Tournament Behavior in Australian Superannuation Funds: A Non-parametric Analysis

Terrence Hallahan
RMIT University

Robert Faff*
Monash University

JEL Classification: G11, G23, G24

Keywords: Tournaments, Mutual Funds, Risk taking, Incentives

*Corresponding author:

Professor Robert Faff
Department of Accounting and Finance
Monash University
Vic 3800 AUSTRALIA
Telephone: 61 3 9905 2440
Email: robert.faff@buseco.monash.edu.au

Tournament Behavior in Australian Superannuation Funds: A Non-parametric Analysis

Abstract

Taylor's (2003) extension of the tournament model of Brown et al (1996) proposes that using an exogenous (endogenous) benchmark, will induce losing (winning) managers to gamble. This presents two competing testable hypotheses that are investigated in the current study. We use a sample period covering 1989 to 2001 of Australian multi-sector growth funds. We apply the non-parametric Cross-Product Ratio methodology. Generally, we find evidence in support of Taylor's model. Specifically, when an exogenous benchmark is used the support is particularly evident for the Calendar-year analysis. Viewed as a whole, our analysis involving endogenous benchmarks is also quite supportive – particularly so for the Financial-year investigations (and to a lesser extent also with the Calendar-year results). Overall, our findings are consistent with the view that the Australian financial press and investors are particularly fixated on Financial and Calendar-year investment performance.

"Well in our country, said Alice, still panting a little, you'd generally get to somewhere else – if you ran very fast for a long time, as we've been doing.

A slow sort of country, said the Queen. Now here you see, it takes all the running you can do to keep in the same place."

Lewis Carroll

1. Introduction

In a tournament, players compete for prizes where their effort and their share of the prizes depends upon their ranking: relative performance matters. Tournament contracts can be viewed as attempts to address the principal-agent problem that exists when the principal does not have full information about the ability of the agent(s).[1] Initial empirical testing of tournament models focused on sporting tournaments in golf and tennis, for example, Ehrenberg and Bognanno (1990), Orszag (1994). While these studies attempted to assess whether tournament compensation schemes actually elicited effort responses, other researchers began examining the incentive effects of tournaments on risk-taking as well as effort responses, in the sporting, corporate management and funds management fields.

Three basic observations are helpful in understanding the funds application of the tournament model. First, investment funds usually receive compensation in the form of a fee that is a fixed percentage of funds under management. An incentive therefore exists to pursue those strategies that will maximize funds under management. Second, findings by Ippolito (1992), Capon, Fitzsimons and Prince (1996) and others give support to the

[1] Early work in this area appeared in the labor economics literature, for example Lazear and Rosen (1981), Green and Stokey (1983), Nalebuff and Stiglitz (1983), and focused on the normative aspects of tournament models: theoretical analysis indicated that under certain circumstances, for example, where participants are risk averse and output disturbances are caused by a common shock, the incentive effects of rank-order compensation schemes are considered to induce optimal levels of effort among participants.

widely held view that the crucial factor influencing choice of fund by retail investors is past investment performance. This finding gives strong support to the interpretation of the funds flow-investment performance relationship as an implicit incentive contract. Third, researchers such as Sirri and Tufano (1992, 1998) found that while those funds which recorded the highest performance during a period attracted the largest increases in funds under management, those funds which had performed poorly were not penalized by proportionate outflows of funds under management, indicating an asymmetric structure to the investment performance-funds flow relationship.[2]

In light of this Brown, Harlow and Starks (1996) [hereafter BHS] developed their tournament model to the funds domain. Specifically, they hypothesized that fund managers who were interim losers were likely to increase fund volatility in the latter part of the assessment period to a greater extent than interim winners. BHS found that losers did indeed appear to gamble, a result also confirmed by Koski and Pontiff (1999). Acker and Duck (2001) develop a tournament model that predicts losing managers will adopt extreme portfolios. Both Goriaev, Palomino and Prat (2001) and Basak, Pavlova and Shapiro's (2002) analysis produces results similar to Acker and Duck (2001). However, other studies document contradictory evidence, suggesting that it is winners rather than losers who gamble (Chevalier and Ellison, 1997 and Qui, 2003). However, Busse (2001), using higher frequency data, was unable to find evidence that intra-year winners or losers actively altered the risk of their portfolio in response to past performance. While the

[2] Berkowitz and Kotowitz (2000) found that fund flows were positively related to a distributed lag of past performance, with a strong degree of inertia, and exhibiting a significant nonlinear effect at the extreme levels of performance. Consistent with Sirri and Tufano (1992, 1998), and later confirmed by the results of Goriaev, Nijman and Werker (2002), they found the strongest nonlinearity to be associated with extremely good performance.

empirical results are mixed, recent theoretical developments by Taylor (2003) argued that using an exogenous (endogenous) benchmark, will induce losing (winning) managers to gamble. This presents two competing testable hypotheses that are investigated in the current study.

Empirical studies to date use data from markets where the calendar year, financial year and reporting year coincide. In Australia, the situation is more complicated: there are many instances of the financial press giving prominence to calendar year investment performance, both in respect to ordinal rankings and in comparison to the performance of the All Ordinaries Index. As retail investors normally have June financial (tax) years, attention is also focused on fund performance over the July-June period, both by the media and investors. Added to this is the fact that investment managers operating in Australia have financial reporting periods that can coincide with the calendar year, the financial year, or in a number of cases, an October-September reporting year.

Against this background, the current study uses a non-parametric methodology to look for evidence of tournament (gaming) behavior in the performance of a group of Australian retail superannuation funds classified as "multi-sector growth funds" by Morningstar. In doing so, we extend the tournaments literature by examining three datasets, based on the calendar year, the financial year and an October-September year, over the period 1989/90 to 2000/01 using a range of within-year assessment periods, against both an exogenous and an endogenous benchmark.

A major motivation for choosing an Australian dataset of investment funds is to accommodate the general argument of Leamer (1983) and extended by Lo and MacKinlay (1990) regarding the concern about data snooping in finance research.

Moreover, as Australia has the most sophisticated retail funds management market outside the United States, it is appropriate that finance research initially focusing on the US funds management industry should be extended to other developed markets like Australia.

The basic thrust of our findings can be summarized as follows. Generally, we find evidence in support of Taylor's (2003) model. Specifically, when an exogenous benchmark is used, the support (although somewhat variable) is particularly evident for the Calendar-year analysis. That is, against an exogenous benchmark in this case, our tests suggest some support for losing managers gambling, whereas winning managers play it safe. Viewed as a whole, our analysis involving endogenous benchmarks is also quite supportive – particularly so for the Financial-year investigations (and to a lesser extent also with the Calendar-year results). That is, against an endogenous benchmark, our tests suggest good support for winning managers increasing risk, while their losing counterparts tend to play it safe. Overall, our findings are consistent with the view that the Australian financial press and investors are particularly fixated on Financial and Calendar-year investment performance.

The remainder of this paper is structured as follows. Section 2 provides a brief review of the most relevant literature. In Section 3 the data and research method are described, while Section 4 outlines the research goal and hypotheses. The research findings are presented in Section 5 and Section 6 concludes the paper.

2. Brief Literature Review

In light of the asymmetric structure to the investment performance-funds flow relationship, Brown, Harlow and Starks (1996) placed portfolio management within the framework of a multi-period, multi-game tournament and focused on the possible strategic responses of funds identified at interim ranking stages as likely to be ultimate "winners" or "losers". BHS hypothesized that fund managers who were interim losers (in the sense of being below the median performance for the first part of the assessment period), were likely to increase fund volatility in the latter part of the assessment period to a greater extent than interim winners. This strategy of increasing volatility was based on the expectation that higher volatility gave the losing manager a better chance of a major performance reversal that would redeem their ranking and, hence, secure a major tournament prize at year end. While greater volatility also increased the risk of experiencing an even more disastrous full year performance, the losing manager would take the view that because of the tournament nature of the fund industry, coupled with the asymmetric response of news flows to performance, they had nothing much to lose.

