Portfolio Concentration and Investment Manager Performance*

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Abstract:

This study examines the relationship between investment performance and concentration in active equity portfolios. Active management is dependent on the success of two important components in the investment process – stock selection skill and portfolio management. Our study documents a positive relationship between fund performance and portfolio concentration. The relationship is stronger for stocks in which active managers hold overweight positions, as well as for stocks outside the largest 50 stocks listed on the Australian Stock Exchange (ASX). We find more concentrated funds tend to be those implementing growth styles, having smaller aggregate assets under management, being institutions which are not affiliated with a bank or life-office entity, whose funds experience past period outflows, and who are benchmarked to narrower indexes than the S&P/ASX 300.

JEL classification: G23

Keywords: Portfolio concentration, investment performance, tracking error, active funds

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I. Introduction

The extent to which investment performance is rigorously scrutinized is even more significant today than ever before. The significant attention provided fund performance has primarily arisen due to the substantial size of assets delegated to professional money managers, as well as the continued debate between the merits of active versus passive fund management.[1] In terms of the degree of scrutiny applied to tests of active management, recent literature has documented inconsistent evidence with the efficient markets hypothesis, where some value-added is achievable and therefore consistent with the Grossman-Stiglitz (1980) informational equilibrium (e.g. Grinblatt and Titman (1989), Wermers (2000), Daniel *et al.* (1997), Chen *et al.* (2000), Pinnuck (2003), Gallagher and Looi (2005)). In particular, Wermers (2000) has contributed significantly to this literature by re-opening the debate about the value of active management, where he utilizes a database of security holdings for U.S. mutual funds. He finds evidence that stocks held by fund managers outperform characteristic-based benchmarks by 1.3 percent per annum on a gross basis (and underperform by -1 percent on a net basis). Wermers' findings suggest that on average, active managers exhibit some degree of stock picking skill to cover their expenses.

In light of Wermers' (2000) recent evidence supporting the value of active management, subsequent studies have also utilized higher frequency data on equity holdings as a means of better quantifying the stock selection ability of managers from aggregate trading data. This finer decomposition of performance measurement has arisen through the use of snapshots of portfolio

[1] According to statistics as at September 2003, $A193 billion in assets are delegated to investment managers by institutional investors, representing 35 percent of all superannuation fund assets. Even more surprising is the significant growth rate in pension fund assets, which have more than doubled since June 1996. The substantial growth in assets managed by investment firms in Australia has been primarily due to compulsory employer sponsored superannuation contributions. The Superannuation Guarantee Levy is equivalent to nine percent of an employer's gross salary.

holdings at quarter-end.[2] While an active manager's stock picking ability can be quantified in terms of the purchase and sale activities executed, aggregate portfolio return also relies on a second important component of portfolio management – portfolio construction. Interestingly, prior research examining both the stockholdings and portfolio allocations to individual securities is limited. Accordingly, our study provides an important contribution to the measurement of active performance using a unique database of monthly portfolio holdings that also includes equities, cash, and derivative securities held by fund managers. While Blake *et al.* (1999), Brinson *et al.* (1986, 1991) and Chen *et al.* (2000) identify portfolio design as a significant determinant of total return variation, the literature has only rigorously examined one important phase of the investment process, namely stock picking ability. Accordingly, the purpose of this study is to examine an important attribute of portfolio management by quantifying the role of portfolio concentration in active return generation. Portfolio concentration measures the extent to which the portfolio weights held in stocks, industries and sectors deviate from the underlying index or market portfolio.[3]

Given that active portfolio management requires that fund managers constrain their tracking error volatility through the implementation of a diversified portfolio, the manager therefore faces a trade-off decision between managing the beta risk of the fund, while at the same time implementing strategies designed to capture outperformance relative to the market. While portfolio concentration is defined as deviations of stock weights from the market portfolio, the measure might also be extended to include deviations relative to the risk attributes of the underlying market portfolio. In terms of beta risk, active managers construct and manage

[2] Interestingly, Wermers' (2000) database of portfolio holdings only accounts for stock holdings, and does not include fund exposures to bonds, cash or derivative instruments. Wermers identifies that for the universe of funds irrespective of investment objective, between 79.9 and 85.4 percent of fund assets were held in equities (See Table 1, p.1664). For an excellent discussion of the Wermers' (2000) study, see Moskowitz (2000).

[3] Fund performance is achieved with respect to two interactive decisions – stock selection and portfolio construction. The former represents the ability of active investment managers to identify and exploit mispriced stocks, and the latter accounts for the portfolio manager's ability to correctly weight the stocks in the portfolio in such a manner which attempts to outperform the market.

portfolios within a mean-variance framework, where portfolio optimization techniques attempt to constrain a fund's tracking error volatility in accordance with the fund's objectives.[4] Therefore, an analysis of portfolio weights relative to the market portfolio represents an important component of a fund's design, and has implications for tracking error risk and performance.

While fund managers are concerned about the need to implement appropriate risk management practices in managing a portfolio's tracking error, increasing the concentration of the portfolio (i.e. in stocks, industries or sectors) is designed to enhance the fund's performance relative to the market. Active portfolio tilts (or bets) reflect a manager's private information set, and the magnitude by which the portfolio deviates from the market index weight is an important determinant of the active fund's total return, and therefore the degree of managerial skill. If active managers hold valuable information, an analysis of portfolio concentration represents a direct test of the value of active management. Accordingly, if skilful managers exhibit capabilities not only in identifying mispriced stocks, but also in managing the portfolio's stock allocation, then superior ability (i.e. performance) should be directly related to a portfolio's concentration.

Empirical evidence concerning the relationship between portfolio concentration and performance is sparse. Kacperczyk, Sialm and Zheng (2005) are the first to provide rigorous examination to whether industry concentration for U.S. mutual funds is related to performance, and find that those funds with a high degree of industry concentration perform better than funds which hold more stocks across many different industries. Kacperczyk *et al.*'s (2005) results are consistent with the theory that some funds possess superior investment ability. Their research is also supported by Wermers (2003), who evaluates the relationship between active fund returns and

[4] Return covariances and variances are critical inputs to the optimisation process. Moskowitz (2003) documents the relationship of stock size and to a lesser extent book-to-market value of equity to portfolio covariance risk, and Chan, Karceski and Lakonishok (1999) find evidence that market, size, and book-to-market value of equity capture the general structure of these return covariances.

tracking errors for a sample of U.S. mutual funds. Wermers finds a positive relationship between risk (volatility) and performance, confirming that the cross-sectional variation in fund returns is explained by successful managers taking larger portfolio bets. While the magnitude of bets taken by fund managers is an important issue in terms of portfolio concentration and performance, our study also considers the direction of the bet (i.e. under-or-overweight) and the importance of stock size in the allocation decision (given the risk control considerations of active managers). Our study also contributes to the literature by examining how differences in fund size and manager characteristics (e.g. style, organizational structure, benchmark index) explain the degree of portfolio concentration of active Australian equity funds.

Our research provides an important contribution to the performance evaluation literature in a number of other respects. First, we employ a more frequent interval relating to the portfolio holdings of active equity funds (i.e. monthly versus quarterly), providing a more precise estimation of the concentration and performance relationship. Furthermore, the data in this study also accounts for a fund's holdings of exchange-traded options, which ensures a more accurate determination of aggregate stock exposures. While Kacperczyk *et al.* (2005) argue that industry allocations in portfolio management are important, their study also relies on the assumption that the aggregated industry classifications capture differences in risk dimensions. Their study also relies on self-calculated industry classifications that are not directly observable by fund managers.[5] In comparison, this study employs 24 directly observable industry classifications within the Australian equity market. The Australian case is also interesting, relative to the U.S. market, in the sense that both the investment industry is highly concentrated, as well as the benchmark index being dominated by a small number of relatively large stocks.[6]

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[5] The Kacperczyk *et al.* (2005) framework aggregates 48 individual sectors in 10 groups based on non-quantifiable relationships. However, fund managers may not necessarily manage their portfolios to such aggregate industry classifications.

