation decisions of 23 South African financial advisors.

Since its formulation, Markowitz theory has been the subject of much debate. The theory is just one paradigm of rationality, and there may be other theories that generalise it or improve upon it so that the concept of rationality can be evaluated under less stringent, more realistic assumptions. Therefore, an important question is how valid and realistic Markowitz theory is in the first place. The answer to that question also determines how seriously the "losses of efficiency" due to deviation from the Markowitz efficient frontier should be taken.

Siebenmorgen and Weber (2000) use behavioural models in an attempt to explain the disparity between portfolios implied by Markowitz theory and those recommended by German financial advisors. This case study applies their methodology to the asset allocations recommended by South African advisors to local investors. In order to ascertain how exactly local advisors make asset allocation decisions for their clients, I distributed questionnaires amongst them. They were asked to provide their market expectations and to propose an asset allocation for each of the three scenarios posed to them. Their asset allocation recommendations are examined and compared to the allocations recommended by the behaviour models of Siebenmorgen and Weber (referred to in this paper as S&W), as well as the optimal Markowitz allocations.

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ABBREVIATIONS

CAPM: Capital Asset Pricing Model

EFR: Efficient Frontier Resampling

TAA: Tactical Asset Allocation

MPT: Modern Portfolio Theory a.k.a Markowitz theory or Mean/Variance optimisation

ALBI: South African All Bond Index

ALSI: South African All Share Index

GLOSSARY OF TERMS

Although many other definitions may exist for the terms listed, in the context of this paper the definitions listed below are applicable.

Asset Allocation¹:

- the process of dividing investments among different kinds of assets, such as stocks, bonds, real estate and cash, to optimize the risk/reward tradeoff based on an individual's or institution's specific situation and goals. It is a key concept in financial planning and money management.²
- the process of dividing a portfolio among major asset categories such as bonds, stocks or cash. The purpose of asset allocation is to reduce risk by diversifying the portfolio.³
- the practice of distributing a certain percentage of a portfolio between different types of investment assets, such as stocks, bonds, mutual funds, cash, real estate, options, etc. By diversifying an individual's asset base, one hopes to create a favourable risk/reward ratio for a portfolio.⁴
- Elton and Gruber define asset allocation simply as “the allocation of funds across broad classes of assets⁵.”

Capital Asset Pricing Model: A model in which the cost of capital for any security or portfolio of securities equals the risk-free rate plus a risk premium that is proportionate to the amount of systematic risk of the security or portfolio.

Diversification: spreading of risk by putting assets into several categories of investments.

Efficient frontier: In short, this is set of portfolios that a rational investor can choose from, if the assumption of mean-variance (expected return-risk) optimisation holds. These portfolios are less risky than any other portfolios with the same expected return and have higher returns than any portfolio with the same level of risk.

Efficient Frontier Resampling: process which attempts to reduce the effects of error in the mean, standard deviation and correlation estimates of the assets.

¹ It is important to realize that in most literature “asset allocation” refers to the process of selecting a mix of asset classes, as opposed to selecting individual securities within these asset classes.

² www.investorwords.com

³ www.investopedia.com

⁴ www.investordictionary.com

⁵ *The rationality of asset class recommendations*, Elton and Gruber (1999).

Naïve diversification: the degree to which assets are evenly spread across the available underlying asset classes. Mathematically,

$$\text{naïve diversification} = \sqrt{\frac{1}{n} \sum_{i=1}^n (\alpha_i - \bar{\alpha})^2}$$

where α_i for $i=1$ to n are the proportions invested in each of the n underlying assets.

Pure risk: weighted sum of risks of the different assets in the portfolio without considering correlations.

Rational asset allocation: A rational asset allocation can only be understood in the context of how risk and payoff are defined. However the risk and payoff are defined, for a portfolio to be considered rational, it must have the lowest risk for its expected payoff, and the highest payoff for portfolios with the same risk.

Risk: Every individual or investment advisor has his or her own view of what constitutes risk, whether he or she can explicitly define it or not. One of the most important roles of an advisor or investment manager is the assessment of what definition of risk is the most appropriate for its clients. In the most general sense risk can be defined as the possibility that the portfolio does not reach its target.

Strategic asset allocation: A portfolio strategy that involves periodically rebalancing the portfolio in order to maintain a long-term goal for asset allocation. The target allocation is based on long-run historical underlying asset returns, and is often derived using MPT.

Tactical asset allocation: An active management portfolio strategy that rebalances the percentage of assets held in various categories in order to take advantage of market pricing anomalies or strong market sectors. The portfolio manager would base his allocations on the house views of the expected returns and volatilities of the underlying assets, often by employing MPT. The success of TAA is usually measured against a notional strategic asset allocation

Estimation error: In determining the expected returns, risks and correlations, there will always be, to a greater or lesser extent, errors in these estimates. There is simply no way to know the “true” value of these input parameters. It is important to be aware of the possible effect of these errors in determining the optimal portfolios.

1. INTRODUCTION

The term “asset allocation” is used to describe the process of dividing investments among assets classes which exhibit diverse risk and return characteristics. The most popular asset classes are stocks, bonds, property and cash. The exact composition of securities within each of these asset classes would be decided by a separate process termed “security selection”. This case study assumes asset allocation and security selection to be separate investment activities.

The fundamental goal of asset allocation is to identify the mix of assets that is optimal in terms of the investor’s required return and risk (where risk must be appropriately defined for each investor). It has been shown that the asset allocation decision is a major determinant of return and risk (Ibbotson & Kaplan 2000). However, according to Elton and Gruber (1999), asset allocation theory has been somewhat neglected in the literature of Financial Economics. Moreover, research done by Paul Myners (March 2001), shows that asset allocation research is under-resourced in the investment world.

Most individual investors turn to financial advisors for advice on how to invest their wealth. What criteria must an advisor take into account when constructing a portfolio? If one assumes the two dimensional paradigm of risk and pay-off as the only criteria for investment decisions, the set of *efficient* portfolios an investor must choose from (known as the *efficient frontier*), are all those portfolios that satisfy the following two criteria **simultaneously**:

1. each must have the highest pay-off for its level of risk, for all possible portfolios;
2. **and** the lowest risk for its level of pay-off, for all possible portfolios.

Any investor that accepts this paradigm will now select a portfolio from this efficient set, depending on his minimum return requirement, or alternatively, his maximum risk limit.

The Markowitz paradigm adopts the above definition of efficiency, and defines *risk* as standard deviation of returns and *pay-off* as expected return⁶. However, a finding that features in many of the papers researched and referenced in this work, is that financial advisors do not recommend portfolios that are Markowitz efficient. For example, according to, among others, Siebenmorgen and Weber (2000) and Canner, Mankiw and Weil (1997), the majority of recommendations show a decreasing tendency (relative to standard deviation) of the bond-to-stock ratio, as opposed to the increasing tendency of Markowitz-efficient portfolios. Also, advisors do not follow the two-fund separation theorem⁷. These inconsistencies are collectively known as the Asset Allocation Puzzle.

⁶ From here on the terms “mean” and “expected return” will be used interchangeably. The terms mean-variance theory, modern portfolio theory and Markowitz theory will also be used synonymously.

⁷ This theorem is the building block of the most basic Capital Asset Pricing Model (CAPM). The theorem states that more risk averse investors should hold more of their portfolios in the riskless asset. The composition of risky assets, however, should be the same for all investors. The theorem is irrelevant to this study as it does not hold if the short

Ever since Markowitz did his pioneering work, his theory has been scrutinised and criticised for all its shortcomings. Recent variations or enhancements of the original model include a process known as Efficient Frontier Resampling (Michaud, 1998), as well as dynamic solutions, by amongst others, Woody Brock (2004).

Efficient Frontier Resampling (EFR) is based on Markowitz theory, but attempts to reduce the effects of error in the mean, standard deviation and correlation estimates of the assets. Markowitz optimisation is an estimation error maximising exercise (Michaud, 1998), in the sense that risk and return outcomes (as measured *ex-ante*) of “optimal” allocations’ will be more prone to error than non-optimal portfolios. For example, the MVO optimal allocation will be overexposed to the asset classes that have return estimates that are too high and standard deviations that are too low, resulting in a portfolio in which expected return tends to be overestimated and standard deviation tends to be underestimated to a larger degree than a randomly picked portfolio. The sensitivity of MVO to the inputs means that small errors in estimating risk and return parameters of the underlying assets can lead to vastly different allocations. This is because standard MVO assumes that the estimates for expected return, standard deviation and correlations are precise, and can therefore in some instances lead to undue concentration in some asset classes, and a complete omission of others. It is impossible to know whether inputs are precise, since they are not observable and can only be estimated using various imprecise techniques. The EFR employs powerful statistical tools such as bootstrapping or Monte Carlo simulation to reduce the effects of input estimation errors on the optimal weights suggested by the optimisation.

In a very recent paper, Brock (2004) suggests a dynamic generalisation of Markowitz theory. An overly strict assumption in Markowitz theory is that assets have a stationary joint normal distribution. This implies that at any given moment, there is no information, other than the historical returns, standard deviations and correlations that can be used to have dynamic asset allocations that improve upon the static Markowitz portfolio. However, according to Brock, it is well known that there are signals in the market that allow one to improve upon simply using historical data to predict parameters. The fact that investment professionals generally have asset allocations that deviate from Markowitz efficiency suggests that they feel the same way. Consequently, he proposes a dynamic optimal strategy, rather than a static efficient portfolio (strategic asset allocation).

Despite its shortcomings, research done by Fabozzi, Gupta and Markowitz (2002) indicates that Markowitz theory is unlikely to ever be rendered obsolete. They claim that Markowitz theory is widely used not only in asset allocation development, but also in the areas of portfolio management and portfolio construction. They strongly believe that the theory is unlikely to lose its popularity and will thus occupy a permanent place in the theory and practice of finance.

sale constraint is imposed. The short sale constraint has to be invoked, since most advisors and individuals recommend or invest on assuming no short-selling.

This case study is organized as follows:

- **Section 2** gives a brief background to the Markowitz theory;
- **Section 3** highlights some of the attempts at resolving the asset allocation puzzle;
- **Section 4** is the main focus of the paper and details my analysis of the asset allocation decisions of financial advisors in South Africa and compares them to:
 - the asset allocation decisions by investment professionals in Germany, as researched by S&W;
 - asset allocations dictated by the modern portfolio theory, and;
 - the behavioural models defined by S&W and applied to the South African data.
- **Section 5** of this paper is devoted to the frontier itself, questions its efficiency, and focuses on more recent studies and findings which suggest that the traditional theory can indeed be enhanced;
- **Section 6** looks at the new models of asset allocation;
- **Section 7** concludes the paper.
- **Appendices A to C** contain the questionnaire and further results

2. BACKGROUND THEORY

In 1952 Harry Markowitz wrote a landmark paper entitled “Portfolio Selection”. The ideas which he introduced in his article have come to form the foundations of what is now universally referred to as Modern Portfolio Theory (MPT).

The theory has profoundly shaped how asset allocation as well as security selection decisions are made. It explores how risk-averse investors can construct optimal portfolios taking into consideration the trade-off between market volatility and expected returns. It dictates that given inputs such as estimates of the returns, standard deviations and correlations of a set of investments and constraints on investment choices, it is possible to perform an optimization that results in the mean-variance efficient frontier. It then depends on the risk attitude of the investor which portfolio is chosen.

There are a number of approaches that can be used to obtain estimates of inputs, and all have their advantages and disadvantages. Historical performance is often used, but many investment professionals believe that past performance is not necessarily a good predictor of future performance, and attempt forecasting the parameters based on macroeconomic views or security or asset class specific views. If these forecasts are different from historical numbers, the allocations obtained optimising to these inputs are termed “tactical asset allocations” in the investment industry. Strategic asset allocation is defined as the optimal allocations if long run historical returns are used in forecasts. An investment house that uses strategic asset allocations is in effect saying that it is unable to improve upon historical outcomes as predictors of future returns. This approach, in contrast with tactical allocations, is consistent with the belief that markets are stationary and efficiently priced.