BHS found that losers did indeed appear to gamble: in a sample of growth-oriented mutual funds, mid-year losers tended to increase fund volatility in the second half-year to a greater extent than mid-year winners, a result also confirmed by Koski and Pontiff (1999). In a similar vein, Chen and Pennacchi (2001) show that funds with poor performance relative to an exogenous benchmark have an incentive to increase the tracking error of the fund. Interestingly, they show that an increase in tracking error does not necessarily equate to an increase in the fund's volatility, as measured by BHS. Acker and Duck (2001) develop a tournament model that predicts losing managers will adopt

extreme portfolios, defined in terms of market exposure, and that the portfolios will be more extreme the further behind the manager becomes and the nearer the final ranking period. Their model incorporates fund size and managers' expectations about market movements. Both Goriaev, Palomino and Prat (2001) and Basak, Pavlova and Shapiro's (2002) analysis produces results similar to Acker and Duck (2002).

However, other studies document contradictory evidence, suggesting that it is winners rather than losers who gamble. For example, Chevalier and Ellison (1997) found that funds that had recorded returns in excess of a benchmark in the first nine months of the calendar year, increased their volatility in the remaining quarter. Qui (2003) found that mid-year losers had less incentive to increase the risk of their funds relative to mid-year winners. Moreover, there was evidence that managers of funds whose performance was near to that of the top performing funds had a greater incentive to increase the risk of the fund than the managers at the top, who displayed a tendency to lock in the performance of their funds. It was also found that termination risk and multiple-manager arrangements reduced the risk-taking incentives for loser funds. However, Busse (2001), using higher frequency data, was unable to find evidence that intra-year winners or losers actively altered the risk of their portfolio in response to past performance.

While the empirical results are mixed, recent theoretical developments by Taylor (2003) suggest that the choice of the tournament benchmark for deciding winners and losers will influence strategic responses by participants. Specifically, he argued that using an exogenous benchmark, such as a sharemarket index, will induce losing managers to gamble while winning managers will index to lock in their lead. In contrast, using an endogenous benchmark, such as the median fund performance, will induce winning

managers to gamble. In this case the argument is that the winner will expect the loser to gamble so the winner will therefore gamble in order to maintain his or her lead. As the loser recognizes that the winner has a higher probability of success, and given the asymmetric nature of the funds flow-investment performance relationship, the optimum strategy for the loser is not to gamble but to index. This result, while contrary to the predictions and empirical findings of BHS is consistent with the results of Chevalier and Ellison (1997) and also the findings of Palomino and Prat (2003) who examine the impact of contract design on fund managers' decisions regarding effort and risk taking.

3. Research Framework

3.1 Superannuation Funds

A superannuation fund is an ongoing fund designed to provide retirement and death benefits to its members. Such funds are an integral part of the retirement income system in Australia. The demographic impact of the ageing of the "baby boomer" generation has meant that government provision of retirement income through a pension scheme would become prohibitively costly. Consequently, access to such a pension has become much more restricted and superannuation has become increasingly important in funding retirement.

Mandatory superannuation contributions for all employees were introduced through Federal Government legislation in July 1992. Since its introduction, employer contributions have risen and they are now required to contribute 9% of an employee's

wage to superannuation.[3] The Australian Prudential Regulation Authority (APRA)[4] classifies superannuation funds into the following groups: Corporate (Employer), Industry (Award), Public Sector, Retail (Public Offer) and Small Funds. Table 1 provides summary information about these different types of funds.

[Insert Table 1 about here]

As a result of the Australian Government's aggressive retirement provision policies aimed at shifting the burden of funding retirement incomes from the public sector to the private sector, superannuation has become the principal retirement savings vehicle for Australians. Consequently, as reflected by the figures shown in Table 1, superannuation funds constitute a significant part of the managed funds industry in Australia.

3.2 Data and Sampling

The data were supplied by Morningstar, an independent research house which monitors the managed funds industry. The database consists of monthly index series return data for the period 1989/90 to 2000/01 for retail superannuation funds classified as multi-sector growth and comprises all such funds in existence over this period. A fund was included in our analysis for each full year in which it was present in the database, thereby

[3] The Superannuation Guarantee operates in conjunction with award superannuation. For example, if an award stipulates a superannuation contribution of 6%, then the Superannuation Guarantee requirement would require the employer to contribute an additional 3% to make a total contribution of 9%

[4] The Australian Prudential Regulation Authority (APRA) is the prudential regulator of the Australian financial services industry. It oversees banks, credit unions, building societies, general insurance and reinsurance companies, life insurance, friendly societies, and most members of the superannuation industry.

largely avoiding the major survivorship bias problem created when funds which do not survive for the full sample period are absent from the database.[5]

To be classified as multi-sector, the funds in our sample invest across at least two asset classes, and have between 60 per cent and 80 per cent of their investments allocated to growth oriented assets, defined by Morningstar as equities and property. Growth funds accounted for around 50 per cent of total multi-sector superannuation funds over the period. Such funds present a relevant environment for assessing tournament-type behavior, since managers have a reasonable degree of scope and flexibility to pursue aggressive asset allocation changes.

For each fund in the sample, data are available from either 1989/90 or the first entire year of operation, if inception is later than this date. The index series reflects changes in the value of an investment in a fund over time, and is based on a notional $10,000 investment in the fund. Monthly index values are calculated by reference to the month-end exit price of the fund, which is net of management fees and assumes reinvestment of all cash and bonus unit distributions. The index series therefore gives representative returns which an actual investor may have achieved and measures the monthly performance of the fund.

Consistent with the theoretical insights of Goriaev, Palomino and Prat (2001) and Taylor (2003), we define fund winners/losers in relation to two alternative types of benchmark: (a) an endogenous benchmark – the 'median' manager (that is, being

[5] A number of studies such as Grinblatt and Titman (1989), Brown, Goetzman, Ibbotson and Ross (1992), Carpenter and Lynch (1999) and Carhart, Carpenter, Lynch and Musto (2002) document the economic significance of survivorship bias in studies of equity mutual fund performance, particularly in relation to the issue of persistence in performance. However, and as noted by Del Guercio and Tkac (2002), studies by Sirri and Tufano (1998), Chevalier and Ellison (1997) and Goetzmann and Peles (1997) found that survivorship bias does not affect inferences about the funds flow-performance relationship and, therefore, is not a major issue in studies involving annual tournaments.

above/below the median performance of similar funds for the first part of the assessment period), and (b) an exogeneous benchmark- the Australian All Ordinaries Accumulation Index (that is, being above/below this market index return for the first part of the assessment period).

Unlike the scenario in the United States where the calendar year and the fiscal year coincide, the Australian fiscal year ends 30 June. Moreover, a number of major Australian financial institutions have reporting years ending 30 September.[6] We are therefore presented with three annual tournament scenarios which are not mutually exclusive: (a) calendar year; (b) fiscal year and (c) September year.

Calendar year performance receives substantial coverage in the Australian financial and popular press. Fiscal year performance also receives substantial press coverage and because of domestic taxation implications is the most likely performance period examined by investors when reviewing their portfolios. While September year performance receives little attention in the press and is unlikely to be of significance to investors, it may be very relevant to fund managers whose employers report annual profitability on a September basis. The compensation of such fund managers, particularly bonus components, will be affected by September year performance. Accordingly, we use all three variants of the annual performance year.

[6] The 30 September financial reporting year is a legacy of the reporting year adopted early in the 20th century by a number of banks and insurance offices of British origin. In recent times there has been a move to discard this in favor of a standard financial or calendar year reporting period. For example, in 2003 AXA moved from a September year to a calendar year reporting period.