[6]For example, the largest 10 managers account for approximately 60 percent of aggregate assets, and the largest 20 stocks listed on the ASX exceeds 62 percent of the market capitalization weights of the S&P/ASX 300 Index. In

We find a positive and significant relationship between performance and portfolio concentration for our sample of active equity funds. This relationship is stronger for those stocks in which active funds hold overweight positions, as well as for stocks which fall outside the largest 50 stocks listed on the Australian Stock Exchange (ASX) by market capitalisation. More concentrated funds tend to be those with relatively smaller assets under management, who experience fund outflows in the previous quarter, implement growth investment styles, benchmarked to a narrower index than the S&P/ASX 300, and being institutions that are not affiliated with a bank or life-office firm.

This study proceeds as follows. Section 2 describes the data and is followed by a description of the portfolio design attributes of the active managers in our sample. Section 3 examines the relationship between investment performance and portfolio concentration, followed by an investigation of whether portfolio concentration is explained by specific fund manager characteristics. The final section concludes the study and makes suggestions for future research.

II. Data

This study examines the relationship between portfolio concentration and investment performance for a sample of 37 actively managed institutional equity funds in the period 1 January 1995 to 31 December 2001. The portfolio holdings data is sourced from the *Portfolio Analytics Database* and contains all assets held by the fund, including stock holdings, options securities, futures contracts and the cash balance. The database reports holdings at a monthly frequency and fund returns are measured on a before expenses and pre-tax basis.[7]

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comparison to the U.S., the ratio of average manager size to average stock size translates into Australian managers being estimated at between 5-10 times larger per stock.

[7] The manager holdings data was collected from all participating institutions at a common time period and as a result a degree of survivorship bias is present. However, after comparing the performance of the funds in the *Portfolio Analytics Database* to the performance of the survivorship free population of funds in the Mercer Investment Consulting *Manager Performance Analytics* (MPA) database, it appears that this bias is limited. The performance of

The investment managers were each requested to provide information for up to two of their largest institutionally operated active Australian equity fund (i.e. a pooled investment vehicle such as a 'unit trust'). The definition of 'active' fund was explicitly defined as funds exhibiting a target *ex-ante* tracking error greater than 100 basis points per annum. The term 'largest' was defined as the marked-to-market valuation of assets under management at the end of the sample period. The largest fund was deemed appropriate as being representative of the investment process executed by the investment firm in the management of domestic equity assets.

Given that the database was compiled at a single point in time, was voluntary, and that participation of the managers required contributing a substantial amount of effort in aggregating the information, the data collection procedure adopted was determined as the best means available in maximising participation. The collection procedure was also justified given a number of other considerations. First, and most importantly, the number of pooled products publicly available to institutional investors is small. Indeed, most managers offer only one or two unit trust vehicles across each asset class for institutional investors. By requesting the two largest funds, the study ensures that fund managers are not able to selectively determine which fund data was supplied. Second, the organizational operation of Australian equity funds is typically executed by a team of investment specialists, under the direction of the Head of Equities, and the team includes a number of individual portfolio managers and analysts. The team approach adopted by investment managers within a single investment style ensures that all money invested in that asset class (including private accounts) is managed in a consistent manner.

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the funds in the MPA database is very similar to that of the *Portfolio Analytics Database* funds and indicates our sample is representative of the population.

Table 1 provides descriptive statistics for the institutional active funds in the sample. Over the seven-year period there are on average of 22.9 funds at any point in time. The average fund size is $A313.50 million, however this statistic is skewed. Ranked by funds under management, the sample comprises five of the largest 10 Australian fund managers across the population, four ranked 11-20, five ranked 21-30 and 16 outside the largest 30 managers. The average length of data provided by the managers is approximately four and a half years; however fund length and age are not identical, given that the managers supplied data historically as far back as their archival systems permitted. Annualised portfolio turnover is on average 0.767 times total fund assets.

<<INSERT TABLE 1>>

A significant advantage over U.S. studies that employ portfolio holdings is the availability of holdings information pertaining to securities other than ordinary shares. The *Portfolio Analytics Database* includes stock holdings, options securities, futures contracts, cash positions and miscellaneous securities (e.g. warrants, convertibles, etc.). Their inclusion in the determination of total fund holdings gives rise to a more accurate reflection of the portfolio's total exposure to any given stock.[8]

Fund manager characteristics data is also examined in this study, and is sourced from the *Portfolio Analytics Database*, IFSA Questionnaires and other publicly available sources. The study also merges stock price information which is sourced from the ASX Stock Exchange Automated Trading System (SEATS), which was provided by SIRCA. The SEATS data includes all trade information for stocks listed on the ASX. Our data also includes the ASX and S&P/ASX benchmark index weights for constituent stocks of the ASX All Ordinaries

[8] Options are accounted for by determining the equivalent number of ordinary shares (using the option's delta) and adding this to the manager's stock holding. This procedure was first employed by Pinnuck (2003).

Accumulation Index (pre April 2000) and the S&P/ASX 100, 200 and 300 Accumulation Indices (post April 2000). In our sample, two managers are benchmarked to S&P/ASX 100, six to the S&P/ASX 200 and 28 the S&P/ASX 300. Our study employs a monthly Treasury bill instrument as the proxy for the risk-free rate, obtained from the Reserve Bank of Australia website.

III. Portfolio Design

Examination of the performance of active manager portfolios begins with a detailed examination of the portfolio's configuration. Table 2 provides descriptive statistics relating to the portfolio design of funds in the period January 1995 and December 2001. Results in Panel A of Table 2 indicate that on average, active managers hold between 50 and 60 stocks in their portfolios, whereas the median is slightly lower than the mean (ranging between 43 and 54 stocks). In contrast, Kacperczyk *et al.* (2005) document mean portfolio holdings of 91.42 stocks for U.S. equity mutual funds, and a median of 63 securities. However, this difference in stock holdings between Australian and U.S. managers reflects differences in (1) the universe of stocks available to managers and (2) the composition of market indices.

<<INSERT TABLE 2>>

The degree of concentration present in an investment manager's portfolio is examined in terms of the magnitude of bets (i.e. underweight and overweight) taken relative to the underlying benchmark index. A substantial 'bet' taken for a particular security indicates the manager's future expectations pertaining to the performance of the security. Given that active managers are also concerned with tracking error volatility, it is imperative that appropriate risk controls are implemented such that the portfolio's risk-return objective is not compromised. Table 2 shows the extent to which the aggregate manager moves their portfolio's constituents away from the benchmark index.

Table 2 (Panels B and C) also reports the number of times over-and-under index weight the fund managers are prepared to move their portfolios from the market portfolio. The stock level bets taken by active funds range between 4.73 and 7.03 times index weight. Furthermore, the results show active fund managers take overweight portfolio positions in stocks up to 22 times the benchmark. In comparison, a manager with a negative outlook on a security is likely to refrain from including the stock in the portfolio. Thus the extent to which a manager allocates an underweight position within their portfolio holdings is on average substantially lower than for overweight holdings. Panels D and E of Table 2 also show the average number of overweight and underweight exposures held by the funds in our sample. The average number of underweight positions ranges between 7 and 11, compared with 37 and 40 for overweight positions. This asymmetry is expected, given that managers would be expected to hold a greater proportion of stocks they believe will outperform the benchmark, and therefore, the portfolio will be overweight in such stocks relative to the underlying index. On the other hand, underweight portfolio holdings may arise either due to the manager gradually acquiring or liquidating the security, for tracking error management reasons or given trading cost considerations.

IV. The Relationship Between Portfolio Concentration and Investment Performance

The previous section revealed that active managers are prepared to take significant overweight positions in securities on the basis of information, however, the extent to which superior (or inferior) performance is explained by portfolio deviations from the market index remains an empirical issue. Consequently, this section examines the relationship between portfolio performance and the degree of concentration exhibited by the fund. Concentration is examined at the stock level, industry level and on a sector basis.

