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How Much Does Tax Erode Fund Alpha?

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Abstract

We model the tax drag from active funds management by simulating portfolios based on reported monthly holdings of 207 active Australian equity funds between July 2000 and December 2010, and then compare both pre-tax- and after-tax fund returns versus those for passive indices modeled under the same assumptions. Tax drag erodes 65% of the 0.74% alpha in Broad Market funds, but only 21% of the 1.80% alpha in Small-Cap funds for Australian superannuation (pension) fund investors. We also find that tax drag varies with investment style; market state being most detrimental during bull markets; and fund turnover – although the relation between turnover and after-tax alpha is non-monotonic. For high-income individual investors, tax drag is exacerbated to the extent that active management only generates meaningful alpha after-tax for Small-Cap funds of certain styles. Our study highlights the importance of investigating performance and tax effects in a unified framework, and confirms the critical importance of considering tax when choosing between active and passive funds management.

JEL classification: G23

Keywords: after-tax performance, active management, portfolio holdings, trades, alpha generation

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1. Introduction

Investors in active equity funds are typically cognizant of pre-tax dividend income and capital gains, but may be unaware of the total tax impact their investments create. In this study, we use a unique database of monthly portfolio holdings to simulate the tax effects realized by actively managed equity funds between July 2000 and December 2010. We focus on the extent to which tax effects erode the active returns achieved by investors relative to benchmark indices, which we model after-tax under consistent assumptions to the fund sample.

Our results demonstrate that tax effects can substantially erode the value proposition offered by actively managed funds to taxable investors, particularly during bull markets. We make three main contributions to the literature. First, by observing monthly portfolio holdings, we estimate the tax effects arising from actual investment decisions that cannot be captured by simulating mechanical strategies: a method that has previously been widely used to estimate the tax effects of active management.[1] This allows us to move beyond evaluating proxies, towards directly estimating the value created by active managers arising from their discretionary decisions in addition to any style bias. Second, by estimating effects within Australia's unique tax regime, where imputation tax credits[2] play a large role, we can analyze the extent to which tax regimes matter. Most research into tax effects has so far focused on the US market, which operates a classical tax framework (albeit with concessionary tax rates on qualified dividends since 2003). Our findings indicate that the US results do not reliably generalize to other countries. Finally, our approach of evaluating the performance of active funds against a constructed after-tax benchmark provides a meaningful estimate of the relative value of active versus passive investment. It recognizes that passive indices also incur tax effects related to taxation of dividend income and any capital gains associated with rebalancing the index.

The question of whether active fund managers are able to add value for investors is of considerable public interest. While there is a large body of literature analyzing the performance of active management on a pre-tax-basis, only a modest number of mostly US-focused studies have considered the impact of tax effects on the net returns achieved by investors (e.g. Jeffrey and Arnott (1993); Dickson and Shoven (1993); Arnott, Berkin and Ye (2000, 2001); Dickson *et al.* (2000); Longmeier and Wotherspoon (2006); Israel and Moskowitz (2010); Bergstresser and Pontiff (2013); Sialm and Zhang (2015)). We build on this research by examining the impact of tax on the returns achieved by investors in Australian equity funds. Our core analysis adopts the perspective of an Australian superannuation (pension) fund investor. Mandatory participation in superannuation[3] means that the majority of the Australian workforce is effectively invested in the Australian equity market, with a large proportion of this being subject to active management. Australian superannuation funds managed A$1.91 trillion as of September 2015, which amounts to 74% of the total Australian managed funds industry, with 25%-30% invested in domestic equities.[4] The concessional tax rate applied to superannuation, of 15% on income and short-term capital gains and 10% on long-term capital gains, is hence broadly applicable to the general public. Further, Australia

[1] For example, Berkin and Ye (2003), Horvitz and Wilcox (2003), and Bouchey, Stein and Vadlamudi (2008)

[2] Australia's imputation tax system provides a full tax credit to shareholders on dividends for the domestic corporate taxes paid on the profits from which dividends are distributed. A classical tax system does not provide any credit for tax paid by companies, and taxes shareholders based on dividends received.

[3] Compulsory superannuation was introduced into Australian in 1992. For many Australians, it represents not only their largest investment in equity markets, but also a significant determinant of their quality of life after retirement.

[4] Source: Australian Bureau of Statistics, Catalogue 5655.0 *Managed Funds, Australia*

was the fifth largest pension fund market in the world in 2015,[5] and offers a number of points of distinction compared to the US. Unlike their US counterparts, Australian investment funds are not obliged to disclose their after-tax performance. Further, Australian domestic investors are entitled to any imputation credits attached to dividends. These effectively operate as a tax credit to be deducted from other tax liabilities, and are applied at the corporate tax rate of 30%, meaning that superannuation funds benefit from a net tax credit of 15% on 'fully franked' dividends. While superannuation is the major investor type in Australia, for completeness we also generate estimates for individual investors on the highest marginal income tax rate of 47%. This establishes a maximum for tax effects, thus spanning the range for Australian investors.

Our method involves simulating pre-tax and after-tax returns for both active equity funds and passive benchmarks. This is done by tracking reported portfolio rebalancing activities and market events such as dividend distributions, then estimating the associated tax effects. This approach allows us to compare both the active returns and the tax liabilities incurred by active funds relative to the alternative of passively investing in an index. We use a unique database of the monthly portfolio holdings of 207 long-only active Australian equity funds with data covering the period between 1st July 2000 and 31st December 2010. The use of actual monthly stock holdings offers strong advantages over previous studies attempting to quantify the magnitude of tax costs through either theoretical analysis[6] or empirically-based simulation methods.[7] These two methods do not fully capture the real-life scenarios facing taxable investors. Other studies use return-based after-tax performance data to estimate the broad magnitude of tax costs incurred by the investment management industry.[8] However, these studies are unable to extract detailed information on the underlying tax exposures of the funds. Our holdings-based approach supports an evaluation of the sources and nature of the tax effects arising from the decisions of active fund managers. Our research also extends prior simulation-based studies, which have focused primarily on the capital gains tax aspect, by providing coverage of concurrent dividend income related tax effects. The latter plays a significant role in after-tax performance, given the systematic differences in dividend seeking behavior across different fund styles. Further, the Australian dividend imputation system provides some unique tax benefits by fully mitigating the double-taxation on income for domestic investors. For instance, superannuation funds are able to use imputation credits to reduce their tax liabilities, reflecting the difference between the 15% superannuation income tax rate and the 30% corporate tax rate at which imputation credits are accrued. Capturing this dimension is essential when considering the after-tax returns of active investment; and helps to highlight how tax effects may vary with tax regimes.

By simulating the portfolio holdings of the appropriate index benchmark, we are able to capture the true opportunity cost of active investment. Our analysis separates active funds into two groups: Broad Market funds have scope to invest across the entire market, and are evaluated against a simulated S&P/ASX300 Index. Small-Cap funds tend to be concentrated outside Large-Cap securities, and are benchmarked against the S&P/ASX Small Ordinaries Index, defined as the S&P/ASX300 Index excluding companies in the S&P/ASX100 Index. Benchmark indices are simulated under the same assumptions as the active portfolios. By deriving the tax liabilities associated with holding the benchmark, we can analyze both the capital gains tax (CGT) effects

[5] Source: *Global Pension Assets Study 2016*, Willis Towers Watson, 2016

[6] See Jeffrey and Arnott (1993), Constantinides (1984), and Dammon and Spatt (1996).

[7] See Berkin and Ye (2003), Horvitz and Wilcox (2003), Stein, Vadlamudi and Bouchey (2008), Dickson, Shoven and Sialm (2000), and Sialm and Zhang (2015).

[8] See Longmeier and Wotherspoon (2006), Arnott, Berkin and Bouchey (2011), and Israel and Moskowitz (2010).

related to the marginal turnover generated by active investment, and the tax impacts of preferences for dividends and franking (i.e. imputation) credit yield among active managers. Our primary measure of the value of active management is return in excess of the index, which we denote 'alpha'.

We uncover considerable variation in alpha and tax effects across funds by Broad Market and Small-Cap segments and investment styles. Broad Market funds not only earn lower average pre-tax alphas than Small-Cap funds (0.74% p.a. versus 1.80% p.a.), but also have a much higher proportion of their alpha eroded by taxes (65% versus 21%). The net result is that Broad Market funds generate insignificant after-tax alpha of only 0.26% p.a. on average; while Small-Cap funds deliver significant after-tax alpha of 1.43% p.a. Across funds of differing investment styles, the general theme is that pre-tax alphas vary considerably more than the marginal tax drag. Accordingly, fund styles that generate higher pre-tax alphas tend to leak a smaller percentage of this as additional tax, so that they also deliver higher alpha after-tax. For example, Broad Market Value funds generate 1.37% pre-tax alpha but lose only 0.43% (31%) to tax drag relative to the benchmark, leaving significantly positive after-tax alpha of 0.95% p.a. However, Broad Market Growth funds generate only 0.36% in pre-tax alpha but nevertheless lose 0.44% (121%) to tax drag, resulting in after-tax alpha of -0.08% p.a. Across the fund styles, significantly positive after-tax alpha is delivered by Value and GARP (Growth At a Reasonable Price) funds in the Broad Market segment; and by Neutral, Value, GARP and Quant funds in the Small-Cap segment. Meanwhile, Growth funds deliver negative after-tax alpha in the Small-Cap as well as the Broad Market segment.