Markowitz’s mean-variance analysis has had great success (in terms of popularity) as a maxim for portfolio choice. It has been programmed into optimizers that are used on daily basis around the world in developing asset allocations (Campbell, 2002). However, the theory is based on a number of stringent and unrealistic assumptions, which can to some extent undermine the validity and robustness of consequent solutions.

One of the fundamental assumptions of MPT is that investors base all their decisions solely on the expected returns, volatility and correlations of asset classes. In other words, faced with two possible portfolios, only the expected returns and volatilities of these two portfolios would be used to decide between the two. In practice, there are other considerations, such as liquidity risk of assets, investment horizons, market sentiment and other behavioural factors.

Moreover, many investors either explicitly or implicitly do not see volatility (standard deviation) as their main risk. For example, there are many investors who do not even grasp the concept of standard deviation. Others use Value-at-Risk as their main proxy for risk. Shortfall probability, downside variance and semi-variance are yet other alternatives used by some investors.

Another set of assumptions inherent in MPT can be summarised by the assumption of stationarity of the distributions of the asset classes. This implies the existence of a fixed or invariant return structure. Because this process is fixed, its statistical moments are learnable and all investors are further assumed to know and to use this return structure.⁸ In this highly restrictive context, and only in this context, Markowitz identified the portfolios that lie on the efficient frontier.

The assumption of the stationarity of returns therefore implies that so called “mean reversion” does not exist. This is contrary to the belief of most investment professionals that there are signals in the market that indicate cheapness and dearness⁹. If mean reversion does occur, the strategy of market timing (or tactical asset allocation) would permit investors to outperform the optimal portfolios assuming historic inputs. However, based on pure Markowitz theory, market-timing is not justified, since returns are independently and identically distributed over time, and these distributions are ostensibly known by all market participants.

Classical economics and econometric theory have always assumed stationarity of returns for two reasons.

- Firstly, the early mathematical economists were indoctrinated by the stationary laws of physics (a field of study much more established than economics at that point in time);
- Secondly, it was assumed that, if stationarity was abandoned, no other statistical structure existed that could be used to help explain the forces at work.

According to Brock (2004), academics and practitioners did not thoroughly consider the possibility that a state dependant dynamic optimal “strategy” existed, as opposed to a simple static optimal portfolio. The aforementioned strategy would involve switching between the allocations within a set of optimal allocations, each appropriate in certain market or economic conditions. EFR and Brock’s proposed paradigm are discussed in sections 5 and 6 of this paper.

The CAPM, an extension of the Markowitz theory, adds further restrictive assumptions of no taxes and no transaction costs, where all investors have identical investment horizons and perceptions regarding their expectations of returns, volatilities and correlation.

⁸ The assumptions of that are explicitly or implicitly mentioned above are:

- All investors have free access to fair and correct information on the returns and risk;
- The markets are efficient and absorb the information quickly and perfectly;
- Investors base decisions solely on expected returns and variance or standard deviation of these returns from the mean;
- All investors have the same expected single period investment horizon, and so does all the assets in the investment universe available to these investors.

⁹ Many if not most investment houses in the world are active in nature, i.e. they attempt to improve upon market weighted portfolios. This implies a belief that assets are sometimes mispriced.

3. ATTEMPTS AT SOLVING THE PUZZLE – LITERATURE REVIEW

There is agreement amongst academics that asset allocation advice offered by the financial advisors does not match the economic theory. Many attempts have been made to resolve the asset allocation puzzle within the framework of the portfolio theory. Up to now, no one could satisfactorily explain why one of the key results of the CAPM, which implies that all investors should hold the same combination of risky assets, is being consistently violated.

Canner, Mankiw and Weil (1997) have produced the first study to test the investor rationality⁶ and to inspect the reasoning behind the asset allocation advice. They believe that financial advisors develop more complicated strategies for their clients than dictated by the theorem. As evidence of irrationality, they highlighted the fact that financial advisors consistently recommend that a more risk-averse investors should hold a higher ratio of bonds to stocks.

They explore various possible explanations for the asset allocation puzzle, all within the framework of the CAPM. They attempt to obtain insight into the puzzle by relaxing the assumptions underlying the CAPM. In particular they consider the following:

- absence of a riskless asset;
- preferences that depend on more than the mean and variance of returns;
- portfolio choice in dynamic setting;
- existence of non-tradable assets.

As they deviated from the assumptions, they calculated optimal portfolios based on the historical distribution of returns from 1926 to 1992.

Their attempts to explain the puzzle have led them to following three conclusions:

- They find it difficult to explain popular advice using models of fully rational investors¹⁰ (e.g. the Markowitz model). They note that they cannot rule out that popular advice is consistent with some model of rational behaviour. So far, however, they have been unable to find such a model;
- The advice can be partially explained if one assumes that investors care about nominal rather than real returns;

¹⁰ In this context, rational asset allocations can be defined as asset allocations that are optimal with respect to some model that according to a sound theoretical basis maximises the utility of a group of investors, independent of what these investors believe themselves. Investors may not understand themselves how to quantify risk, so it is up to the investment industry to define risk for them. The Markowitz model is rational in the sense that it gives the optimal portfolio in the mean-variance framework. However, it is possible to define other rational models. One possibility is to construct a model that somehow incorporates third or higher moments of asset class distributions. Risk could be defined as a combination of various moments. This model could also be rational and would improve upon the standard Markowitz model which assumes normality, if it is properly defined. The only reason such a model is not popular, is that it is computationally onerous and requires more data than the simple Markowitz model. A further example of a rational paradigm is one that uses downside volatility, Value-at-Risk or expected shortfall as the risk factor instead of standard deviation.

- The loss of return from the apparent failure of optimization is not very great – although popular advice on portfolio allocation is below the efficient frontier measured in real terms, investors who follow the advice lose at most 22 basis points of return per annum.

Their results further indicate that the absence of a riskless asset¹¹ and deviations from mean-variance preferences are unlikely to help resolve the puzzle. They also state that the fact that the asset allocation recommendations of financial advisors do not match economic theory suggests that the problem is not necessarily that they cannot reach objectives, but rather the advisors' understanding of the objectives of individuals may be poor. As will be highlighted later in the paper, it appears that South African advisors are turning their attention to developing an understanding of their clients' objectives.

Gomes and Michaelides (2004) show that the presence of undiversifiable human capital rationalizes the asset allocation puzzle, even if expected returns are not time-varying. More risk-averse households accumulate more financial wealth and are more comfortable to compensate for decrease in human capital as retirement approaches with a larger investment in relatively safe assets, such as Treasury bills and long term bonds. As a result, more risk averse households at similar points in the life cycle generally hold a smaller proportion of their portfolio in equities. The same mechanism generates a life-cycle investment pattern that is consistent with the standard professional investment advice: young households should invest a higher fraction of their wealth in stocks.

Even more recently, DeMiguel, Garlappi and Uppal (2005) conducted a study where they evaluated the performance of simple asset-allocation strategies, such as allocating $1/N$ to each of the N assets available. They find that such rule to investing is not far from efficient. The loss from naïve rather than optimal diversification is smaller than the loss arising from the estimation error in the parameters needed to implement optimal asset allocation rules. As such, they maintain that, whilst there has been considerable progress in the design of optimal portfolios, more resources need to be devoted to improving the estimation of parameters for the moments of asset returns or the processes driving these moments. Theorists and practitioners have taken cognisance of the effect of estimation error in the optimizing process. In conclusion, DeMiguel et al. claim that when evaluating the performance of a particular strategy for optimal asset allocation, the simple $1/N$ naïve diversification rule (i.e. simply spreading assets evenly among all the asset classes) serves as a useful benchmark.

The estimation error problem is magnified by the fact that mean-variance optimisation tends to select portfolios with larger errors in the overall expected return and standard deviation than a randomly selected portfolio. For example, if one overestimates the expected return and underestimates the standard deviation on equities, more equities will be included in the portfolio, thus resulting in a portfolio that will tend to overestimate return and underestimate

¹¹ Cash returns are sometimes seen as riskless for the sake of simplicity. Of course, they are not absolutely riskless. Many banks have historically gone bankrupt or mismanaged their credit and as a result could not redeem the funds owed to their clients.

standard deviation. This problem has given rise to a method known as Efficient Frontier Resampling, or EFR. This involves generating (“resampling”) returns for each asset class from the joint distribution of all the asset classes. The mean, variance and correlations are then recalculated from the generated data, and an asset allocation is produced. A new set of returns are then again generated from the original joint distribution, and so the procedure is reiterated. At the end of a certain number of iterations, all the weights for the asset classes are averaged over iterations to reach a final allocation. This method, although it is a heuristic, leads to portfolios that are less affected by error.

Scheel, Blatcher, Kirschner and Denman (2005) trace the performance of on-frontier and off-frontier investment portfolios for different historical periods. They also seek to determine what the sensitivity of the frontier is to possible sampling error in risk-return space. They find no clear-cut superiority to the on-frontier portfolios, although lower risk-return on-frontier portfolios were generally found to perform better relative to comparable, off-frontier portfolios than those at higher risk levels. They thus question whether practical deployment of optimization methods can occur in the presence of both high sampling error and the relatively inconsistent historical performance of on-frontier portfolios. In their paper, they ask and answer the following questions: In creating an efficient frontier, what sample of returns is used? What is the meaning of sampling error, and how might it affect the way efficient frontiers are measured? Would an efficient frontier for security returns really be efficient?

Goetzmann and Kumar (2005) have recently also studied diversification methodologies of individual investors, and question their motives for under-diversification. Following the traditional portfolio theory, Brennan (1975) and Merton (1987) highlight that transaction costs, search costs, small portfolio size and investors’ ability to buy in round lots may prevent investors from diversifying properly. Many investors also believe that holding any multiple-stock portfolio, irrespective of its covariance structure, will be well-diversified. Alternatively, investors may adopt an “erroneous” diversification strategy where they hold stocks with lower volatility¹² and ignore correlations among them. This may be closely linked with some psychological and behavioural factors, such as ignoring correlations altogether (Kroll, Levy and Rapoport, 1988a and 1988b) and (Weber and Camerer, 1998). Those investors who **do** take correlations into account, tend to not understand the difference between weak and strong correlations.

3.1. Behavioural Portfolio Theory

One study which I found particularly interesting was performed by Siebenmorgen and Weber (2000) where they take a fresh approach to the asset allocation puzzle – behavioural portfolio theory. By describing two simple investment models, they have been able to explain the puzzle quite well. It was this approach that prompted me to do a similar study in the South African context.

¹² standard deviation of annual return

S&W do not believe that financial advisors and especially individual investors manage stochastic problems the way literature describes it. They are aware that the behavioural approach is not compatible with expected utility theory, which carries very restrictive assumptions. They want to explore intuitive decision making on a portfolio level, where investors use heuristics which are not compatible with expected utility theory.

They argue that investors take three aspects into account when creating an optimal portfolio:

- expected returns;
- pure risk, and
- naïve diversification.

They show that recommendations of investment advisors gathered from literature, and by their own study, are much closer to the results of behavioural portfolio theory than to the results of the traditional theory.

To verify their findings, they conduct a survey to collect information about market expectations and three asset allocation recommendations of German financial advisors, which they then apply to their behavioural model.

They note that the main difference from the traditional approach is the way financial advisors consider risk. Even though they are aware of the importance of diversification, there is evidence that they are inept at dealing with correlations. Instead, they perceive risk to consist of two components: pure risk and lack of naïve diversification.

The next section focuses on the behavioural portfolio models developed by S&W. These models are used in this study to obtain an understanding of the basis of the asset allocation recommendations of local financial advisors..

4. BEHAVIOURAL PORTFOLIO MODELS – SOUTH AFRICAN CASE

This study of the asset allocation decisions made by the South African financial advisors is primarily based on the behavioural models developed by S&W (2000). The purpose of this study is to understand the basis for the asset allocation decisions. Since it is commonly believed that financial advisors do not follow traditional theory, what theory do they follow?