3.3 Some Descriptive Statistics

Table 2 provides a summary of some descriptive statistics for the dataset.

[Insert Table 2 about here]

One notable aspect of Table 2 is the growth in the number of funds in the sample over the period. Both the financial year and the September year sample sizes increased at a compound rate of about 7.5% per year while the calendar year sample increased at a rate of 10.7% per year.

As might be expected, the index benchmark displays a greater range of values than the median manager benchmark across each of the tournament years chosen. Interestingly, the range of values for the index and for the median manager in the financial year dataset are much closer to each other than the corresponding figures for the September year data and the calendar year data. For example, the difference between the highest (lowest) index return and the highest median manager return, annually, is 4.4 (6.4) percentage points in the financial year sample compared to 11.1 (15.4) percentage points in the September year and 12.8 (15.6) percentage points in the calendar year samples. Notably, the standard deviation of the median manager annual returns is consistently about half that of the index returns across the three datasets although, and as would be expected given the range of values (discussed above), the magnitude of the standard deviation is much greater for the September year and the calendar year.

It is also interesting to note also that the standard deviation of the annual median manager return has decreased from around five to six per cent in the period up to 1992-93 to around two to three per cent in the period since then. This reduction in volatility is of interest given the risk adjustment metric we use to examine tournament behavior.

Our final observation in terms of the descriptive statistics concerns the performance required by a fund to be classified as a winner or a loser based on the fund's annual return. Where the exogenous (index) benchmark is used to identify winners and losers, there are nine (out of 35) tournament years in which simply breaking even, that is, earning a zero return, would have been sufficient to classify a fund as a winner. However, there are other years in which a return of around 20 - 30 per cent would be required. For the endogenous benchmark, there are only two instances where a zero annual return would have made a fund a winner and two cases where a return in the 20-25 per cent range was required. Considered from a different perspective, the average median manager return was nearly three percentage points higher than the average index return across the financial, September and calendar years.

3.4 Method of Analysis

We choose to apply a non-parametric 'contingency table/ CPR'[7] framework as the basis of our empirical analysis. This choice is founded on several considerations. First, contingency tables are the primary framework within which Brown, Harlow and Starks (1996) perform their investigation. Given that the purpose of our paper is to investigate whether their findings hold in a different dataset, for comparability purposes, analysing contingency tables is a natural choice. Second, the application of contingency tables and *CPRs* is common in other areas of the fund performance literature, see for example, Goetzmann and Ibbotson (1994); Kahn and Rudd (1995); Phelps and Detzel (1997). Third, the application of the contingency table approach is quite straightforward and the

[7] CPR stands for Cross-Product Ratio and it will be explained in the text shortly.

consequent relative ease of understanding that it affords an audience beyond the academic sphere (e.g. by investment advisors and even everyday investors) is a positive. Such wide-ranging penetration of knowledge is of great appeal in the funds management research area since it holds such obvious and direct interest to investment industry participants. Accordingly, we now explain the contingency table/ *CPR* setup.

Recall that BHS hypothesized that fund managers who are interim losers are likely to increase fund volatility in the latter part of the assessment period to a greater extent than interim winners. This behavior is captured in the predicted relationship between the "risk adjustment ratios" of loser portfolios and winner portfolios:

$$(\sigma_{2L}/\sigma_{1L}) > (\sigma_{2w}/\sigma_{1w}) \quad (1)$$

where σ_1 and σ_2 refer to portfolio risk levels in the first and second periods (of each year), respectively, and the subscripts L and W denote loser and winner.

Accordingly, for each performance year we establish two classifications: In the first classification we identify interim winners and losers on the basis of the fund's relative return between the commencement of the year and month M, where M ranges from the third month to the ninth month of the relevant year. This means that for each performance year tournament we calculate seven interim ranking periods ranging from three months to nine months. Discrete monthly return data were calculated from the index series produced by Morningstar for each fund. Following BHS, we calculate the M-month compound return of each fund 'j', in tournament year 'y', denoted as RTN_{jMy}:

$$RTN_{jMy} = [(1+r_{j1y})\,(1+r_{j2y})\ldots\,(1+r_{jMy})] - 1 \quad (2)$$

where r_{jMy} is the monthly change in the fund's index series value as reported by Morningstar.

In the second classification we construct the 'Risk Adjustment Ratio', RAR, which is the ratio of fund volatility before and after the interim assessment period. This measures (relative) changes in the risk of the fund's portfolio and is calculated as:

$$\mathrm{RAR}_{\mathrm{jMy}} = \sqrt{\left(\frac{\sum_{m=M+1}^{12} \left(r_{jmy} - \bar{r}_{j(12-M)y} \right)^2}{(12-M)-1} \right)} \div \sqrt{\left(\frac{\sum_{M=1}^{M} \left(r_{jmy} - \bar{r}_{jMy} \right)^2}{M-1} \right)} \qquad (3)$$

We then classify the (RTN, RAR) pair for each fund, in each tournament, based upon whether the fund is a (a) Winner (above benchmark return in the assessment period) or Loser (below benchmark return in the assessment period) and (b) whether the fund is High RAR (has increased its risk in the second period i.e. RAR > 1) or Low RAR (has decreased its risk in the second period i.e. RAR < 1). Specifically, we require cell counts of the four joint RTN/RAR classifications of funds: (a) N_{WH} – the number of winning funds with high RAR; (b) N_{WL} – the number of winning funds with low RAR; (c) N_{LH} – the number of losing funds with high RAR; and (d) N_{LL} – the number of losing funds with low RAR. Based on these classifications we then generate 2 x 2 contingency tables upon which tests of association are conducted. The non-parametric contingency table analysis is used therefore to identify the frequency with which funds defined as winners or losers during the assessment part of the tournament period, increased or decreased their risk level in the succeeding period.

To test for independence from period to period, the contingency table results can be summarized by the use of the Cross-Product Ratio (Fienberg 1980) or Odds-Ratio (Christensen 1990) which gives the ratio:

$$CPR = \frac{(N_{WH} * N_{LL})}{(N_{WL} * N_{LH})} \tag{4}$$

The *CPR* is a basic measure of association for 2 x 2 tables. When *CPR* = 1, it reflects an equal number of observations in each cell of the contingency table and would support the null hypothesis that the two classifications are independent. Alternatively, when *CPR* < 1 (*CPR* > 1), it indicates interim losing managers have increased (decreased) second period risk and interim winners have decreased (increased) risk. The test statistic for the *CPR* is referred to as the z-statistic. It is the standard deviation of the log of the *CPR* and is given by the square root of the sum of the reciprocals of the cell counts. For large samples it is normally distributed with mean log *CPR* and can be used as an alternative to the chi-square statistic to test for independence.

4. Tournament Behavior in Australian Superannuation Funds: Research Goal and Hypothesis Development

In this paper we extend the managed fund literature by investigating an Australian dataset for evidence of tournament behavior. Our contribution is related to two specific hypotheses concerning the strategic interaction between active fund managers when alternate benchmarks are specified.

Stated formally, our null hypothesis is that subsequent period fund risk is independent of ranking period performance. Given our research design, we would fail to reject the null hypothesis when the *CPR* is equal to unity: a *CPR* of one represents equal counts in each of the cells of the contingency table, and indicates an absence of association between fund performance over the assessment period and changes in fund risk over the remaining part of the tournament.