A. Concentration Measure

Portfolio concentration (referring to the extent to which the fund portfolio deviates from the market portfolio) can be measured using a Divergence Index at either a stock, industry or sector level. This metric was first developed and implemented by Kacperczyk *et al.* (2005) as an industry concentration measure. The Divergence Index at time t for fund F is defined in equation (1) and is the sum of the squared differences of the weights for N securities in the portfolio ($w_{i,t}{}^{F}$), relative to the weights of the securities in the underlying benchmark ($w_{i,t}{}^{m}$).

$$DI_t^F = \sum_{i=1}^{N} (w_{i,t}^F - w_{i,t}^M)^2 \qquad (1)$$

In addition to quantifying the divergence of a portfolio on the basis of individual stock holdings, we also examine the portfolio's deviation from the benchmark with respect to holdings at both the industry and sector levels. Standard and Poor's and the ASX classify securities on the basis of 24 industries and 9 sectors (see Appendix 1). These classifications provide additional tests of the performance-concentration relationship, given that fund managers may also deviate their fund holdings from the index on the basis of aggregate stock characteristics (which are defined by industries and sectors). These classifications are performed in an effort to improve the manner in which the level of concentration of a portfolio is measured.[9]

[9] For example, a fund with an overweight position in one of the four major financial institutions would at the stock level potentially have a greater Divergence Index than for a fund which holds a slightly lower overweight position in all four of the major financial institutions. However, this latter manager is taking a significant bet on banks at an aggregate level, indicating a positive outlook on the industry. Classifying stocks into industries and sectors looks at concentration from this perspective, and takes into account the strength of bets taken at each of these levels.

Alternative measures of portfolio concentration are the Entropy and Herfindahl Indexes. The former is defined as the sum of the weight in each of securities multiplied by the natural log of its weight, and the latter the sum of the squared weights for each of the securities in the portfolio. However, results for these measures are not considered given the findings of Kacperczyk *et al.* (2005), which show these approaches are highly correlated, with the Divergence Index yielding similar results. Furthermore, given that we are interested in the strength (or magnitude) of bets taken against the benchmark, a measure that is relative to the underlying benchmark (i.e. the Divergence Index) is a more intuitive measure.

Figure 1 shows the distribution of the Divergence Index over the entire sample period for all active funds. The distribution is skewed to the right across stock, industry and sector classifications, and there exists substantial cross-sectional variation in the Divergence Index levels. However this variation becomes less pronounced as the analysis moves from the stock level to the sector level.

<<INSERT FIGURE 1>>

B. Performance Measures

The relationship between performance and portfolio concentration is examined for each of a series of performance measures, namely fund excess returns to the market index, one and four factor alphas, and the appraisal ratio.[10]

The 1-factor alpha reported in equation (2) is a risk-adjusted performance measure that controls for a single market factor, estimated using an OLS regression with monthly returns. The four factor model of Carhart (1997) (see equation (3)) employs an additional three factors to the single index model, namely size, book-to-market and momentum. The inclusion of the size and

[10] The excess return of fund *i* at time *t* is the difference between the monthly raw return of the fund and that of the fund specific benchmark, which is one of either the S&P/ASX 300, S&P/ASX 200, or S&P/ASX 100 Accumulation Indices.

book-to-market factors originates from the seminal work of Fama and French (1993), while the one-year momentum anomaly identified by Jegadeesh and Titman (1993) represents a control of price momentum strategies documented in securities markets.

$$R_{it} = \alpha_{1i} + \beta_i RMRF_t + \varepsilon_{it} \tag{2}$$

$$R_{it} = \alpha_{4i} + \beta_i RMRF_t + \beta_{SMBi} SMB_t + \beta_{HMLi} HML_t + \beta_{PRi} PR1YR_t + \varepsilon_{it} \tag{3}$$

where:

R_{it} = The excess return of fund i in period t (where excess return is equal to fund return less the risk-free rate);

$RMRF_t$ = The excess return of the market portfolio in period t;

α_i = The risk-adjusted excess return (alpha) of fund i using either the one factor or four factor model;

β_i = The systematic (beta) risk of fund i;

SMB = The size factor measured as the difference between an equally weighted return of firms comprising the top and the bottom quintile of stocks (ranked by market capitalisation);

HML = The HML factor is the difference between an equally weighted return of firms comprising the top and the bottom quintile of stocks (ranked by book-to-market ratio);

$PR1YR$ = The momentum factor is the difference between an equally weighted return of firms comprising the S&P/ASX 300 Accumulation Index with the highest quartile annual return (lagged one month) and the lowest quartile yearly return (lagged one month);

ε_{it} = Random error term of fund i in period t.

In order to capture the impact of idiosyncratic (diversifiable) risk, the appraisal ratio is included as an additional performance measure. This metric reflects the tendency of a portfolio to deviate significantly from the market portfolio, and to incur higher levels of unsystematic risk. The appraisal ratio (see equation (4)), is a modified version of that specified by Treynor and Black (1973) and Kacperczyk *et al.* (2005). The former employ the CAPM alpha in the numerator, and the latter the 3-factor alpha of Fama and French. The appraisal ratio appearing in this analysis features the 4-factor alpha as previously defined. It is theoretically evident that investors have a preference for higher appraisal ratios.

$$APR_{i,t} = \frac{a'_{i,t}}{o'_{e,i,t}} \tag{4}$$

where:

a'_i = The four factor risk-adjusted return (alpha) for fund *i* in period *t*;

$o'_{e,i}$ = The residual standard error for fund *i* in period *t*.

C. Regression Analysis

This section employs a multivariate regression model as a means of examining the relationship between active fund performance and portfolio concentration using monthly data. Concentration is examined using the Divergence Index, which is estimated at the stock, industry and sector levels. A series of control variables are also specified in the regression framework in order to capture the impact of fund manager characteristics that are related to portfolio concentration. The model is estimated as an unbalanced pooling regression with panel corrected standard errors.[11]

[11] The panel is unbalanced as most of the funds in the sample either do not exist over the entire sample period or whose data was only provided for a limited time period.

The regression is specified as:

$$Performance_{i,t} = \beta_0 + \beta_1 DI_{i,t-1} + \beta_2 TU_{i,t-3} + \beta_3 lTNA_{i,t-3} + lLNG_{i,t-3} + ITI_{i,t-1} + \varepsilon_{i,t} \quad (5)$$

where:

DI = Divergence Index of fund *i* at time *t-1*;

TU = Average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year);

lTNA = Natural logarithm of the total net assets of fund *i* at time *t-3*;

lLNG = Natural logarithm of the length of time in which the manager of fund *i* at time *t* appears in the Mercer Investment Consulting *Manager Performance Analytics* (MPA) database, which is a proxy for a fund's age;

ITI = Industry Turnover Index of fund *i* at time *t*;

ε_{it} = Random error term of fund *i* at time *t*.

For those regressions performed at both the industry and sector level, the variable *ITI* in equation (6) captures the degree of manager activity in switching between industries/sectors. *ITI* is measured as the sum of the squared deviations of the weights for each of the industries/sectors held by the funds relative to their portfolio holdings in the previous period.

$$ITI_t^F = \sum_{i=1}^{N} (w_{i,t}^F - w_{i,t-1}^F)^2 \quad (6)$$

The regression results examining portfolio performance and the relationship to portfolio concentration, as well as concentration and other manager characteristics, are presented in Table 3. The coefficients for each of the performance measures are documented in Panels A through D at the stock, industry and sector levels. Consistent with successful active managers exhibiting concentrated portfolios, the coefficient on the Divergence Index is both positive and highly significant for all regressions. These results are also consistent with U.S. evidence for mutual funds.

The positive and significant Divergence Index coefficients for the appraisal ratio regressions indicate that the performance-concentration relationship is not driven by an increase in idiosyncratic or diversifiable risk. Our findings for the 4-factor alpha regressions also indicate that additional risk factors do not provide contradictory evidence from the results obtained when performance is measured using the single index model. In addition, our findings are also robust to different measures of portfolio concentration (i.e. at the stock, industry and sector level).

In order to determine the economic significance of the results, we examine the impact on portfolio performance of an increase in the Divergence Index (as determined by the size of the *DI* coefficients estimated in the above regressions). The inter-quartile range for the Divergence Index distribution (stock level) is 66.5 points; which is a relevant change in concentration for the purposes of illustrating the economic significance of the performance/concentration relation. We calculate the change in each of the performance measures following an increase of 66.5 points in the Divergence index. The annual excess return for the average fund increases by 2.84% (=66.5*0.00355*12), implying that in addition to being statistically significant, the results are also economically significant. Similarly, the one factor alpha increases by 0.15, the four factor alpha by 0.11 and the appraisal ratio by 0.07.

The impact of a similar increase in concentration at the industry and sector levels does not translate into as great an improvement in fund performance, suggesting that abnormal performance is generated more so by bets made at the stock level. Further evidence supporting this intuition is the negative coefficient on the industry/sector turnover variable, suggesting that better performing funds switch between industries less frequently than poor performing funds. Therefore, performance appears to be derived from stock picking ability from within industries (i.e. at the stock level) rather than the ability of managers to identify particular industries. This represents an interesting extension to the work of Kacperczyk *et al.* (2005).

