“Further evidence on the approximation of confidence intervals for Sharpe style weights: the case of Australian listed managed funds”

AUTHORS	Kok Fai Phoon John Watson Jayasinghe Wickramanayake

ARTICLE INFO	Kok Fai Phoon, John Watson and Jayasinghe Wickramanayake (2008). Further evidence on the approximation of confidence intervals for Sharpe style weights: the case of Australian listed managed funds. *Investment Management and Financial Innovations*, *5*(2)
RELEASED ON	Thursday, 26 June 2008
JOURNAL	"Investment Management and Financial Innovations"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
0	0	0

© The author(s) 2024. This publication is an open access article.

Kok Fai Phoon (Australia), John Watson (Australia), Jayasinghe Wickramanayake (Australia)

Further evidence on the approximation of confidence intervals for Sharpe style weights: the case of Australian listed managed funds

Abstract

The rapid expansion in assets managed by the Australian managed fund industry has resulted in it becoming a major sector of the financial system, second only to that of the banking industry. With more than A$550 billion invested in the industry investors should be concerned with the lack of reliable information available in regard to equity style management. In particular investors should be concerned with the probable mismatch between stated objectives and the actual objectives pursued by fund managers. In this study, we apply return-based style analysis (Sharpe, 1988, 1992) to investigate the style and asset allocation strategies of 50 listed managed funds. Using monthly data we investigate manager performance on the basis of the information ratio and adopt a two-step approach following Lobosco and DiBartolomeo (1997) to generate confidence intervals for each of the estimated style weights. A significant contribution made by this paper is that in contrast to Lobosco and DiBartolomeo we initially identified asset classes (on the basis of low correlations and different risk-return measures) and then carried out return based style analysis thus negating the problem of spurious regression. Our findings confer with those of Lobosco and DiBartolomeo and thus suggest that the recommended daily data are not required for constructing reliable style weights. This paper provides further evidence that Sharpe style weights in conjunction with confidence intervals provide an insight into listed managed funds.

Keywords: managed funds, Return Based Style Analysis, asset allocation, confidence intervals.
JEL Classification: G23; G20; G11.

Introduction

The investment style of a managed fund is not always obvious for investors not fully acquainted with its manager or the philosophy of the fund family to which it belongs. Due to the existence of the large number of funds, one would have to wonder whether the original Enigma code-breakers[1] could decipher the information and misinformation surrounding the investment style of an individual investment fund. Traditionally fund management companies tend to label their products using a few common categories based on asset classes, geographic focus, industry sectors, and self-declared investment objectives (Lhabitant, 2004). Fund managers appointed by fund management companies will then adopt an investment philosophy that allows careful construction of a portfolio. This process of constructing a portfolio on the basis of a stated investment philosophy will cause the portfolio's returns to behave in a certain way. It is this behavior that is commonly referred to as "style".

Two approaches frequently adopted by both practitioners and academics to assess a fund's investment style are (i) holding-based style analysis (HBSA) and (ii) return-based style analysis (RBSA). The former derives style information from portfolio holdings and uses actual portfolio constituents as inputs (Daniel, Grinblatt, Tittman and Russ, 1997). The latter derives information from a time series of realized returns (Larrymore and Rodriguez, 2007). In order to carry out HBSA successfully two sets of data are required. Initially, a database of securities needs to be acquired that contains information pertaining to the characteristics of each security to be analyzed. Secondly, accurate records of asset holdings for each fund need to be created. The databases being created also require time period comparability. Because up-to-date asset holdings of managed funds are often not available, HBSA often leads to poor and unreliable information. In contrast RBSA acts as a low cost alternative to that of holding-based style analysis (Lhabitant, 2004). With RBSA a fund's historical returns are regressed against the returns of a set of passively constructed reference portfolios. Each of the reference portfolios represents a separate asset class or an investment style (e.g., value, growth, and small cap). Using regression analysis it is possible to determine a mixture of the reference portfolios that has moved the most with a managed fund. In other words RBSA involves the construction of a portfolio that best mimics the historical performance of a managed fund.

The aim of this study is to identify how successful RBSA can be as a tool for wealth creation within the Australian managed fund industry. There seems to be no studies that have applied RBSA to the Australian managed fund industry. We aim to fill this gap by following an approach used in a US study and outlined in detail in the Financial Analysts

© Kok Fai Phoon, John Watson, Jayasinghe Wickramanayake, 2008.

[1] During WWII the Germans used mechanical devices to encrypt their radio messages. The best known of these machines is the Enigma. The Enigma code breakers were a diverse group of Allied code breakers associated with deciphering the German armed forces secret codes. A detailed discussion is provided at the following website for interested readers. http://www.mikekemble.com/ww2/enigma.html

Journal (Lobosco and DiBartolomeo, 1997). The objectives of our study are to:

- investigate asset allocation strategies by approximating the confidence intervals for estimated style weights using monthly return data;
- examine manager ability by analyzing the information ratio obtained by fund managers associated with large managed funds within the Australian managed fund industry;
- demonstrate the importance of identifying an appropriate benchmark index for wealth optimization to be achieved.

The remainder of the paper is structured as follows. The next section provides an insight into style analysis in the form of a literature review. Section two details the methodology employed in this study. The third section provides a brief description of the data used. Results of the study are summarized in section four while the final section provides concluding remarks and suggestions for further research.

1. Relevant literature

Previous studies in this area have focused on RBSA alone, rather than analyzing it with a view to test its ability to create wealth (Lobosco and DiBartolomeo, 1997; Kaplan, 2003; and Hardy, 2003). These prior investigations have made important contributions to our understanding of the limitations of RBSA and ways of improving the method's accuracy. However, due to the push towards self-funded retirement in Australia it is important that the methods adopted in practice provide some degree of transparency to pension fund market participants with respect to wealth creation in the long term.

1.1. RBSA as a tool. William F. Sharpe's seminal papers[1] (Sharpe, 1988; 1992) first introduced a method of matching a fund's historical returns to the mix of investment benchmarks that explains historical variations on performance. Since then there has been a number of proponents for the use of style analysis as a tool for identifying optimal asset allocation.

Evidence exists to support the use of RBSA as a tool for determining and analyzing the optimal asset mix of a fund manager (Tierney and Winston, 1991). In this study the authors made use of style-point analysis by using a four equity style portfolio produced by Wiltshire Asset Management as a generic portfolio. They concluded that creation of a custom benchmark is the best way to address the style issue. In a study that challenged equity style classifications a relationship was found to exist between past return patterns, portfolio characteristics and future returns (Christopherson, 1995). Christopherson's findings emphasized that the reason for studying investment style was in order to anticipate future returns. Given the inclination of investment professionals to use style analysis as a tool, it is surprising that it was not until 1997 when it was first noted and there were no explicit measures of confidence intervals on the resultant coefficients or style weights (Lobosco and DiBartolomeo, 1997). They developed a formula to measure the "confidence intervals" of various style weights and recommended using daily return data, as opposed to the more commonly used monthly data. The argument for using daily data rather than monthly data is that the lower volatility would result in a reduction in confidence intervals, deriving more precise weights. Intuitively this makes sense but no empirical evidence was provided to support the claim and to show that daily data significantly improve the results obtained using RBSA. The notion of using daily data rather than monthly data in order to improve the quality and timeliness of RBSA has subsequently been supported empirically (Hardy, 2003). However, in this study, issues of computing unbiased estimates in the presence of the GARCH processes (an expectation when using daily return data) were not addressed.

In a critical analysis of RBSA (using US data for the period 2000:01 through 2002:12 for 1909 mutual funds), confidence intervals were generated for the estimates without imposing traditional RBSA coefficient restrictions such as constraining the coefficients to be non-negative (Kaplan, 2003). Another acknowledged criticism of the Lobosco and DiBartolomeo approach is that they fail to display asymptotic results for the distribution of the estimates, thus, the usefulness of the standard errors that they report is not clear (Rekenthaler, Gambera and Charlson, 2004).