H_0: CPR = 0

If the null hypothesis of independence between fund performance and subsequent changes in fund risk can be rejected, our alternative hypotheses focus on examining the strategic response of fund managers to performance rankings under different benchmark regimes.[8] First, following Taylor's (2003) game-theoretic analysis, we investigate whether, under an exogenous benchmark (index) regime, losing managers at the end of the assessment period increase the risk of the fund in the subsequent period while winning managers reduce their risk. Evidence supporting this alternative hypothesis would be provided by a CPR less than unity:

H_1: CPR < 1

Our second alternative hypothesis concerns the strategic response of fund managers when their within tournament performance is assessed against an endogenous benchmark. Under this benchmark regime, Taylor's (2003) analysis predicts that when performance is measured against the median manager, winning managers at the end of the ranking period will increase their portfolio risk over the remaining period while losing managers will reduce their risk. Stated formally:

H_2: CPR > 1

Support for this hypothesis would contradict the findings of BHS but would be consistent with the results reported by Chevalier and Ellison (1997).

Our research therefore contributes to the tournaments literature by providing evidence on the different predictions for strategic behavior derived under alternative benchmark regimes used in ranking fund manager performance within tournaments. We

test the hypotheses under three different tournament structures, namely, calendar year, financial year and September year, using a dataset of funds from one of the most sophisticated managed fund markets outside the United States.

5. Results

5.1 Analysis Relative to an Exogenous Benchmark

The first hypothesis (H_1) is that assessment against an exogenous benchmark, such as a sharemarket index, will induce losing managers to gamble and take on more risk in the subsequent period while winning managers will index to lock in their lead, and in doing so reduce their portfolio risk. This hypothesis is supported where the CPR is less than unity.

Table 3 reports the outcome of the contingency table/ CPR analysis applied to Calendar year tournaments assessed against the index benchmark. This table reveals our strongest results in support of H_1. Primary focus in this table should be directed to the bottom row of figures which indicate the aggregate *CPR* results for the complete set of eleven years of Calendar tournaments. Here we see that the overall *CPR* ratio is less than one for all assessment periods – from (3, 9) through to (9, 3).[9] Moreover, all these CPRs are found to be statistically different from (less than) unity at the 5% level, the sole exception being the (8,4) assessment period which, nevertheless, is significant at the 10% level. This evidence is strongly in favor of H_1: in our sample, in the Calendar-year

[8] Consistent with earlier literature, Taylor (2003) analyses the strategic response of fund managers in terms of two-person non-cooperative games where one player is the fund manager and the other player represents the benchmark.

[9] Assessment period (M, 12-M) involves an interim period of M months and a 'post' period of 12-M months (M = 3, 4, …, 9). For example, (3, 9) indicates the tournament in which interim performance is based on the first 3 months of the relevant year and the post period is the latter 9 months (i.e. months 4 to 12) of that year.

tournaments assessed against an exogenous benchmark, losing (winning) managers appear to gamble (play it safe) and take on more (less) risk in the subsequent period.

[Insert Table 3 about here]

Due to maximizing the effective sample size, the aggregate results discussed above provide the most powerful and, hence, the most reliable test of our tournament hypothesis. Nevertheless, it is of interest and worthwhile making a guarded micro-assessment of the individual results – keeping a particular eye out for any patterns or trends that may provide further insights into tournament-type behavior in our sample. To this end, further examination of Table 3, does present some supplementary findings. First, it is apparent that some variation in the effect occurs over time and across assessment periods. Within the 77 individual calendar year tournaments, there were 12 instances each of a significant *CPR* less than one and greater than one (at the 5% level). Second, the tournament of 1999 is a 'stand-out' in the sense that it was the only year in which each assessment period had individual *CPRs* less than one, and all were significant at the 5% level.

Third, is the question of whether any 'within-tournament' patterns or trends reveal themselves? Very little can be detected in this regard, although perhaps there is a weak pattern in which assessment periods with shorter (longer) interim periods tend (not) to support H_1. To the extent that such an effect is real, it would be consistent with losing/winning fund managers being more likely to act earlier (or not at all). Fourth, relates to the question of whether there are any 'across-year' patterns or trends which might suggest changing behavior over time? Again, there is very little to go on here. There does however, appear to be a concentration of support for H_1 in the latter two years

of our sample, which may suggest that while fund managers historically were not susceptible to the gaming behavior, they may have changed in recent years (perhaps due to increasing competition in the industry). However, this is only conjecture based on our limited sample and evidence. To be confirmed, it would require extended examination in future research.

The final and overall comment with regard to the Table 3 results is that while strong (aggregate) support is found for H_1, the volatility underlying this finding warrants a careful qualification to the conclusion we can draw from this analysis. In particular, the extent to which this gaming behavior occurs (for Calendar/index benchmark tournaments), either (a) it is a more long-term in nature or (b) it is largely a recent phenomenon (with no guarantee of continuation). Either way, given the limited evidence to date, it will be difficult to predict over any short-term horizon.

The counterpart September-year and Financial-year results for the exogenous benchmark were far less conclusive.[10] With regard to the September-year analysis, only nine significant *CPR* results (at the 5% level) emerged from the 84 individual tournaments. However, it is notable that seven of these cases favored H_1 i.e. they indicated that interim losers increased risk. Furthermore, in turn, three of these cases were recorded for the (8,4) tournament periods in 1991/92, 1990/2000 and 2000/2001. Moreover, the only overall *CPR* which was significant at the 5% level was the (8,4) period which recorded a *CPR* of 0.67. The Financial-year exogenous benchmark analysis returned only six significant *CPR* results from the 84 individual tournaments. Again, H_1 was the main beneficiary, with five of these cases indicating that interim losers (winners)

[10] To conserve space, detailed results for these two cases are not reported. They are available from the authors upon request.

increased (reduced) risk. However, at an aggregate level no tournament assessment period recorded a significant overall CPR.

Taken together, all of the analysis involving exogenous benchmarks does provide a degree of support favoring H_1. This is particularly so for the Calendar-year results and suggests that the extent to which fund managers in our sample are 'tournament-conscious', they probably view the Calendar year as most important. This is consistent with the argument mounted earlier that Calendar-year investment performance is given considerable prominence by the Australian financial press.

5.2 Analysis Relative to an Endogenous Benchmark

The second hypothesis (H_2) is that assessment against an endogenous benchmark, such as a median performance, will induce winning (losing) managers to take on more (less) risk in the subsequent period. This hypothesis is supported where the *CPR* exceeds unity.

At a general level, the results for the endogenous (median manager) benchmark produced a greater number of significant results compared to the exogenous benchmark. In both the Calendar Year and the Financial Year, 43 percent of the individual tournaments recorded significant results while in the September year the comparable figure was 39 percent. More specific details are discussed below.

Table 4 reports the outcome for the September-year results for the endogenous benchmark. This analysis returned 33 significant *CPR* results from the 84 individual tournaments. Of these cases, 24 indicated that interim period losers increased risk in the second period – thereby providing support for H_1. Moreover, the overall *CPR* results revealed the same behavior in five of the seven assessment periods (at the 5% level), with

the (3,9) and (8,4) periods being the exceptions, although the latter of these two cases was significant at the 10% confidence level. The concentration of significant below unity *CPR* results in the individual annual tournaments was highest at five (out of 12 years) in the (4,8) period, with four of those results recorded consecutively in the years 1992/93 to 1995/96. Interestingly, the last three years of the dataset reveal a similar concentration in the (9,3) assessment period. The year 1992/93 is notable in as much as the first five assessment periods record significant *CPR* results. That year recorded the highest median manager return of 21.2 percent. At first sight this would suggest that buoyant market conditions created high performance pressures on managers. However, a similar pattern is not evident in 1996/97, the year with the next highest median manager return of 17.8 percent.

[Insert Table 4 about here]

The basic thrust of the September/ Median Benchmark results provides reasonably strong support for H_1, contrary to the prediction (based on Taylor, 2003) of H_2, namely, that interim winners (losers) will increase (decrease) risk. There is however, some weak evidence that may point to this latter hypothesis being relevant in the latter years of our sample. Specifically, in the years 1994/95, 1996/97, 1998/99 and 1999/00 the *CPR* significantly exceeds unity (at the 5% level) for the (3,9) period, possibly suggesting that winning (losing) managers are more likely to act earlier to increase (decrease) risk.