S&W have found answers to this question in behavioural portfolio models. In their very practical approach, they distributed a questionnaire to German investment advisors in order to gather data required to conduct the analysis. The questionnaire presented the advisors with three hypothetical clients with identical characteristics except for their risk attitudes, and asked them to recommend one asset allocation for the next 12 months. They were also asked for estimates of the underlying asset class returns, volatility and correlations, and the volatility of the recommended portfolios over the next 12 months. Their aim was to compare how well the Markowitz and the behavioural portfolio selection models describe the recommendations of investment professionals,

By comparing the advisors' market expectations with their proposed asset allocations, S&W conclusively found that they follow the behavioural models more closely than the Markowitz model.

4.1. Method

In line with the asset allocation puzzle tests performed by S&W, I sent out a questionnaire (Appendix A) to various financial advisors in South Africa, asking them for their recommended asset allocations based on three different scenarios. To my knowledge, based on my research, no studies were done to test the optimality (in the Markowitz sense) of recommendations in the South African market.

4.1.1. Questionnaire

The original questionnaire was based on the one prepared by S&W. It presented three subjects, each with a different risk attitude to investing – conservative, moderate and aggressive. I received many responses from local financial planners, stating that they do not believe in traditional risk profiling, but rather focus on determining of individuals' income needs, allowing them to set appropriate investment objective for them. Only then do they develop appropriate portfolios, to target the objectives set. These advisors were therefore not willing to complete the questionnaire. This is quite an interesting shift. In the past, "risk-profiling", i.e. deciding on an appropriate level of risk (often considering investors age only), and then finding the portfolio with the highest expected return given that risk-profile, had been the angle preferred by advisors.

To accommodate these advisors, I adjusted the questionnaire to give them a choice between targeting three levels of risk, or, targeting three successively higher returns. This enabled me to obtain more completed questionnaires. This should not affect the study in any way, since their asset allocations should still be consistent with their asset class expectations. S&W did not comment on the attitudes of German investment advisors to risk profiling versus return targeting.

In essence, I presented three different scenarios, and asked the advisors for the following:

- asset class weights for each scenario;
- their expectations of the ranges of returns of each asset class;
- their estimations of the correlations between the four asset classes;
- their estimations of portfolio returns.

Having gathered these estimates, I could begin to compare the recommended portfolios to those predicted by the various models.

4.1.2. Sample

I distributed approximately 200 questionnaires throughout the entire country. My specific target groups were financial planners, investment consultants and asset managers. I obtained their email addresses on the internet, explained the purpose of my study and emailed the questionnaires to them.

Many of the advisors did not participate in the survey, as they did not believe they had the expertise to make asset allocation decisions. They stated that they outsource the asset allocation decisions to the experts. Many questionnaires were returned incomplete, and others, due to lack of the advisors' time, were never completed and returned to me.

Through considerable perseverance, I eventually managed to obtain 23 completed questionnaires, the same amount used in the S&W study. This proved to be enough to make meaningful comparisons between the various models and the proposed allocations.

The practitioners that ultimately completed the questionnaires which were used in this were diverse in terms of geography, background, and the size of their businesses.

4.2. The analysis of asset allocation recommendations

4.2.1. Risk

S&W note that the main difference between the behavioural model and the traditional theory is the way in which financial advisors consider risk. Therefore, a first step in determining the basis for the asset allocation recommendations of South African advisors is to investigate how they consider the risk in a portfolio.

The questionnaire asked the advisors to provide weights of asset classes for each scenario, ranges of returns for each of the asset classes, and correlations amongst these asset classes. It then asked that they assess the volatilities of their recommended portfolios.

The concept of expected return is a reasonably intuitive one, and there is agreement on how it should be calculated. Risk is much more abstract and many individuals and advisors have difficulty calculating it. Further, research shows that there is much debate among academics as to how it should be defined (that debate is of a very technical nature and falls outside the scope of this paper). In this paper I will assume that standard deviation is the “rational” measure of risk.

Appendix B shows the average historical returns and volatilities of the four asset classes used in this case study for the period of 30 years ending April 2004. These are compared to the advisors’ expected returns and volatilities. The table indicates that the advisors, on average, have relatively low market expectations. Their assessment of volatilities is also well below the historical average.

When asked directly for correlations, on average, they gave estimates which differed greatly from historical data. This can be seen in Appendix C.

In order to investigate whether or not financial advisors take the correlation effects into account when judging portfolio risk, for each participant k , I firstly compared the assessed volatility of the recommended portfolios for conservative (C), moderate (M) and aggressive (A) investor σ_k^C, σ_k^M and σ_k^A , with the implicit volatility $\hat{\sigma}_k^C, \hat{\sigma}_k^M$ and $\hat{\sigma}_k^A$. The assessed and implicit volatilities are defined as follows:

- Assessed volatility: the volatility that advisors believe their recommended portfolios will experience. This was specifically asked for separately of their asset class predicted volatilities. It was therefore left up to them to either calculate this number from their asset class volatilities, correlations and their recommended portfolio weights, or any other means that they choose.
- Implicit volatility: the volatility of recommended portfolios if one applies the asset class volatilities and correlations supplied by advisors to the asset allocations supplied by them. This is effectively the volatility number that advisors should have given as

their assessed volatility if they had the technical ability required to correctly take into account correlations and volatilities.

Implicit volatility is thus defined as the standard deviation implied by the advisors' volatilities and correlations for the four asset classes and the given portfolio recommendations $\alpha_{i,k}^C$, $\alpha_{i,k}^M$ and $\alpha_{i,k}^A$, i.e.

$$\hat{\sigma}_k^C = \sqrt{\sum_{i=1}^{n=4} \sum_{j=1}^{n=4} \alpha_{i,k}^C \cdot \alpha_{j,k}^C \cdot \sigma_{i,k} \cdot \sigma_{j,k} \cdot \rho_{ij,k}}$$

and similarly for $\hat{\sigma}_k^M$ and $\hat{\sigma}_k^A$

In order to measure advisors' opinions on volatilities they were asked to give a low (10% quantile), a median and a high (90% quantile) for the distribution of each asset class, and each of the three recommended asset allocations. These quantiles were applied to the "three-point estimator" of Pearson and Tukey (as described in Keefer and Bodily, 1983) to extract standard deviations for the four asset classes and the three portfolios.

S&W do not mention this, but by using this estimator, it is implicitly assumed that standard deviation alone is sufficient to describe the distributions that the advisors had in mind. If the advisor specifies high and low returns that are not an equal distance from the mean (i.e. an asymmetrical distribution), standard deviation is not an appropriate measure of risk. For example, consider two asset classes with the following characteristics:

- Asset class A: 10% low, 11% mean and 15% high;
- Asset class B: 7% low, 11% mean and 12% high.

These two asset classes of identical means and standard deviations (as measured by the three point estimator), but A is preferable to B. If an advisor's recommendations were influenced by the third moment (skewness) of asset class distributions, his assessed portfolio volatility number above will not accurately convey his view on the "riskiness" of those asset classes and portfolios which are considered to have skewness of returns distributions. Consequently, Markowitz theory would not be appropriate in finding the optimal asset allocation for these advisors. It is, however, unlikely that advisors had third or higher moments in mind when they decided on their volatility numbers.

S&W refer to "pure risk" as the standard deviation of recommended portfolios assuming all the correlations between asset classes are equal to one. It can be shown that the pure risks for each participant k and each portfolio recommendation (C, M or A) simplify to:

$$Pure\ risk_k^R = \sum_{i=1}^{n=5} \alpha_{i,k}^R \cdot \sigma_{i,k}$$

for each participant k , where $\sigma_{i,k}$ is the predicted (assessed) volatility of participant k for asset class i , and R can be C, M or A, depending on which of the three portfolios (conservative, moderate or aggressive) is relevant.

Table 2 shows the assessed and implicit volatilities as well as the pure risk for all participants. It also shows the average and median over all participants.

	Conservative			Moderate			Aggressive		
	assessed	implicit	pure	assessed	implicit	pure	assessed	implicit	pure
1	5.04%	4.13%	5.96%	9.16%	8.59%	10.77%	10.69%	10.61%	12.61%
2	10.07%	6.96%	10.07%	15.50%	12.71%	15.50%	19.95%	18.42%	19.95%
3	12.63%	10.92%	12.64%	20.03%	17.47%	20.05%	22.98%	21.27%	23.00%
4	4.65%	3.31%	5.35%	10.07%	8.97%	11.07%	17.82%	17.02%	18.49%
5	4.06%	2.88%	4.06%	5.02%	4.03%	5.02%	5.53%	4.60%	5.53%
6	1.55%	2.26%	2.62%	1.95%	2.46%	2.77%	1.95%	3.08%	3.28%
7	2.32%	2.32%	3.76%	5.42%	6.00%	8.14%	12.01%	13.66%	15.26%
8	10.86%	3.39%	4.31%	14.16%	4.50%	5.37%	27.89%	5.06%	6.03%
9	0.97%	0.66%	0.97%	1.32%	0.98%	1.32%	1.49%	1.21%	1.49%
10	0.77%	0.77%	0.77%	2.72%	1.74%	2.47%	6.70%	3.94%	4.49%
11	2.32%	0.71%	0.77%	3.87%	4.58%	5.16%	7.99%	6.55%	6.83%
12	2.81%	5.11%	6.95%	7.12%	7.79%	10.44%	16.25%	13.40%	15.49%
13	5.77%	5.67%	6.86%	10.81%	9.16%	10.91%	14.95%	12.65%	14.95%
14	2.59%	2.56%	2.56%	2.90%	2.90%	2.90%	3.87%	3.87%	3.87%
15	1.16%	0.89%	1.16%	1.74%	1.05%	1.74%	2.32%	1.80%	2.32%
16	12.13%	10.97%	12.06%	12.07%	10.60%	11.97%	12.13%	11.11%	12.58%
17	7.31%	5.44%	7.34%	8.75%	6.78%	8.75%	9.78%	7.74%	9.80%
18	6.55%	4.73%	5.64%	7.95%	6.87%	8.14%	9.03%	8.73%	9.89%
19	1.17%	0.65%	1.17%	1.21%	1.15%	1.70%	2.32%	1.53%	2.04%
20	3.10%	1.86%	2.82%	3.94%	2.60%	3.65%	12.43%	2.71%	3.81%
21	3.99%	1.79%	3.35%	6.20%	2.99%	4.49%	11.62%	4.48%	5.80%
22	2.66%	0.43%	0.76%	2.37%	2.06%	2.14%	4.14%	1.78%	1.98%
23	1.55%	1.43%	1.59%	15.98%	13.93%	15.56%	21.62%	19.51%	21.37%
Average	4.75%	3.56%	4.63%	7.01%	5.73%	7.02%	10.63%	7.96%	9.07%
(median)	3.55%	2.72%	3.91%	5.81%	4.54%	5.27%	10.24%	5.80%	6.43%

Table 2: assessed volatilities, implicit volatilities and pure risk

The results show that the assessed volatilities tend to overestimate the correct standard deviations. The assessed volatilities of only 3 out of 23 participants are underestimated for a conservative portfolio, 5 for a moderate portfolio and 3 for an aggressive portfolio.

For pure risks, the following results were found: for conservative portfolios, pure risk is above the assessed volatilities for 11 out of 23 participants, for moderate portfolio, 12 out of 23, and for an aggressive portfolio, 12 out of 23. However, the pure risks are closer to assessed volatilities than implicit volatilities for 16 out of 23 conservative portfolios, 16 out of 23 moderate portfolios, and 18 out of 23 aggressive portfolios.

A one-sided Wilcoxon test¹³ reveals that assessed volatilities are greater than implicit volatilities with a p-value of 0.05% for conservative portfolios, 0.05% for moderate portfolios and 0.02% for aggressive portfolios. Assessed volatilities are therefore higher than implicit volatilities with a very high degree of certainty. On the other hand an equivalent Wilcoxon test for the contention assessed volatilities are smaller than pure risks have p-values of 55%, 81% and 34% respectively for the three risk classes, and thus it cannot be asserted that pure risks are significantly higher than assessed volatilities.