However, despite the constant support and enhancement of RBSA as a tool for accurately implementing a targeted portfolio mix it must be remembered that the approach is somewhat controversial in that, the technique used for fund analysis is dramatically different from the traditional method of fundamental analysis. While some aspect of fundamental analysis looks at accounting based characteristics of individual portfolio holdings, RBSA uses only historical returns relative to a passive benchmark. Sharpe himself identified potential problems with his own technique when he critiqued his own approach (Sharpe, 1988). He stated that RBSA is not a tool, which would allow

[1] William Sharpe originally used the expressions "effective asset mix" and "attribution analysis" to describe what is now commonly referred to as return based style analysis (RBSA).

the user to dissect a creature to determine if its DNA belonged to that of a duck, but as a tool it would allow the user to identify if it at least had sufficient duck-like characteristics to qualify.

1.2. RBSA as a tool for the misguided. Ample research evidence exists supporting the claim that many of today's managed funds are misclassified with respect to style (Brown and Goetzmann, 1997; DiBartolomeo and Witkowski, 1997; Kim, Shukla and Thomas, 2000). Consequently, any conclusions drawn by investors and researchers using the stated style objectives may be somewhat misleading.

In the last decade alone the number of managed funds available in Australia has increased rapidly. It is not yet apparent as to why managed funds are unclear about their investment policy, even though plenty of conjecture exists as to the reasons why (Chan, Chen and Lakonishok, 2002). A possible reason for vagueness in the stated objective of the managed fund can be attributed, in Australia in particular (which has a reputation for a high level of litigious activity), to law suit avoidance. While temporary deviations from the style are often observed, and to be expected, the official investment objective is rarely changed. As a result the stated objectives for managed funds are often not that stringent and allow a degree of flexibility and interpretation. To illustrate this we provide a quote from the 2006 Perpetual Wholesale Funds Product Disclosure Statement. Its main objective is stated as follows: "The aim is to provide long-term capital growth and income through investment in quality Australian industrial and resource shares" (Perpetual Wholesale Funds, 2006, page 10).

Another plausible but yet to be proven reason for having misleading fund style names or style objectives is to cloud the investor's notion in regard to the risk associated with a particular strategy. This is not to imply that funds are deliberately misleading their client base but instead wish to keep asymmetric information just that, asymmetric. As DiBartolomeo and Witkowski (1997, p. 34) phraze it: "The easiest way to win a contest for the largest tomato is to paint a cantaloupe red and hope the judges do not notice. In other words, identification of exposures to relevant style or risk factors is of importance for individual and institutional investors alike".

Other similar studies (Brown and Goetzmann, 1997; DiBartolomeo and Witkowski, 1997) used realized fund returns as inputs for their analysis on US mutual funds. The results were consistent in that each study supported the claim that up to 40 percent of managed funds are in one way or another misclassified on style. A more recent study (Kim, Shukla and Thomas, 2000, p. 319) reported style misclassification as high as 50 percent when taking into account other fund attributes such as income ratio or percentage invested in shares rather than relying on simple risk and return measures.

1.3. RBSA in USA and now in Australia. Academic coverage of RBSA in the Australian managed fund industry has been extremely limited in comparison with the extensive amount of US literature that exists. Moreover, the methodologies adopted, and both the size and quality of the data are also generally less developed in Australia. Strategic asset allocation is the dominant force or style in determining total portfolio outcomes in the Australian context. The landmark paper in this area is a famous US study (Brinson, Hood and Beebower, 1986). In this paper it was identified for the first time that a portfolio's asset allocation is the major determinant of portfolio return variability and that security selection and market timing play only minor roles. Analyzing quarterly return data of 91 large pension funds over the period of 1974-1983 the authors conclude that 94% of the variability of total portfolio returns is explained by the strategic asset allocation (Brinson, Hood and Beebower 1986, p. 43).

In a more recent study by the Vanguard Group, Inc. a more in-depth analysis was carried out using a larger more robust data set involving the returns of US pooled fund managers relative to their benchmarks (The Vanguard Group, 2003). A summary of the key findings of this US study are provided by Brennan (2003). Brennan also referred to the current Australian experience and identified that Vanguard Group Australia had contemplated extending the US research to the Australian market. The aim of that proposed Vanguard study was to analyze a deep, long-dated and robust database of returns for Australian superannuation funds, comparing those returns to their own benchmark returns, while segmenting results between fund characteristics. However, no such historical database exists for Australian managed (non-superannuation) funds. As an alternative to the stated aims of the study, The Vanguard Group analyzed the Mercer Pooled Fund of balanced and growth funds over the time period July 1994 through June 2003 relative to each fund's benchmark returns. The results were found to be highly consistent in that (i) fund returns were lower, on average, than benchmark returns, (ii) the volatility of fund returns were higher, on average, than the volatility of benchmark returns (iii) 91% of the variability of (total) fund returns were explained by the benchmark returns (Brennan 2003, p. 3). Like the seminal paper by Brinson et al. and subsequent research that followed, in the Vanguard study asset allocation was found to be the

critical element with market timing and security selection playing less of an important role.

2. Research design and data

2.1. Returns based style analysis (RBSA). RBSA is based on the regression of a portfolio's historical return performance against a variety of benchmarks to determine what the appropriate benchmark mix for a given product should be. Put simply, it is an accepted approach for determining an appropriate benchmark (Travis, 2004). The main advantage of this type of analysis is that it provides a useful tool for tracking how "loyal" a portfolio is to its stated style by comparing its regressed style benchmark over a period of time. The underlying concept of the RBSA is easy to follow in that whatever spin is used to explain a funds performance over a period of time by a fund manager, the only tangible element that should be trusted by institutional investors and individual investors is the audited historical performance of that fund. Comparison between historical returns can thus be made with a series of passive indices allowing for identification of the optimal combination of indices that would allow for the closest possible replication of a funds actual performance over a specified period of time. RBSA involves the use of constrained quadratic programming for solving the asset allocation problem. However, application is far easier than it sounds. Anybody with access to Excel and the available add-in feature Solver can carry out the analysis. In addition to the use of a computer and the Excel software all that is required are managed fund and benchmark returns.

2.2. The original mode. From a modelling perspective the RBSA is an application of an asset-class factor model. This paper will initially introduce the generic factor model in equation (1) before adapting it so that it may be applied in style analysis in equation (2):

$$\widetilde{R}_i = \left[b_{i1}\widetilde{F}_1 + b_{i2}\widetilde{F}_2 + .. \ ... + b_{in}\widetilde{F}_n\right] + \widetilde{e}_i. \qquad (1)$$

$\widetilde{R}_i$ represents the return on asset *i*, $\widetilde{F}_1$ represents the value of factor 1, $\widetilde{F}_2$ represents the value of factor 2, $\widetilde{F}_n$ represents the value of the nth (the final) factor, and $\widetilde{e}_i$ the "non-factor" component of the return on asset *i*. An underlying assumption with the asset class factor model is that the non-factor return for one asset (e.g., $\widetilde{e}_i$) is assumed to be uncorrelated with that of all others (e.g., $\widetilde{e}_j$). As a result of this, it is apparent that the only source of correlation among returns lies with the factors. The remaining values (b_{i1} through to b_{in}) represent the sensitivity of asset *i* to factors $\widetilde{F}_1$ through to $\widetilde{F}_n$.

Each factor in the model represents the return generated for an asset class. In addition the sensitivities (b_{ij} values) are also required to sum to 1 (100%). With reference to equation (1) the return on asset *i* is represented as a return on a portfolio (calculated by summing the terms in the bracket on the RHS of equation (1)) invested in *n* asset classes plus a residual component e_i. This residual component explains the return attributable to selection whereas the sum of terms within the brackets attempts to explain the return due to style.

In this paper, we have concentrated on funds that do not maintain net short positions in any asset class[1]. The generic factor model (1) introduced above can be rewritten as follows:

$$\widetilde{e}_i = \widetilde{R}_i - \left[b_{i1}\widetilde{F}_1 + b_{i2}\widetilde{F}_2 + ... \ ... \ + b_{in}\widetilde{F}_n\right]. \qquad (2)$$

In equation (2) $\widetilde{e}_i$ represents the difference between the managed fund return and selection. In order for style to be identified, the variance of the residual return $\widetilde{e}_i$ must be minimized subject to the following constraints:

$$\sum_{i=1}^{n} b_{ik} = 1 \text{ for any fund } i \text{ and fund class } k, \qquad (2.1)$$

and $0 < b_{ik} < 1$. (2.2)

The usefulness of the asset class factor model is only as good as the asset classes selected for its implementation. As stated by Sharpe (1992, p. 8)[2] "while not strictly necessary, it is desirable that such asset classes be 1) mutually exclusive, 2) exhaustive, and 3) have returns that "differ".