Portfolio turnover is inversely related to fund performance, such that superior performing funds experience lower trading as a percentage of fund assets, however, this variable is largely insignificant in a statistical sense across the Panels in Table 3. Smaller funds are found to be the superior performers in our sample across all performance measures, as well as on the basis of all three concentration partitions (i.e. stock, industry and sector levels). It is also evident that on average, older funds record higher performance than younger funds.

<<INSERT TABLE 3>>

D. Over- and Under-Weighting Decisions

The above examination of the relationship between fund performance and concentration at an aggregate level demonstrates an important relationship exists between these variables. However, consideration of the direction of the bet taken (in addition to magnitude) may lead to important insights in terms of portfolio design and fund performance. Therefore, partitioning the portfolio holdings according to overweights and underweights (relative to the benchmark) is also examined, and these results are presented in Table 4.

<<INSERT TABLE 4>>

As discussed earlier, an active fund manager with a negative outlook for a security is likely to exclude that stock entirely from their portfolio, rather than underweight the security relative to the benchmark weight. Stocks held in the portfolio as underweight exposures likely reflect (1) a change in manager sentiment, leading to the liquidation of the stock over time, (2) the manager progressively acquiring the stock, or (3) the portfolio owning the stock for tracking error considerations. If active managers select stocks on the basis of private information and if stocks are generally owned where a long-only active manager expects the stock to outperform, then the portfolio performance and concentration relationship is likely to be asymmetric (given that stock picking talent is principally determined as an overweight decision).

The results in Table 4 report the panel regression estimates for both overweight and underweight portfolio holdings. In terms of the overweight partition, our results are more significant, both statistically and economically. This is consistent with fund managers deriving superior performance by taking bets on stocks they expect to outperform, and overweighting these in the fund. All concentration coefficients are positive and statistically significant at the 1% level, and robust to all measures of performance. Moreover, the coefficients are of larger magnitudes than for the aggregate sample (i.e. Table 3). In comparison, for the underweight partition, the estimate on the concentration variable is insignificant across all Panels of Table 4. However, these results are not conclusive, as the analysis in Table 2 shows the average number of underweight positions is significantly lower than the number of overweight positions and thus the Divergence Index calculated for the former may not be as reliable. Furthermore, the lower adjusted R^2 for each of the underweight models points to the power of the test being weaker.

In order to assess the economic significance of these results, and to compare them against the aggregate sample, we examine the implications for performance following a change in the Divergence Index. Increasing the Divergence Index by 66.5 (which is the size of the inter-quartile range of the stock divergence indexes for the aggregate sample) results in the annual excess return for the fund increasing by 3.00% (compared to 2.84% for the aggregate sample). This demonstrates that the performance/concentration relationship is stronger for stocks in which the manager is overweight. Similarly, the one factor alpha increases by 0.164, the four factor alpha by 0.132 and the appraisal ratio by 0.091, compared to 0.148, 0.108 and 0.067 for the aggregate sample.

E. Stock Size – Top 50 and Ex-Top 50

Given that active decisions relating to portfolio holdings expose the portfolio to tracking error risk, an individual stock's contribution to portfolio tracking error volatility should be considered in light of how an active fund manager executes active bets. The contribution to tracking error is a function of stock size (or the benchmark index); therefore, small firms may be included in a portfolio for different reasons than large firms. Large stocks cannot be significantly under/over weighted relative to the Index, since even small price movements for large stocks can generate significant over/under performance. In addition, risk compliance practices adopted by investment management institutions seek to constrain the magnitude of the over-and-under weights positions held by their portfolios, particularly in the largest stocks. However, lower tracking error contribution stocks can be more easily removed, or larger bets taken in such securities (subject to liquidity), given they exhibit lower relative tracking error risk. This issue is of particular relevance in the Australian market given the concentrated nature of the ASX. As detailed in Appendix 2, the largest 10 stocks comprise more than 47% of the aggregate weight of the S&P/ASX 300.

In light of the fact that tracking error is directly related to the stock size of index constituents, small stocks are more likely to be *included* for private information reasons, whereas large stocks should be *included* and well represented in an active manager's portfolio for both information and non-information reasons. We hypothesize that the performance/concentration relationship is likely to be better explained according to smaller stock positions. Smaller stock holdings also help to ensure greater divergence in holdings across fund managers on the basis of information value, as well as fund managers not facing the same constraints on the portfolio's relative exposure to these stocks. We investigate this by partitioning the sample on the basis of stock size, where regressions are performed for manager's holdings in the largest 50 stocks (Top 50) (ranked by market capitalisation) and ex-top 50 stocks. The results are presented in Table 5.

<<INSERT TABLE 5>>

Consistent with our hypothesis, the performance/concentration relation is stronger for smaller stocks, and the coefficients for the ex-top 50 sample are economically and statistically significant. For all performance measures (with the exception of 1 factor alpha), the concentration coefficient for the top 50 regressions is indistinguishable from zero. Thus, active managers appear to derive less informational value from large stocks, and this result is also consistent with the findings relating to trading performance by Gallagher and Looi (2005).

Commonality in large-cap holdings is also more likely to arise across the manager universe, and therefore cross-sectional variation is likely to be smaller compared to ex-top 50 securities. In terms of tracking error and portfolio optimization, we also acknowledge that large stocks have a more important influence on overall fund tracking error, and therefore the deviations away from benchmark weight may be limited by managers. Concentration coefficients for ex-top 50 stocks are all positive and significant at the 1% level and larger than coefficients for top 50 stocks, indicating that concentration in small securities is contributing more to fund performance than larger securities. In Appendix 3 we also report performance and concentration results for the largest twenty stocks, stocks ranked 21-100 by market capitalisation, and the remaining portfolio securities, and report consistent evidence to our findings in Table 5 about the importance of small-cap bets to fund performance.

V. Portfolio Concentration and Fund Manager Characteristics

The existence of a significant and positive relationship between performance and portfolio concentration leads to questions of whether the degree of concentration can be explained with respect to investment manager characteristics. This section examines the determinants of concentration by employing a multivariate regression framework to examine the relationship between the Divergence Index and a series of both qualitative and quantitative fund characteristic variables. The model is estimated as an unbalanced pooling regression with panel corrected standard errors.

The regression model is estimated as:

$$DI_{i,t} = \beta_0 + \beta_1 lTNA_{i,t-3} + \beta_2 TU_{i,t-3} + \beta_3 FF_{i,t-3} + \sum_{j=1}^{3} D_j S_{j,i,t} + D_4 BU + D_5 BM_{i,t} + D_6 BA_{i,t} + \varepsilon_{i,t} \quad (7)$$

Where:

DI = Divergence Index of fund *i* at time *t;*

lTNA = Natural logarithm of the total net assets of fund *i* at time *t-3*;

TU = Average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year);

FF = Annual net fund flow for previous 12 months of fund *i* at time *t* measured by:

$$NETFLOW_{i,t} = [ASSETS_{i,t} - ASSETS_{i,t-12} * (1 + R_{i,t})] / ASSETS_{i,t-12}$$

where:

$Assets_{i,t}$ = Size of fund *i* at time *t*

$Assets_{i,t-1}$ = Size of fund *i* at time t-12; and

$R_{i,t}$ = Return of fund *i* from time *t-12* to time *t.*

S_j = A series of three dummy variables reflecting the investment style, S_1 = 1 for value funds, S_2 = 1 for growth funds and S_3 = 1 for GARP (growth at a reasonable price) funds, the fourth style classification is style neutral/other funds;

BU = A dummy variable which is 1 for bottom-up funds and 0 for top-down funds;

BM = A dummy variable that is equal to 1 if the fund is benchmarked to the S&P/ASX 300 and 0 otherwise;

BA = A dummy variable that is equal to 1 if the fund is bank or life office affiliated and zero otherwise;

ε_{it} = Error term of fund *i* at time *t*.

The inclusion of a variable relating to the size of the fund reflects the assumption that larger funds are more susceptible to restrictions, whereby limitations arise with respect to a fund's capacity to hold significantly concentrated portfolios. This is particularly important for larger fund managers, as well as in cases involving smaller and less liquid stocks.[12] Secondly, larger investment organizations are more likely to be subject to prudent man-type investment constraints that may limit the degree to which large bets are taken, and therefore the extent of concentration in a portfolio. Table 6 shows that smaller funds exhibit a higher degree of concentration, witnessed in the negative and significant size coefficient.