The Financial-year analysis for the endogenous benchmark is shown in Table 5. Again, initial attention should be directed to the bottom row of figures which indicate the aggregate *CPR* results for the complete set of twelve years. Here we see that the overall

CPR ratio exceeds unity in all but two cases, but in both of those it is very close to unity. Of these aggregate *CPRs*, two are statistically significant and greater than unity (at the 5% level) – namely, the (3,9) and (8,4) cases. This represents reasonable support in favor of H_2, consistent with the prediction of Taylor's (2003) model for the endogenous benchmark case. When we more closely assess the individual results, 36 (44) of the 84 individual tournaments were significant at the 5% (10%) level. Notably, a considerable majority of 21 (29) cases indicate that it was the interim winners (losers) who subsequently increased (reduced) their risk. This provides substantial reinforcing support for H_2, just as predicted for analysis based on endogenous benchmarks. While the individual tournament period results do not reveal a pattern of concentration within any assessment period, it is notable that 10 of the significant *CPRs* greater than unity are recorded in the two years 1996/97 and 1997/98.

[Insert Table 5 about here]

The Calendar-year analysis is revealed in Table 6. In broad terms the results are quite similar to the counterpart Financial-year results just discussed, again with some reasonable support for H_2. As such, only a few brief additional comments will be made here. It does seem that, if anything, H_2 is a little less favored here than in the previous Financial-year analysis. Specifically, while 32 (39) of the 77 individual tournaments record significant *CPRs*, 14 (16) cases support H_1, i.e. they indicate interim losers (winners) increase (decrease) second period risk and 18 (23) cases indicate the opposite i.e. support for H_2 at the 5% level (10% level) of significance. This is a little more balanced split than was observed above for the Financial-year analysis. The overall *CPR* results show losers increasing risk in the (4,8) assessment period and the winners

increasing risk in the (8,4) and (9,3) periods. Moreover, it does seem that support for H_2 is generally concentrated in these longer interim period tournaments – there are five (four) such individual year *CPRs* that are significantly greater than unity for (8,4) and (9,3), respectively. This is suggestive that winning (losing) managers are more likely to act later to increase (decrease) risk in this Calendar-year setting.

[Insert Table 6 about here]

Viewed as a package, the analysis involving endogenous benchmarks is quite supportive of H_2. This is particularly so for the Financial-year investigations (and to a lesser extent also with the Calendar-year results). Once again, this is consistent with the argument mounted earlier that Financial and Calendar-year investment performance is given considerable prominence by the Australian financial press and investors.

6. Summary and Conclusion

The funds management industry has proven to be fertile ground for theoretical and empirical research over the past forty years. Since the performance and risk-shifting behavior of fund managers was initially put under the spotlight by Treynor and Mazuy (1966) and Jensen (1968), it is possible to identify an evolving strand in the research where performance assessment is examined within the framework of the principal-agent literature. One focus that has emerged in this literature is the tournament model developed by Brown, Harlow and Starks (1996). Specifically, they hypothesized that fund managers who were interim losers were likely to increase fund volatility in the latter part of the assessment period to a greater extent than interim winners. While the empirical results are mixed, recent theoretical developments by Taylor (2003) argue that

using an exogenous (endogenous) benchmark, will induce losing (winning) managers to gamble. This presents two competing testable hypotheses.

Using a sample period covering 1989 to 2001, we investigate the tournament induced risk-shifting behavior of Australian "multi-sector growth funds". Specifically, following Taylor (2003), we test the ability of the two competing hypotheses to predict risk-shifting behavior in our sample. To this end, we apply the non-parametric Cross-Product Ratio methodology and examine tournaments based on the calendar year, the financial year and an October-September year, using a range of within-year assessment periods, against both an exogenous and an endogenous benchmark.

Our findings can be summarized as follows. At a broad level we find evidence in support of Taylor's model. Specifically, when an exogenous benchmark is used (i.e. market index return), we uncover support for the hypothesis that losing managers at the end of the interim assessment period increase the risk of the fund in the subsequent period, while winning managers reduce their risk (H_1). This support is particularly evident for the Calendar-year analysis. However, the volatility underlying this finding warrants a careful qualification to the conclusion we can draw from this analysis. In particular, the extent to which this gaming behavior occurs (for Calendar/index benchmark tournaments), either (a) it is a more long-term in nature or (b) it is largely a recent phenomenon (with no guarantee of continuation). Either way, given the limited evidence to date, it will be difficult to predict over any short-term horizon.

The second hypothesis (H_2) which comes from the Taylor (2003) model, is that assessment against an endogenous benchmark, such as a median fund performance, will induce winning (losing) managers to take on more (less) risk in the subsequent period.

Viewed as a whole, our analysis involving endogenous benchmarks is also quite supportive of H_2. This is particularly so for the Financial-year investigations (and to a lesser extent also with the Calendar-year results). Once again, this is consistent with the view that the Australian financial press and investors are particularly fixated on Financial and Calendar-year investment performance.

Our research therefore extends the empirical literature on fund manager behavior, by seeking evidence of tournament effects in a dataset from one of the most sophisticated funds management market outside the United States. Moreover, we employ three different representations of the annual tournament period and examine behavior against two ranking benchmarks, one endogenous and one exogenous. While our study is concerned primarily with evidence of risk-taking behavior on the part of fund managers, it can also be viewed as providing, albeit indirectly, empirical evidence on the question of whether benchmark choice may affect such behavior. In an era when fund manager performance and behavior is under unprecedented scrutiny, both by regulators and by increasingly knowledgeable and financially literate investors, this study therefore provides an empirical contribution to an issue of current relevance, which will have enduring interest for some time to come.

References

Acker, D., & Duck, N. W. (2001). A Tournament Model of Fund Management. *Working Paper*. 01/529, Department of Economics, University of Bristol.

Basak, S., Pavlova, A., & Shapiro, A. (2002). Offsetting the Incentives: Risk Shifting, and Benefits of Benchmarking in Money Management. *Working Paper, NYU Stern School of Business*.

Berkowitz, M. K., & Kotowitz, Y. (2000). Investor Risk Evaluation in the Determination of Management Incentives in the Mutual Fund Industry. *Journal of Financial Markets,* 3, 365 - 387.

Brown, K. C., Harlow, W. V., & Starks, L. T. (1996). Of Tournaments and Temptations: An Analysis of Managerial Incentives in the Mutual Fund Industry. *Journal of Finance,* 15(1), 85 - 110.

Brown, S. J., Goetzman, W. Ibbotson, R.G. and Ross, S.A. (1992), Survivorship Bias in Performance Studies, *Review of Financial Studies*, 5, 553-580.

Busse, J. A. (2001). Another Look at Mutual Fund Tournaments. *Journal of Financial and Quantitative Analysis,* 36(1), 53-73.

Capon, N., Fitzsimons, G.J. and Prince, R.A. (1996), An Individual Level Analysis of the Mutual Fund Investment Decision, *Journal of Financial Services Research*, 10, 59-82.

Carhart, M., Carpenter, J., Lynch, A., and Musto, D. (2002), Mutual Fund Survivorship, *Review of Financial Studies* 15, 1439-1463.

Carpenter, J.N. and. Lynch, A.W (1999), Survivorship Bias and Attrition Effects in Measures of Performance Persistence, *Journal of Financial Economics*, 54, 337-374.

Chen, Hsiu-lang and Pennacchi, G., (2001) Does prior performance affect a mutual fund's choice of risk? Theory and further empirical evidence, Working Paper, University of Illinois at Urbana-Champaign.

Christensen, R., (1990), *LogLinear Models*, (Springer-Verlag, New York).