Given constraint (2.1) and (2.2), the coefficients found in equation (2) will resemble the weights within a stated portfolio. The fund returns are then measured against the style-based passive benchmark (calculated by summing the terms in the bracket on

[1] Funds known to employ short positions would invoke other bounds. The Australian hedge fund industry has shown strong growth during the period up to June 2004. However, as total funds (approximately $15½ billion) in this sector is small at 2% of total funds under management funds (McNally, Chambers and Thomson, 2004, p. 57) employing net short positions are excluded from the sample as their net asset value is insufficient to satisfy the criteria outlined for selection.

[2] Ideally, each should represent a market-capitalization weighted portfolio of securities: (i) no security should be included in more than one fund class, (ii) as many securities as possible should be included within each fund class, (iii) the fund classes should have low correlations with one another, or, in cases where high correlations exist, significantly different standard deviations are essential (Sharpe, 1992).

the right hand side of equation (2)). In other words, the left hand side is equal to the difference between the return on the fund and that of the passive portfolio with the same style. This difference is referred to as the fund's "tracking error" and its variance is treated as the fund's "tracking variance".

The objective of this analysis is not to minimize (maximize) the average value of this difference in order to make the fund look bad (good). Instead the purpose is to generate as much information as possible regarding the exposure of a fund to a change in the return of an asset class. Once quadratic programming[1] is used on equation (2), the proportion of variance "explained" by the selected asset classes, for fund *i* may be obtained using equation (3) below.

$$R^2 = 1 - \frac{Var(\tilde{e}_i)}{Var(\tilde{R}_i)}. \quad (3)$$

The right-hand side of equation (3) represents the difference between 100% and the proportion of variance "unexplained". The left-hand side indicates the proportion of the variance "explained" by the *n* asset classes.

The Sharpe ratio has become a standard risk measurement tool in finance since its inception in 1962. In order to use the Sharpe ratio correctly the return on a benchmark that has the same sort of risk exposure to asset classes as that of the managed fund under investigation should be subtracted so that the average difference can be obtained. The average difference in performance can then be divided by the standard deviation of the difference in performance. This is commonly referred to as the "information ratio". Equation (4) illustrates the value added (subtracted) through active management per unit of added risk for monthly data.

$$Information\ ratio\ (IR) = MIR \times 12. \quad (4)$$

MIR denotes the monthly information ratio and can be found by dividing the monthly mean return by the standard deviation of monthly return $E(\tilde{e}_i) / \sigma_{\tilde{e}_i}$.

The monthly mean returns can then be measured for statistical significance using t-statistics to test the following null hypothesis: H_0: IR = 0.

The style weights that result from performing a style analysis can be thought of as estimates of the true style-weight combination of market indices. The standard deviations of the estimates are approximated using the following formula:

$$\sigma_{wi} = \frac{\sigma_a}{\sigma_{Bi} \times \sqrt{n-k-1}}. \quad (5)$$

In equation (5) *i* represents the index corresponding to the style weight being estimated, σ_a is the standard deviation of the style analysis, σ_{Bi} denotes the "unexplained RBSA index volatility" for index *i*, *n* – the total number of returns used in the style analysis, and *k* – the number of market indices with non-zero style weights. Before the calculation of the standard deviation first σ_{Bi} is calculated by subtracting the returns on the RBSA index for market index *i* analyzed against all market indices exclusive of *i* from the returns on market index *i*.

2.3. Six-fund class model. RBSA requires identification of both dependent and independent variables in order for the analysis to be carried out. The dependent variable is represented by the continuous compounding return for each managed fund. The independent variables are represented by a series of continuous compounded returns for specific asset classes invested in by fund managers.

The model developed for this study uses six asset classes. The return of each is represented by a market capitalization weighted index of the returns for the securities that are included within each asset class. The asset classes that represent the investment universe are identified in Table 1. These indices are widely cited by Australian investment managers, institutional investors and asset consulting firms as appropriate benchmarks for the defined asset classes (Faff, Gallagher and Wu, 2005). The decision to use widely cited benchmarks in this study for determining style weights is appropriate given recent findings that analyzed differences in behavior of commonly used style indices and reported only minor differences (Puttonen and Seppa, 2007).

Table 1. Benchmark indices employed as asset class proxies

Asset class	Code	Benchmark index
Australian equities	AEQ	S&P/ASX 300 Accumulation Index
International equities	IEQ	MSCI (ex-Australia) Index in $A (net dividends reinvested)
Listed property	LP	S&P/ASX 300 Listed Property Accumulation Index *
Australian bonds	AFI	UBS Warburg Composite Bond Index
Overseas bonds	OFI	Salomon Smith Barney World (ex Australia)
Cash	CASH	UBS Warburg Bank Bills Index

Notes: * ASX property trusts – Total Return Index was used prior to 1 April 2000.

[1] This study uses the gradient method (Sharpe, 1987). An alternative to the approach adopted in this paper could involve the implementation of the Markowtiz' critical line method (Markowitz, 2000). Even though it has been acknowledged that the Sharpe method produces only an approximate solution, differences between the results obtained with the latter method have been proved to be of no practical significance.

2.3. Data. This study employs monthly end-of-month entry price (buy price) data for a total of 50 managed Australian funds in the period from January 1998 to December 2002. Qualifying funds were based on those with the largest net asset value (NAV) as of 31 December 2002 and with at least five years of return and entry price data. RBSA requires at least sixty months of consecutive data for each fund (Sharpe, 1988; Sharpe, 1992). The time period selected for this study is of importance to the managed fund literature, as it was a period that resulted in a dramatic increase in regards the total number of funds under management in Australia. The time period of 1998-2002 saw the volume of funds under management increase in excess of $200 billion Australian dollars (Moodie and Ramsey, 2004, p. 4). This growth is due to Australia maintaining one of the most progressive Government-led retirement provision policies in the world. Entry price was selected as the measure of the performance as it reflects the actual amount of capital a fund manager has to invest. Table 2 provides a composition of the sample data.

Table 2. Composition of sample data (for the period from January 1998 to December 2002)

Classification	No. of funds	Percentage
Share funds	20	40.00%
Diversified funds	16	32.00%
Bond funds	7	14.00%
Property funds	5	10.00%
Cash funds	2	4.00%
Total funds	50	100.00%

The Morningstar Total Access database was used for this study. The database is comprehensive and provides daily, monthly and annual returns for 635 Australian managed funds (as of December 31st, 2002) with 60 observations. As a result of the large volume of data readily available the sample was further restricted to the largest 50 Australian managed funds as determined by their NAV[1]. Table 3 presents descriptive statistics of the managed funds sampled as sorted by category and market capitalization. The top 50 funds market capitalization as illustrated in Table 3 is representative of the market. The market capitalization of the top 50 funds increased approximately 270% over the sample period (18 billion to 66 billion) compared to the total managed fund industry that increased approximately 200% (315 billion to 967 billion) over the same time period (Meagher, 2003).

3. Empirical results

Summary statistics are provided in Table 4. The usefulness of the model is only as good as the asset classes selected for its implementation. It is imperative that an appropriate benchmark is identified in order for RBSA to provide reliable results. Table 4 provides mean, standard deviation and correlation coefficients between the asset class returns.

From Table 4 it is evident that no two asset classes are perfectly correlated. The fact that the highest correlation between two asset classes is 0.724 is encouraging and provides confidence that results obtained will be reliable and informative. The lower the correlation between asset classes is, the greater the diversification and hence the less likely managed funds will be classified in two or more of the asset classes used as benchmarks. To further reassure that our results are robust and reliable we refer to the strength of the relationship that exists between the S&P/ASX Accumulation Index and MSCI World Index (0.724) in Table 4 and the strength of the relationship that exists between UBS Warburg Composite Bond Index and Salomon Smith Barney World Govt. Bond Index (0.680). An examination of the summary statistics with respect to return and standard deviation illustrates further that these asset classes are different. Regardless of whether we examine monthly or annualized measures it is reassuring that these descriptive statistics are significantly different and as a result the requirements as stipulated by Sharpe are satisfied. Using equations (2) through (5) the style analysis was carried out and evaluated using Excel and Excel Solver[2]. For each of the funds included within the sample, the degree of style and degree of selection were calculated. The estimated style weights were then approximated and the standard deviation was found for each. The unexplained RBSA index volatility was then used to examine in more detail one specific fund, namely Perpetual's Wholesale – Australian Fund. Perpetual investments was used as an example because it is one of Australia's leading investment managers, with over 25.2 billion funds under management and more than 155,000 investors (Perpetual Investment Management Limited, p. 4). Confidence intervals are calculated for each of the sampled managed funds. Results of the RBSA are shown in Table 5 and Table 6.