Table 6 also reveals that more concentrated funds turn over their portfolios more frequently, which is consistent with the U.S. evidence (see Kacperczyk *et al.* (2005)). The direction of the net fund flow coefficients indicates that funds are more concentrated following negative fund flows. This may be a result of firstly, managers reinvesting any new money into securities not already owned and secondly, in the case of outflows, managers selling down specific holdings rather than relatively small liquidations across a large number of holdings. The results suggest

[12] Golec (1996) finds that as U.S. mutual fund managers become larger they typically invest in larger companies.

that market manipulation, where managers induce positive price pressure on stocks already owned, does not occur.

The investment style of an institution may also be related to fund concentration. Dummy variables are included to examine this effect. The *Portfolio Analytics Database* includes information relating to the self-stated investment style of the fund. Of the 37 managers examined in this study, 10 are value managers, 11 are GARP managers, five are growth managers and 11 are managers employing other styles, including style neutral. The results presented in Table 6 show that value and GARP fund managers exhibit significantly lower concentration, whereas growth funds have significantly more concentrated portfolios.

The regression results in Table 6 include a variable that specifies whether the investment manager emphasizes a "top-down" or "bottom-up" approach in determining the composition of the portfolio. In other words, bottom-up managers emphasize individual stock picking, whereas top-down managers first determine sector bets, and then allocate funds to individual stocks to achieve the desired weight allocations. While the results indicate that a bottom-up approach leads to portfolios which are more heavily concentrated, the coefficient is statistically insignificant. A variable relating to the index against which the fund is benchmarked is also included. While there is very little difference between the market capitalisation coverage (and stock weights) for the S&P/ASX 200 and 300 indices, our results indicate that funds benchmarked to the S&P/ASX 300 are less concentrated than funds benchmarked to narrower indices. This may be motivated by concern for tracking error risk. In order to minimize tracking error risk it is likely that a portfolio benchmarked to the S&P/ASX300 will contain more stocks than those benchmarked to the S&P/ASX200 or S&P/ASX100.

<<INSERT TABLE 6>>

We also examine the institutional structure of the firm to determine whether differences in organisation, incentives, and marketing or distribution platforms explain portfolio concentration. The analysis is also motivated given the findings of Del Guercio (1996) where bank fund managers tend to be influenced by prudent-man type constraints more than mutual fund managers. This would be expected to minimize the size of the bets taken by these managers, and therefore portfolios would be expected to be more broadly diversified. Our results show that bank and life office affiliated managers hold significantly less concentrated portfolios than other fund managers (e.g. boutiques).

VI. Conclusion and Suggestions for Future Research

This study examines the relationship between fund performance and portfolio concentration for a sample of active Australian equity managers. Our study evaluates concentration by assessing how the portfolio's weights across stocks, industries and sectors deviate from the underlying benchmark index. The research represents an important contribution to the literature by empirically examining how portfolio construction impacts on an active manager's ability to earn returns in excess of the market. We document a positive relationship between fund performance and portfolio concentration at the stock, industry and sector levels, which is consistent with successful active managers holding portfolios exhibiting higher concentration. The performance/concentration relationship is also significant (insignificant) for stocks in which managers hold overweight (underweight) positions.

A partition on the basis of stock size was performed in light of active fund managers' portfolio risk control considerations (i.e. tracking error). Given that tracking error is related to the size of stocks in the Index, small stocks are more likely to be *included* for private information reasons, whereas large stocks are expected be *included* more as a means of constraining tracking error (i.e. diversification reasons). Consistent with this hypothesis, the performance/concentration relationship is stronger for stocks in which active managers hold both overweight positions, and for stocks outside the S&P/ASX 50 (i.e. smaller stocks in terms of market capitalisation). The relationship between portfolio concentration and a series of qualitative and quantitative fund characteristic variables is also examined as a means of identifying the determinants of portfolio bets executed by active management institutions. Concentrated funds with higher portfolio concentration are those with smaller assets under management, who have experienced fund outflows in the previous quarter, implement a growth investment style, are not affiliated with a bank or life-office institutions, as well as their funds being benchmarked to a narrower index than the S&P/ASX 300.

Portfolio concentration may also be examined in terms of the deviations of the portfolio relative to the risk attributes of the market portfolio. This is motivated by the observation that managers typically construct portfolios with respect to a mean-variance framework (where portfolio optimisation techniques seek to constrain the fund's tracking error volatility). The active 'bets' taken across stocks and sectors represent one empirical test of concentration, and an examination that also examines differences in holdings with respect to mean-variance and optimisation is also likely to be important. Future research should examine the relationship between portfolio concentration and investment manager performance with respect to portfolio optimisation techniques that are implemented by active managers in portfolio construction. Modern Portfolio Theory shows that investors achieve optimal portfolios which are mean-variance efficient. Indeed, institutional fund managers are highly sophisticated in their use of quantitative risk models in portfolio construction, and various commercial software packages (e.g. BARRA) provide managers with tools to perform portfolio optimisation outcomes that seek to constrain the fund's tracking error volatility. Return covariances and variances are key inputs to these optimisation techniques and can be incorporated into our determination of portfolio concentration with respect specific risk factors. Moskowitz (2003) documents the relationship of size and book-to-market value of equity to portfolio covariance risk and Chan, Karceski and Lakonishok (1999) find evidence that market, size and book-to-market value of equity capture the general structure of these return covariances. Hence, portfolio optimisation techniques represent other important dimensions in portfolio design, and are offered as suggestions for future research.

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Table 1
Descriptive Statistics

This table presents descriptive statistics for the actively managed institutional equity funds in the *Portfolio Analytics Database* between January 1995 and September 2001. *Number of Funds* refers to the number of funds as at 31 December of each year. *Length* measures the number of years each of the funds is present in the sample, and is a proxy for fund age. *TNA* refers to the total net assets under management for each fund as at the end of the month. *Turnover* is the average annual turnover and is defined as the minimum of purchases and sales over the average TNA for the calendar year. *Return* is defined as the monthly raw return of the fund.

	Mean	**Median**
Number of Funds	22.88	22.51
Length (Years)	4.60	4.75
TNA (Millions)	313.51	149.13
Turnover (%)	76.74	70.11
Return (%)	1.02	1.13

Table 2
Portfolio Composition

Panel A reports descriptive statistics relating the number of stocks held by active managers in the period January 1995 to December 2001. Similar descriptive statistics are also reported for the average number of times over benchmark weight for overweight (OW) and underweight (UW) positions in Panels B and C. Times Index Weight (OW) is measured by the stock's weight in the portfolio divided by the index weight for that stock, and is determined for all stocks held by the manager for which the stock's weight in the portfolio is greater than the index weight. Times Index Weight (UW) is measured as the ratio of a stock's index weight in the benchmark, divided by the portfolio's weight held in the stock. In other words, OW and UW ratios are measured differently to one another as a means of ensuring consistency with the definition "times". Summary statistics for the Average Number of OW and UW Positions are also reported in Panels D and E.

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Panel A (Number of Stocks)							
Mean	59.58	52.93	54.16	56.62	58.97	60.11	58.83
Median	49.50	43.00	45.00	50.5	54.00	54.00	54.00
Minimum	18.00	28.00	19.00	22.00	18.00	28.00	28.00
Maximum	140.00	155.00	122.00	128.00	122.00	143.00	155.00
Standard Deviation	37.55	24.59	29.18	29.67	27.01	29.77	26.83
Panel B (Times Index Weight (OW))							
Mean	7.03	5.95	5.18	5.00	4.73	5.24	4.52
Median	6.32	5.16	5.16	3.92	3.77	4.41	3.66
Minimum	1.89	2.09	2.10	1.84	1.88	1.97	1.91
Maximum	15.63	11.78	11.28	19.85	22.57	22.02	13.39
Standard Deviation	4.37	3.39	2.68	3.58	3.76	3.65	2.62
Panel C (Times Index Weight (UW))							
Mean	1.69	1.74	1.81	1.76	1.69	1.66	1.74
Median	1.54	1.47	1.52	1.61	1.59	1.52	1.62
Minimum	1.06	1.28	1.12	1.18	1.16	1.09	1.20
Maximum	3.42	3.26	3.58	3.00	3.16	2.88	3.03
Standard Deviation	0.61	0.59	0.73	0.47	0.50	0.41	0.43
Panel D (Average Number of OW Positions)							
Mean	41.69	39.81	37.76	37.71	37.05	39.38	39.67
Median	37.5	34.16	33.58	32.25	32.71	32.33	34.5
Minimum	12.80	18.91	16.58	18.66	19.41	20.50	22.50
Maximum	89.25	72.66	82.00	82.45	72.33	87.66	77.81
Standard Deviation	20.72	16.38	16.88	17.16	14.14	16.68	15.87
Panel E (Average Number of UW Positions)							
Mean	8.23	8.39	7.25	9.73	9.70	9.17	11.05
Median	3.12	6.90	4.25	7.50	7.25	6.27	8.29
Minimum	1.000	1.42	1.00	1.00	1.00	1.00	1.36
Maximum	50.00	25.75	22.00	33.75	32.33	36.08	40.41
Standard Deviation	13.65	6.74	5.98	8.33	7.59	7.73	8.63