It appears that assessed volatilities are very different from volatilities implied by the theory, suggesting that advisors do not take correlations properly into account when assessing portfolio volatility. This may imply that they do not fully appreciate the volatility benefits afforded by imperfect (below one) correlations between assets.

The results are similar to those obtained by S&W, in that they indicate that correlation effects cannot explain the assessed volatilities. The assumption that people use pure risk, however, is compatible with the data. This fact makes a strong case to investigate the role that pure risk plays in the asset allocation process. This is exactly what S&W then did, and indeed, pure risk does seem to play a large role in asset allocations that German advisors recommend to their clients.

However, if most advisors implicitly assume that all correlations are equal to 1, it should be expected that their recommended portfolios have concentrated holdings, i.e. they will have a low degree of naïve diversification (tendency of even spread across asset classes). Clearly if all asset classes move in perfect harmony, the benefits of spreading assets across various asset classes would not lead to less volatile portfolios. However, as mentioned earlier, advisors' portfolios *do* exhibit naïve diversification, which led to inclusion of the naïve diversification factor (formally defined in the next section) by S&W in their behavioural models.

4.2.2. The behavioural portfolio models

This section outlines the behavioural models developed by S&W which will be applied to the asset allocation recommendations of South African financial advisors.

S&W demonstrate that German advisors are not very skilful at dealing with correlations among various asset classes. In particular, their estimates of portfolio volatilities and their asset allocations seem to imply that their volatility estimates effectively take all correlations to be 1 (resulting in what S&W term "pure risk"). Paradoxically, they subscribe to the benefits of "naïve" diversification, believing that irrespective of the correlations between asset classes and all else being equal, portfolios with a more even spread among the asset classes are more desirable than those with concentrated holdings in less asset classes. Therefore risk as perceived by advisors could be described by pure risk and lack of naïve diversification.

¹³ Null hypothesis: the assessed volatilities and implicit volatilities are of the same magnitude. Alternative hypothesis: the assessed volatilities are greater than the implicit volatilities.

The behavioural models thus consider the following three variables:

- expected return
- pure risk
- naïve diversification

The assumption underlying the behavioural models is that financial advisors optimize their asset class mix by searching asset allocations that are on an “efficient frontier” of various combinations of those three variables.

For each behavioural model S&W define one target function and one restriction function using the three target variables. They linearly combine two of the three target variables and end up with 6 possibilities, as shown in table 1. The highlighted areas are the primary models that are studied in detail.

restriction	target
expected return (model M2)	linear combination of diversification and pure risk
linear combination of diversification and pure risk	expected return
pure risk (model M3)	linear combination of expected return and diversification
linear combination of expected return and diversification	pure risk
diversification	linear combination of expected return and pure risk
linear combination of expected return and pure risk	diversification

Table 1: Alternative models

The Markowitz model (M1a and M1b) and the behavioural models M2 and M3, are tested using the recommendations and returns expectations gathered from the South African financial advisors. I restricted the actual return, pure risk and standard deviations (calculated by using each advisors’ asset class risk and returns estimates, and applying the recommended weights to those estimates) of the given recommendations. Therefore, for model M2, as in the original paper, I calculated the expected return for each portfolio and used these values in the restriction of the model. This procedure generates 69 benchmark portfolios per model, three for each advisor’s inputs, which I compared with the actual recommendations of the financial advisors. Similarly, for the primary model M3, I calculated

pure risks for each of the 69 recommended portfolios and used these values in the restriction of the model. Keeping these values fixed, I maximized the target function.

4.2.2.1. Markowitz Models (M1a and M1b)

Model M1a restricts the portfolio to a certain level of standard deviation and maximises the return. Model M1b uses the return as the restriction and finds a portfolio with minimum standard deviation.

4.2.2.2. Behavioural Model M2

Model M2 determines a portfolio that is optimal with respect to pure risk and diversification, for each value of expected return \hat{e} . This is done by defining a target function that combines the two variables: diversification and pure risk using a linear function, as follows:

Model M2(β) : $\beta \in [0;1]$

$$\text{Min } \beta * \text{Diversification} + (1 - \beta) * \text{Pure Risk}$$

$$\text{s.t. Expected Return } \geq \hat{e}$$

$$\sum \alpha_i = 1 \text{ and } 0 \leq \alpha_i \leq 1 \quad \forall i = 1, \dots, n$$

where:

- β = relative weighting of the two target variables in the target function. This weighting is possibly investor specific, and as such could be estimated separately for each person. I will start the analysis with $\beta = 0.5$, but I will conduct sensitivity analysis later on in the paper.
- α_i = weight allocated to asset class i
- Diversification (D) is defined as follows:

$$\text{Std}(\alpha_1, \dots, \alpha_n) = \sqrt{\frac{1}{n} \sum_{i=1}^n (\alpha_i - \bar{\alpha})^2}$$

4.2.2.3. Behavioural Model M3

Model M3 is the primary behavioural model. It ensures that the behavioural benchmark portfolio will have the same pure risk as the recommended portfolio. Model M3 assumes that investors restrict their portfolio decisions to a certain amount of pure risk, r . Given this constant amount of pure risk, they maximize a linear combination of the target variables: expected return and diversification:

Model M3(γ) : $\gamma \in [0;1]$

$$\text{Max } [\gamma \text{ER} - (1-\gamma)\text{D}], \gamma \in [0;1]$$

$$\text{s.t. pure risk} \geq r$$

$$\sum \alpha_i = 1 \text{ and } 0 \leq \alpha_i \leq 1 \forall i = 1, \dots, n$$

where:

- ER = expected return
- r = pure risk
- D = diversification (as defined above)
- γ = relative weighting of the two target variables in the target function.
- α_i = weight allocated to asset class i

4.2.3. Results of the behavioural asset allocation models

In this section, I analysed the asset allocations and compared the efficient frontiers implied by the two behavioural models, Model M2(0.5) and Model M3(0.5), and the Markowitz model.

I collected historical monthly returns (source: *Inet*) for the following four asset classes dating back to 1975:

- local cash: consists of short-term interest paying securities, each with a duration shorter than one year and negligible probabilities of default;
- local bonds: consists of local interest paying securities with very small probabilities of default;
- local equities: consists of equities listed on the JSE;
- international equities: consists of international equities listed on developed exchanges across the world.

Many financial advisors also use property and international bonds as asset classes. Equities could further be separated into large and small capitalisation shares, which S&W included in their study. However, I have considered only the four main asset classes listed above. The South African equity market is relatively small and may not warrant the segregation of equities according to size.

4.2.3.1. The asset allocations and the efficient frontier according to Markowitz

Figure 1 below shows the optimal portfolio proportions of the Markowitz model, based on historical correlations between the four asset classes, and the constraint of no short selling (which will be assumed throughout this study).

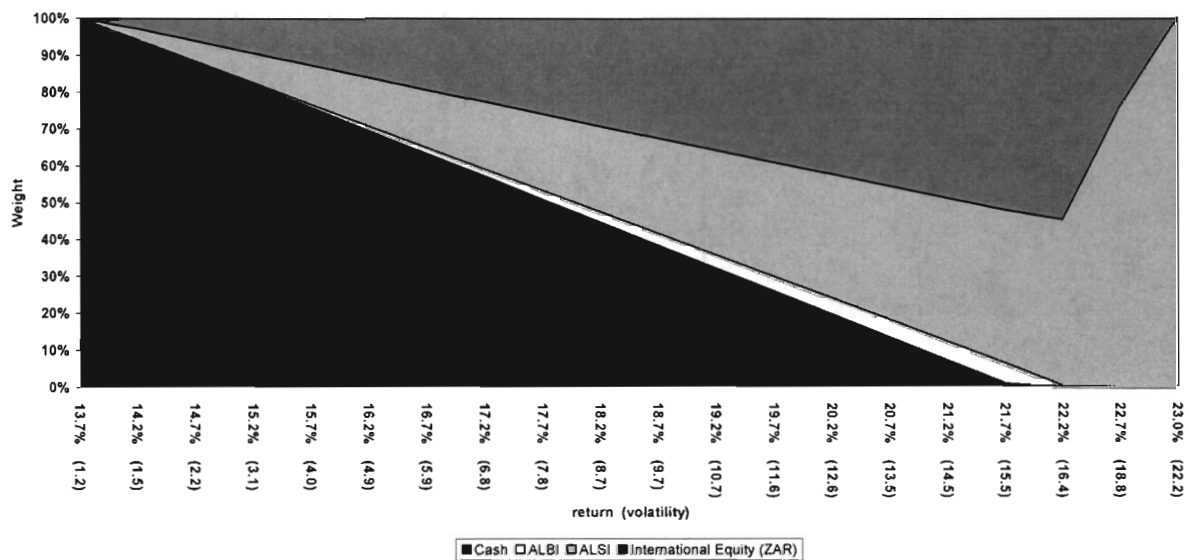


Figure 1: Efficient asset allocations according to the Markowitz model

The horizontal axis denotes the return and standard deviation of the portfolio, and the vertical axis illustrates the proportions of the different asset classes.

By examining the above graph, and assuming that past returns are the most reliable proxy for future returns, the following conclusions can be reached:

- conservative investors should hold most of their monies in cash, and have a small exposure to local and international equity, but no bonds;
- at the other extreme, aggressive investors should only hold local and international equities, and no bonds or cash.
- for moderate investors cash exposure declines and exposure to local and international equities increases – there is a very small exposure to bonds which increases with increasing risk attitudes, but only up to a certain level of risk;
- the proportion of bonds to equities increases as the risk target increases.

The allocations make intuitive sense on a superficial level, i.e. a level that does take into account correlations. It is however, difficult to explain why bonds should play such a small role in an optimal portfolio. In fact, most practitioners would, after examining the above graph, quite possibly suggest that this alone is evidence that either past returns cannot be used as future returns expectations, or that the Markowitz model is, if not flawed, incomplete.

It is interesting to note that the composition of “risky” exposure of the efficient portfolios (local and international equities, and bonds) does not maintain the same proportion in the three risky asset classes. The mutual fund separation theorem states that the composition of the risky assets must stay the same, and only the relative size of the risky versus riskless assets should change according to the risk/return target. The mutual fund separation theorem does however not hold when the no short selling constraint is imposed. If short selling is not allowed, the proportions of the risky assets relative to each other will vary with the level of risk/return targeted, as is seen above.

In summary, according to the Markowitz model and 30 years of South African asset class history, bonds do not form a great part in the portfolios of conservative and aggressive investors, and exposure is limited for moderate investors. What little allocation there is to bonds, should however in theory increase as the return/risk targeted increases.

Figure 2 shows the efficient frontier in a standard deviation-expected return diagram.

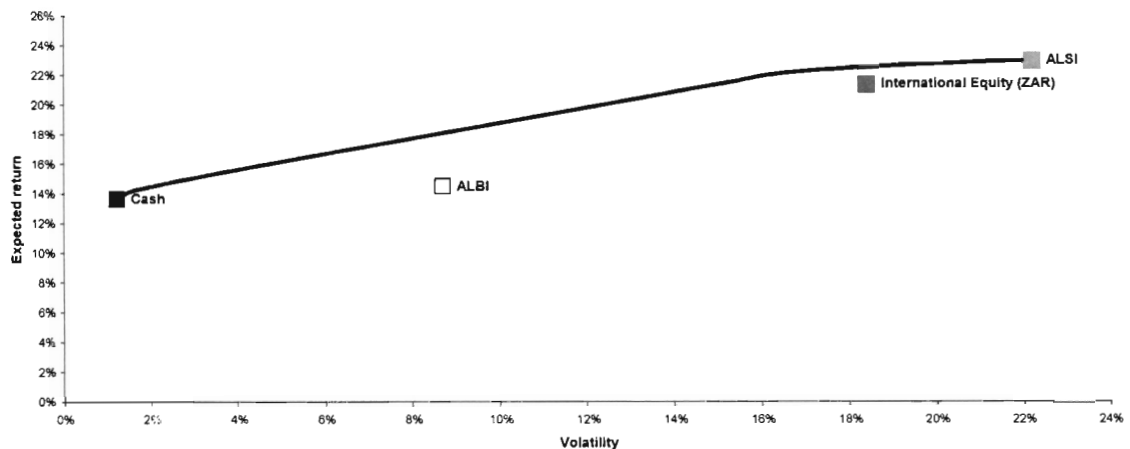


Figure 2: Efficient Frontier for the Markowitz model

Each portfolio on the efficient frontier offers the highest possible return for the risk it undertakes, and conversely, the lowest possible risk for the return it targets. For a portfolio to be truly efficient, both these conditions must be met *simultaneously*.