[1] The sample size that satisfied the criteria outlined numbered 52. Deutsche – Wholesale Property Fund was excluded due to management's inability to clearly define objectives, strategies and asset allocation within the Morningstar Total Access Database. Macquarie ADF Super/Rollover Fund were excluded, as unit price data were not available for the sample period.

[2] A thorough discussion of the RBSA model developed in Excel and then formulated using the add-in feature Excel solver is provided as an appendix to this paper. The appendix can be obtained directly by contacting one of the authors.

Table 3. Listed managed funds – sorted by category and market capitalization

Fund	Fund name	Category	Morningstar ticker	31/12/2002 Market cap ($m)	5-yr monthly Mean return	5-yr monthly Std. deviation	Coefficient of variation
01	Col First State Wholesale – Imputation Fund	Share fund	3405	$6,110.77	0.87%	3.55%	4.0573
02	Col First State Mgd Inv – Imputation Fund	Share fund	1598	$3,201.55	0.80%	3.59%	4.4912
03	Col First State Wholesale – Australian Share Fund	Share fund	3404	$2,898.47	0.67%	3.55%	5.3136
04	Perpetual's – Industrial Share Fund	Share fund	1820	$2,500.60	0.78%	2.83%	3.6464
05	Perpetual's Wholesale – Industrial Fund	Share fund	4362	$2,500.60	0.86%	2.82%	3.2998
06	Vanguard Wholesale – Int'l Shares Index Fund	Share fund	4489	$1,985.23	0.16%	4.20%	25.8566
07	Col First State Wholesale – Industrial Share Fund	Share fund	5514	$1,942.15	0.75%	3.68%	4.9149
08	Merrill Lynch – Wholesale Imputation Fund	Share fund	3461	$1,543.30	0.63%	3.58%	5.6752
09	UBS – Australian Share Fund	Share fund	3352	$1,219.40	0.91%	3.33%	3.6794
10	Col First State Mgd Inv – Future Leaders Fund	Share fund	3672	$914.36	1.18%	4.75%	4.0321
11	Vanguard Wholesale – Aust'n Shares Index Fund	Share fund	4488	$849.32	0.57%	3.30%	5.7741
12	Col First State Wholesale – Geared Share Fund	Share fund	4715	$814.74	1.23%	6.77%	5.4815
13	Col First State Wholesale – Leaders Fund	Share fund	3878	$780.22	0.81%	3.34%	4.1332
14	Merrill Lynch – Imputation Fund	Share fund	1083	$705.97	0.55%	3.61%	6.5869
15	Perpetual's Wholesale – Smaller Companies Fund	Share fund	4363	$664.20	1.27%	3.26%	2.5630
16	Advance – Imputation Fund	Share fund	33	$630.98	0.71%	3.09%	4.3525
17	BT – International Fund	Share fund	215	$627.47	-0.00%	4.86%	-3.2986
18	BT – Australian Share Fund	Share fund	218	$617.42	0.23%	3.66%	15.7605
19	Perpetual's Wholesale – Australian Fund	Share fund	4361	$583.00	0.93%	3.03%	3.2482
20	Col First State Wholesale – Global Resources Fund	Share fund	4713	$574.04	1.49%	5.81%	3.9092
21	Col First State Wholesale – Diversified Fund	Diversified fund	3484	$5,955.79	0.56%	2.37%	4.2077
22	Col First State Wholesale – Balanced Fund	Diversified fund	4714	$1,942.41	0.68%	1.78%	2.6099
23	Col First State Wholesale – Conservative Fund	Diversified fund	4189	$1,756.86	0.56%	0.98%	1.7515
24	Merrill Lynch – Wholesale Balanced Fund	Diversified fund	2798	$1,644.63	0.34%	2.32%	6.7997
25	Commonwealth PensionSelect – Managed	Diversified fund	2928	$1,059.34	0.40%	1.79%	4.4676

Table 3 (cont.). Listed managed funds – sorted by category and market capitalization

Fund	Fund name	Category	Morningstar ticker	31/12/2002 Market cap ($m)	5-yr monthly Mean return	5-yr monthly Std. deviation	Coefficient of variation
26	Col FCL Supermanagement – Stable Fund	Diversified fund	2316	$930.10	0.40%	0.88%	2.1765
27	Commonwealth Pers Super & RO – Managed	Diversified fund	2046	$911.92	0.33%	1.65%	4.9332
28	State Super Pers Retirement – Growth Fund	Diversified fund	4819	$874.30	0.19%	2.57%	13.2861
29	Col First State Mgd Inv – Diversified Fund	Diversified fund	1599	$830.38	0.49%	2.31%	4.7060
30	Commonwealth Life Rollover – Managed Fund	Diversified fund	2079	$794.90	0.33%	1.65%	4.9332
31	Westpac – Balanced Growth Fund	Diversified fund	1942	$754.70	0.38%	1.94%	5.0402
32	Westpac – Moderate Growth Fund	Diversified fund	1941	$712.83	0.39%	1.03%	2.6490
33	Commonwealth PensionSelect – Balanced	Diversified fund	3984	$672.79	0.43%	0.70%	1.6373
34	Perpetual's Wholesale – Balanced Growth Fund	Diversified fund	4756	$658.80	0.54%	2.06%	3.8290
35	Commonwealth Pers Super & RO – Growth	Diversified fund	4004	$596.85	0.38%	1.88%	4.9767
36	State Super Pers Retirement – Balanced Fund	Diversified fund	2230	$508.25	0.32%	1.80%	5.6046
37	Col First State Wholesale – Diversified F/I Fund	Bond fund	4712	$1,524.53	0.51%	1.03%	2.0386
38	Vanguard Wholesale – Aust Fixed Interest Index	Bond fund	4487	$1,500.48	0.55%	1.07%	1.9562
39	Col First State Wholesale – Australian Bond Fund	Bond fund	4122	$1,125.85	0.54%	1.13%	2.0973
40	AMP Wholesale – International Bond Fund	Bond fund	4198	$703.67	0.60%	0.94%	1.5634
41	AMP Wholesale – Australian Bond Fund	Bond fund	4193	$686.28	0.52%	1.13%	2.1900
42	ANZ – Cash Plus Fund	Bond fund	6110	$679.75	0.43%	0.11%	0.2629
43	Macquarie Master – Fixed Interest Fund	Bond fund	3980	$626.80	0.50%	1.12%	2.2563
44	Col First State Wholesale – Property Securities	Property fund	3482	$2,178.11	0.95%	2.69%	2.8356
45	Challenger – Howard Mortgage Trust	Property fund	485	$1,532.92	0.48%	0.05%	0.1127
46	AMP Wholesale – Listed Property Trusts Fund	Property fund	4678	$849.93	0.96%	2.67%	2.7901
47	Perpetual's – Monthly Income Fund	Property fund	1469	$825.70	0.46%	0.04%	0.0842
48	AXA – Australian Income Fund	Property fund	981	$728.83	0.42%	0.06%	0.1331
49	Commonwealth Life Rollover – Capital Secure Fund	Cash fund	2078	$752.60	0.30%	0.66%	2.1723
50	MLC Masterkey – Cash Management Trust	Cash fund	59	$704.52	0.33%	0.05%	0.1479

Table 4. Mean, standard deviation, correlation coefficients between the asset classes returns

Asset class	Accumulation	World	Listed	Composite	World govt.	Bank bills
S&P/ASX Accumulation Index	1.000					
MSCI World Index	0.724	1.000				
S&P/ASX Listed Property	0.470	0.229	1.000			
UBS Warburg Composite Bond Index	0.028	-0.226	0.429	1.000		
Salomon Smith Barney World Govt Bond Index	-0.229	-0.470	0.122	0.680	1.000	
UBS Warburg Bank Bills Index	0.040	-0.094	0.098	0.327	0.249	1.000

Asset class	Monthly		Annual	
	Mean return	Std. deviation	Mean return	Std. deviation
S&P/ASX Accumulation Index	0.63%	3.36%	7.79%	12.14%
MSCI World Index	-0.02%	5.05%	-0.25%	18.61%
S&P/ASX Listed Property	0.68%	2.85%	8.47%	10.23%
UBS Warburg Composite Bond Index	0.56%	1.07%	6.90%	3.77%
Salomon Smith Barney World Govt Bond Index	0.64%	0.81%	7.97%	2.83%
UBS Warburg Bank Bills Index	0.43%	0.06%	5.29%	0.19%

An overview of the asset allocation across the different fund types is presented in Table 5. Only self-classified share funds have substantial holdings in Australian Equities (71.5%). Funds which follow a "Diversified" approach to investment in general invested in locally listed companies but not to the extent thought prior to analysis (24.3%). Not surprisingly given the relative weakness of the Australian dollar over a substantial part of the sample period only 10.7% and 14.9% of funds available for shares (column IEQ, Table 5) and diversified funds (column IEQ, Table 5) were invested offshore respectively.