Dividing the sample into market states, we document considerable variation in fund performance and tax liabilities across differing market conditions. Broad Market funds, on average, generate significantly positive pre-tax alpha both in the bull market prior to the Global Financial Crisis (GFC) and the subsequent recovery phase; but generate insignificantly negative pre-tax alpha during the GFC bear market. However, tax effects predominantly related to CGT completely erode excess performance during the long pre-GFC bull market between March 2003 and October 2007, resulting in no net benefit to superannuation investors. Small-Cap funds are able to generate significant after-tax alpha during bear and recovery markets, but not during the bull market when their significant pre-tax alpha is substantially eroded by CGT. These findings suggest that active management may struggle to add value after-tax during bull markets due to the greater likelihood of realizing CGT in rising markets.

Sorting funds into portfolios by turnover uncovers a complex relation between fund performance, tax impacts and trading activity. Existing studies and general industry preconceptions stress the value of managing portfolio turnover to minimize short-term capital gains.[9] Our results confirm the notion that higher turnover is associated with greater CGT liabilities. We also find that the highest turnover funds generate lower pre-tax and after-tax alphas than the lowest turnover funds. However, the relation between turnover and after-tax alpha is far from monotonic across the portfolios. For instance, in the Broad Market segment, the greatest after-tax alpha is generated by those funds ranked in the second lowest turnover quintile; while the lowest after-tax alpha emerges for funds in the middle quintile. These findings suggest that no straightforward linear relation exists between turnover and the net value realized by investors.

[9] Horan and Adler (2009), Horvitz and Wilcox (2003), and Longmeier and Wotherspoon (2006) document a tax benefit of keeping portfolio turnover low to benefit from long-term capital gains.

Lastly, we find that the tax drag from active management is greatly exacerbated when tax rates are increased to the highest tax bracket for individuals. For such investors, 162% of the total pre-tax alpha in Broad Market funds is lost through tax drag, resulting in significantly negative average after-tax alpha of -0.46% p.a. across this segment. In the Small-Cap segment, pre-tax alphas are eroded by 74%, leaving insignificantly positive after-tax alpha of 0.46% p.a. Only Small-Cap Growth at A Reasonable Price (GARP) and Small-Cap Quant funds continue to deliver significantly positive after-tax alpha for investors on the top marginal tax rate. This confirms that the value of active management depends on the tax status of the investor.

Our research contributes to the understanding of how tax impacts on the value of active management. By simulating returns based on the observed real-life portfolios of active equity fund managers, we illustrate the potentially adverse impact that can arise from tax externalities. Further, we evaluate after-tax investment outcomes from active funds against after-tax outcomes from market benchmarks, enabling a like-for-like comparison of active versus passive investment. We demonstrate how tax effects may vary substantially across size segments, investment style, market conditions and investors. While we have not accounted for management fees, these too can vary considerably across investors, reinforcing that the case for active management may depend on the underlying investor concerned. Furthermore, our results contrast with those arising from US markets in many ways, thus highlighting how tax impacts also depend on the tax regime and market setting. Overall, we find that there is no universal answer to the question of whether tax effects arising from greater turnover undermine the case for active management. It depends on how the portfolio is managed (e.g. manager skill, style, possibly turnover); the market environment (e.g. market state, country); and most importantly, the investor themselves (e.g. tax status, management fees).

The remainder of this paper is organized as follows. Section 2 provides a review of the literature. Section 3 details the data and presents descriptive statistics. Section 4 outlines the method of calculating returns and associated tax effects for both the active funds and the index benchmarks. Section 5 reports and discusses the empirical findings. Section 6 presents the conclusions.

2. Background

There is substantial academic and industry interest in whether active fund managers can beat passive indices. A number of studies over the past decade have approached this question by examining the trades and holdings of active equity funds, and found that active managers do indeed exhibit some skill.[10] However, most studies use pre-tax returns as their measure of performance. This creates a disconnect between the findings of these studies and the actual after-tax returns received by investors. In the US, researchers such as Jeffrey and Arnott (1993), Dickson and Shoven (1993), Arnott, Berkin and Ye (2000, 2001), Dickson *et al.* (2000) and Longmeier and Wotherspoon (2006) aim to address this gap by examining tax effects for actively managed funds in both theoretical and simulated contexts. These studies show that variations in tax efficiency, arising from different fund styles and tax management strategies, can have a significant impact on the after-tax performance. In at least some cases, taxes completely erode any pre-tax advantage funds have over their passive benchmarks. Sialm and Zhang (2015) use reported before- and after-tax returns to directly observe fund performance, and find that mutual funds with higher tax burdens do not offset these additional costs with superior before-tax performance.

[10] See for example Wermers (2000), Pinnuck (2003), Gallagher and Looi (2006), and Chen *et al.* (2010).

The focus on after-tax performance has arisen, in part, from the US Securities and Exchange Commission (SEC) requirement for mutual funds to report both pre-tax and after-tax returns. Introduced in 2001, this legislation was designed to help investors understand the magnitude of tax costs and compare after-tax fund performance. The SEC methodology calculates after-tax returns by accounting for dividend distributions, short-term and long-term capital gains realization, and tax loss carry-forwards. In addition to after-tax returns, a number of measures have been developed to further quantify the tax efficiency of overall portfolios. Tax impact, calculated as the pre-tax return minus the after-tax return, is the most commonly used due to its simplicity.[11] Stein (1999) develops tax alpha, calculated as the pre-tax excess return minus the after-tax excess return, to separate the value added through tax management. Following Stein (1999), Longmeier and Wotherspoon (2006) provide empirical evidence that mutual funds as a group are not able to add meaningful after-tax alpha except in certain categories such as Small-Cap funds. Subsequent studies employ tax efficiency ratios, with Israel and Moskowitz (2010) and Bergstresser and Pontiff (2013) using effective tax rate as a measure of tax efficiency. Calculated as the tax impact divided by the pre-tax return, this indicates how much alpha is given up to taxes as a percentage of pre-tax return. The measures of tax efficiency we use for this study are based on those described above. Our key innovation is to make an adjustment for tax effects in the benchmark, by applying the same method to the benchmark index that is used to estimate tax for active funds.

A number of US studies examine the tax efficiency of different fund styles. Israel and Moskowitz (2010) and Bergstresser and Pontiff (2013) find that momentum-driven portfolio strategies have the highest effective tax rates, attributable to high turnover and positions often being sold with short-term capital gains. Value funds were also found to be tax disadvantaged in the US, since they are more exposed to high dividend yielding stocks and hence the degree to which dividends are taxed more heavily than capital gains. This is in sharp contrast to Australian Value funds, which are able to take advantage of tax credits associated with imputation for domestic investors. Longmeier and Wotherspoon (2006) further compare Large- and Mid-Cap active funds with Small-Cap funds in the US. They find that while the former two groups underperform the market after-tax, the latter group generally outperforms. This finding is consistent with our own that Australian Small-Cap funds produce higher pre-tax alphas and are more tax efficient; although otherwise our style-related findings differ somewhat to the US results.

With regard to the interrelation between turnover, alpha and tax, the conventional view is that portfolio turnover is negatively correlated with portfolio tax efficiency. Hence it is often seen as tax effective to keep portfolio turnover low, in order to benefit from tax deferral and long-term capital gains. However, Jeffrey and Arnott (1993) show that the marginal impact of taxes diminishes as turnover increases, and entirely disappears at turnover rates above 100%. They argue that the relationship between the impact of taxes and portfolio turnover is non-linear because the holding period is the reciprocal of the turnover rate. Following Jeffrey and Arnott (1993), Horvitz and Wilcox (2003) conduct a simulation analysis exploring the value of reducing turnover (i.e. extending the holding period beyond 12 months) to minimize the incidence of short-term gains. They argue that deferred capital gains tax is valued more than an interest-free loan from the government, as it is compounded over time. This leads to higher total assets in the future relative to the assets that would remain if investors chose to crystallize capital gains. The main shortcoming of these studies is that they are not based on the direct examination of actual portfolio positions, and hence are not able to

[11] See Stein (1999), Longmeier and Wotherspoon (2006), Brunel (2000), Gannon and Blum (2006), Arnott *et al.* (2011), Israel and Moskowitz (2010) and Bergstresser and Pontiff (2013).

capture the interplay between turnover-dependent alpha generation and turnover-related tax effects. Further, they do not capture the tax implications of the benchmark itself, as we do. While our analysis confirms that elevated turnover tends to be associated with higher CGT liabilities relative to the index; our simulations also implicitly account for the alpha impacts from trading. After accounting for all these effects, the relation between turnover and both pre-tax and after-tax alpha is found to be complex, so that no unambiguous monotonic relation between turnover and after-tax alpha emerges.

We also contribute to the existing literature by examining how income and capital gains tax liabilities vary across different market states. Prior studies such as Longmeier and Wotherspoon (2006) have argued, albeit without empirical evidence, that active management is more favorable in down markets. We provide some support for this contention by showing that marginal CGT liabilities arising from active management are primarily incurred during the bull market. Our study also provides insight on how investors under different tax regimes (superannuation vs. high income) are affected by marginal tax liabilities in active funds compared to a passive index. To our knowledge, we are the first to examine this perspective.