4.2.3.3. Efficient frontier according to Model M2(0.5)

Figure 5 shows the portfolios that give the lowest risk as defined by the model.

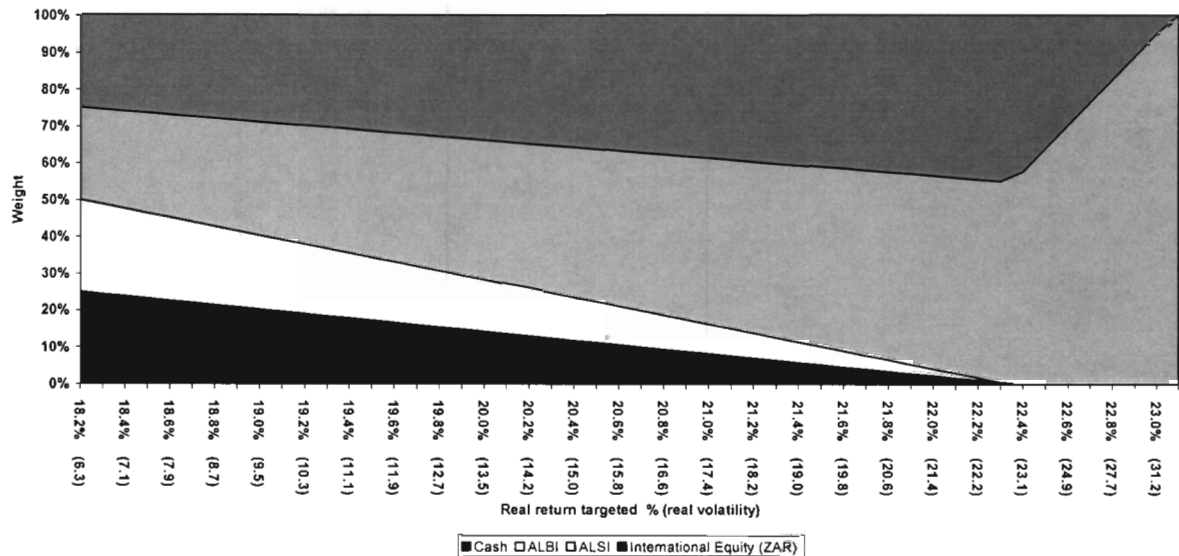


Figure 5: Asset proportions of the behavioural portfolio model M2(0.5)

A comparison to the Markowitz efficient portfolios yields the following results:

- the proportion of equities in “efficient” portfolios increases as the risk restriction is relaxed, consistent with Markowitz theory;
- the allocation to bonds and cash decreases as the risk targeted increases, consistent with the Markowitz model;
- model M2(0.5), like model M3(0.5) below, recommends portfolios with higher bond allocations than Markowitz theory for every level of return targeted;
- the proportion of bonds to equities again decreases for higher levels of return, in contrast to the increasing ratio recommended by the Markowitz model.

Figure 6 below illustrates the efficient frontier for M2(0.5).

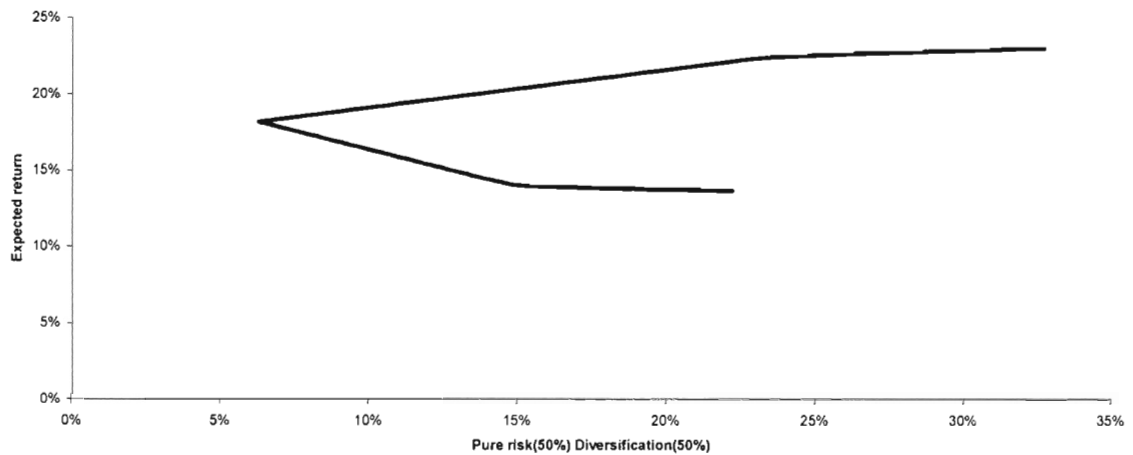


Figure 6: Efficient frontier of the behavioural portfolio model M2(0.5)

The graph shows portfolios that have the lowest pure risk and diversification, for each value of expected return targeted. The points that have a return less than approximately 18% (vertical axis) are dominated by the points on the frontier perpendicularly above them (since they give a higher return for the same level of “risk”). These points are therefore not strictly speaking on this efficient frontier.

4.2.3.2 The efficient frontier according to Model M3(0.5)

Figure 3 shows the proportions of the four asset classes when optimising for pure risk versus a linear combination between expected return and diversification.

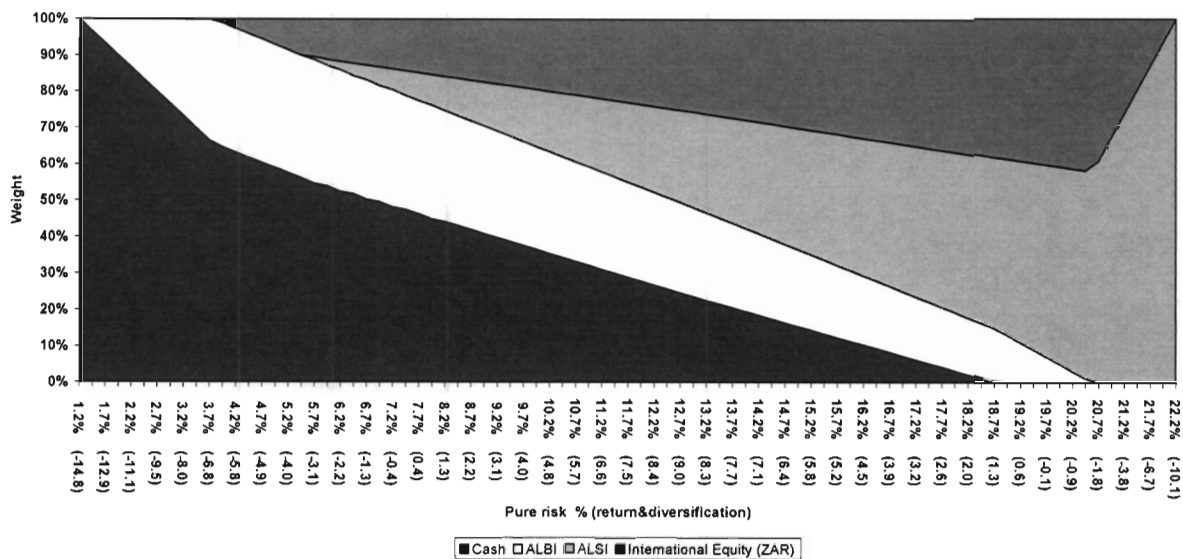


Figure 3: Efficient asset proportions according to the behavioural portfolio model M3(0.5)

The results are similar to S&W findings and can be summarised as follows:

- the exposure to equities increases as the targeted “risk” increases, consistent with Markowitz theory;
- the proportion of cash and bonds decreases as the target “risk” increases;
- the exposure to bonds is significantly higher at every risk/return level than dictated by the traditional theory;
- the ratio of bonds to equities now decreases for increasing levels of risk targeted, in contrast to the Markowitz model, which recommends an increasing ratio.

Figure 4 illustrates the efficient frontier for M3(0.5). As S&W find, this “efficient frontier” is not monotonous.

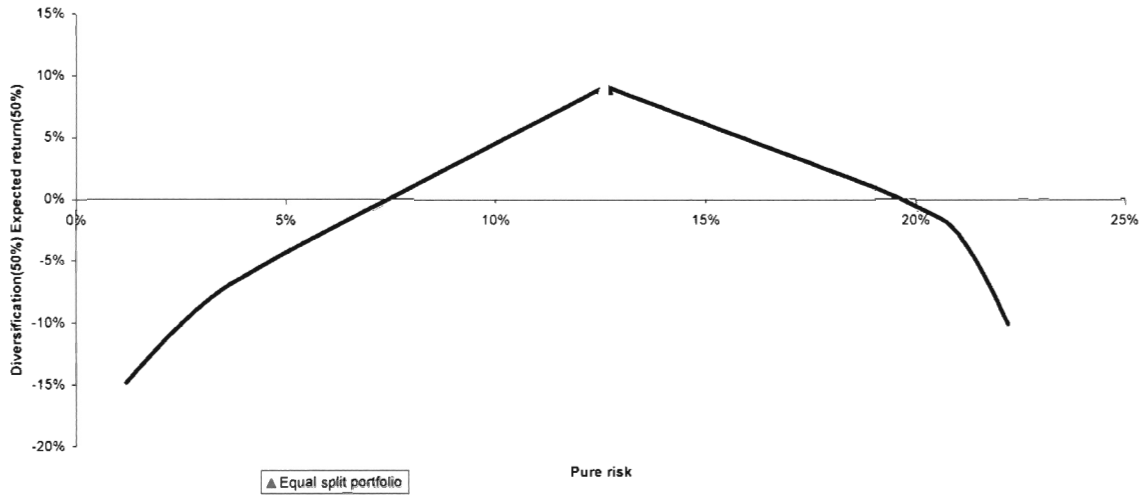


Figure 4: Efficient frontier of the behavioural portfolio model M3(0.5)

According to the graph, no investor should accept pure portfolio risk that is above approximately 12.5%. The inflection point is reached at the portfolio that spreads assets evenly across the four asset classes. At this point, the loss of naive diversification starts to dominate the benefit of higher return. Portfolios with pure risks higher than the pure risk of this point have less and less “payoff” for given level of pure risk and the portfolios to the right of this point are therefore strictly speaking not efficient.

4.2.4. Comparative analysis

This section compares the portfolios recommended by financial advisors for South African investors to the three basic models investigated, i.e. the two behavioural models M2(0.5) and M3(0.5), and the Markowitz model.

To ascertain which models explain advisor behaviour the best, S&W use distance measure in order to determine the distance between a model and the recommended portfolio. The distance measure is defined as follows:

$$DM_k^C = \sqrt{\sum_{i=1}^4 (\hat{\alpha}_{i,k}^C - \alpha_{i,k}^C)^2}$$

similarly for DM_k^M and DM_k^A

where $\hat{\alpha}_{i,k}^C$, $\hat{\alpha}_{i,k}^M$ and $\hat{\alpha}_{i,k}^A$ denote the predicted portfolio proportions of the models.

Table 3 shows the mean and median results for the three types of individuals considered in this study and the different models which are compared. The last column shows the average distance measured over all risk classes.