Remaining asset classes have no significant investment in equities at all whether they are Australian or international equities. Other observations of note include the surprising lack of investment in the property sector (column LP, Table 5) particularly given the buoyant market in Australia between 1997 and 2003. A particularly alarming feature of the RBSA is that number of the self-classified property funds that maintained minimal investment in the market at all. Instead they tended to opt for investment in low risk low return securities such as that offered in the cash market. This is an interesting phenomenon that needs greater investigation to find out again if any misclassification of funds has occurred within the sample examined. Bond funds tended to follow closely their stated objectives with heavy investment in Australian and overseas bond markets (approximately 82%). The majority of funds were invested locally. Again the weakness of the Australian dollar and higher yields made domestic markets more attractive than overseas markets. Cash funds predictably invested heavily in the Australian cash market.

In Table 5 it is demonstrated that most of the asset classes had comparable degrees of style (ranging between 75%-93%). An exception were the cash funds that had significantly higher degree of selection (45%) compared to that of style (55%). Even though the split of 55:45 makes intuitive sense we would have expected an even greater emphasis placed on selection rather than style given the nature of cash funds. This result could be biased due to a lack of cash funds included in our sample and could be corrected as greater observations are added.

The information ratio calculated for each of the funds (see Table 6) shows that many of the high asset backed funds underperformed relative to their benchmark over the sample period covered. According to Grinold and Kahn (1999), a top quartile manager has an information ratio of one half (0.50) or higher[1]. From examination of the funds within the sample only 12 fund managers would have been deemed to be doing a good job. The Information ratio is regarded as a straight forward way to evaluate the return fund managers achieve, given the risk they take on. Since this ratio considers the annualized standard deviation of both series (as measures of risks inherent in owning either the fund or the benchmark), the ratio shows the

[1] In their text "Active portfolio management – a quantitative approach for producing superior returns and constructing risk" Grinold and Khan (1999) state that "a top-quartile manager has an information ratio of one-half". For a symmetric distribution of information ratios, centered on zero refer to page 114 of their text. Here they stipulate that an Information Ratio = 0.5 indicates good performance, and an Information Ratio = 1.0 represents exceptional performance.

Table 5. RBSA results: style, selection and asset classification by fund

Fund	Style	Selection	AEQ	IEQ	LP	AFI	OFI	CASH	Fund	Style	Selection	AEQ	IEQ	LP	AFI	OFI	CASH
01	0.845	0.155	0.838	0.000	0.000	0.162	0.000	0.000	28	0.905	0.095	0.242	0.181	0.097	0.088	0.128	0.263
02	0.648	0.352	0.655	0.182	0.027	0.000	0.137	0.000	29	0.885	0.115	0.246	0.200	0.073	0.071	0.121	0.288
03	0.592	0.408	0.000	0.741	0.000	0.000	0.000	0.259	30	0.900	0.100	0.228	0.163	0.083	0.071	0.072	0.383
04	0.518	0.482	0.915	0.000	0.085	0.000	0.000	0.000	31	0.751	0.249	0.328	0.192	0.069	0.000	0.006	0.406
05	0.856	0.144	0.817	0.038	0.145	0.000	0.000	0.000	32	0.885	0.115	0.320	0.172	0.094	0.042	0.000	0.371
06	0.884	0.116	0.781	0.060	0.159	0.000	0.000	0.000	33	0.877	0.123	0.287	0.136	0.123	0.000	0.135	0.319
07	0.621	0.379	0.868	0.132	0.000	0.000	0.000	0.000	34	0.846	0.154	0.406	0.229	0.025	0.000	0.000	0.341
08	0.354	0.646	0.728	0.061	0.211	0.000	0.000	0.000	35	0.725	0.275	0.249	0.161	0.122	0.000	0.306	0.163
09	0.863	0.137	0.818	0.036	0.147	0.000	0.000	0.000	36	0.733	0.267	0.126	0.072	0.068	0.190	0.169	0.376
10	0.807	0.193	0.685	0.096	0.219	0.000	0.000	0.000	Diversified funds	0.846	0.154	0.243	0.149	0.094	0.080	0.100	0.334
11	0.802	0.198	0.765	0.038	0.181	0.000	0.008	0.008	37	0.928	0.072	0.000	0.013	0.025	0.961	0.000	0.000
12	0.799	0.201	0.856	0.014	0.130	0.000	0.000	0.000	38	0.694	0.306	0.022	0.000	0.000	0.374	0.470	0.135
13	0.807	0.193	0.864	0.010	0.127	0.000	0.000	0.000	39	0.950	0.050	0.000	0.000	0.006	0.007	0.004	0.982
14	0.801	0.199	0.706	0.026	0.053	0.028	0.187	0.000	40	0.991	0.009	0.000	0.000	0.007	0.993	0.000	0.000
15	0.801	0.199	0.802	0.000	0.028	0.046	0.093	0.031	41	0.954	0.046	0.008	0.027	0.014	0.884	0.066	0.000
16	0.805	0.195	0.718	0.016	0.055	0.027	0.184	0.000	42	0.987	0.013	0.000	0.001	0.007	0.992	0.000	0.000
17	0.515	0.485	0.574	0.004	0.216	0.000	0.207	0.000	43	0.999	0.001	0.003	0.000	0.000	0.984	0.013	0.000
18	0.944	0.056	0.962	0.000	0.001	0.000	0.036	0.000	Bond funds	0.929	0.071	0.005	0.006	0.008	0.742	0.079	0.160
19	0.990	0.010	0.951	0.006	0.034	0.008	0.000	0.000	44	0.799	0.201	0.000	0.000	0.790	0.199	0.011	0.000
20	0.665	0.335	0.000	0.676	0.000	0.000	0.000	0.324	45	0.992	0.008	0.000	0.003	0.000	0.000	0.000	0.998
Share funds	0.746	0.254	0.715	0.107	0.091	0.014	0.043	0.031	46	0.984	0.016	0.001	0.000	0.000	0.000	0.010	0.989
21									47	0.817	0.183	0.000	0.000	0.809	0.108	0.083	0.000
22	0.882	0.118	0.229	0.261	0.188	0.064	0.132	0.127	48	0.989	0.011	0.000	0.000	0.000	0.000	0.000	1.000
23	0.883	0.117	0.411	0.033	0.103	0.159	0.237	0.057	Property funds	0.916	0.084	0.000	0.001	0.320	0.061	0.021	0.597
24	0.833	0.167	0.225	0.007	0.057	0.021	0.092	0.599	49	0.909	0.091	0.00	0.00	0.00	0.00	0.00	1.000
25	0.884	0.116	0.229	0.265	0.207	0.106	0.087	0.106	50	0.185	0.815	0.00	0.03	0.01	0.05	0.07	0.850
26	0.900	0.100	0.228	0.163	0.083	0.071	0.072	0.383	Cash funds	0.547	0.453	0.000	0.013	0.004	0.025	0.034	0.924
27	0.864	0.136	0.052	0.090	0.029	0.167	0.045	0.617									