Our study is distinguished from prior US-based studies by our consideration of imputation credits, which are unique to the Australian tax system. Domestic Australian investors are able to receive franking credits for company taxes already paid by the dividend-issuing firm. The dividend imputation system was introduced in July 1987 to alleviate the double taxation of dividends at the company and then personal income tax level. Under the imputation system, investors may use franking credits to offset income tax liabilities on both dividend and non-dividend income. Further, where the value of income credits exceeds an investor's total income tax liabilities, the difference can be paid out to the investor as a cash rebate. The dividend imputation system adds an additional element that is not present in the US, and hence allows us to evaluate the extent to which US-based results can be generalized to other contexts.

In Australia, there is limited academic literature on tax effects in a fund management context, with only a few studies examining how tax influences the investment decisions of active Australian equity funds. Fong, Gallagher, Lau and Swan (2009) investigate the impact of the introduction of a 50% tax discount for capital gains on assets held for at least one year. The authors find that equity funds respond by significantly increasing the proportion of long-term gains realized, albeit with significant variation across funds. Further, Ainsworth, Fong, Gallagher and Partington (2015) show that active equity funds are not motivated to capture imputation credits through their trades, but rather seek to generate capital gains from opportunistic trading around the ex-dividend date.[12] There are no Australian studies examining after-tax returns, largely due the absence of data. After-tax returns do not need to be reported in Australia. Further, pooled equity funds do not generate after-tax returns, but rather distribute tax effects to investors to include in their own tax returns. These tax distributions are also not generally available. Our study is the first to focus on after-tax returns for Australian equity funds.

In summary, our main contribution relates to empirically examining the impact of tax on alpha that arises as a consequence of observed decisions by active managers, which is compared with a passive benchmark index where tax effects are similarly accounted for. This contrasts with many of the prior

[12] These results are largely attributable to unit trusts, which are pass-through entities for tax purposes. By contrast, we assume a superannuation fund, which is a tax-paying investment vehicle.

studies that examine tax effects either from a theoretical basis, or without the use of actual fund holdings; while not allowing for tax effects that are incurred under passive investment. Hence, our approach generates a more meaningful measure of the effective after-tax contribution from active management. Further, our method allows us to explore the dimensions of fund styles, market conditions, and portfolio turnover using the real investment decisions of fund managers. Our work is further distinguished by using Australian data, where there exists a dividend imputation system. This makes our analysis not only practically relevant for a broad demographic of Australian investors; but also allows us to comment on the applicability of US-based findings to other contexts.

3. Data

Monthly equity holdings for Australian long-only active equity funds from July 2000 to December 2010 were sourced from the Russell Investments ('Russell') research database. We draw from the Russell database information on monthly stockholdings and self-declared investment styles. However, the database does not include derivative positions, cash holdings or cash flows. Style categories are tailored to the Australian market, with managers self-declaring their appropriate category under guidance from Russell researchers. The database identifies five active style categories: GARP (Growth-at-a-Reasonable-Price),[13] Growth, (style) Neutral, Quant (model-driven)[14] and Value. Funds that do not fit into any of these groups are denoted as 'Undeclared".

Table 1 presents summary statistics for the data, with the sample detailed by year in Panel A and by style in Panel B. Over the 10-year period, the sample covers a total of 207 active equity funds, commencing with 37 funds in 2000 and peaking at 138 funds in 2009. Funds under A$5 million in total net assets are omitted from the sample. Funds on average held 56 unique stocks in the portfolio, and had total net assets of $A422 million. Average portfolio turnover ranges from a low of 41.5% in 2006, to a high of 65.8% in 2009. The sample comprises 171 Broad Market funds and 36 Small-Cap funds: the latter are typically mandated to invest outside the top 100 stocks by market capitalization, but some may have flexibility around this requirement. The Broad Market cohort contains a reasonable exposure to funds of each style, ranging from a minimum of 20 for Growth to a maximum of 43 for Value. Style representation is much thinner in the Small-Cap cohort, ranging from only 2 Quant and 3 GARP funds up to 11 Neutral funds.

There is no minimum survival requirement for a fund to be included in the Russell database. However, Russell attempts to maintain comprehensive coverage of the universe of Australian equity funds, which limits the scope for survivorship bias and selection bias.[15] Bennett *et al.* (2015) adopt the method of Ainsworth, Gallagher and Gardner (2007) for gauging the potential for selection bias by estimating the performance differential between new entrants and pre-existing funds within the Russell universe. The estimated differential of 4.8 basis points per month represents an upper limit for potential selection bias, bearing in mind that there may be other reasons why newly started funds could outperform pre-existing funds (e.g. benefits of smaller size, and differences in ownership structure such as boutiques).

[13] GARP funds tend to favor stocks with growth attributes, but also consider valuations.
[14] Quant funds are funds that use quantitative research and computer models to select securities.
[15] Maintaining a comprehensive real-time record of all managers is feasible in Australia as it is a relatively small market with a limited number of managers. Nevertheless, it is possible that the sample may not be fully comprehensive to the extent that some managers do not report data such as portfolio holdings to Russell.

We merge the Russell data with SIRCA's SPPR (Share Price and Price Relative) database for stock prices, returns, dividends, and franking ratios. Further, we also use the Aspect Huntley database for financial statement information. To construct our passive benchmarks, we use historical constituent stocks and weights for the S&P/ASX300 index. This was manually extracted from Standard and Poor's website prior to it being removed. We use the universe of stocks ranked 101 through 300 to form an "S&P/ASX Small Ordinaries" index as a benchmark for Small-Cap funds.

4. Research Design

Our general approach is initially described and discussed, followed by details on the calculation methods.

4.1. General Approach

Our approach involves simulating the evolution of the portfolio of each fund by tracking dollar-value changes in separate accounts for accrued dividends, capital growth, income tax, capital gains tax and imputation credits. Dollar values are aggregated in order to estimate portfolio returns. Simulated portfolios are rebalanced at the end of each month by imputing trades as the net difference between the simulated portfolio holdings and reported monthly holdings. An equivalent method is used with respect to the benchmark indices.

The simulation commences by assuming that the initial portfolio positions are acquired on the initialization date. This establishes the initial tax base for all positions. The simulation algorithm then iteratively applies market events to a simulated portfolio on a daily basis, including collecting dividends and adjusting for other events such as dilutions arising from new issues. At each month-end, accrued cash, stock positions and taxes are aggregated to form an interim simulated portfolio, which is compared with the updated fund holdings information. The portfolio is then rebalanced by executing the trades required to align the simulated portfolio with the reported portfolio holdings at month-end prices. Since fund flow data is not available for our sample, we infer a net cash flow in each month equal to the trade imbalance. We also assume that tax liabilities are paid when they are incurred, i.e. we do not allow for deferral of taxes. This may lead to temporary differences when capital gains are offset against subsequent capital losses; however these effects should reverse over the longer-term.

Since the cost-base and holding period cannot be reliably established when a fund initially enters the sample, funds are "burned in" for 12 months (i.e. rebalancing is simulated for the first year, but the outcomes are not incorporated in the results). We chose an exclusion period of 12 months as a reasonable compromise between retaining enough observations to make statistically valid inferences, and ensuring sufficient history to establish a cost base. Further, a minimum "burn-in" of 12 months is required to accurately establish whether short-term or long-term CGT should be applied to any sales of the initial holdings. We also extend the "burn-in" period to 24 months as part of the robustness check around our main results.

In order to aggregate observations on a pooled basis, we calculate changes within each month for each fund's set of accounts. Log changes are used so that simple averages can be taken in the pooled sample, and do not bias statistical tests. Our unit of observation is the equally-weighted average of returns and return contributions for funds in the sample for a month. Thus our results reflect the experience of an investor that is equally exposed to all available funds during each month,

rebalancing this notional portfolio on a monthly basis. Funds are therefore more highly represented in the results if they have a longer data history. Our statistical tests are based around the time series of the monthly estimates.

The results focus on the difference between the returns and taxes accrued by actively managed portfolios versus those for the rebalanced index portfolios. We denote this difference as 'alpha', although observe that it reflects an excess return without any risk adjustment. Pre-tax alpha is the difference between the simulated pre-tax fund and pre-tax index returns, while after-tax alpha is the difference between the simulated after-tax fund and after-tax index return. This approach is more useful than looking at absolute returns and tax liabilities for evaluating the value added by active management. It implicitly adopts passive investment in the index as a benchmark, on the basis that this offers a viable alternative to actively managed funds.[16] To establish statistical significance in the difference between active and passive investments, we use a matched two-sample t-test to compare the difference between log monthly-changes in each portfolio account and the corresponding account in the benchmark portfolio. Log returns are converted back into arithmetic returns for reporting in the tables.

Our method may not recover realized portfolio returns for a number of reasons. Due to fund holdings data being constrained to month-end portfolio snapshots, we are not able to measure the effects of interim trading within the month. Inferred trades could result in either overestimating or underestimating the true performance and tax impacts of interim trading, depending on how they differ from actual trades (including any market impact). For example, failure to observe actual transactions could lead to underestimation of trading contributions if trading skill exists. On the other hand, failure to allow for market impact might contribute to overestimation of the contribution from trading. Prior work on Australian data suggests that interim trading returns may contribute an additional 0.4% p.a. to funds' pre-tax alpha, with minimal net tax impact (Chen, Gallagher and Warren, 2015). Further, our imputed trades do not allow for any market impact (which would vary with the specific trade algorithm implemented). Our method also does not account for actual cash flows, as reliable data on cash flow and actual cash held by funds is not available. Finally, we do not consider the impact from un-invested cash holdings, which would have a dampening impact on total fund returns in rising markets and the converse in declining markets.