The Markowitz model has the following properties – both must be considered since they lead to different asset allocations:

- M1a minimises volatility for the given level of return of the advisor portfolio;
- M1b maximises return for the given level of volatility.

	conservative	moderate	aggressive	all
M1a	41.1% (31.4%)	40.4% (38.3%)	37.4% (29.9%)	39.7% (33.8%)
M1b	42.4% (32.5%)	39.7% (35.6%)	37.3% (29.3%)	39.8% (31.7%)
M2(0)	58.3% (57.0%)	46.7% (42.0%)	46.3% (35.5%)	50.4% (42.0%)
M2(0.25)	37.3% (32.9%)	24.8% (23.2%)	25.3% (18.9%)	29.1% (24.7%)
M2(1)	39.1% (32.9%)	25.7% (23.5%)	26.2% (22.2%)	30.3% (26.1%)
M3(0)	29.0% (28.9%)	34.5% (31.3%)	50.5% (52.4%)	38.0% (40.6%)
M3(0.9)	30.4% (27.3%)	26.5% (25.5%)	33.8% (33.0%)	30.2% (27.7%)
M3(1))	58.4% (53.9%)	50.8% (51.0%)	49.2% (36.9%)	52.8% (48.2%)

Table 3: Aggregate distance measures (mean and median) between models and recommendations

Consistent with the findings of S&W, there appear significant differences in the explanatory power of the three models. The behavioural models describe advisor behaviour with respect to their asset allocations recommendations better than the Markowitz model, with the stipulation that there must be weight on the diversification term.

Table 4 compares the distance measures on an individual basis. The parameters selected, namely 0.25 for M2 (i.e. risk function has 25% weighting on diversification and 75% on pure risk), and 0.9 for M3 (i.e. payoff function has a 90% weighting on expected return and a 10% weighting on diversification), are those that showed the best fit (of all parameters investigated) to advisor portfolios for the two models respectively. The distances are calculated over all three risk preference portfolios for each advisor.

Participant	M1a	M1b	M2(0.25)	M3(0.9)
1	24%	24%	22%	26%
2	48%	46%	21%	16%
3	61%	16%	51%	25%
4	37%	34%	15%	24%
5	35%	33%	16%	18%
6	20%	20%	28%	26%
7	88%	15%	58%	48%
8	54%	33%	34%	22%
9	39%	38%	32%	33%
10	79%	92%	48%	53%
11	26%	34%	24%	13%
12	92%	25%	31%	28%
13	74%	51%	39%	39%
14	100%	105%	66%	68%
15	28%	30%	29%	24%
16	35%	21%	26%	14%
17	58%	29%	63%	39%
18	108%	54%	53%	58%
19	44%	44%	29%	26%
20	39%	45%	16%	27%
21	23%	16%	29%	19%
22	25%	21%	29%	22%
23	66%	76%	60%	22%

Table 4: Distance measures for the models on an individual basis

The highlighted cells in the M1a column indicate those advisors for which the Markowitz model describes advisor allocations better than M2(0.25). Highlighted cells in M1b indicate better predictions of portfolios than model M3(0.9). On an individual basis the superiority of the behavioural models is not as convincing as on an overall aggregate basis. Nevertheless, the behavioural models do show better explanatory power of advisor allocations than the Markowitz models.

Model M2(0.25) and M3(0.9) show better results for 18 and 21 out of 23 participants when compared to M1a and M1b respectively.

To test whether the models are significantly better than the Markowitz model, a Wilcoxon test was done to compare the distances over all portfolios. Applying the Wilcoxon test to the 69 portfolios yields the following p-values:

	M2 (1)	M2 (0.9)	M2 (0.75)	M2 (0.5)	M2 (0.25)	M2 (0.1)	M2 (0)
M1a	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
M1b	19.05%	18.73%	18.09%	17.01%	11.19%	74.94%	100.00%

	M3 (1)	M3 (0.9)	M3 (0.75)	M3 (0.5)	M3 (0.25)	M3 (0.1)	M3 (0)
M1a	90.53%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
M1b	100.00%	0.20%	37.70%	38.60%	38.80%	39.00%	39.00%

Table 5: Wilcoxon-test between Markowitz model and the behavioural models across all portfolios

Model M2 describes advisor portfolios significantly better than Markowitz model M1a for all values of the parameter, except zero. In other words, practitioners tend to look for the portfolio with the best naive diversification out of all the portfolios with a high enough return, more than they tend to look for the Markowitz-efficient portfolio. M2 also outperforms M1b, except now it is not highly significant. If one however ignores diversification completely (M2(0)), the model is significantly worse than the Markowitz model at predicting advisor behaviour. The parameter that yielded the lowest p-value is 0.25.

Model M3 describes advisor behaviour better than the Markowitz models for all parameter values except 1. The parameter value that gives the most significant p-values is 0.9. In fact, M3(0.9) is the best model of all those considered by varying the parameter values in M2 and M3. Interestingly, ignoring expected returns completely and just finding the portfolio that gives the best diversification for the given level of pure risk (i.e. M3(0)), still outperforms the Markowitz model. This is perhaps a surprising result. It implies that advisors are very reluctant to recommend portfolios that are not relatively evenly spread across all asset classes, irrespective of the return implications. The allocations for M3 do not change significantly for parameter values smaller than 0.75, as the diversification factor already starts to dominate the “pay off” at that parameter value.

Examining the results of M2 and M3 simultaneously for all the parameters above, it becomes clear that the most important factor to advisors in deciding asset allocations is in fact diversification.

When the distances are compared separately for the three risk attitudes, the following p-values are found:

		M2(β)						
		1.00	0.90	0.75	0.50	0.25	0.10	0.00
M1a	Conservative	50.0%	50.0%	50.0%	50.0%	32.4%	13.0%	99.5%
	Moderate	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	99.2%
	Aggressive	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	97.8%
M1b	Conservative	47.6%	47.6%	47.6%	46.4%	33.5%	36.9%	99.5%
	Moderate	4.1%	3.9%	4.1%	4.1%	3.6%	56.0%	99.4%
	Aggressive	53.6%	53.6%	53.6%	50.0%	50.0%	84.2%	99.8%

		M3(α)						
		1.00	0.90	0.75	0.50	0.25	0.10	0.00
M1a	Conservative	99.4%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%
	Moderate	50.0%	0.0%	0.6%	0.6%	0.7%	0.7%	0.7%
	Aggressive	46.4%	0.0%	17.3%	18.1%	18.1%	18.1%	18.1%
M1b	Conservative	100.0%	0.9%	2.1%	2.2%	2.2%	2.2%	2.2%
	Moderate	99.7%	0.8%	18.1%	18.9%	18.9%	18.9%	18.9%
	Aggressive	100.0%	44.0%	97.8%	97.8%	97.8%	97.8%	97.8%

Table 6: Wilcoxon-test between the Markowitz models and the behavioural models by risk preference

One could define a model that conditions on the risk preference of a portfolio. For example, for low risk portfolios, M2 would take effect, and conversely, for high risk portfolios, M3 would be used. This conditional model would then have more significant p-values than both M2 and M3, when considering the distance measures over all portfolios.

S&W mention that the parameter values for the two behavioural models would in reality be advisor specific, as each advisor would place different relative weight on expected returns, pure risk and diversification. One could therefore test what values of the two parameters best describe the behaviour of each advisor. This could only increase the significance of the explanatory power of the behavioural models.

It was shown in the previous section that advisors inappropriately take account of correlations (and therefore confuse volatility and pure risk). The other “behavioural” factor also has strong practical validity, as humans have a natural “don’t put all your eggs in one basket” behaviour. The statistical significance of the superiority of the models, in combination with the practical explicability of the two factors, provides strong evidence that South African advisors do not follow Markowitz theory nearly as closely as they do the behavioural models suggested by S&W.

4.2.5. Alternative approaches

In addition to the distance measure, S&W carry out alternative evaluations of the data gathered from German advisors. This is in order to examine if it may be more appropriate to find the Markowitz portfolios that are “nearest” to the proposed allocations in the expected returns and standard deviations space, while still using the market expectations of each individual advisor. They attempt to find the portfolio on the Markowitz efficient frontier that has a standard deviation and expected return such that:

$$\underset{\hat{\alpha}_{i,k}}{\text{Min}} DM_k(\alpha_{i,k}, \hat{\alpha}_{i,k})$$

s.t. There is a \hat{r} , for that $(\hat{\alpha}_{i,k})$ is the solution of the following problem:

$$\underset{\tilde{\alpha}_i}{\text{Max}} \sum_{i=1}^n \tilde{\alpha}_i \cdot \mu_{i,k}$$

$$\text{s.t.} \quad \text{Risk} = \sqrt{\sum_{i=1}^n \sum_{j=1}^n \tilde{\alpha}_i \cdot \tilde{\alpha}_j \cdot \sigma_{i,k} \cdot \sigma_{j,k} \cdot \rho_{ij,k}} \leq \hat{r}$$

$$\sum_{i=1}^n \tilde{\alpha}_i = 1 \quad \text{and} \quad 0 \leq \tilde{\alpha}_i \leq 1 \forall i = 1, \dots, n$$

Repeating this exercise for our 23 local advisors, p-values in table 6 below are found. As is evident from the table, the behavioural models’ allocations follow those of the practitioners more closely than those of the Markowitz models for most parameter values.

M2 (1)	M2 (0.9)	M2 (0.75)	M2 (1)	M2 (0.25)	M2 (0.1)	M2 (0)
0.33%	0.33%	0.28%	0.25%	0.16%	49.40%	100.00%

M3 (1)	M3 (0.9)	M3 (0.75)	M3 (0.5)	M3 (0.25)	M3 (0.1)	M3 (0)
99.50%	0.00%	3.17%	3.13%	3.09%	3.09%	3.04%

Table 7: Wilcoxon-test between the nearest Markowitz portfolio and the behavioural portfolios

S&W observe that comparing the recommended portfolios to the nearest Markowitz solution is probably not the most appropriate method, since the nearest Markowitz solution is often so different from the proposed allocation that it is unlikely that the nearest Markowitz solution is what these practitioners had in mind. They also find that some of the advisors' three recommended portfolios actually change their rank with respect to their relative risks employed, strongly indicating that the nearest the Markowitz solution is not a good indication of practitioners intentions.

Although none of the advisor's portfolios examined in the South African study changed rank in risk employed, the nearest Markowitz allocations were in many cases vastly different from the recommended portfolios. This supports finding by S&W that the "nearest Markowitz solution" is less relevant than M1a and M1b.

4.2.6. Losses of efficiency

Important question being addressed in this study is how valid and realistic Markowitz theory is in the first place. The answer to that question also determines how seriously the "losses of efficiency" due to deviation from the Markowitz efficient frontier should be taken.

These efficiency losses are calculated assuming that all the assumptions underlying Markowitz theory are correct. To clarify that point, suppose a new, improved theory were developed, the allocations implied by this model would also be inefficient in the Markowitz paradigm as defined by Markowitz. Perhaps the only way to truly assess the loss of efficiency, would be to do a back-test on the returns and standard deviations of the asset allocations suggested by the models and advisors respectively, using actual asset class returns. Nevertheless, if the returns of efficient asset allocations that target the standard deviations implied by advisor market expectations and allocations are compared to the implied expected returns of the recommended portfolios, losses of return can be summarised by table 8 below.

	Conservative	Moderate	Aggressive	All
loss of return	-1.29%	-1.42%	-1.68%	-1.46%

Table 8: Average losses of expected return

The expected losses of return are significant, although roughly half the magnitude found by S&W in their German study. Thus on average, advisors are "losing" 1.46% of return per asset allocation, for the given amount of risk they are employing.

5. EFFICIENT FRONTIER RESAMPLING

It is believed in the investment world that Markowitz optimisation is too powerful for the quality of its inputs. Traditional optimising implicitly assumes that its inputs, namely the expected returns, volatilities and correlations are known with 100% certainty. Small changes in the inputs (well within the estimation error) can therefore lead to significantly different asset allocations. Further, mean-variance optimisation is an error maximising process. If for example, one overestimates the returns of an asset class, it will tend to select that asset class over others, thereby compounding the error in the expected return of that portfolio.

To minimise the effects of estimation error, a technique called EFR was introduced by Richard Michaud in 1998. It allows the user to visualise and diminish the effects of estimation error. If one uses historical returns to estimate inputs, one is effectively just using one outcome out of many others that were possible, since the assumption is that returns follow a random normal distribution. This implies that, even if returns are stationary, there is still estimation error that will decrease, but never completely disappear, as the length of the sample is increased.