Table 6. RBSA results: information ratio by fund

Fund	Information ratio	t-statistic		Fund	Information ratio	t-statistic	
01	0.262	0.587		31	-0.255	-0.570	
02	-0.454	-1.015		32	0.457	1.021	
03	-0.110	-0.246		33	-0.924	-2.067	**
04	0.570	1.274		34	-0.780	-1.743	*
05	0.480	1.074		35	-0.398	-0.891	
06	0.205	0.458		36	-0.698	-1.560	
07	0.579	1.295					
08	0.655	1.464		37	-0.396	-0.885	
09	0.694	1.551		38	0.107	0.240	
10	0.365	0.816		39	-0.176	-0.394	
11	0.457	1.021		40	-0.661	-1.478	
12	-0.165	-0.368		41	-0.618	-1.383	
13	0.005	0.012		42	-1.691	-3.782	***
14	0.435	0.973		43	-1.016	-2.272	**
15	0.792	1.770	*				
16	0.642	1.435		44	2.960	1.911	*
17	0.938	2.097	**	45	-0.660	-1.475	
18	1.270	2.839	***	46	5.116	11.439	***
19	-0.562	-1.256		47	0.838	1.873	*
20	0.053	0.118		48	2.654	5.935	***
21	-0.486	-1.087		49	-14.149	-31.638	***
22	0.212	0.474		50	-0.746	-1.668	
23	0.482	1.078					
24	0.392	0.876		***	Significance at 1%		
25	0.528	0.012		**	Significance at 5%		
26	-0.752	-1.681	*	*	Significance at 10%		
27	-0.098	-0.219					
28	-0.356	-0.796					
29	-0.339	-0.759					
30	-0.752	-1.681	*				

risk-adjusted excess return over and above the benchmark.Only 4 funds obtain a ratio of greater than 1.0. Of the best performing funds three were listed property funds, namely Challenger – Howard Mortgage Trust (see Fund 46 Table 6), UBS – Australian Share Fund (see Fund 18 Table 6) and Perpetual's Wholesale Australian Fund (see Fund 15 Table 6). No similarities appear to exist between the better performing funds with respect to the information ratio and that of the other funds. Challenger – Howard Mortgage Trust has an unexplainably high allocation invested in cash. It is well documented that investing in T-bills provides for consistent income as a buffer during periods of economic uncertainty. However, the extent of the allocation in this particular asset class suggests something other than simple conservative investment practice. The investment practice of the remaining two funds is much easier to explain as a large proportion of the two funds (96% and 80%) have been invested in Australian equities to exploit the expected upturn in the Australian economy. The balance of funds have been invested in bonds and property in order to provide some stability in the form of income and potential capital gain with respect to the overheated global property market.

So that confidence intervals could be calculated for the funds included within the sample the two step approach adopted by Lobosco and DiBartolomeo is followed (Lobosco and DiBartolomeo, 1997). To illustrate how these measures are calculated, we consider the example of Perpetual's Wholesale – Australian Fund. Having carried out a broad style analysis using the six asset classes it was then necessary to determine the RBSA index for the asset class Australian equity (S&P ASX 300 – Total Return Index) that is composed of the other five indices. The standard deviation of the return series for the Australian equity index was then calculated relative to the RBSA index (which is termed the Unexplained RBSA index volatility). The procedure was then repeated for each of the remaining indices for the other five asset classes. The results are shown in Table 7.

Table 7. Unexplained RBSA index volatility

Index	Unexplained Sharpe style index volatility
S&P ASX 300 – tot return ind	2.06%
MSCI WORLD EX AU – tot return ind	3.50%
S&P/ASX 300 Real estate – tot return ind***	2.28%
UBS Composite all maturities – tot return ind	2.58%
CGBI (DISC) - SEE SBWNADU(RIHD) – tot return ind	0.59%
UBS Australianbank bills – all mats – price index	0.65%

The results in Table 8 are provided for Perpetual's Wholesale – Australian Fund and show, using the six market indices, an active standard deviation of 1.38 percent[1] a month for the fund relative to its RBSA index. The R^2 figure is 0.801 and the results indicate that for Index group one 80.18% should be allocated to Australian equities, 9.31% to overseas bonds, 4.62% to Australian bonds, 3.12% to cash and 2.77% to listed property.

As further information is revealed about the true investment behavior of a fund additional analysis can be carried out. For example, we are now informed in advance that Perpetual's Wholesale – Australian Fund refrains from investing in fixed income securities. The above analysis would then be repeated but with the absence of UBS Composite all Maturities Total Return Index and Salomon Smith Barney World (ex Australia) Government Bond Index. This calculation would produce the results in Table 8 shown in the row labeled Index Group Two. Our findings support those of Lobosco and DiBartolomeo, (1997) in that we identify a reduction in the cash weights standard deviation from removing the fixed income indexes. The results shown in the row labeled Index Group three are for the actual allocation based on 2002 annual reports. Also consistent with previous literature we find that the R^2 measure decreases as the number of indices decreases (Lobosco and DiBartolomeo, 1997). This result emphasizes the importance of finding a middle ground between the number of style weights and reliability of each of those weights.

Table 8. Style weights and volatility of style weights for Perpetual's Wholesale – Australian Fund

Perpetual's Wholesale – Australian Fund	AEQ	IEQ	LP	AFI	OFI	CASH
Index group I (All)	**80.18%**	**0.00%**	**2.77%**	**4.62%**	**9.31%**	**3.12%**
R^2 = 0.801	(9.12%)*	(5.37%)	(8.24%)	(7.28%)	(31.83%)	(28.89%)
Index group II (No fixed income but cash)	**79.04%**	**0.00%**	**4.50%**			**16.46%**
R^2 = 0.800	(8.94%)	(5.26%)	(8.08%)			(28.34%)
Index group III (actual)	**79.73%**		**2.54%**	**9.77%**		**7.95%**
R^2 = 0.799	(9.02%)		(8.15%)	(7.20%)		(28.58%)

Notes: * The approximated standard deviations for each of these style weights are shown in the parentheses below the designated weights. All numbers are in percentage.

Table 9[1] shows the confidence interval (upper and lower bounds) for returns calculated for each of the funds in the sample. This is a comprehensive table and as a result we will concentrate our analysis again on Perpetual's Wholesale-Australian Fund. From Table 9 Perpetual's Wholesale-Australian Fund has an asset allocation of 79.91% (Fund 15, column AEQ) invested in the S&P/ASX 300 Index, 9.91% (Fund 15, column AFI) invested in the UBS Composite All Maturities Index, 8.52% (Fund 15, column CASH) invested in the UBS Australian Bank Bills Index and 2.71% (Fund 15, column LP) invested in the S&P/ASX300 Real Estate Index. The confidence intervals obtained and outlined for Perpetual's Wholesale – Australian Fund and all other funds are consistent with one another in that the comparison of the actual allocations for the various funds with these confidence intervals indicates that the results lie within the 95% confidence interval.

The confidence interval results highlight the excellent performance of the share funds relative to all other funds given their orientation to invest primarily in Australian equities. Another observation is the startling behavior of some property funds to invest in low yielding cash securities, (namely AXA – Australian Income Fund, Challenger – Howard Mortgage Trust and Perpetual's – Monthly Income Fund) rather than maximizing investor wealth through investment in the specific funds preferred asset class as dictated by their investment guidelines.

As identified in existing literature the confidence intervals provide the measure that best describes the quality of fit for the individual style weights (Lobosco and DiBartolomeo, 1997). The creation of confidence intervals in conjunction with existing knowledge about current asset allocation allows for greater refinement with regard to the level of investment that should be made within each asset class.

[1] Using equation (5), the standard deviation of the RBSA index can be expressed as $\sigma_{wi} = \frac{1.38}{\sigma_{Bi} \times \sqrt{60-5-1}}$ for Index Group One. For Index Group One five indices had non-zero weight.