While there may be scope for some small estimation bias in our method, it nevertheless provides a solid foundation with regard to our prime objective of evaluating the impact of tax effects on fund performance. In particular, we note that our pre-tax and after-tax fund return estimates embed the same underlying portfolio holdings and transaction assumptions. Further, our use of monthly holdings data represents a significant improvement upon prior studies that rely on quarterly portfolio snapshots, and is effective for revealing systematic differences in the way funds generate alpha and incur tax liabilities.

4.2. Dividends

[16] Passive investment in the index can occur either through index-replicating mutual funds, or Exchanged Traded Funds. It is worth noting that passive style indexed funds are not widely available in Australia. For instance, Vanguard Australian only offers an Australian Shares High Yield fund on its menu in addition to its standard Australian equities index products as at the date of writing (see https://www.vanguardinvestments.com.au/).

For the simulated portfolios, the dividend yield within each month is given by the summed dollar value of dividends paid on stocks within the portfolio on each day, divided by the total equity value of the portfolio at the close of trading in the previous month-end:

$$d_T = \log\left(\left(\sum_{t\in T}\sum_{s\in p_t} u_{s,t}d_{s,t}\right)\Big/ \mathcal{p}_{T-1}\right) \quad (1)$$

d_T	Dividend yield within month T
$u_{s,t}$	Units of stock s held in the portfolio p on day t
$d_{s,t}$	Dividend per share of stock s on day t
$\mathcal{p}_{T-1}$	Portfolio value at the prior month-end

4.3. Imputation Credits

The value of imputation credits accrued each month is calculated as the sum of realized imputation credits paid on stocks within the portfolio on each day, divided by the total equity value of the portfolio at the close of trading in the previous month-end. In order for an imputation credit to be realized, the underlying stock must be held for a minimum of 45 days around the dividend date. Furthermore, we follow the Australian Tax Office's requirement that the 45-day rule be calculated based on LIFO accounting of purchased stock lots.[17] Portfolio calculations are based on equation (2), with equation (3) describing the estimation of available franking credits yield per company holding.

$$f_T = \log\left(\left(\sum_{t\in T}\sum_{s\in p_t} u_{s,t}f_{s,t}\right)\Big/ \mathcal{p}_{T-1}\right) \quad (2)$$

f_T	Franking credit yield within month T
$f_{s,t}$	Value of franking credits per share, as defined below:

$$f_{s,t} = \left(\frac{d_{s,t} \times \mathcal{C}}{1-\mathcal{T}}\right) \times \mathcal{f}_{s,t} \times \mathcal{h} \quad (3)$$

$\mathcal{C}$	Company tax rate (30% during the analysis period)
$\mathcal{f}_{s,t}$	Proportion of franking credits paid out
$\mathcal{h}$	Equals 1 if the 45-day holding rule is satisfied, or 0 otherwise

4.4. Gross Income Tax

On each dividend event, the income tax rate is applied to the summed value of the dividend and any attached imputation credits, multiplied by the units of the dividend-paying stock held in the portfolio

[17] We disregard the minimum threshold of AU$5000 for the value of franking credits when determining when to apply the rule (for simplicity). We also ignore the possibility that the ordinary risks associated with holding a stock might have been mitigated by more than 70% due to hedging derivatives (due to lack of derivatives data).

on the dividend date. The accrued tax within each month is calculated as a proportion of the portfolio value at the prior month-end.

$$\tau_T = \log\left(\left(\sum_{t\in T}\sum_{s\in p_t} u_{s,t}\left(d_{s,t} + f_{s,t}\right)\right) \times \mathcal{I} \Big/ \mathcal{p}_{T-1}\right) \quad (4)$$

τ_T Gross income tax within month T
$\mathcal{I}$ Income tax rate

4.5. Capital Gains Tax (CGT) Paid

On each transaction event that results in a capital gain or loss, we establish whether CGT is payable using the following procedure, consistent with the rules imposed by the Australian Tax Office:

1. If a capital loss is realized, we add it to any existing capital losses.
2. If a capital gain is realized, we offset it against any existing capital losses.
3. We apply the appropriate tax rate to any remaining capital gain, and accumulate it to the *CGT Paid* account.
    a. If the asset is held for less than one year, apply the full CGT rate.
    b. If the asset is held for more than one year, apply the discounted CGT rate.

We use a continuous CGT tracking procedure. In order to determine the tax base for CGT calculations, we assume a Highest-In-First-Out (HIFO) system of tax lot management, whereby the most expensive lot is selected to be sold in order to minimize CGT realizations. We make the further assumption that each portfolio is initiated with no accrued capital gains or losses, since no data is available. This provides the cleanest starting point to demonstrate the methodological advantages of using daily trade data to determine tax effects. The capital gains tax paid ($\mathcal{g}_T$) is calculated as a proportion of the portfolio value at the end of the prior month.

4.6. Tax Rates

Our core analysis models taxation effects from the perspective of an Australian superannuation (i.e. pension) fund. We also evaluate the results from the perspective of an Australian individual investor. Here we use the projected top marginal tax rate at the time of analysis, on the basis that this is more relevant for interpreting the findings on a forward-looking basis. The assumed tax rate of 47% on income and short-term capital gains reflects the top marginal income tax rate of 45% plus the 2% Medicare levy, and excludes the 2% temporary budget repair levy. The following tax rates are applied:

	Superannuation Fund	*Individual Investor*
Capital gains tax rate—short-term (less than 12 months):	15%	47%
Capital gains tax rate—long-term (12-months or more):	10%	23.5%
Tax on regular income, i.e. gross dividends:	15%	47%

Under the Australian tax system, imputation credits attached to dividends received can be considered as a prepayment of taxation for domestic tax-paying recipients at the rate of 30%.[18] The effect is that imputation credits deliver a tax credit for superannuation funds. However, imputation credits are only available to domestic investors who hold the stock at risk for at least 45 days around the dividend date. We do not find evidence that funds substantially breach the 45-day rule around dividend dates in their trading.

4.7. Inferred Cash Flows

Funds in our sample periodically receive cash inflows from additional contributions by investors, or experience drawdowns to service liquidity requirements. Our dataset does not contain information on the timing and value of these cash flows. In order to minimize the effect of cash flows from inferred portfolio returns, we calculate a hypothetical cash flow each month equal to the difference between cash spent on the purchase of shares and cash received from dividends and the sale of shares. We then enable all reported and inferred transactions to be executed without margin, while removing all excess cash from the portfolio at month-end. Hence, if a fund purchases more stock than can be funded by the cash received from the sale of stock, a cash injection within that period is assumed, and vice versa. The inferred cash flow is then subtracted from the net change in total portfolio value. By adjusting for inferred cash flows, we are able to isolate returns that arise purely from dividend income and changes in the market value.

4.8. Pre-tax Return

The pre-tax return for each month is calculated as the net change in portfolio value between the end of the prior month and the current month, adjusted for accrued dividends and net cash inflows within the month, divided by the prior month portfolio value.

$$r_T = \log\left(\frac{\mathcal{P}_T - \mathcal{P}_{T-1} - \Delta cash_T + D_T}{\mathcal{P}_{T-1}}\right) \tag{5}$$

r_T	Pre-tax return
$\mathcal{P}_T$	Portfolio value at month-end
$\mathcal{P}_{T-1}$	Portfolio value at the prior month-end
D_T	Total dividends received in month T
$\Delta\, cash_T$	Inferred cash flow to/from the fund in month T

4.9. After-tax Return

The after-tax return is the pre-tax return (above) adjusted for imputation credits, income tax, and capital gains tax.

[18] The 30% reflects the corporate tax rate (for large companies, with turnover in excess of A$2 million), and represents the rate that is applied to the pre-tax profits out of which the fully-franked portion of dividends is paid.

$$r_T = \log\left(\frac{p_T - p_{T-1} - \Delta cash + D_T - B_T + F_T - Y_T - G_T}{p_{T-1}}\right) \quad (6)$$

r_T	After-tax return in month T
f_T	Total imputation credits received in month T
Y_T	Total income tax paid in month T
G_T	Total CGT paid in month T

4.10. Benchmarks

We construct pre-tax and after-tax index benchmarks for both Broad Market and Small-Cap funds. Broad Market funds are benchmarked against the S&P/ASX300 Index. Small-Cap funds are benchmarked against the S&P/ASX Small Ordinaries Index. This is comprised of constituents of the S&P/ASX300 Index with the largest 100 stocks by index weight removed, and the remaining stocks reweighted to sum to one. In order to create a realistic benchmark that reflects both the tax liabilities incurred in holding the index, we track the securities that historically comprised the S&P/ASX300 Index based on the same portfolio simulation algorithm that is used for the daily fund portfolios. Due to the data difficulties, we find that approximately 12% of the historical S&P/ASX300 Index (by weight) and 7% of the S&P/ASX Small Ordinaries Index cannot be accurately priced. This reflects a combination of missing price and returns data, and incomplete mapping of historical tickers to their SEDOL and ISIN identifiers through which market data are available. To address these data limitations, we reconcile the total returns of the simulated benchmark (based on known prices and returns of individual stocks) with the reported S&P/ASX300 returns and inferred S&P/ASX Small Ordinaries returns,[19] by creating dummy instruments that account for the respective differences between simulated and reported index returns. Further, we assume that the dummy instruments pay franked dividends at the same dividend yield as the tracked securities within each index. Contributions to both pre-tax and after-tax returns on the simulated index benchmark portfolios are reported in Table 2.