Chevalier, J., & Ellison, G. (1997). Risk Taking by Mutual Fund as a Response to Incentives. *Journal of Political Economy,* 105(6), 1167-1200.

Del Guercio, D. and P.A.Tkac, (2002), The Determinants of the Flow of Funds of Managed Portfolios: Mutual Funds vs. Pension Funds, *Journal of Financial and Quantitative Analysis,* 37, 4, 523-557.

Ehrenberg, R. G., & Bognanno, M. L. (1990). Do Tournaments Have Incentive Effects? *Journal of Political Economy,* 98(6), 1307-1324.

Fienberg, S.E., (1980), *The Analysis of Cross-classified Categorical Data*, Second Edition, MIT Press, Cambridge Mass.

Goetzman, W. N. and Ibbotson, R.G. (1994). Do Winners Repeat? *Journal of Portfolio Management*, 3, 9-18.

Goetzman, W.N. and Peles, N. (1997). Cognitive Dissonance and Mutual Fund Investors. *Journal of Financial Research*, 20, 145-158.

Goriaev, A., Palomino, F., & Prat, A. (2001). Mutual Fund Tournament: Risk Taking Incentives Induced by Ranking Objectives. *CEPR Discussion Paper No. 2794, Tilburg University*.

Goriaev, A. P., Nijman, T. E., & Werker, B. J. M. (2002). The Dynamics of the Impact of

Past Performance on Mutual Fund FLows. *Discussion Paper, Department of Finance and Finance Research Group Center, Tilburg University*.

Green, J. R., & Stokey, N. L. (1983). A Comparison of Tournaments and Contracts. *Journal of Political Economy,* 91(3), 349 - 364.

Grinblatt, M., and Titman, S. (1989). Mutual Fund Performance: An Analysis of Quarterly Portfolio Holdings. *Journal of Business*, 62, 3 393-417.

Ippolito, R. A. (1992). Consumer Reaction to Measures of Poor Quality Funds from the Mutual Fund Industry. *Journal of Law Economics,* 35, 45 - 70.

Jenson, M.C. (1968). The Performance of Mutual funds in the Period 1945-64. *Journal of Finance*, 23, 389-416.

Kahn, R. N., and Rudd, A. (1995). Does Historical Performance Predict Future Performance? *Financial Analysts Journal*, 43-52.

Koski, J. L., & Pontiff, J. (1999). How are derivatives used? Evidence from the mutual fund industry. *Journal of Finance,* 54(2), 791-810.

Lazear, E.P. and Rosen, S.. (1981). Rank-Order Tournaments as Optimum Labor Contracts. *Journal of Political Economy,* 89, 841-64.

Leamer, E.E. (1983). Let's Take the Con Out of Econometrics. *American Economic Review*, 73, 31-43.

Lo, A. and MacKinlay, C. (1990). Data Snooping Biases in Tests of Financial Asset Pricing Models. *Review of Financial Studies,* 3, 431-467.

Nalebuff, B. J., & Stiglitz, J. E. (1983). Information, Competition, and Markets. *AEA Papers And Proceedings,* 73(2), 278 - 283.

Orszag, J. M. (1994). A new Look at Incentive Effects and Golf Tournaments. *Economics Letters,* 46(1), 77-88.

Palomino, F., and Prat, A. (2003). Risk taking and optimal contracts for money managers. *RAND Journal of Economics,* 34(1), 113 - 137.

Phelps, S. and Detzel, L. (1997). The Nonpersistence of Mutual Fund Performance. *Quarterly Journal of Business and Economics,* 36, Spring 55-69.

Qui, J. (2003). Termination Risk, Multiple Managers and Mutual Fund Tournaments. *European Finance Review,* 7(2), 161-190.

Sirri, E. R., & Tufano, P. (1992). The Demand for Mutual Fund Services by Individual Investors. Working Paper, Harvard University.

Sirri, E. R., & Tufano, P. (1998). Costly Search and Mutual Fund Flows. *Journal of Finance,* 54(5), 1589-1623.

Taylor, J. (2003). Risk-taking Behavior in Mutual Fund Tournaments. *Journal of Economic Behavior and Organisation*. 50, 373-383.

Treynor, J.L., and Mazuy, K.K. (1966). Can Mutual Funds Outguess the Market?, HBR, July-August, 131-136.

Table 1: Australia's Superannuation Industry June 2001

Type of fund	Assets (AUD $b)	Members (millions)
Corporate	71.7	1.4
Industry	45.0	6.9
Public sector	113.9	2.8
Retail	158.2	11.3
Small Funds	78.2	0.4
Total	467.0	22.8

Source: APRA June 2001 "Superannuation Trends".

Table 2: Descriptive Statistics for a Sample of Multi-sector Growth Superannuation Funds

Financial Year					September Year					Calendar Year				
Year	Number of Funds	Annual Return Statistics Index[1]	Median[2]	StDev[3]	Year	Number of Funds	Annual Return Statistics Index[1]	Median[2]	StDev[3]	Year	Number of Funds	Annual Return Statistics Index[1]	Median[2]	StDev[3]
1989/90	126	-0.013	0.097	0.041	1989/90	128	-0.195	0.008	0.056	1990	122	-0.224	0.014	0.053
1990/91	135	0.004	0.085	0.057	1990/91	133	0.118	0.150	0.051	1991	121	0.290	0.181	0.072
1991/92	129	0.092	0.100	0.049	1991/92	129	-0.049	0.051	0.053	1992	129	-0.112	0.036	0.046
1992/93	139	0.057	0.099	0.051	1992/93	143	0.323	0.212	0.051	1993	144	0.363	0.235	0.061
1993/94	156	0.144	0.065	0.032	1993/94	158	0.033	0.000	0.023	1994	169	-0.120	-0.068	0.021
1994/95	170	0.014	0.063	0.031	1994/95	175	0.053	0.086	0.028	1995	179	0.152	0.151	0.025
1995/96	196	0.112	0.094	0.018	1995/96	198	0.072	0.087	0.019	1996	257	0.101	0.095	0.019
1996/97	216	0.216	0.172	0.028	1996/97	220	0.208	0.178	0.028	1997	284	0.079	0.121	0.024
1997/98	231	-0.021	0.081	0.023	1997/98	233	-0.065	0.041	0.021	1998	294	0.075	0.113	0.024
1998/99	260	0.113	0.074	0.019	1998/99	260	0.114	0.085	0.023	1999	322	0.121	0.085	0.024
1999/00	322	0.047	0.112	0.022	1999/00	272	0.127	0.129	0.029	2000	337	0.001	0.064	0.017
2000/01	283	0.051	0.043	0.020	2000/01	278	-0.079	-0.041	0.028					
Maximum[4]		0.216	0.172				0.323	0.212				0.363	0.235	
Minimum[5]		-0.021	0.043				-0.195	-0.041				-0.224	-0.068	
Average[6]		0.068	0.090				0.055	0.082				0.066	0.093	
Std. Dev.[7]		0.070	0.032				0.140	0.076				0.175	0.083	

[1] Index is the return on the All-Ordinaries Accumulation Index for the year indicated.
[2] Median is the return for the median manager in the sample for the year indicated.
[3] StDev is the standard deviation of the return for the median manager for the year indicated.
[4] Maximum is the highest annual return observed in the benchmark indicated.
[5] Mimimum is the lowest annual return observed in the benchmark indicated
[6] Average is the arithmetic average of the annual returns
[7] Std. Dev. is the standard deviation of the annual returns