Table 3

Regression Evidence: Concentration and Fund Performance

This table reports the coefficients and t-statistics of the monthly panel regression for the following model: $Performance_{i,t} = \beta_0 + \beta_1 DI_{i,t-1} + \beta_2 TU_{i,t-3} + \beta_3 lTNA_{i,t-3} + lLNG_{i,t-3} + ITI_{i,t-1} + \varepsilon_{i,t}$. The data consists of the holdings of 37 actively managed institutional equity funds between January 1995 and December 2001. Performance measures include fund excess returns (raw return – benchmark return), 1 factor alpha, 4 factor alpha and the appraisal ratio the results for which are seen in Panels A through D. The *Divergence Index* of fund *i* at time *t* is sum of the squared differences of the weights for *N* securities in the portfolio ($w_{i,t}^F$), relative to the weights of the securities in the underlying benchmark ($w_{i,t}^m$). *Turnover* is the average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year). *Log(TNA)* is the natural logarithm of the total net assets of fund *i* at time *t-3*. *Log(Length)* is the natural logarithm of the length of time in which the manager of fund *i* at time *t* appears in the Mercer Investment Consulting *Manager Performance Analytics* (MPA) database (i.e. a proxy for fund age). *Industry/Sector Turnover* is the sum of the squared deviations of the weights for each of the industries/sectors held by the funds relative to their holdings in the previous period. The model is estimated as an unbalanced pooling regression with panel corrected standard errors. *N. Obs* is the number of observations.

	Stock		Industry		Sector	
Variable	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Panel A (Excess Returns)						
Intercept	0.799	1.19	2.143	3.10 ***	1.742	2.60 ***
Divergence Index	0.004	3.53 ***	0.001	2.60 ***	0.001	2.64 ***
Turnover	-0.001	-1.21	-0.001	-1.62	-0.001	-1.66
Log(TNA)	-0.052	-1.35	-0.115	-2.91 ***	-0.095	-2.45 **
Log(Length)	0.085	1.09	0.154	2.10 **	0.135	1.79
Industry/Sector Turnover	na	na	-0.002	-1.82	0.000	-0.50
Adj. R^2	1.720		1.610		1.520	
Wald Chi^2	20.570 ***		14.370		13.060	
N Obs	1199		1190		1183	
Panel B (1 Factor Alpha)						
Intercept	0.380	2.98 ***	1.084	9.36 ***	0.951	9.61 ***
Divergence Index	0.002	8.67 ***	0.000	2.75 ***	0.001	3.43 ***
Turnover	0.000	-0.95	0.000	-1.79	0.000	-1.08
Log(TNA)	-0.013	-2.01 **	-0.043	-7.08 ***	-0.038	-7.28 ***
Log(Length)	-0.008	-0.58	0.023	1.76	0.023	1.68
Industry/Sector Turnover	na	na	-0.001	-3.15 ***	-0.001	-2.68 ***
Adj. R^2	9.040		4.360		4.690	
Wald Chi^2	217.930 ***		61.390 ***		81.390 ***	
N Obs	1258		1249		1241	
Panel C (4 Factor Alpha)						
Intercept	0.663	4.74 ***	1.116	8.99 ***	1.043	9.46 ***
Divergence Index	0.002	6.12 ***	0.000	2.28 **	0.000	2.35 **
Turnover	0.000	-1.13	0.000	-1.70	0.000	-1.69
Log(TNA)	-0.030	-3.89 ***	-0.048	-6.73 ***	-0.044	-6.92 ***
Log(Length)	0.022	1.37	0.041	2.88 ***	0.037	2.50 **
Industry/Sector Turnover	na	na	-0.001	-1.56	0.000	-2.25 **
Adj. R^2	5.610		3.280		3.470	
Wald Chi^2	103.300 ***		51.410 ***		53.590 ***	
N Obs	1255		1246		1238	
Panel D (Appraisal Ratio)						
Intercept	1.656	7.13 ***	2.091	9.17 ***	1.939	9.21 ***
Divergence Index	0.001	2.94 ***	0.000	2.02 **	0.000	2.80 ***
Turnover	-0.001	-2.06 **	0.000	-1.53	-0.001	-1.62
Log(TNA)	-0.075	-6.15 ***	-0.094	-7.45 ***	-0.087	-7.50 ***
Log(Length)	0.040	1.61	0.059	2.34 **	0.054	2.15 **
Industry/Sector Turnover	na	na	-0.002	-3.36 ***	-0.001	-3.09 ***
Adj. R^2	5.200		5.670		5.570	
Wald Chi^2	70.160 ***		62.390 ***		63.260 ***	
N Obs	1218		1198		1191	

***, ** indicates statistical significance at 1% and 5% levels respectively

Table 4
Regression Evidence for Concentration and Fund Performance: Overweight and Underweight Positions

This table reports the coefficients and t-statistics of the monthly panel regression for the following model: $Performance_{i,t} = \beta_0 + \beta_1 DI_{i,t-1} + \beta_2 TU_{i,t-3} + \beta_3 lTNA_{i,t-3} + lLNG_{i,t-3} + \varepsilon_{i,t}$. The data consists of the holdings of 37 actively managed institutional equity funds between January 1995 and December 2001. Performance measures include fund excess returns (raw return – benchmark return), 1 factor alpha, 4 factor alpha and the appraisal ratio the results for which are seen in Panels A through D. The *Divergence Index* of fund *i* at time *t* is sum of the squared differences of the weights for *N* securities in the portfolio ($w_{i,t}^F$), relative to the weights of the securities in the underlying benchmark ($w_{i,t}^m$). *Turnover* is the average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year). *Log(TNA)* is the natural logarithm of the total net assets of fund *i* at time *t-3*. *Log(Length)* is the natural logarithm of the length of time in which the manager of fund *i* at time *t* appears in the Mercer Investment Consulting *Manager Performance Analytics* (MPA) database (i.e. a proxy for fund age). *Industry/Sector Turnover* is the sum of the squared deviations of the weights for each of the industries/sectors held by the funds relative to their holdings in the previous period. The model is estimated as an unbalanced pooling regression with panel corrected standard errors. *N Obs* is the number of observations.