4.11. Tax Efficiency

We estimate two measures of tax efficiency. The first is 'tax drag', calculated as the simple difference between after-tax alpha and pre-tax alpha (equation (7)). Tax drag also equates to the difference in the sum of tax effects related to income (dividends), imputation credits and CGT between the fund and the index. Tax drag measures the extent that tax reduces return for the investors, in excess of the tax effects that are embedded in the passive index benchmark. Second, we estimate 'alpha erosion' as after-tax alpha divided by its pre-tax alpha (equation (8)).

$$TD_f = (r_f - r_b) - (r_f - r_b) \quad (7)$$

$$AE_f = \frac{r_f - r_b}{r_f - r_b} \quad (8)$$

TD_f	Tax drag
AE_f	Alpha erosion

[19] S&P/ASX Small Ordinaries returns are calculated from the S&P/ASX300 and S&P/ASX100 indices.

r_f	After-tax return of fund *f*
r_b	After-tax return of the benchmark
r_f	Pre-tax return of fund *f*
r_b	Pre-tax return of the benchmark

Alpha erosion provides a metric for the degree to which net tax effects relative to the benchmark reduce pre-tax alpha, when the pre-tax alpha is positive. When pre-tax alpha is negative, this metric must be interpreted differently due to a reversal of the sign on the denominator. In this case, a fund is incurring a further tax drag relative to the benchmark would generate a positive alpha erosion measure; while a negative measure would result where a fund recoups some of its underperformance relative to the benchmark through its tax effects. To avoid confusion, we report alpha erosion only if pre-tax alpha is positive.

5. Results

The section details the outcomes from our analysis of fund returns and tax effects over the period July 2000 to December 2010. Results are reported for the period July 2001 to December 2010, and are reported separately for Broad Market and Small-Cap funds. Fund alphas and benchmark-relative tax impacts for superannuation investors are analyzed in total (see section 5.1), as well as along three dimensions: investment style (section 5.2), market state (section 5.3) and fund turnover (section 5.4). Total and style-based estimates for individual investors on the top marginal tax rate are then presented (section 5.5), followed by robustness checks around the initial "burn-in" period (section 5.6). We conclude our reporting of results with a discussion of caveats regarding the analysis (section 5.7).

5.1 Overall Results

We commence with an examination of the overall findings for superannuation investors in the Broad Market and Small-Cap fund segments. In contrast to Longmeier and Wotherspoon (2006), who use the Russell 1000 Index as a benchmark for all fund types examined in their study, we use two different benchmarks for Broad Market and Small-Cap funds. This more appropriately captures the differing investment universes and risk profiles for these segments. Further, because our study uses holdings data rather than returns data, we are able to break down the sources of tax liabilities into those respectively relating to income and realization of capital gains. This allows us to evaluate the influence of Australia's dividend imputation system, and provides a point of comparison to US studies. We report total return estimates in the text only; and report pre-tax alphas, after-tax alphas and related contributions in Table 3.

Over the entire period, the average total pre-tax return on active Broad Market funds is 7.37% p.a., which compares to a benchmark total return of 6.63% p.a.[20] The difference of 0.74% p.a. is primarily driven by superior capital gains (3.36% p.a. vs. 2.42% p.a.). Average dividend yield for the Broad Market fund cohort is marginally lower than the benchmark (4.02% p.a. vs. 4.23% p.a.). The below-index dividend yield of active funds results in lower income tax liabilities, but also fewer imputation credits than the benchmark. Note that since superannuation investors are taxed at a lower income tax

[20] These estimates are based on the average of monthly returns for both the funds and the index benchmark, which is annualized by multiplying the natural log of one plus monthly average by 12, and taking the exponential.

rate (15%) than the company tax rate (30%), imputation credits (assuming full franking) result in a tax rebate. Imputation also makes dividend income more tax-efficient than capital gains for Australian superannuation funds relative to US investors.[21] Actively managed funds incur higher CGT than the index due to a combination of higher capital gains and elevated turnover (see section 5.4). The latter not only makes it more likely that funds may realize more capital gains, but also potentially more short-term capital gains which are taxed at a higher rate than long-term capital gains. The detrimental effect of tax on fund alphas is consistent with findings in the US (Longmeier and Wotherspoon (2006); Sialm and Zhang (2015)), even when compared against benchmarks that are also adjusted for tax effects.

Small-Cap funds outperform their benchmark by a much greater magnitude. The average Small-Cap fund generates average pre-tax total returns of 9.14% p.a. versus the S&P/ASX Small Ordinaries Index return of 7.35%. The 1.80% p.a. outperformance by Australian Small-Cap funds broadly confirms the finding of manager skill in this segment by Chen *et al.* (2010). Small-Cap funds earn lower dividend yields than the S&P/ASX Small Ordinaries Small-Cap Index, but actually earn more imputation credits. This indicates that Small-Cap funds are more concentrated in stocks with higher franking ratios. The outperformance by Small-Cap funds may be partly related to the fact that they are not wholly invested in S&P/ASX Small Ordinaries stocks, with around 12.5% of the aggregated Small-Cap portfolio held in S&P/ASX100 stocks and 33.6% invested outside of the S&P/ASX300 constituents. Hence these funds may be garnering additional alpha and imputation credits from ex-benchmark exposures. Also, Small-Cap funds may be biasing their portfolios to profitable companies that have paid domestic taxes and hence generate imputation credits. The combination of these factors results in a tax drag of -0.37% p.a. relative to the index, and a relatively modest erosion of 20.6% of the pre-tax alpha. As a consequence, average after-tax alpha of 1.43% for Small-Cap funds remains significant at the 1% level, unlike their Broad Market counterparts. The positive pre-tax alphas are broadly consistent with Longmeier and Wotherspoon (2006) and Sialm and Zhang (2015), who both find US Small-Cap funds outperform, although only the former find that Small-Cap funds outperform after-tax. However, recall that Longmeier and Wotherspoon (2006) use the broad Russell 1000 Index rather than a specific small-cap benchmark.

Hence, in contrast to US funds, we find that Australian funds earn positive benchmark-adjusted after-tax returns in both the Broad Market and the Small-Cap fund segments. While this provides an additional incentive for Australian investors to go active, that interpretation of these findings must be tempered by the fact that our analysis does not incorporate all factors that may influencing the net return achieved by investors. In particular, we do not allow for management fees, and do not fully account for all the potential costs and benefits associated with trades. We further discuss the shortcomings of our analysis in section 5.7.

5.2 Fund Styles

Pre-tax and after-tax alpha and associated tax effects by fund investment style are reported in Table 3. We find substantial cross-sectional variation across different styles within both Broad Market funds and Small-Cap funds. For the Broad Market cohort, we observe significantly positive average

[21] While dividend income has traditionally been taxed at a higher rate than capital gains in the US, the tax rate on dividends was equalized with the tax rate on long-term capital gains for most investors under the Jobs and Growth Tax Relief Reconciliation Act of 2003, with this arrangement extended under American Taxpayer Relief Act of 2012. Also see Israel and Moskowitz (2010) and Bergstresser and Pontiff (2013).

pre-tax alpha for GARP (1.67% p.a.), Value (1.37% p.a.), Neutral (0.61% p.a.), and Growth (0.36% p.a.) funds; and significantly negative average pre-tax alpha for Quant funds (-0.69% p.a.). The breakdown of contributions reveals that for the non-Value styles, alpha is driven by superior capital gains relative to the index rather than higher dividend income. The skew towards capital gains is associated with mildly adverse tax consequences under Australia's dividend imputation system. Conversely, the combination of higher dividend income and associated imputation credits provides a modest net benefit to Value funds. Indeed, we observe a 0.1% p.a. spread in income-related tax impacts between the fund group with the lowest dividend yield relative to benchmark (GARP funds) and the group with the highest (Value funds).

While Broad Market GARP, Value, Neutral and Growth funds significantly outperform the index pre-tax, only GARP and Value funds continue to do so after-tax. In Neutral and Growth funds, tax effects erode 80% and 121% of pre-tax alpha, resulting in insignificant after-tax alpha of 0.12% p.a. and -0.08% p.a. respectively. GARP and Value funds also experience significant tax erosion, with GARP losing -0.64% p.a. or 38% and Value losing -0.42% p.a. or 31% of pre-tax alpha respectively. Nevertheless, both styles generate sufficient pre-tax alpha to support after-tax alpha of around 1% p.a., which indicates that active management has added meaningful value in these style groups. These results contradict some US studies (e.g. those by Israel and Moskowitz (2010) and Bergstresser and Pontiff (2013)) that find Value funds to be tax inefficient. The contradictory findings are partly attributable to the differing ways that the Australian and US tax systems treat dividend income. Meanwhile, the Broad Market Quant funds perform poorly in our sample. Not only do Quant fund generate significantly negative pre-tax alpha of -0.69% p.a. (primarily because of lower capital gains), but underperformance is further exacerbated by tax drag of -0.58% relative to the index, resulting in significantly negative after-tax alpha of -1.27%.

Small-Cap funds generate significantly positive pre-tax alpha not only on average (1.80% p.a.), but also across all fund styles with the exception of Growth (only 0.11% p.a.). Small-Cap funds skew towards lower dividend yields than the small-cap index benchmark. At the upper end, Small-Cap Value funds earn 0.19% p.a. higher dividend yields than the Small-Cap index, whereas Small-Cap Growth funds have dividend yields that are 1.13% p.a. lower than the index. While Broad Market funds are at a marginal tax disadvantage because of their tendency towards capital gains over dividend income, we do not observe this in Small-Cap funds. As mentioned earlier, Small-Cap funds receive disproportionately more imputation credits than their dividend yields would indicate: this holds for all fund styles, with the notable exception of Growth.