Table 9. Style weight confidence intervals

Fund	Fund name	Upper limit						Lower limit					
		AEQ	IEQ	LP	AFI	OFI	CASH	AEQ	IEQ	LP	AFI	OFI	CASH
01	Advance – Imputation Fund	84.13%	0.00%	0.00%	0.00%	0.00%	16.54%	83.81%	0.00%	0.00%	0.00%	0.00%	15.52%
02	BT – Australian Share Fund	86.11%	0.00%	0.00%	0.00%	0.00%	15.09%	85.53%	0.00%	0.00%	0.00%	0.00%	13.27%
03	BT – International Fund	0.00%	74.40%	0.00%	0.00%	0.00%	27.15%	0.00%	0.00%	0.00%	0.00%	0.00%	24.62%
04	Col First State Mgd Inv – Future Leaders Fund	100.00%	0.30%	0.00%	0.00%	0.00%	1.36%	99.57%	0.00%	0.00%	0.00%	0.00%	-1.00%
05	Col First State Mgd Inv – Imputation Fund	96.70%	1.50%	0.00%	0.00%	0.00%	2.70%	96.32%	0.00%	0.00%	0.00%	0.00%	1.50%
06	Col First State Wholesale – Australian Share Fund	94.71%	3.40%	0.00%	0.00%	0.00%	2.70%	94.37%	0.00%	0.00%	0.00%	0.00%	1.61%
07	Col First State Wholesale – Geared Share Fund	100.00%	0.00%	0.00%	0.00%	0.00%	1.72%	99.46%	0.00%	0.00%	0.00%	0.00%	-2.00%
08	Col First State Wholesale – Global Resources Fund	97.20%	2.90%	0.00%	0.00%	0.00%	2.90%	95.96%	0.00%	0.00%	0.00%	0.00%	-1.00%
09	Col First State Wholesale – Imputation Fund	96.30%	1.30%	0.00%	0.00%	0.00%	3.28%	95.94%	0.00%	0.00%	0.00%	0.00%	2.14%
10	Col First State Wholesale – Industrial Share Fund	89.40%	6.20%	0.00%	0.00%	0.00%	5.47%	88.94%	0.00%	0.00%	0.00%	0.00%	4.01%
11	Col First State Wholesale – Leaders Fund	88.03%	0.00%	0.00%	0.00%	0.00%	12.82%	87.62%	0.00%	0.00%	0.00%	0.00%	11.53%
12	Merrill Lynch – Imputation Fund	95.08%	0.00%	0.00%	0.00%	0.00%	5.82%	94.65%	0.00%	0.00%	0.00%	0.00%	4.45%
13	Merrill Lynch – Wholesale Imputation Fund	86.58%	1.08%	12.86%	0.17%	0.72%	0.66%	86.16%	0.83%	12.49%	0.00%	-1.00%	-1.00%
14	Perpetual's – Industrial Share Fund	70.81%	2.69%	5.47%	2.89%	19.30%	0.54%	70.47%	2.49%	5.16%	2.62%	18.20%	-1.00%
15	Perpetual's Wholesale – Australian Fund	79.91%	0.00%	2.71%	9.91%	0.00%	8.52%	79.55%	0.00%	2.38%	9.63%	0.00%	7.38%
16	Perpetual's Wholesale – Industrial Fund	73.24%	0.00%	4.87%	14.27%	0.00%	8.61%	72.90%	0.00%	4.56%	14.00%	0.00%	7.54%
17	Perpetual's Wholesale – Smaller Companies Fund	57.70%	0.55%	21.83%	0.25%	21.76%	0.98%	57.08%	0.19%	21.27%	0.00%	19.61%	-1.00%
18	UBS – Australian Share Fund	96.46%	0.00%	1.35%	0.00%	0.00%	2.69%	96.26%	0.00%	1.17%	0.00%	0.00%	2.06%
19	Vanguard Wholesale – Aust'n Shares Index Fund	95.97%	0.00%	3.35%	0.80%	0.00%	0.13%	95.89%	0.00%	3.27%	0.73%	0.00%	0.00%
20	Vanguard Wholesale – Int'l Shares Index Fund	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.78%	0.00%	0.00%	0.00%	0.00%
	Share funds												
21	Col First State Wholesale – Balanced Fund	41.16%	3.31%	10.39%	16.02%	23.96%	6.01%	40.98%	3.21%	10.24%	15.88%	23.36%	5.47%
22	Col First State Wholesale – Conservative Fund	22.53%	0.73%	5.73%	2.11%	9.42%	60.10%	22.41%	0.65%	5.62%	2.01%	8.99%	59.71%
23	Col First State Wholesale – Diversified Fund	23.06%	26.57%	20.80%	10.69%	9.04%	10.93%	22.84%	26.44%	20.61%	10.51%	8.28%	10.24%
24	Col First State Mgd Inv – Diversified Fund	12.81%	7.33%	6.95%	19.14%	17.69%	38.24%	12.37%	7.07%	6.56%	18.79%	16.19%	36.87%
25	Col FCL Supermanagement – Stable Fund	8.30%	6.83%	8.22%	22.67%	0.21%	54.37%	8.18%	6.76%	8.11%	22.58%	-0.21%	54.00%
26	Commonwealth Life Rollover – Managed Fund	22.86%	16.34%	8.37%	7.15%	7.49%	38.48%	22.72%	16.26%	8.24%	7.04%	7.00%	38.04%
27	Commonwealth PensionSelect – Balanced	5.26%	9.02%	2.89%	16.71%	4.68%	61.84%	5.17%	8.97%	2.82%	16.65%	4.40%	61.58%

Table 9 (cont.). Style weight confidence intervals

Fund	Asset code (refer page 74) =	Upper limit						Lower limit					
		AEQ	IEQ	LP	AFI	OFI	CASH	AEQ	IEQ	LP	AFI	OFI	CASH
28	Commonwealth PensionSelect – Managed	24.31%	18.15%	9.77%	8.88%	13.11%	26.53%	24.16%	18.06%	9.63%	8.76%	12.59%	26.06%
29	Commonwealth Pers Super & RO – Growth	24.68%	20.09%	7.41%	7.17%	12.42%	29.09%	24.51%	19.99%	7.25%	7.03%	11.81%	28.55%
30	Commonwealth Pers Super & RO – Managed	22.86%	16.34%	8.37%	7.15%	7.49%	38.48%	22.72%	16.26%	8.24%	7.04%	7.00%	38.04%
31	Merrill Lynch – Wholesale Balanced Fund	32.91%	19.24%	7.02%	0.12%	0.74%	41.50%	32.60%	19.06%	6.74%	0.00%	0.00%	40.52%
32	Perpetual's Wholesale – Balanced Growth Fund	32.10%	17.28%	9.53%	4.28%	0.33%	37.42%	31.91%	17.17%	9.36%	4.12%	0.00%	36.82%
33	State Super Pers Retirement – Balanced Fund	28.79%	13.68%	12.35%	0.07%	13.78%	32.16%	28.62%	13.58%	12.20%	0.00%	13.21%	31.64%
34	State Super Pers Retirement – Growth Fund	40.74%	22.93%	2.57%	0.10%	0.45%	34.49%	40.48%	22.78%	2.33%	0.00%	0.00%	33.68%
35	Westpac – Balanced Growth Fund	25.01%	16.14%	12.29%	0.11%	31.06%	16.74%	24.73%	15.98%	12.04%	0.00%	30.11%	15.88%
36	Westpac – Moderate Growth Fund	12.66%	7.24%	6.82%	19.02%	17.20%	37.79%	12.52%	7.16%	6.68%	18.91%	16.68%	37.32%
	Diversified bonds												
37	AMP Wholesale – Australian Bond Fund	0.00%	0.00%	0.00%	99.69%	0.00%	0.48%	0.00%	0.00%	0.00%	99.62%	0.00%	0.20%
38	AMP Wholesale – International Bond Fund	0.00%	0.00%	0.00%	62.14%	0.00%	38.20%	0.00%	0.00%	0.00%	62.00%	0.00%	37.66%
39	ANZ – Cash Plus Fund	0.00%	0.00%	0.00%	1.69%	0.00%	0.04%	0.00%	0.00%	0.00%	1.67%	0.00%	0.00%
40	Col First State Wholesale – Australian Bond Fund	0.00%	0.00%	0.00%	100.00%	0.00%	0.05%	0.00%	0.00%	0.00%	99.99%	0.00%	0.00%
41	Col First State Wholesale – Diversified F/I Fund	0.00%	0.00%	3.50%	87.58%	0.13%	9.09%	0.00%	0.00%	3.44%	87.52%	0.00%	8.86%
42	Macquarie Master – Fixed Interest Fund	0.00%	0.00%	0.00%	100%	0.00%	0.05%	0.00%	0.00%	0.00%	99.99%	0.00%	0.00%
43	Vanguard Wholesale – Aust Fixed Interest Index	0.33%	0.00%	0.01%	98.36%	1.35%	0.02%	0.31%	0.00%	0.00%	98.35%	1.31%	0.00%
	Bond (fixed income) bonds												
44	AMP Wholesale – Listed Property Trusts Fund	0.00%	0.00%	83.84%	0.00%	0.00%	16.83%	0.00%	0.00%	83.54%	0.00%	0.00%	15.79%
45	AXA – Ausralian Income Fund	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.98%
46	Challenger – Howard Mortgage Trust	0.06%	0.00%	0.00%	0.00%	0.00%	99.96%	0.05%	0.00%	0.00%	0.00%	0.00%	99.93%
47	Col First State Wholesale – Property Securities	0.16%	0.00%	85.32%	0.00%	0.00%	15.32%	0.00%	0.00%	85.03%	0.00%	0.00%	14.33%
48	Perpetual's – Monthly Income Fund	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.98%
	Property funds												
49	MLC Masterkey – Cash Management Trust	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%
50	Commonwealth Life Rollover – Capital Secure Fund	0.00%	0.00%	0.00%	6.75%	0.00%	93.59%	0.00%	0.00%	0.00%	6.61%	0.00%	93.05%
	Cash funds												