Table 3: Cross-Product Ratios for Calendar-year Tournaments: Index Benchmark

	Assessment Period													
	(3, 9)		(4, 8)		(5, 7)		(6, 6)		(7, 5)		(8, 4)		(9, 3)	
Year	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z
1990	0.33	-0.68	0.33	-0.68	0.33	-0.68	1.00	0.00	0.59	-0.50	1.00	0.00	5.17	1.05
1991	1.02	0.01	1.02	0.01	1.02	0.01	1.02	0.01	0.20	-1.04	0.33	-0.67	1.02	0.01
1992	0.20	-3.76	1.72	0.52	7.46	1.32	2.40	1.70	2.20	2.18	0.61	-0.71	3.00	0.67
1993	0.14	-1.31	0.42	-0.88	0.42	-0.88	1.00	0.00	0.59	-0.50	0.14	-1.31	0.14	-1.31
1994	0.33	-0.68	0.92	-0.23	2.00	2.21	6.69	2.70	0.62	-1.51	0.55	-1.40	1.90	2.06
1995	0.46*	-1.93	0.42	-0.87	2.30	2.74	2.00	2.29	1.86	0.77	1.01	0.01	1.01	0.01
1996	11.96	3.67	1.01	0.00	5.20	1.06	63.81	2.90	0.31	-4.49	1.38	0.90	2.79	2.13
1997	0.91	-0.38	0.91	-0.39	0.14	-1.30	1.00	0.00	0.56	-0.74	3.90	4.56	0.27	-1.43
1998	1.52	1.12	1.07	0.19	1.89	2.28	0.93	-0.20	1.09	0.28	0.98	-0.01	1.72	1.13
1999	0.00	-4.20	0.00	-4.31	0.00	-4.33	0.00	-4.24	0.00	-4.22	0.06	-7.68	0.07	-7.54
2000	0.26	-2.17	1.67	0.49	3.00	0.67	0.41	-3.84	2.24	2.67	1.23	0.75	0.43	-3.63
Total	0.69	-4.45	0.69	-4.29	0.85	-1.90	0.78	-2.86	0.69	-4.39	0.86*	-1.78	0.76	-3.31

Note: This table reports cross-product ratios (CPR) and their associated z-statistics (Z) with reference to Calendar-year tournaments, against an index benchmark. The CPR is calculated as:

$$CPR = \frac{(N_{WH} * N_{LL})}{(N_{WL} * N_{LH})}$$

where: N_{WH} (N_{WL}) is the number of winning funds with high (low) RAR and N_{LH} (N_{LL}) is the number of losing funds with high (low) RAR. The Risk-Adjustment Ratio (RAR) is calculated as:

$$\mathrm{RAR}_{\mathrm{jMy}} = \sqrt{\left(\frac{\sum_{m=M+1}^{12} \left(r_{jmy} - \bar{r}_{j(12-M)y} \right)^2}{(12-M)-1} \right)} \div \sqrt{\left(\frac{\sum_{M=1}^{M} \left(r_{jmy} - \bar{r}_{jMy} \right)^2}{M-1} \right)}$$

where $\mathrm{RAR}_{\mathrm{jMy}}$ (r_{jMy}) is the Risk-Adjustment Ratio (fund monthly return) for fund 'j', over the M-month interim period, in tournament year 'y'. The assessment period (M, 12-M) involves an interim period of M months and a 'post' period of 12-M months (M = 3, 4, …, 9). Winning (Losing) funds are those with interim return performance above (below) the benchmark specified above. High (Low) RAR funds are those with a RAR > 1 (RAR < 1). Lighter shading indicates periods supporting H_1 (at the 5% level) i.e. where interim Winners (Losers) have decreased (increased) second period risk (i.e. *CPR* < 1). Darker shading indicates periods supporting H_2 (at the 5% level) i.e. where interim Winners (Losers) have increased (decreased) second period risk (i.e. *CPR* > 1). * indicates significant at the 10% level.

Table 4: Cross-Product Ratios for September-year Tournaments: Median Benchmark

	Assessment Period													
	(3, 9)		(4, 8)		(5, 7)		(6, 6)		(7, 5)		(8, 4)		(9, 3)	
Year	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z
1989/90	1.00	0.00	1.00	0.00	0.78	-0.71	0.41	-2.45	0.88	-0.35	0.88	-0.35	0.60	-1.41
1990/91	0.91	-0.26	1.03	0.09	1.31	0.78	1.89	1.81	1.67	1.47	1.89*	1.81	0.81	-0.61
1991/92	0.14	-4.99	1.50	1.14	1.17	0.44	2.19	2.19	0.49	-2.01	1.50	1.14	1.32	0.79
1992/93	0.39	-2.74	0.31	-3.38	0.49	-2.08	0.49	-2.08	0.39	-2.74	0.78	-0.75	0.78	-0.75
1993/94	0.57	-1.74	0.21	-4.50	0.86	-0.48	2.97	3.30	0.63	-1.43	0.95	-0.16	0.86	-0.48
1994/95	1.86	2.03	0.47	-2.48	0.56*	-1.88	0.23	-4.51	0.47	-2.48	0.74	-0.98	1.17	0.53
1995/96	0.46	-2.68	0.30	-4.06	0.59*	-1.84	0.89	-0.43	0.59*	-1.84	1.22	0.71	1.22	0.71
1996/97	2.83	3.73	1.34	1.08	0.52	-2.42	0.75	-1.08	0.93	-0.27	0.60*	-1.88	0.38	-3.47
1997/98	0.72	-1.24	1.25	0.85	1.09	0.33	0.95	-0.20	1.34	1.11	1.17	0.59	1.77	2.15
1998/99	1.98	2.72	1.45	1.49	0.50	-2.72	0.50	-2.72	0.65*	-1.73	0.57	-2.23	0.39	-3.69
1999/00	2.61	3.84	1.81	2.42	0.89	-0.49	0.89	-0.49	0.89	-0.49	0.34	-4.31	0.55	-2.42
2000/01	0.77	-1.08	0.61	-2.03	1.46	1.56	0.92	-0.36	0.48	-2.98	1.37	1.32	0.43	-3.45
Total	0.95	-0.57	0.82	-2.42	0.80	-2.76	0.83	-2.26	0.72	-4.00	0.86*	-1.84	0.72	-3.91

Note: This table reports cross-product ratios (CPR) and their associated z-statistics (Z) with reference to September-year tournaments, against a median benchmark. The CPR is calculated as:

$$CPR = \frac{(N_{WH} * N_{LL})}{(N_{WL} * N_{LH})}$$

where: N_{WH} (N_{WL}) is the number of winning funds with high (low) RAR and N_{LH} (N_{LL}) is the number of losing funds with high (low) RAR. The Risk-Adjustment Ratio (RAR) is calculated as:

$$\mathrm{RAR_{jMy}} = \sqrt{\left(\frac{\sum_{m=M+1}^{12} \left(r_{jmy} - \bar{r}_{j(12-M)y} \right)^2}{(12-M)-1} \right)} \div \sqrt{\left(\frac{\sum_{M=1}^{M} \left(r_{jmy} - \bar{r}_{jMy} \right)^2}{M-1} \right)}$$

where $\mathrm{RAR_{jMy}}$ ($\mathrm{r_{jMy}}$) is the Risk-Adjustment Ratio (fund monthly return) for fund 'j', over the M-month interim period, in tournament year 'y'. The assessment period (M, 12-M) involves an interim period of M months and a 'post' period of 12-M months (M = 3, 4, …, 9). Winning (Losing) funds are those with interim return performance above (below) the benchmark specified above. High (Low) RAR funds are those with a RAR > 1 (RAR < 1). Lighter shading indicates periods supporting H_1 (at the 5% level) i.e. where interim Winners (Losers) have decreased (increased) second period risk (i.e. $CPR < 1$). Darker shading indicates periods supporting H_2 (at the 5% level) i.e. where interim Winners (Losers) have increased (decreased) second period risk (i.e. $CPR > 1$). * indicates significant at the 10% level.