	Overweight		Underweight	
Variable	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Panel A (Excess Returns)				
Intercept	0.6887	1.02	1.6361	2.45 **
Concentration (DI)	0.0038	4.25 ***	0.005	0.49
Turnover	-0.0006	-0.78	-0.0012	-1.54
lnTNA	-0.0464	-1.21	-0.0828	-2.20 **
lnLength	0.0831	1.07	0.1153	1.52
Adj. R^2	2.33		0.63	
Wald Chi^2	33.43 ***		6.53	
N Obs	1210		1155	
Panel B (1 Factor Alpha)				
Intercept	0.3035	2.38 **	0.8409	6.70 ***
Concentration (DI)	0.0025	9.25 ***	0.0006	0.26
Turnover	-0.0001	-0.69	-0.0003	-1.23
lnTNA	-0.0092	-1.45	-0.0282	-3.84 ***
lnLength	-0.0105	-0.74	0.0041	0.27
Adj. R^2	10.37		1.5	
Wald Chi^2	257.16 ***		21.99 ***	
N Obs	1262		1211	
Panel C (4 Factor Alpha)				
Intercept	0.5678	4.15 ***	1.0041	8.94 ***
Concentration (DI)	0.002	7.44 ***	0.0035	1.59
Turnover	-0.0002	-0.94	-0.0003	-1.37
lnTNA	-0.0253	-3.43 ***	-0.0412	-6.17 ***
lnLength	0.0172	1.10	0.0223	1.46
Adj. R^2	7.04		2.28	
Wald Chi^2	125.48 ***		43.54 ***	
N Obs	1259		1208	
Panel D (Appraisal Ratio)				
Intercept	1.5518	6.72 ***	1.8002	7.90 ***
Concentration (DI)	0.0014	3.95 ***	-0.0034	-0.90
Turnover	-0.0005	-1.90	-0.0003	-1.04
lnTNA	-0.0705	-5.84 ***	-0.0765	-6.24 ***
lnLength	0.0352	1.44	0.0151	0.62
Adj. R^2	5.68		4.26	
Wald Chi^2	80.45 ***		42.61 ***	
N Obs	1222		1105	

***, ** indicates statistical significance at 1% and 5% levels respectively

Table 5
Regression Evidence for Concentration and Fund Performance: Top 50 Stocks and Ex-Top 50 Stocks

This table reports the coefficients and t-statistics of the monthly panel regression for the following model: $Performance_{i,t} = \beta_0 + \beta_1 DI_{i,t-1} + \beta_2 TU_{i,t-3} + \beta_3 lTNA_{i,t-3} + lLNG_{i,t-3} + \varepsilon_{i,t}$. The data consists of the holdings of 37 actively managed institutional equity funds between January 1995 and December 2001. Performance measures include fund excess returns (raw return – benchmark return), 1 factor alpha, 4 factor alpha and the appraisal ratio the results for which are seen in Panels A through D. The *Divergence Index* of fund *i* at time *t* is sum of the squared differences of the weights for *N* securities in the portfolio ($w_{i,t}^F$), relative to the weights of the securities in the underlying benchmark ($w_{i,t}^m$). *Turnover* is the average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year). *Log(TNA)* is the natural logarithm of the total net assets of fund *i* at time *t-3*. *Log(Length)* is the natural logarithm of the length of time in which the manager of fund *i* at time *t* appears in the Mercer Investment Consulting *Manager Performance Analytics* (MPA) database (i.e. a proxy for fund age). *Industry/Sector Turnover* is the sum of the squared deviations of the weights for each of the industries/sectors held by the funds relative to their holdings in the previous period. The model is estimated as an unbalanced pooling regression with panel corrected standard errors. *N Obs* is the number of observations.

	Top 50		Ex-Top 50	
Variable	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Panel A (Excess Returns)				
Intercept	1.404	2.10 **	0.722	1.08
Concentration (DI)	0.002	1.23	0.007	3.05 ***
Turnover	-0.001	-1.29	-0.001	-1.52
lnTNA	-0.074	-1.93	-0.048	-1.26
lnLength	0.100	1.28	0.157	2.19 **
Adj. R^2	0.740		1.740	
Wald Chi^2	7.250		21.020 ***	
N Obs	1203		1202	
Panel B (1 Factor Alpha)				
Intercept	0.671	6.02 ***	0.251	1.71
Concentration (DI)	0.002	5.65 ***	0.005	7.70 ***
Turnover	0.000	-0.95	0.000	-1.53
lnTNA	-0.023	-3.84 ***	-0.008	-1.10
lnLength	-0.013	-0.84	0.039	3.37 ***
Adj. R^2	4.360		11.460	
Wald Chi^2	93.340 ***		153.840 ***	
N Obs	1262		1261	
Panel C (4 Factor Alpha)				
Intercept	1.142	6.94 ***	0.501	3.51 ***
Concentration (DI)	0.000	0.30	0.004	6.47 ***
Turnover	-0.001	-2.93 ***	0.000	-1.64
lnTNA	-0.045	-4.82 ***	-0.023	-3.12 ***
lnLength	0.033	1.87	0.058	4.18 ***
Adj. R^2	3.060		8.180	
Wald Chi^2	34.690 ***		101.690 ***	
N Obs	1228		1258	
Panel D (Appraisal Ratio)				
Intercept	1.826	8.30 ***	1.406	5.71 ***
Concentration (DI)	0.001	1.06	0.004	4.57 ***
Turnover	-0.001	-2.12 **	-0.001	-2.39 **
lnTNA	-0.081	-6.84 ***	-0.065	-5.16 ***
lnLength	0.042	1.79	0.067	2.67 ***
Adj. R^2	4.620		6.840	
Wald Chi^2	56.470 ***		83.070 ***	
N Obs	1222		1221	

***, ** indicates statistical significance at 1% and 5% levels respectively

Table 6
Regression Evidence for Concentration and Fund Characteristics

This table reports the coefficients and t-statistics of the monthly panel regression for the following model:

$$DI_{i,t} = \beta_0 + \beta_1 lTNA_{i,t-3} + \beta_2 TU_{i,t-3} + \beta_3 FF_{i,t-3} + \sum_{j=1}^{3} D_j S_{j,i,t} + D_4 BU + D_5 BM_{i,t} + D_6 BA_{i,t} + \varepsilon_{i,t}$$

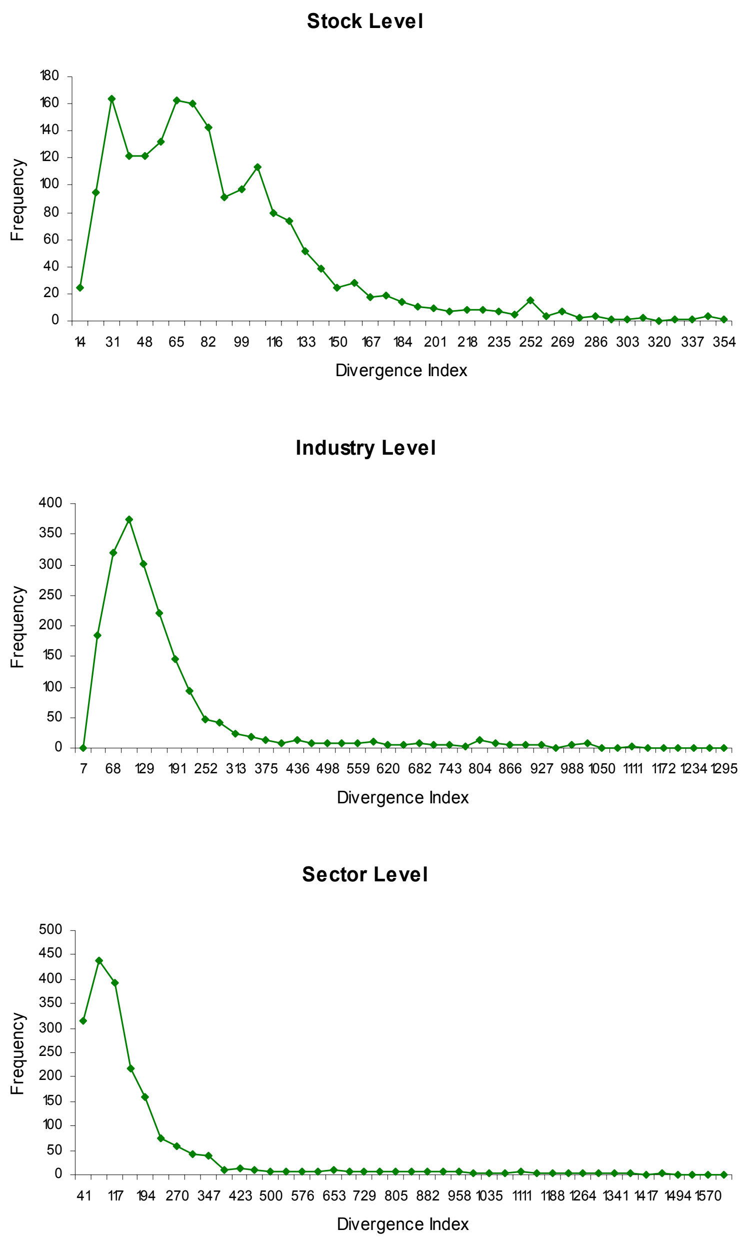
The data consists of the holdings of 37 actively managed institutional equity funds between January 1995 and December 2001. The *Divergence Index (DI)* of fund *i* at time *t* is measured as $DI_t^F = \sum_{i=1}^{N} (w_{i,t}^F - w_{i,t}^M)^2$, where $w_{i,t}^F$ is the weight of the fund holdings in stock *i* and $w_{i,t}^m$ is the weight of the market in stock *i*. *(TNA)* is the natural logarithm of the total net assets of fund *i* at time *t-3*. *Turnover* is the average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year). *Fund Flow* is the annual net fund flow for the previous 12 months of fund *i* at time *t*. S_j are a series of 3 dummy variables reflecting the investment style, S_1 = 1 for value funds, S_2 = 1 for growth funds and S_3 = 1 for GARP (growth at a reasonable price) funds, the fourth style classification is style neutral/other funds. *BU* is a dummy variable which is 1 for bottom-up funds and 0 for top-down funds, *BM* is a dummy variable that is equal to 1 if the fund is benchmarked to the S&P/ASX 300 and 0 otherwise and *BA* is a dummy variable that is equal to 1 if the fund is bank or life office affiliated and zero otherwise. The model is estimated as an unbalanced pooling regression with panel corrected standard errors. *N. Obs* is the number of observations.