Resampling reduces the effects of this estimation error by randomly drawing possible outcomes from the original joint normal distribution implied by the parameter estimations. Each new set of generated returns is then used to calculate new means, variances and correlations. The generated set of returns must be of the same length as the length of the historical data used to estimate the original parameters. The generated returns will then be “statistically equivalent” to the actual historical returns. This process is repeated to collect as many new sets input parameters as is deemed necessary. These sets are then all successively used to optimise and find an optimal allocation. These sets of optimal weights are then averaged for each asset, to obtain a single average weight for each asset. These weights are the end product of the EFR method. Enough sets of inputs must be generated for the average weights to converge to a sufficient degree of precision.

The process above is also known as Monte Carlo simulation, and is the parametric approach to resampling. A non-parametric method known as bootstrapping can also be used. According to Scherer, the two methods do not lead to significantly optimal portfolios.

Michaud has presented results based on out-of-sample tests which show that resampled efficient portfolios, on average, outperform standard optimal portfolios.

The fact that resampling does not place as much certainty on the parameters means that it leads to more diversified portfolios. To better understand why this is the case, consider an asset that is given a zero allocation in the standard mean-variance optimisation. It is quite likely, that for at least one of the resampled sets of inputs, some allocation will be given to that asset. That is an extreme case, but clearly this can be applied to any asset, and will lead to more diversified portfolios. This characteristic of EFR led me to comparing its optimal portfolios to those recommended by my 23 advisors. In principle, it is possible that advisors

have some kind innate ability to not place too much certainty on parameters, and to do some kind of “mental resampling”.

The results below show that this is not the case. The behavioural models are still significantly better at describing advisor recommendations than the EFR method. However, the statistical validity of these numbers is contestable.

In order to perform the resampling, and since I do not know how exactly advisors decided on their inputs, I had to arbitrarily decide on the length of the data I generated for each advisor. I decided on generating 5 years of data from the joint normal distribution specified by each advisor, and then calculating the new joint normal distribution. I performed only 350 iterations, but the weights did not change significantly from 300 to 350 iterations. The length of the samples generated, can be seen as the “certainty” placed on the original estimates for the parameters. It is unlikely that advisors consider their estimates very accurate, and I thus attempted to explain all of their behaviours by using relatively short samples of 5 years. A more complete examination of the results of EFR could possibly reveal that advisor behaviour does to an extent mimic the mechanism of resampling.

M2 (1)	M2 (0.9)	M2 (0.75)	M2 (1)	M2 (0.25)	M2 (0.1)	M2 (0)
0.17%	0.17%	0.16%	0.14%	0.18%	43.94%	100.00%

M3 (1)	M3 (0.9)	M3 (0.75)	M3 (0.5)	M3 (0.25)	M3 (0.1)	M3 (0)
99.15%	0.00%	2.70%	2.90%	2.90%	3.00%	3.00%

Table 9: Wilcoxon-test between the optimal resampled solution and the behavioural portfolios

One flaw of resampling is that the new input parameters are generated from the distribution that contains the estimation error in the first place, which means that it will also suffer from estimation error. At least the effect of this error will not influence allocations as seriously as in standard optimisation. Resampling also does not circumvent the problem of non-stationary distributions. Using data sets that go too far back in history will still result in portfolios that are not truly optimal.

Nevertheless, EFR is an interesting technique which does seem to have a solid statistical foundation, as well as results superior to those of standard mean-variance optimisation¹⁴.

¹⁴ Michaud, Richard “Efficient Asset Management: A Practical Guide to Stock Portfolio Optimization and Asset Allocation”, 2001

6. A NEW MODEL OF ASSET ALLOCATION

Is the efficient frontier really efficient? This question arises from work done by Brock (2004), among others. In his work on the new asset allocation logic, Brock comes to a fundamental conclusion. He claims that although the concept of the efficient frontier is invaluable, Markowitz identified a frontier that only holds under certain very strict assumptions, most notably the assumption of a stationary joint normal distribution of assets. His alternative perspective suggests that there generally exists a superior frontier, whereby one can achieve greater return without greater risk than is possible along the classical Markowitz frontier. This is achieved by replacing the concept of optimal portfolios with that of optimal strategies. An optimal strategy is defined as a set of portfolios, each to be used in a different “state” of the market. Brock proposes that a dynamic strategic asset allocation is superior to the static strategic asset allocation. The state of the market depends on the various relevant factors that have to be identified, for example recent returns, historic returns, price earnings ratios, GDP, inflation etc. The possibilities are endless, but have to be narrowed down by statistically finding the significant factors.

Brock introduces the problem with the traditional theory in the following way: he first points out that most investors are intuitively uncomfortable with the strictures imposed upon them by the Markowitz paradigm of asset allocation. This theory instructs them to remain invested in the same portfolio no matter what the market conditions are at that point. Almost all practitioners believe that there is information available in the market that allows them to improve upon simply using historical data as inputs. The diversity of asset allocations (for the same return targets) seen in practice are testimony to this fact. In his new theory, Brock insists that the stationary joint normal distribution must be replaced by state dependant dynamic joint Normal distributions, where the leaps between states are governed by some general Markov process, which does not necessarily have to be discrete. In order to model this new distribution, highly mathematically complex “Dynamic Programming” (see Stokey and Lewis, 1989), techniques will have to be utilised.

The “optimal” allocation implied by the new approach differs markedly from that of Markowitz theory, since it calls for a generalized form of “Buy Low/Sell High” market timing. The implications for pension funds and other institutional investors are obviously profound. The new model extends and generalizes the earlier theory in a way that makes it possible to solve problems that are more challenging and realistic than those considered to date. The logic is consistent with historical returns data that strongly rejects the concept of random walk returns central to classical Markowitz theory finance. It is also consistent with modern economic theory, in particular the new falsifiable theory of Rational Beliefs, which generalizes classical MPT. The theory of Rational Beliefs was introduced by Mordecai Kurz in the mid-1990s and is the first theory that has the potential to replace, or more accurately, generalize the classical CAPM/Rational Expectations/Efficient markets paradigm. It is unique in its peer group of pretender theories in that it has an internally consistent account of market equilibrium. The assumption that investors are rational and know the expected returns,

volatilities and correlations is replaced by a far less stringent and much more realistic assumption that investors act rationally on their input parameters, but each will have his own inputs, based on his belief regarding the state of the markets. This theory alleges that it is not possible to know the true parameters, so every investor's inputs will reflect his subjective view. This is clearly much more consistent with reality.

According to Brock, the portfolio theory is currently in its most important transition period since Markowitz proposed his theory all those decades ago. He makes an illuminating comparison to what Einstein did to Newton's theories – the emerging theory does not reject the prevailing theory, but rather generalises it. The implications of this generalization of Markowitz theory could however have far reaching implications for how asset allocations are derived. There is no research available on whether anyone has successfully implemented this new paradigm, so it remains to be seen whether the investment world will embrace it, or whether it is even feasible.

7. CONCLUSION

The aim of this paper was to test the basis of the asset allocation recommendations of the South African advisors. As was highlighted in this study, it is well known that financial advisors do not rely on the Markowitz theory when making asset allocation recommendations. The question is: if they do not follow the traditional theory – what do they follow? To answer this question, behavioural portfolio models developed by S&W were used.

It turns out that the phenomena highlighted by S&W also occur in the asset allocations of South African advisors and asset managers. The superiority of the behavioural portfolio models in explaining practitioners' allocations is less significant than in S&W, but nevertheless significant for most parameter values. These phenomena can be summarised as follows:

- Practitioners generally do not correctly calculate the standard deviations of portfolios (given the underlying asset class standard deviations and correlations). More specifically, despite specifying correlations for asset classes that are not all 1, they tend to estimate overall portfolio standard deviation as if correlations are perfect. The consequence of this is that they overestimate standard deviation, as they do not fully appreciate the benefits of low correlations.
- Practitioners do not generally seem to follow Markowitz theory when selecting asset allocations. More specifically, it is possible to define behavioural models that more closely follow their recommended asset allocations than Markowitz theory. Practitioners apparently consider (whether explicitly or implicitly) the following factors when allocating assets:
 - Naïve diversification, i.e. practitioners seem to prefer, all else being equal, allocations that tend to spread assets equally across all asset classes. This makes intuitive sense, as humans have an innate bias towards not keeping all their eggs in one basket.
 - Pure risk, i.e. the standard deviation of the overall allocations had all correlations between asset classes been 1. Given that practitioners seem to assume all correlations to be 1 when calculating the standard deviation of a combination of assets, it makes sense that they would be averse to pure risk rather than standard deviation calculated using actual correlation estimates.
 - Expected return. This seems to be the one consideration within asset allocation that practitioners can deal with satisfactorily. It's not surprising, since expected return is a much more intuitively appealing parameter than standard deviation.

Instead of using standard deviation as a proxy for risk, it would seem that practitioners consider risk to comprise of two components: naïve diversification (or more precisely, the lack

thereof) and pure risk. This could seem somewhat like a paradox: optimising to pure risk only will lead to less diversified portfolios than optimising to true standard deviation. This is because the diversifying effect of less than perfectly correlated asset classes is not taken into account in the former, which would lead to more concentrated allocations. However, this is offset by their inclination to prefer portfolios that exhibit naïve diversification. Using these two risk factors in an optimisation still leads to different allocations than a Markowitz optimisation, chiefly because the theoretical benefits of lower than 1 correlations are not fully appreciated.

It has to be emphasised that this study and that of S&W do not necessarily suggest that practitioners specify allocations inferior to those of Markowitz. Markowitz relies heavily on the notion of stationarity, a condition that does not seem to hold in reality. The only way to prove relative inefficiency would be to calculate the performance of practitioners' allocations (which would of course change over time) using historical returns and comparing that to the performance of allocations dictated by Markowitz theory. Even then one would have to decide on a risk measure and pay-off function, which is a highly subjective exercise.

It is hoped that this study has shed some light on why practitioners do not follow Markowitz theory. According to Ibbotson and Kaplan asset allocation determines 40%, 90% or a 100% of a balanced fund's¹⁵ performance. There is however very little consensus on how to go about this exercise, and a generalised theory of asset allocation does not seem to be imminent, if academic studies are anything to go by. Studies like this one and S&W should however improve our understanding of the shortcomings and perceived shortcomings of current asset allocation theory.

¹⁵ A fund in which there is an allocation to broad asset classes, but also a process of security selection within each asset class. Very recently, however, the validity of their findings has been disputed, and Jahnke (1997) assert that security selection and asset allocation are equally determinant of overall performance on a risk-adjusted basis

APPENDIX A – QUESTIONNAIRE

Introduction

My name is Magda Mendecka and I am completing a Masters degree in Economics at the University of Cape Town this year.

This questionnaire forms part of my thesis. I appreciate that your time is valuable; therefore, once completed, I will make my thesis available to you and it could possibly lead to results of interest to you or your business/company. Also note that all the information you supply will be completely confidential and no real names will be used in the thesis or conveyed to anyone under any circumstances whatsoever.

I would appreciate it a great deal if you would be so kind as to take the time to complete what follows, and if possible send it back to me by the 20th of June (my contact details are given at the end of this questionnaire).

If, during the course of filling in this questionnaire, any questions arise, please feel free to email me at magda.uct@gmail.com and I will respond to your query within a few days. If you are in possession of a hard copy, and would like to fill in an electronic copy, you can send a mail to the above address and I will supply you with an MS Word document. I would also appreciate it if you would let me know at the above email address as soon as possible whether you intend to fill in the questionnaire.

The topic I have chosen requires me to study recommended/constructed asset allocation of investment consultants and asset managers. In this context, I am especially interested in your recommendations for asset allocations given the current market situation. Since your advice depends on your clients' characteristics, I ask you to please imagine the following scenarios:

1. Scenarios

Please either assume throughout this questionnaire that no tax is applicable to any of the individuals or asset classes, or if you prefer, make a tax assumption and state it.