Table 5: Cross-Product Ratios for Financial-year Tournaments: Median Benchmark

	Assessment Period													
	(3, 9)		(4, 8)		(5, 7)		(6, 6)		(7, 5)		(8, 4)		(9, 3)	
Year	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z
1989/90	0.56	-1.60	0.73	-0.89	0.56	-1.60	0.73	-0.89	1.21	0.53	1.07	0.18	0.94	-0.18
1990/91	3.74	3.63	1.39	0.95	1.39	0.95	2.25	2.31	2.89	2.98	2.25	2.31	1.76*	1.63
1991/92	1.93*	1.84	0.91	-0.26	0.43	-2.36	0.38	-2.70*	0.63	-1.32	0.71	-0.97	0.71	-0.97
1992/93	0.69	-1.10	0.87	-0.42	0.30	-3.43	0.77	-0.76	0.69	-1.10	0.48	-2.11	0.38	-2.77
1993/94	1.11	0.32	1.67	1.60	1.51	1.28	0.81	-0.64	0.25	-4.08	0.90	-0.32	1.67	1.60
1994/95	0.30	-3.78	0.49	-2.29	2.25	2.59	1.68*	1.68	0.65	-1.38	0.65	-1.38	0.33	-3.48
1995/96	1.00	0.00	0.37	-3.39	0.85	-0.57	1.28	0.86	1.28	0.86	1.78	1.99	1.78	1.99
1996/97	2.47	3.24	2.12	2.71	1.68*	1.90	3.68	4.55	3.13	4.03	1.35	1.09	1.68*	1.90
1997/98	2.45	3.33	3.06	4.09	1.98	2.55	1.84	2.29	1.60*	1.77	1.72	2.03	2.64	3.58
1998/99	2.40	3.45	0.73	-1.24	1.28	0.99	0.47	-2.96	0.61	-1.98	1.64	1.98	1.06	0.25
1999/00	1.00	0.00	0.83	-0.74	1.63	1.96	1.53*	1.72	1.73	2.21	1.53*	1.72	1.06	0.25
2000/01	0.87	-0.60	0.55	-2.49	0.23	-5.71	0.69	-1.55	1.45	1.55	0.87	-0.60	0.46	-3.20
Total	1.26	2.75	0.94	-0.75	0.97	-0.33	1.11	1.25	1.13	1.50	1.18	2.00	1.02	0.25

Note: This table reports cross-product ratios (CPR) and their associated z-statistics (Z) with reference to Financial-year tournaments, against a median benchmark. The CPR is calculated as:

$$CPR = \frac{(N_{WH} * N_{LL})}{(N_{WL} * N_{LH})}$$

where: N_{WH} (N_{WL}) is the number of winning funds with high (low) RAR and N_{LH} (N_{LL}) is the number of losing funds with high (low) RAR. The Risk-Adjustment Ratio (RAR) is calculated as:

$$\mathrm{RAR_{jMy}} = \sqrt{\left(\frac{\sum_{m=M+1}^{12} \left(r_{jmy} - \bar{r}_{j(12-M)y} \right)^2}{(12-M)-1} \right)} \div \sqrt{\left(\frac{\sum_{M=1}^{M} \left(r_{jmy} - \bar{r}_{jMy} \right)^2}{M-1} \right)}$$

where $\mathrm{RAR_{jMy}}$ (r_{jMy}) is the Risk-Adjustment Ratio (fund monthly return) for fund 'j', over the M-month interim period, in tournament year 'y'. The assessment period (M, 12-M) involves an interim period of M months and a 'post' period of 12-M months (M = 3, 4, …, 9). Winning (Losing) funds are those with interim return performance above (below) the benchmark specified above. High (Low) RAR funds are those with a RAR > 1 (RAR < 1). Lighter shading indicates periods supporting H_1 (at the 5% level) i.e. where interim Winners (Losers) have decreased (increased) second period risk (i.e. *CPR* < 1). Darker shading indicates periods supporting H_2 (at the 5% level) i.e. where interim Winners (Losers) have increased (decreased) second period risk (i.e. *CPR* > 1). * indicates significant at the 10% level.

Table 6: Cross-Product Ratios for Calendar-year Tournaments: Median Benchmark

	Assessment Period													
	(3, 9)		(4, 8)		(5, 7)		(6, 6)		(7, 5)		(8, 4)		(9, 3)	
Year	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z	CPR	Z
1990	0.55	-1.62	0.55	-1.62	0.82	-0.54	0.42	-2.34	0.82	-0.54	1.07	0.18	3.14	3.04
1991	0.69	-1.00	0.46	-2.08	1.18	0.45	1.18	0.45	2.02*	1.90	1.54	1.18	0.53*	-1.72
1992	0.25	-3.71	1.93*	1.84	1.70	1.49	2.19	2.19	2.19	2.19	1.50	1.14	2.50	2.53
1993	0.45	-2.32	0.80	-0.67	0.72	-1.00	1.96	1.99	0.89	-0.33	1.96	1.99	1.00	0.00
1994	1.50	1.31	1.13	0.38	1.81*	1.92	0.93	-0.23	0.70	-1.15	0.77	-0.85	1.65	1.61
1995	0.98	-0.08	1.84	2.01	2.42	2.89	2.01	2.30	1.68*	1.71	2.01	2.30	1.53	1.42
1996	1.22	0.81	0.51	-2.67	1.11	0.43	1.08	0.31	0.31	-4.49	0.70	-1.43	0.90	-0.44
1997	1.49*	1.66	0.62	-2.01	1.18	0.71	0.31	-4.68	0.33	-4.45	10.09	8.31	4.65	6.02
1998	1.07	0.29	0.49	-2.96	0.73	-1.34	2.47	3.76	1.16	0.64	5.99	6.95	1.10	0.41
1999	0.84	-0.78	1.10	0.45	1.16	0.68	1.10	0.45	1.87	2.78	2.99	4.74	1.69	2.34
2000	0.73	-1.47	0.69*	-1.69	0.45	-3.63	0.45	-3.63	1.98	3.09	0.53	-2.88	0.60	-2.34
Total	0.87	-1.63	0.78	-3.03	1.02	0.19	0.98	-0.27	1.02	0.27	1.83	7.24	1.37	3.85

Note: This table reports cross-product ratios (CPR) and their associated z-statistics (Z) with reference to Calendar-year tournaments, against a median benchmark. The CPR is calculated as:

$$CPR = \frac{(N_{WH} * N_{LL})}{(N_{WL} * N_{LH})}$$

where: N_{WH} (N_{WL}) is the number of winning funds with high (low) RAR and N_{LH} (N_{LL}) is the number of losing funds with high (low) RAR. The Risk-Adjustment Ratio (RAR) is calculated as:

$$\mathrm{RAR}_{\mathrm{jMy}} = \sqrt{\left(\frac{\sum_{m=M+1}^{12} \left(r_{jmy} - \bar{r}_{j(12-M)y} \right)^2}{(12-M)-1} \right)} \div \sqrt{\left(\frac{\sum_{M=1}^{M} \left(r_{jmy} - \bar{r}_{jMy} \right)^2}{M-1} \right)}$$

where $\mathrm{RAR}_{\mathrm{jMy}}$ (r_{jMy}) is the Risk-Adjustment Ratio (fund monthly return) for fund 'j', over the M-month interim period, in tournament year 'y'. The assessment period (M, 12-M) involves an interim period of M months and a 'post' period of 12-M months (M = 3, 4, …, 9). Winning (Losing) funds are those with interim return performance above (below) the benchmark specified above. High (Low) RAR funds are those with a RAR > 1 (RAR < 1). Lighter shading indicates periods supporting H_1 (at the 5% level) i.e. where interim Winners (Losers) have decreased (increased) second period risk (i.e. $CPR < 1$). Darker shading indicates periods supporting H_2 (at the 5% level) i.e. where interim Winners (Losers) have increased (decreased) second period risk (i.e. $CPR > 1$). * indicates significant at the 10% level.