Overall, Small-Cap funds tend to generate lower tax impacts than Broad Market funds, primarily because of the offsetting effects from their elevated imputation credit yield. Average tax drag of -0.37% p.a. and alpha erosion of 21% for Small-Cap funds compares with -0.48% p.a. and 65% respectively for Broad Market funds. Small-Cap Neutral funds exemplify this, having the lowest tax drag (-0.12% p.a.) despite earning 3.22% pre-tax alpha. Most other Small-Cap fund types also exhibit relatively low tax effects, ranging from -0.29% p.a. or around 13% of pre-tax alpha for GARP funds; up to -0.67% or 36% of pre-tax alpha for Value funds. Quant is the best performing style in the Small-Cap cohort (and overall), generating after-tax alpha of 3.39% p.a., with tax effects reducing their alpha by -0.76% or 19%. This stands in stark contrast to Broad Market Quant, which is the worst performing style; although our sample only contains two Small-Cap Quant funds. The exception in the Small-Cap cohort is the Growth funds, which incur -0.57% in tax drag, leaving them with (insignificantly) negative after-tax alpha of -0.45% p.a. Some of these results may relate to the fact that the funds cover different historical periods, and hence are benchmarked against different

segments of index returns. For example, the average annualized benchmark return for Small-Cap Neutral funds is 2.6%, while that of Small-Cap Value funds is 8.6%. This implies that observations for the former group are more frequently distributed during the GFC than observations for the latter group. We examine time periods effects in section 5.3.

Our results demonstrate the importance of considering net tax effects when comparing fund styles. While GARP, Value, Neutral and Growth funds in the Broad Market segment all earn significantly positive pre-tax alphas (in that order), only GARP and Value retain their outperformance after-tax. Even in these funds, we find that tax effects erode around a third of their alphas. On the other hand, many Small-Cap strategies may be worthy of consideration for superannuation investors after taxes. Compared to the benchmark, most Small-Cap strategies deliver strong pre-tax alpha, and only around a fifth of this alpha is eroded by net tax liabilities. All Small-Cap styles with the exception of Growth generate significant after-tax alpha. However, investors need to be cautious of potentially higher systematic and idiosyncratic risks being embedded in Small-Cap stocks compared to the broader market, as well as the higher fees that are typically charged for Small-Cap products. We also note that average S&P/ASX Small Ordinaries Index return was actually lower than that of the S&P/ASX300 Index, returning 7.35% versus 9.46% when weighted over the same observation periods. Hence our findings suggest that superannuation investors may have been better off pursuing active strategies in Australian small caps rather than investing in the Small-Cap index; and should not be interpreted as indicating that Small-Cap active managers generated superior total returns.

Again, our findings contrast with US results. Sialm and Zhang (2015) examine the returns of mutual funds by investment style. They find that all style categories generate negative excess returns (and negative four-factor alphas) both pre-tax and after-tax, with the single exception that funds biased to small stocks generate positive pre-tax excess returns. They also uncover much higher tax burdens, which only seem partly attributable to higher tax rate assumptions. Thus while there is little evidence that US funds of any style can add value after-tax, we find that Australian funds can do so across a number of styles.

5.3 Market State

We now examine the systematic differences in the way funds generate alpha across four market states: an "initialization" phase from 1st July 2001[22] to 28th February 2003, a "bull" market from the 31st March 2003 to 31st October 2007, a "bear" market from 1st November 2007 to 28th February 2009, and a "recovery" market from 1st March to 31st December 2010. Figure 1 plots the S&P/ASX300 and S&P/ASX Small Ordinaries return indices with the market state periods indicated. Identification of market states is straightforward for the particular sample period, with the four states being quite distinctive. The bull and bear market states contain strongly trending markets surrounding the pre-GFC peak; while the recovery state involves an initial rebound from the GFC low, followed by a sideways movement. The initialization period is characterized by a volatile but overall flat market. We report but do not emphasize the results for the initialization period for two reasons. First, the fund sample size is fairly small during this early period, and hence it is difficult to establish whether the available funds are representative. Second, the lack of actual cost base for many of the positions observed in this period reduces the confidence in estimating the tax impacts from trading.

[22] The simulation actually starts on 1st July 2000, but we exclude a 12-month "burn-in" period for each fund from the analysis. This means that the earliest date to be included in the results is 1st July 2001.

The results reported in Table 4 reveal considerable variation in fund alphas and tax effects across different market states. Pre-tax alphas are mostly driven by variation in capital gains relative to the index benchmark. For Broad Market funds, relative capital gains versus the S&P/ASX300 Index range from 1.84% p.a. in the initialization period to -0.05% during the GFC bear market. Relative dividend yields track over a far narrower range, from -0.37% p.a. below the index during the bull market to 0.03% above benchmark in the post-GFC recovery market. Overall, this leads to statistically significant positive pre-tax alphas during the initialization phase, the bull market, and the recovery market. Broad Index funds nominally underperformed the index by -0.17% p.a. in the bear market, suggesting that these funds as a group do not mitigate downside risk during adverse market conditions (at least not for the bear market observed in our sample). Again this provides another contrast with the US, where some evidence exists that funds outperform during market weakness (see Glode (2011)).

Section 5.1 reported that Broad Market funds significantly outperform the S&P/ASX300 benchmark pre-tax, but not after-tax. By separating the data into different market states, we find that this result is primarily driven by high tax impacts during the bull market. While Broad Market funds generate 0.75% p.a. pre-tax alpha during the bull market, this converts to after-tax alpha of -0.15% p.a. The tax drag of -0.90% p.a. relates to Broad Market funds earning a greater proportion of their total return as capital gains (as opposed to dividend income) during the bull market, coupled with accelerated realization of capital gains relative to the benchmark through higher turnover. CGT liabilities in Broad Market funds comprise 0.88% out of the 0.90% tax drag relative to the index. The capacity of active funds to generate and preserve positive alphas in bull markets is particularly relevant, given that this market state dominates the sample period and Australian equity market conditions in general. The bull market also appears to be the only period when CGT is a dominant driver of net taxes, as compared to income tax effects. During the bear and recovery markets, tax drag is evenly dispersed between income and capital gains sources, and does not exceed 0.18% p.a. combined. This suggests that marginal tax liabilities compared to passive index benchmarks may be relatively minor when markets are not strongly trending upwards.

Small-Cap funds beat the S&P/ASX Small Ordinaries benchmark pre-tax in all market states, with the alpha primarily arising from superior capital gains. Section 5.2 reported that Small-Cap funds tend to be exposed to stocks with lower dividend yields but higher imputation credits than the index. Table 4 reveals that the exposure to lower dividend yields occurs across all states except the recovery market; but that the preference for stocks with high franking credit ratios persists across the entire sample. While Small-Cap funds incur tax drag relative to the S&P/ASX Small Ordinaries Index of -1.02% p.a. in the bull market, they actually get a net benefit from tax effects in bear and recovery markets. This tax benefit comes from higher imputation credit yield compared to the index; and realizing lower CGT than the index during the bear market. Small-Cap funds earn superior after-tax alphas compared to Broad Market funds during all four states. Nevertheless, we emphasize that the index benchmarks for the two segments are different, so that alpha itself can obscure the total return experience of investors in the two sectors. The Small-Cap index outperformed the Broad Market index in the bull market, but underperformed it in the bear market. Although Small-Cap funds generate economically large alphas during the bear market, their absolute returns over that period were -65.9% annualized, considerably lower than that for Broad Market funds of -0.49% p.a. Hence their strong relative alpha during bear markets does not indicate that Small-Cap funds are better candidates for providing downside protection in recessionary environments. However, Small-Cap funds still outperformed Broad Market funds on an after-tax total return basis over the entire sample period, indicating that they may still be suitable for long-term investors.

5.4 Turnover

Conventional views of active management suggest that portfolio turnover is negatively related to tax efficiency.[23] In other words, funds that have high trading levels are expected to incur higher capital gains tax, resulting in lower tax efficiency. Jeffrey and Arnott's (1993) study is one of the first to discuss the tax impacts of portfolio turnover. They find the tax consequences of trading to be a non-linear function of portfolio turnover, with most of the tax damage done as a fund moves from no turnover to low turnover. Jeffrey and Arnott (1993) further argue that the non-linear relation is an outcome of the holding period being the reciprocal of turnover. This study sets the stage for substantial further empirical tests. Longmeier and Wotherspoon (2006) regress tax alphas on portfolio turnover, and report a significant inverse relationship. However, a recent paper by Arnott *et al.* (2011) examines similar data, and finds no clear relationship between tax impact and portfolio turnover. Some funds included in the analysis have virtually no turnover and yet incur significant taxes. Sialm and Zhang (2015) find a significant relation between tax burden and turnover, which in turn appears associated with increased short-term CGT liabilities.