Conclusion

This paper fills the void that currently exists in the Australian managed fund literature by addressing the importance of RBSA as a tool for wealth optimization. Asset allocation strategies are investigated by approximating confidence intervals for estimated style weights. Also the importance of identifying an appropriate benchmark index is highlighted. This paper differs from the contribution of existing work as we carry out RBSA and then determine acceptance and rejection of asset classes on the basis of t-statistics. The Information Ratio for fund managers is also investigated.

Findings show that self-classified share funds are invested substantially in Australian domestic equities. A heavy emphasis was also found to exist with regard to investment in Australian domestic equities across the other asset classes. An explanation for this was due to the expectation of an upturn in the Australian economy. Additionally the findings indicate that most of the asset classes had comparable degrees of style (75%-93%) with the exception of cash funds which had significantly higher degree of selection (45%). The results in this paper support the original claims made by Lobosco and DiBartolomeo that a reduction in the cash weights standard deviation from removing the fixed income indices hold and that the R^2 measure decreases as the number of indices decreases.

Practitioners and users of RBSA have often used the R^2 statistic as a measure of the goodness of fit. However, increasingly since it was found that confidence intervals for individual style weights further enhanced the reliability of RBSA (Lobosco and DiBartolomeo, 1997) these measures have been constructed. The construction of confidence intervals is of use in a practical sense as it allows for broad statements to be made regarding the statistical significance of results. Due to concerns that have been bought to the market's attention regarding the misclassification of funds these style weights and confidence intervals (to generate enhanced robustness of results) provide a further tool for validating investment practices.

Fund manager performance was measured by way of the information ratio and found that the majority of fund managers (76%) were underperforming their appropriate benchmark. The fund managers that were found to perform better than most were those in control of listed property trusts.

A number of issues were identified that require additional investigation. Firstly, further work is required regarding the potential misclassification of funds within Australia (particularly for the case of self-classified portfolio funds). Secondly, a systematic comparison of confidence intervals around style weights is required using several approaches as well as using parametric and non-parametric bootstrapping methods to further test the claims made by Lobosco and DiBartolomeo.

References

1. Brennan, J. Asset Allocation Rules, OK. Masthead Vanguard Investments, 2003. – pp. 1-3.
2. Brinson, G.L., Hood, L., G. Beebower. Determinants of Portfolio Performance // *Financial Analysts Journal*, 1986. – Vol. 42, No. 4. – pp. 39-44.
3. Brown, S., W. Goetzmann. Mutual Fund Styles // Journal of Financial Economics, 1997. – Vol. 43, No. 3. – pp. 373-399.
4. Chan, L.H., Chen U., Lakonishok, J. On Mutual Fund Investment Styles // The Review of Financial Studies, 2002. – Vol. 15, No. 5. – pp 1407-1437.
5. Christopherson, J. Equity Style Classifications // Journal of Portfolio Management, 1995. – Vol. 21, No .3. – pp. 32-43.
6. Daniel, K., M. Grinblatt, S. Titman, W. Russ. Measuring Mutual Fund Performance with Characteristic-Based Benchmarks // *Journal of Finance*, 1997. – Vol. 52, No. 3. – pp. 1035-1058.
7. DiBartolomeo, D., E. Witkowski. Mutual Fund Misclassification: Evidence Based on Style Analysis // *Financial Analysts Journal*, 1997. – Vol. 53, No. 5. – pp. 32-43.
8. Faff, R., D. Gallagher, E. Wu. Tactical Asset Allocation: Australian Evidence // *Australian Journal of Management*, 2005. – Vol. 30, No. 2. – pp. 261-282.
9. Grinold, R., R. Khan. Active Portfolio Management: A Quantitative Approach for Providing Superior Returns and Controlling Risk, Second Edition, New York: McGraw-Hill, 1999.
10. Hardy, R. Style Analysis: A Ten-Year Retrospective and Commentary. Chapter 4 in Handbook of Equity Style Management, Third Edition, T.D. Coggin and F.J. Fabozzi, New Jersey: John Wiley & Sons, 2003.
11. Kaplan, P. Holdings-Based and Returns-Based Style Models. Morningstar Research Report, June, 2003. – pp. 1-21.
12. Kim, M.R., Shukla, R., M. Thomas. Mutual Fund Objective Misclassification // *Journal of Economics and Business*, 2000. – Vol. 52, No. 4. – pp. 309-323.
13. Larrymore, N., J. Rodriguez. Active Fund Management: Global Asset Allocation Funds // *Journal of Multinational Financial Management*, 2007. – Vol. 17, No. 3. – pp. 244-256.
14. Lhabitant, F. Styles, Clusters and Classification. Chapter 9 in Hedge Funds Quantitative Insights, New Jersey: John Willey & Sons Ltd., 2004.
15. Lobosco, A., D, DiBartolomeo. Approximating the Confidence Intervals for Sharpe Style Weights // *Financial Analysts Journal*, 1997. – Vol. 53, No. 4. – pp. 80-85.

16. Markowitz, H. Efficient Sets for Nondegenerate Models, Chapter 7 in Mean-Variance Analysis in Portfolio Choice and Capital Markets, Frank J. Fabozzi Associates, 2000.
17. Meagher, A. 2003. Managed Funds in Australia' Axis Australia, A division of Invest Australia, document downloaded 31st July 2006, http://staging.investaustralia.hyperlink.net.au/media/managedfundsdatafile.pdf
18. McNally, S., M. Chambers, C. Thompson. The Australian Hedge Fund Industry // *Financial Stability Review*, 2004, September. – pp. 57-65.
19. Moodie, G., I. Ramsey. Managed Investments – An Industry Report. Legal Studies Reserach Paper. Melbourne, 2004, The University of Melbourne. – pp. 1-110.
20. Perpetual Investment Management Limited, Product Disclosure Statement, 2006, pp. 1-71, document downloaded 26th September 2007, http://www.perpetualinvestments.com.au/pdf/P512-WS.pdf
21. Puttonen, V., T. Seppa. So Style Benchmarks Differ? // Journal of Asset Management, 2007. – Vol. 7, No. 6. – pp. 425-428.
22. Rekenthaler, J., M. Gambera, J. Charlson. Estimating Portfolio Style in U.S. Equity Funds. // Morningstar Research Report, 2004, February. – pp. 1-21.
23. Sharpe, W. An Algorithm for Portfolio Improvement. in Advances in Mathematical Programming and Financial Planning, K.D. Lawrence, J.B. Guerard, Jr., and G.D. Reeves, JAI Press, Inc., 1987. – pp. 155-170.
24. Sharpe, W. Determining a Fund's Effective Asset Mix // *Investment Management Review*, 1988. – Vol. 2, No. 6. – pp 59-69.
25. Sharpe, W. Asset Allocation: Management Style and Performance Measurement // *Journal of Portfolio Management*, 1992. – Vol. 18, No. 2. – pp. 7-19.
26. The Vanguard Group Inc. 2003. Sources of Portfolio Performance: The Enduring Importance of Asset Allocation. Vanguard Investment Counselling & Research, July: 1-12.
27. Tierney, D., K. Winston. Using Generic Benchmarks to Present Manager Styles // *Journal of Portfolio Management*, 1991. – Vol. 17, No. 4. – pp. 33-36.
28. Travis, F. Style Analysis. Chapter 10 in Investment Manager Analysis: A Comprehensive Guide to Portfolio Selection, Monitoring, and Optimization. New Jersey, John Wiley & Sons, Inc., 2004.