Dependent Variables	**Coefficient**	**t-stat**
Intercept	239.06	15.51 ***
Log(TNA)	-14.31	-7.13 ***
Turnover	0.02	2.07 **
Fund Flow	0.00	-2.83 ***
S_1	-10.31	-2.80 ***
S_2	20.45	6.35 ***
S_3	-19.57	-8.46 ***
Bottom Up	4.33	1.53
Benchmark	-12.05	-7.17 ***
Bank/Life Office	-42.51	-15.91 ***
Adj. R^2	23.29	
Wald Chi^2	2307.77***	
N. Obs	1770	

***, ** indicates statistical significance at 1% and 5% levels respectively

Figure 1
Histograms of Divergence Index

This figure illustrates the distribution of the Divergence Index determined at the stock, industry and sector levels. The Divergence Index is defined as $DI_t^F = \sum_{i=1}^{N} (w_{i,t}^F - w_{i,t}^M)^2$, where $w_{i,t}{}^F$ is the weight of the fund holdings in stock/industry/sector i and $w_{i,t}{}^m$ is the weight of the market in stock/industry/sector i.



Appendix 1
Industry and Sector Classifications

Securities are classified into 1 of 24 industries and 1 of 9 sectors. The 24 industries are based on the ASX industry classification system that was in effect at the time in which the analysis is conducted. The 24 industries are further subdivided as appears in the 9 sector classification on the basis of the GICS (Global Industry Classification) system. Weights of each industry and sector are reported according to their average representation in the S&P/ASX 300 over the period January 1995 - December 2001.

9 Sector Classification	*Weight (%)*	*24 Industry ASX Classification*	*Weight (%)*
Energy	2.957	Energy	2.957
Materials	18.188	Gold	2.798
		Other Metals	5.251
		Diversified Resources	7.854
		Chemicals	0.794
		Paper and Packaging	1.489
Industrials	10.8974	Developers and Contractors	2.888
		Building and Materials	3.115
		Engineering	0.4792
		Transport	2.794
		Miscellaneous Industrials	1.457
		Diversified Industrials	0.1616
Consumer Discretionary	11.177	Retail	1.489
		Media	7.758
		Tourism and Leisure	1.929
Consumer Staples	5.715	Alcohol and Tobacco	2.791
		Food and Household	2.923
Healthcare	1.905	Healthcare and Biotechnology	1.905
Financials	32.145	Banks and Finance	19.48
		Insurance	3.828
		Investments and Financial Services	1.810
		Property Trusts	7.024
Telecommunication Services	4.753	Telecommunication	4.753
Utilities	4.246	Infrastructure and Utilities	4.246

Appendix 2
Concentration of S&P/ASX 300

This table illustrates the concentration evident in the Australian Stock Exchange (ASX) by reporting the relative weights in the S&P/ASX 300 of varying sub-set of stocks on the basis of their market capitalisation as at 31 March 2002. The S&P/AXS 300 is a value-weighted index comprising 300 stocks.

	Weight in S&P/ASX 300 (%)
Top 5	29.76
Top 10	47.69
Top 20	62.25
Top 50	82.42
Top 100	93.22
Bottom 200	6.78

Appendix 3
Regression Evidence for Concentration and Fund Performance: Top 20 Stocks, 21-100 Stocks and 100+ Stocks

This table reports the coefficients and t-statistics of the monthly panel regression for the following model: $Performance_{i,t} = \beta_0 + \beta_1 DI_{i,t-1} + \beta_2 TU_{i,t-3} + \beta_3 lTNA_{i,t-3} + lLNG_{i,t-3} + \varepsilon_{i,t}$. The data consists of the holdings of 37 actively managed institutional equity funds between January 1995 and December 2001. Performance measures include fund excess returns (raw return – benchmark return), 1 factor alpha, 4 factor alpha and the appraisal ratio the results for which are seen in Panels A through D. The *Divergence Index* of fund *i* at time *t* is sum of the squared differences of the weights for *N* securities in the portfolio ($w_{i,t}^F$), relative to the weights of the securities in the underlying benchmark ($w_{i,t}^m$). *Turnover* is the average annual turnover of fund *i* at time *t-3* (minimum of purchases and sales over the average TNA for the calendar year). *Log(TNA)* is the natural logarithm of the total net assets of fund *i* at time *t-3*. *Log(Length)* is the natural logarithm of the length of time in which the manager of fund *i* at time *t* appears in the Mercer Investment Consulting *Manager Performance Analytics* (MPA) database (i.e. a proxy for fund age). The model is estimated as an unbalanced pooling regression with panel corrected standard errors. *N Obs* is the number of observations.

	Top 20		21 to 100		101 Plus	
Variable	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Panel A (Excess Returns)						
Intercept	1.493	2.24 **	1.219	1.78	0.967	1.52
Divergence Index	0.000	-0.01	0.004	1.68	0.011	2.81 ***
Turnover	-0.001	-1.39	-0.001	-1.34	-0.001	-1.52
Log(TNA)	-0.075	-1.98 **	-0.067	-1.72	-0.061	-1.64
Log(Length)	0.114	1.49	0.103	1.27	0.173	2.37 **
Adj. R^2	0.560		0.910		1.620	
Wald Chi^2	5.360		11.420 **		15.810 ***	
N Obs	1175		1203		1199	
Panel B (1 Factor Alpha)						
Intercept	0.810	6.62 ***	0.515	4.64 ***	0.355	2.29 **
Divergence Index	0.001	1.39	0.004	8.09 ***	0.009	8.05 ***
Turnover	0.000	-1.13	0.000	-1.15	0.000	-1.70
Log(TNA)	-0.029	-4.26 ***	-0.017	-2.93 ***	-0.013	-1.67
Log(Length)	0.007	0.48	-0.005	-0.37	0.046	3.69 ***
Adj. R^2	1.860		6.130		11.620	
Wald Chi^2	34.930 ***		192.770 ***		140.220 ***	
N Obs	1234		1262		1258	
Panel C (4 Factor Alpha)						
Intercept	1.002	7.89 ***	0.737	5.84 ***	0.587	4.30 ***
Divergence Index	0.000	-0.34	0.003	5.41 ***	0.008	6.81 ***
Turnover	0.000	-1.28	0.000	-1.29	0.000	-1.73
Log(TNA)	-0.042	-5.89 ***	-0.032	-4.49 ***	-0.028	-3.90 ***
Log(Length)	0.036	2.35 **	0.021	1.31	0.065	4.46 ***
Adj. R^2	2.330		4.750		8.470	
Wald Chi^2	38.760 ***		79.190 ***		111.860 ***	
N Obs	1231		1259		1255	
Panel D (Appraisal Ratio)						
Intercept	1.990	8.87 ***	1.575	6.45 ***	1.442	5.69 ***
Divergence Index	-0.002	-2.52 **	0.002	3.46 ***	0.006	4.46 ***
Turnover	-0.001	-2.30 **	0.000	-1.00	-0.001	-1.20
Log(TNA)	-0.087	-7.19 ***	-0.070	-5.19 ***	-0.066	-4.85 ***
Log(Length)	0.064	2.75 ***	0.023	0.70	0.060	1.77
Adj. R^2	5.180		5.250		6.570	
Wald Chi^2	54.730 ***		60.480 ***		70.660 ***	
N Obs	1194		1166		1162	

***, ** indicates statistical significance at 1% and 5% levels, respectively