To provide further empirical analysis on the alpha-turnover relationship, we compare the performance and tax efficiency across portfolios of funds sorted by turnover. This allows us to evaluate the intuition that higher turnover funds should incur greater CGT liabilities since they are more likely to realize capital gains, potentially including a larger portion of short-term rather than long-term gains. We sort funds into portfolios by turnover as follows. We begin by partitioning the sample into Broad Market and Small-Cap funds, noting that there appear to be distinct differences when examining returns relative to turnover in the two segments. For each monthly fund observation, we compute the raw turnover as the minimum of inferred buys and sells (by dollar value), divided by the portfolio value at the start of the month. We then demean the observations by subtracting the mean turnover of all available funds in the Broad Market or Small-Cap cohort during that month. This allows us to control for the time-varying differences in turnover we observe across different market states. The funds are then ranked by their average demeaned turnover. Thus high turnover funds are those with a high turnover relative to other funds on average during their time in the sample. Broad Market funds are split into quintiles, while small-Cap funds are split into terciles to account for the fact that there are less Small-Cap funds than Broad Market funds in the sample.

Results are reported in Table 5. While Broad market funds in the lowest turnover quintile generate higher pre-tax alpha than those in the highest turnover quintile, the relation across the quintiles is not a straightforward linear trend. The top two turnover quintiles both exhibit statistically significant positive pre-tax alphas in the vicinity of 0.5% p.a. The middle quintile does not appear to differ in overall performance from the benchmark, with pre-tax alpha of only 0.01% p.a. On the other hand, the second lowest turnover quintile beats the index by 1.65% p.a., while the lowest turnover funds have statistically significant alpha of 0.79% p.a. Hence while it is the case that the two lowest turnover quintiles generate greater pre-tax alpha than the two highest turnover quintiles, the pattern is not monotonic and hints at a complex relation between turnover and alpha generation. This is perhaps unsurprising, given that turnover may or may not be detrimental to pre-tax alpha, depending on whether the rebalancing provides access to additional net returns after costs.

With regard to tax effects, our results show a broadly positive relationship between turnover and the accrual of CGT liabilities in the Broad Market fund cohort. However, whereas Jeffrey and Arnott

[23] For example, see Horan and Adler (2009) and Horvitz and Wilcox (2003).

(1993) assert that the marginal impact of taxes diminishes as turnover increases, we find that tax drag is substantially higher in the top turnover quintile at -0.88% p.a. than the middle three quintiles where it is estimated between -0.45% and -0.46% p.a. Part of this may be explained by the fact that turnover does not increase linearly from the bottom to the top quintile; instead, the average turnover in the top quintile (107%) is far higher than the average turnover in the next three quintiles (65%, 50%, and 38% respectively). Nevertheless, our results are inconsistent with the contention of Jeffrey and Arnott (1993) that increased turnover at the top end has a minimal impact on CGT costs. Broad Market funds with the lowest turnover incur the lowest tax drag of -0.30% p.a., not only reflecting the lowest CGT, but also gaining an additional advantage compared to higher turnover funds through earning relatively more imputation credits due to higher dividend yields. This suggests that low-turnover funds are also more aligned with value-investing paradigms than their higher turnover counterparts. Overall, the highest turnover funds in the Broad Market group incur 0.58% p.a. greater tax drag compared to the lowest turnover group, while at the same time earning lower pre-tax alphas. On balance, however, the pattern of after-tax alpha across the quintiles is quite inconsistent. The greatest after-tax alpha is earned by the second lowest turnover quintile (1.18% p.a.), while the lowest is earned by the middle quintile funds (-0.44% p.a.). These findings reinforce the notion that the relation between turnover and the net value realized by investors is not straightforward.

Within the Small-Cap fund cohort, all three turnover terciles significantly outperform the Small-Cap benchmark. Low turnover funds generate the highest pre-tax alpha of 2.42% p.a. on average. Like Broad Market funds, high turnover Small-Cap funds pay more taxes than low turnover funds. However, comparing the highest turnover tercile with the lowest turnover tercile we find that the majority of the tax drag actually comes from income tax effects rather than CGT effects. High turnover funds earn -0.47% p.a. lower dividend yields than the index, while low turnover funds earn 0.09% p.a. higher. The flow-on tax implications for high turnover funds is that they pay 0.11% less income tax but receive -0.20% fewer imputation credits relative to the index, which combined with higher CGT, sums to a tax drag which is -0.13% p.a. greater in magnitude than the low turnover tercile. This reinforces the underperformance of high- versus low-turnover Small-Cap funds. The complication is that medium turnover Small-Cap funds display very similar traits to the high turnover funds in terms of both pre-tax alpha and tax effects. Again we fail to observe any straightforward, monotonic relation between after-tax alpha and turnover.

Overall, low turnover funds appear to outperform high turnover funds on a pre-tax basis in both the Broad Market and Small-Cap segments. This result is consistent with the findings of Carhart (1997), but contradicts other prominent US studies (e.g. Grinblatt and Titman (1994), Wermers (2000), and Huang, Sialm and Zhang (2011)). In our Australian sample, taxes appear to magnify the performance difference between low- and high-turnover funds. In Broad Market funds, the elevated tax drag in high-turnover funds is primarily driven by increased CGT liabilities. However, in Small-Cap funds, high-turnover funds incur greater taxes because they are systematically skewed away from dividend-paying stocks, which reduce their imputation credit yield. Further, an examination across the Broad Market fund quintiles and Small-Cap fund terciles reveals that the relation between turnover and after-tax alpha is neither simple nor monotonic, suggesting that turnover has a complex relation with the net value earned by investors. Hence while we find some signs that higher turnover may be associated with lower after-tax performance, the evidence is weak at best.

5.5 High Tax Individuals

We now report on the simulations for individuals in the highest income bracket. This analysis amounts to a robustness test on our core results, and places an upper limit on tax effects by using the highest potential tax rate. In Australia, individuals earning above $180,000 pay a marginal rate of 45% on income above this threshold. In addition, a Medicare Levy of 2% is applied on top of the marginal rate, bringing our total marginal tax rate to 47%.[24] This rate is applied as both the income tax and capital gains tax on short-term assets. Long-term assets (i.e. those that are held for at least one year) are taxed at a 50% discount (i.e. 23.5%).

Higher tax rates have a profoundly negative effect on fund returns across all fund types, but are particularly detrimental for the after-tax alpha of Broad Market funds. A number of Broad Market fund styles were observed to achieve significantly positive alphas pre-tax (GARP, Value, Neutral and Growth funds). After-tax, we no longer observe significant positive returns in any of these style groups. Neutral and Growth funds earn significantly negative after-tax alpha of just over -0.5% p.a. Across the Broad Market cohort, we find no evidence to suggest that individual investors on the top marginal tax rate can access positive average after-tax alphas by selecting fund managers of any style. Further, naïve investment across our sample of Broad Market active funds would have generated significant negative after-tax alphas of -0.46% p.a.

Small-Cap funds do a better job of preserving their pre-tax alphas for high-tax paying individual investors compared to Broad Market funds. This arises primarily because they generate much larger pre-tax alpha of 1.79% p.a., which is not entirely eroded by tax liabilities of -1.33% p.a. This leaves the Small-Cap funds with after-tax alpha of 0.46% p.a., although this is statistically insignificant. Of the Small-Cap fund styles, Neutral, Quant and GARP funds (in order) maintain significantly positive alphas after-tax. However, pre-tax alphas of Small-Cap Value and Small-Cap Growth funds are more than wiped out by their tax liabilities, with these funds generating negative after-tax alpha (significant in the case of Growth).

As tax rates increase, active funds management presents a weaker and weaker value proposition for investors. The accelerated realization of capital gains that arises from active management's higher turnover exacerbates the accrual of CGT liabilities compared to the index. This erodes the superior alphas that funds appear to be able to generate pre-tax. Our results suggest that some value can still be found for the high-tax-bracket investor in the Small-Cap space, but accessing this requires some sophistication in their manager selection procedure.

5.6 Extended "Burn-in" Period

As our sample does not track funds since inception, the initial cost base cannot be accurately established. However, as the fund rebalances, legacy positions get gradually traded out, and new positions with known cost bases are added to the portfolio. In the main analysis, we let the portfolio simulations "burn-in" for the 12 months before a fund is included in the sample used to calculate average returns and tax liabilities. This allows the cost-base for the majority of positions to be established in most funds (particularly higher turnover funds), but more importantly, enables capital gains to be classified as either short-term or long-term. In this section, we extend the burn-in period to 24 months in total. This allows identification of more accurate cost bases for a greater proportion

[24] We do not consider the Temporary Budget Repair Levy, in effect at the time of writing, as this does not represent an ongoing tax liability. We also do not apply the Medicare Levy Surcharge (1.5% for individuals with taxable income over $140,000) as individuals are exempt if they have private health insurance.

of positions, and provides an indication of sensitivity to the cost base assumption. The trade-off is that there are fewer total observations. We describe the results here, which can be provided on request.

Using a longer burn-in period reduces the pre-tax alphas that funds generate relative to their respective Broad Market and Small-Cap benchmarks by 0.40% and 0.75% respectively. This suggests that we have discarded periods in which funds performed well versus the benchmark, which quite possibly could in the early years of existence. However, the longer burn-in period does not substantially alter the magnitude of tax drag relative to taxed benchmarks. As a result, after-tax alphas are reduced by around the same amount as pre-tax alphas; which in turn means that a greater percentage of alpha is eroded by tax. From a practical viewpoint, some of the fund types (i.e. Value and GARP funds within both Broad Market and Small-Cap categories) that generated significantly positive alphas in the main results no longer do so after a longer burn-in period is applied. Further, both Broad Market and Small-Cap cohorts significantly underperform their respective indices in the pre-GFC bull market under the longer burn-in period. Finally, having a longer burn-in seems to most adversely affect high-turnover funds in both size categories, reducing pre-tax alphas by over 1.3% and 1.7% p.a. from each category's highest turnover groups. Again, tax drag does not seem to be substantially changed despite sharp reductions in alpha.