In order to fill in this questionnaire, you have to choose one of the following two scenarios (it is my preference that you use scenario (a), but if that is not possible, you may use scenario (b)).

- a. There are 3 clients, each of them 26 years old, not married and without any savings. They have just finished their Masters degree in Economics at the University of Cape Town and will inherit R2 000 000 in the next few days. All of them have accepted their first job offers a few weeks ago, and they will all earn a net R 150 000 per annum. None of them know when they will need portions of their new wealth, but they all have different risk attitudes:

- Client 1 - Barry (conservative): I am cautious. I want some exposure to risky assets as I know they tend to have higher returns, but I certainly do not want to gamble with my inheritance. I am willing to accept losses in any 1 year period but after 10 years I should at least have the original R2 000 000 and some interest.
- Client 2 – Cornel (moderate): I want a well-balanced investment strategy that has the potential for significant gains without being too risky. I am willing to risk a loss of, say 20% in a year, as long as there is significant upside potential too.
- Client 3 – Nico (aggressive): R 2 000 000 is a lot of money and I am willing to risk possible losses. Although I do not want to gamble, I want an aggressive strategy that should yield a high return in the long run. I understand that such a strategy could result in significant losses in the short to medium term.

b. Alternatively, if the above scenario does not agree with your philosophy, you can assume that you have analysed the three clients' needs, current assets and future assets and liabilities in detail, and found that the best estimate of their required return given their current situation is that they require the following nominal returns in the long run:

- Client 1 - 9% to 11%
- Client 2 - 11% to 13%
- Client 3 - 13% to 15%

Please tick the appropriate check box:

I am going to use scenario (a) to fill in this questionnaire (preferred)	<input type="checkbox"/>
I am going to use scenario (b) to fill in this questionnaire (alternative)	<input type="checkbox"/>

The following funds are available to them:

- Precious Cash Fund: Consists of short-term interest paying securities, each with a duration shorter than one year and negligible probabilities of default. The fund is mandated to have an average duration of less than 90 days at all times. The fund is benchmarked against the Alexander Forbes Money Market Index.
- Prudent Bond Fund: Consists of local interest paying securities with very small probabilities of default. It is benchmarked against the All Bond Index.

- EQ Equities Fund: Consists of equities listed on the JSE. The fund is benchmarked against the ALSI.
- BIG International Equities: Consists of international equities listed on developed exchanges across the world and is benchmarked against the Morgan Stanley Composite Index.

Assume that all the managers responsible for these funds are known to be competent and enjoy the respect of their peers.

2. Your Asset Allocation

What portfolio allocation do you advise for the three clients for the next 12 months? Note that this does not necessarily mean the asset allocation will change in 12 months or that the investment horizon is just one year, but only that it will be reassessed one year hence. Assume that the four asset classes discussed are the only ones available to Barry, Cornel and Nico. Please insert percentages and **do not add any other asset classes**:

Asset class	Conservative	Moderate	Aggressive
Cash			
Local bonds			
Local equities			
International equities			
Total	100%	100%	100%

Please indicate how you arrived at the allocations above, making explanatory notes where applicable (if more than one method was used to get to above allocations, you may say “yes” to all of them). If you do not feel comfortable divulging this information, you may leave it completely empty:

Yes/No	Method	Notes
	Using software	

	Through experience of previous clients' portfolios and intuitive feel for the markets	
	Using a mean-variance optimizer	
	You have a policy allocation for each risk tolerance (e.g. low, medium, high risk allocations)	
	Other (please briefly explain in notes)	

3. Your market expectations

In this section I am asking for information that will describe your view of expectations for the performances of the aforementioned investment alternatives and your portfolio propositions in the next 12 months. In all the questions in this section, please take into account interest (from cash) coupons (from bonds), dividends (from shares) or capital appreciation or depreciations (due to market movements in bonds and shares). In other words in all cases we are interested in the total returns (i.e. it assumed that all coupons, income and interest is reinvested).

To quantify your view of what the performance of each asset class is likely to be, please provide what your estimate is for the following statistics **over the next 12 months** for each asset class:

- Firstly provide your view of what the **median** return will be, i.e. the return that you think is equally likely to be outperformed as it is to be underperformed over the next 12 months.
- Secondly, provide your estimate for the return that you feel 90% sure **will not** be exceeded over the next 12 months (**upper bound**).
- Thirdly, provide your estimate for the return that you feel 90% sure **will** be exceeded over the next 12 months (**lower bound**).

At this point I would like to reiterate that it is imperative that you **do not do any research that you would not usually do to fill in this questionnaire**. In other words, if you do not explicitly have the estimates above already, please just fill in your intuitive "guess" or "gut feel". If you would in your normal course of business employ software with built in estimates, please provide those estimates.

3.1. Investment alternatives

	Lower bound	Median	Upper bound
Cash			
Local bonds			
Local equities			
International equities (in ZAR terms)			

	Lower bound	Median	Upper bound
Conservative			
Moderate			
Aggressive			

Please indicate how you arrived at the numbers above:

How did you arrive at the above numbers? Please type in "yes" wherever it is appropriate (please skip this table if you are not comfortable divulging this information):

Method	Notes
Examining long run historical numbers	
Forecasting with a model	
Forecasting through experience	
Other (please specify in notes)	

4. Correlations

Please provide correlations between the various asset classes for the next 12 months. With correlation is meant “how these asset classes move relative to each other”. It must be a number between -100% and 100%. I will now illustrate what is meant by “correlation” with the help of four examples. If you are confident that you are familiar with the concept of correlation, I suggest that you skip the following bullet points. Note that each correlation number in the examples is relevant to only two asset classes, since any one correlation number is an indication of the strength and direction of the relationship in movements between only two asset classes.

- A correlation of 100% means that the two asset classes move exactly in harmony, i.e. they have their best returns at the same time and their worst returns at the same time
- A correlation of -100% implies the exact opposite (perfect discourse), i.e. when the one asset class has its best return, at the same time the other has its worst return.
- A correlation of 0% means that there seems to be no relationship between the two asset classes, and if the one produces an above average return, the other is equally likely to produce a below or above average return.
- A correlation of 20% between asset classes A and B, implies that when A returns an above average return, B will also have a tendency to produce an above average return, but this tendency will be weak, i.e. B will produce an above average return only slightly more often than not.

Please complete the table below, by again not using any research that you would not usually employ. For example, in the table below, the top left hand entry in the table is 100%, because cash clearly is 100% correlated with itself. The cells marked “X%” would be the correlation between Local bonds and Cash, and the cells marked “Y%” will be the correlation between Local bonds and International equities (in ZAR), and so forth. Since the matrix by definition will be symmetrical around the diagonal line of 100% entries, you only need to fill in the shaded cells.

	Cash	Local bonds	Local equities	International equities (in ZAR terms)
Cash	100%	X%		
Local bonds	X%	100%		Y%

Local equities			100%	
International equities (in ZAR terms)		Y%		100%

Please indicate how you arrived at the above numbers (if you are not comfortable divulging this information, please leave empty):

Method	Notes
Looking at historical numbers	
Forecasting with a model	
Forecasting through experience	
Intuition or "gut feel"	
Other (please specify)	

Finally I ask you for your name and the name of your company. This information is only used to manage questionnaires from advisors from the same company in an appropriate manner, to not overly bias the results towards any one company. Again, you may omit this information if you prefer to not disclose it.

Name:

Qualifications:

Company:

Please email the completed questionnaire to magda.uct@gmail.com, or if it is more convenient, fax to (021) 683 2831 (for attention Magda).

Your time and effort is sincerely appreciated. I am confident that my findings will assist you and/or your business in your future endeavours. If you provide me with your email address, I will inform you of my results. I remind you that your answers will remain anonymous under all circumstances.

APPENDIX B

B1. Average historical returns and volatilities (for the 30 years ending April 2004) vs. advisors' expected returns and volatilities:

	Historical		Average advisor	
	Return	Volatility	Return	Volatility
cash	13.7%	1.2%	6.3%	0.9%
local bonds	14.5%	8.7%	7.7%	3.0%
local equity	23.0%	22.2%	12.9%	10.5%
international equity	21.4%	18.4%	10.2%	11.6%

B2. Historical correlations (for the 30 years ending April 2004) vs. advisors' expected correlations:

		Correlations	
		Historical	Average advisor
cash	local bonds	0.14	0.20
cash	local equity	-0.03	-0.18
cash	international equity	0.10	-0.06
local bonds	local equity	0.34	0.03
local bonds	international equity	-0.05	-0.08
local equity	international equity	0.34	0.45

APPENDIX C

Average asset allocations of advisors:

	cash	bonds	equity	international equity
Conservative	38%	28%	26%	8%
Moderate	18%	20%	48%	14%
Aggressive	6%	8%	65%	21%
Overall	21%	19%	46%	14%

REFERENCES

- Bradley, A., Higgins, E. & Abey, A. (2000), *Fortune Strategy*, Mauritius: Investor Education.
- Brennan, M.J., & Xia, Y. (1998), "Resolution of a Financial Puzzle", *Working Paper*, 28-98, 1-8.
- Brock, "Woody" H. (2004), "A Reconstruction of Modern Portfolio Theory", *Strategic Economic Decisions, Inc.*, 2, 1-10.
- Canner, N., Mankiw, N.G. & Weil, D.N. (1994), "An Asset Allocation Puzzle." *NBER Working Paper*, 4857, 1-27.
- Collective Insights "Asset Allocation in the South African Market", Autumn 2004.
- DeMiguel, V., Garlappi, L. & Uppal, R. (2005) "How Inefficient are Simple Asset-Allocation Strategies?" *Working Paper*, 1-73.
- Elton, E.J. & Gruber, M.J. (1999), "The Rationality of Asset Allocation Recommendations." *Journal of Financial and Quantitative Analysis*, 35, 27-41.
- Fabozzi, F.J., Gupta F. & Markowitz, H.M. (2002) "The Legacy of Modern Portfolio Theory." *The Journal of Investing*, 7-21.
- Goetzmann, W.N. & Kumar, A. (2005), "Why do individual investors hold under-diversified Portfolios?" *NBER Working Paper*, 8686, 1-49.
- Gomes, F. & Michaelides, A. (2004), "A Human Capital Explanation of an Asset Allocation Puzzle", <http://www.lse.ac.uk/ubs/pdf/dp24.pdf>, June 2006.
- Goodsall, W.A.R. "Tactical Asset Allocation." First Quadrant Limited, Association for Investment Management and Research.
- Ibbotson, R.G. & Kaplan, P.D. "Does Asset Allocation Policy explain 40%, 90% or 100% of Performance?" http://www.nomoneybusiness.org/articles/the90rule_or40_or100.pdf, January/February 2000.
- Jahnke, W. (1997), "The Asset Allocation Hoax", *Journal of Financial Planning*, http://www.en.wikipedia.org/wiki/Asset_class.
- Kurz, M. (1994a), "On the Structure and Diversity of Rational Beliefs, *Economic Theory*, 4, 877-900.

Michaud, R. (1998), *Efficient Asset Management: A Practical Guide to Stock Portfolio Optimization and Asset Allocation*, New York: Oxford University Press, 2001. First published by Harvard Business School Press, Cambridge, 1998.

Scheel, W.C., Blatcher, W.J., Kirschner, G.S. & Denman, J.J. "Is the Efficient Frontier Efficient?" <http://www.casact.org/pubs/proceed/proceed01/01236.pdf> , June 2006

Scherer, B. (2002) "Portfolio Resampling: "Review and Critique", *Financial Analysts Journal*, 58 (6), 98-109.

Shalit, H. & Yitzhaki, S. (2001) "Solving the Portfolio Allocation Puzzle", *The American Economic Review*, 93(3), 1002-1008.

Shalit, H. & Yitzhaki, S. (2003) "An Asset Allocation Puzzle: Comment." *The American Economic Review*, 93(3), 1002 – 1008.

Siebenmorgen, N. & Weber, M. (2000) "A Behavioural Approach to the Asset Allocation Puzzle",00-46.

Stokey, N. & Lucas, R. (1989), *Recursive Methods in Economic Dynamics*, Massachusetts: Harvard University Press.