The results from this section suggest that funds tend to perform better against their respective benchmarks when they first enter the data set, but that this tends to diminish later on. This could indicate either a selection bias for funds entering the data set (e.g. through backfilling; also see Evans (2010)); or might arise because funds perform better earlier in their life-cycles, say due to having lower funds under management (see Chen *et al.* (2004)). In any event, these results highlight a potential source of upward bias in both pre- and after-tax alphas as reported in our main results, especially for higher-turnover funds. Nevertheless, our key focal point is the nature of tax drag; and these findings remain fairly consistent irrespective of the burn-in period.

5.7 Caveats

An important caveat of our study is that it relies on monthly holdings to infer fund performance. This leaves out the effects of intra-month trading, as well as management fees and transaction costs such as brokerage, market impact and the cost of crossing the spread. A study by Chen, Gallagher and Warren (2015) suggests that intra-month trading may add another 0.4% p.a. to pre-tax returns for Australian equity funds without significantly altering net tax liabilities. The failure to observe intra-month trading may hence be a source of under-estimation of alpha, which is interestingly of a similar magnitude to the reduction in alpha that arises under the longer 24 month burn-in period for Broad Market funds.

We also do not have access to cash-flow data for any of the funds in our sample. Prior studies such as Edelen (1999) and Berk and Green (2004) show that there is an inverse relationship between fund flows and performance, as liquidity motivated trading tends to erode returns. While we estimate changes in cash between monthly portfolio snapshots based on net trading imbalance, we cannot establish whether these actually represent involuntary cash movements in or out of the fund. In theory, trade imbalances can also be an artifact of the missing data, or reflect instances when the fund manager rebalances between equity and non-equity (e.g. cash) asset classes.

In addition, we do not have information on the management fees charged by the active funds in our sample. Hence, while our results are able to provide a general indication of whether funds are able to positive alphas pre-tax and after-tax, we are not able to establish conclusively whether these are sufficient to cover their fees. The situation is further complicated by the fact that different investors can pay widely differing fees to access active funds. The 2014 Mercer Fee Survey indicates that average fees in active Australian Broad Market range from 0.42% to 0.56% p.a.[25] for segregated mandates; from 0.58% to 0.66% p.a. for wholesale unit trusts[26]; and an indicative 0.85% for retail/mutual funds. For active Small-Cap funds, average fees range from 0.65% to 0.87% p.a. for segregated mandates; to an indicative 0.99% for wholesale unit trusts; and 1.65% for retail/mutual funds. The relative cost of passive funds also needs to be taken into account. This too can vary, with the Vanguard Australia website[27] quoting fees for their Australian Shares Index Fund from as high as 0.75% (retail, less than A$50,000); down to 0.10% for their wholesale unit trust; and then reportedly negotiable for large institutional investors. Given this variability in fees, the main message is whether active management adds value after fees as well as taxes will differ across investors, and depends on both their tax status and the fees at which they are able to access funds.

Another caveat of our analysis is that it fails to account for any additional benefit that might arise from active tax management. Our understanding is that few Australian equity funds were actively managing tax over the period of analysis, in part because most funds were being evaluated on a pre-tax basis at the time. As a consequence, our after-tax alphas represent the outcomes from managing portfolios in a mostly tax-unaware manner. Tax effects have recently been coming under closer scrutiny, in part because superannuation funds and other major asset owners have been increasingly requiring their fund managers to manage in a more tax-efficient manner. As a consequence, our analysis may over-estimate the tax impacts relative to what might be achieved in future, to the extent that by active managers begin operating in a more tax-aware manner.

In summary, we identify a number of potential sources of bias in our alpha estimates. Potential sources of upward bias relate to the nature of returns during the period after funds initially enter the sample; and the fact that we have not accounted for management fees. Potential sources of downward bias include the failure to observe intra-month trading, which appears to contribute to alpha generation; and the potential to generate additional after-tax alpha through active tax management. Biases may also result from being unable to observe all portfolio exposures, including cash and derivatives. The net effect of these influences remains unknown.

6. Conclusion

Examination of a broad sample of active Australian equity funds reveals that tax effects substantially erode pre-tax alpha, and hence are a critical factor when considering the value proposition of active funds management. We introduce three innovations to the existing literature. First, we use holdings data to unify traditional pre-tax performance analysis with an examination of tax effects related to income tax, imputation tax credits and capital gains tax. This enables us to estimate the contributing elements to after-tax performance for Australian equity funds. Second, we simulate index benchmark portfolios after-tax, based on both the S&P/ASX300 and S&P/ASX Small Ordinaries indices. Many

[25] The variation reflects the size of the mandate. Mercer reports averages for the range US$25 million to US$200 million. An even wider distribution sits around these reported averages.
[26] These are used by smaller institutions and larger private investors.
[27] https://www.vanguardinvestments.com.au/

prior studies examine the tax effects of actively managed portfolios without controlling for the tax effects that would have been incurred if they had invested in a passively rebalanced portfolio. This tends to overstate the magnitude of tax effects arising from active management, and does not truly reflect the opportunity cost of the alternative. Finally, we use the holistic framework arising from our simulation method to explore the interaction between pre-tax and after-tax alpha across four dimensions: fund investment style, market state, fund turnover, and investor type. By doing so, we highlight that substantial variation can arise in returns and tax effects across all of these dimensions.

On average, we find that tax effects erode pre-tax alphas for Australian superannuation funds by -0.48% p.a. or about 65% for Broad Market funds, and by -0.37% p.a. or 21% in Small-Cap funds. As Small-Cap funds earn substantially higher pre-tax alphas, after-tax alpha remains significantly positive on average, as well as across all fund styles except Growth. However, tax drag is large enough for Broad Market funds to render after-tax alpha insignificant both for the overall sector, and for Neutral and Growth funds. This leaves only GARP and Value funds as generating statistically significant after-tax alpha in the Broad Market segment. Examining the variation in fund performance and tax effects across different market conditions, we find that tax drag is greatest during the long bull market preceding the GFC. The CGT incurred during the rising market is a dominant factor in eroding alphas, with after-tax alpha estimated as negative for Broad Market funds and only mildly positive for Small-Cap funds during the bull market state.

We highlight how Australia's dividend imputation system has a significant influence on after-tax returns, particularly in Small-Cap funds. This is evident when we examine tax effects across different market conditions. Only during the bull market was CGT a clearly dominant factor in driving net tax effects. In other periods, differences in imputation credit yield between funds and the index play an important role in creating (for Broad Market funds) or mitigating (in the case of Small-Cap funds) tax drag. For instance, the skew of Small-Cap funds towards stocks with higher payouts of imputation tax credits than the index has the effect of boosting their after-tax alphas above their pre-tax alphas in periods other than the pre-GFC bull market.

Our study also reveals a complex relation between turnover and after-tax performance. While the lowest turnover funds produce both superior pre-tax alpha and decreased tax drag relative to the highest turnover funds in both Broad Market and Small-Cap segments, the relation across portfolios sorted by fund turnover is non-monotonic. In addition, we demonstrate that investors in higher tax brackets are more adversely affected by tax drag. At the highest marginal tax rate, Broad Market funds on average generate after-tax returns that are significantly lower than those from the passive index, even before management fees are taken into consideration. The after-tax alpha across our sample of Small-Cap funds is reduced to an insignificant 0.46% p.a. at the highest tax rate, although some fund styles (Neutral, Quant and GARP) are still able to earn statistically positive alphas after covering their tax liabilities.

Our results have a number of implications for academic research, for investors in the market, and for the funds management industry overall. From an academic perspective, we demonstrate the benefit of using holdings data to understand after-tax fund performance. Prior studies based on returns data are not able to establish the magnitude of marginal tax liabilities incurred through the higher turnover of actively managed funds compared to passive alternatives, which limits the practical relevance to taxed investors. For investors, our results show that tax effects can easily subsume any pre-tax alpha that fund managers achieve. This means that evidence of superior investment ability pre-tax is not a sufficient justification for active funds management. Not only does the manager need

to create enough additional value to cover their own fees, but they must also demonstrate their ability to cover the additional tax liabilities that their turnover generates. Further, we show that even if funds can earn after-tax alphas for certain investors (e.g. superannuation funds), this may not necessarily apply to other investor groups. Finally for fund managers, our research highlights the need to rebalance portfolios in a tax-aware manner if they are to preserve their espoused value-add for their tax-exposed clients.

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TABLE 1

Fund Summary Statistics

The fund database is sourced from Russell Investments, and contains monthly stockholdings from 207 active Australian equity funds over a 10 and half year time period from July 2000 to December 2010. Panel A presents the total number of funds in the sample, the total number of distinct held by each fund, the total assets under management for each fund, as well as the annualized portfolio turnover rates and annualized average portfolio return during each calendar year. Panel B presents the average descriptive statistics for funds in both the Broad Market and Small-Cap fund segments of the Australian equity market by six investment objective groups: Neutral, Value, GARP (Growth at a Reasonable Price), Growth, Quant (model-driven) and Undeclared.

Panel A: By Year

Year	Number of Funds	Average Stocks Held	Average TNA (A$million)	Portfolio Turnover	Portfolio Returns
2000	37	57	317.78	46.91%	7.07%
2001	40	55	306.27	58.99%	13.29%
2002	57	55	355.76	45.28%	-6.17%
2003	68	59	341.94	57.62%	20.13%
2004	82	62	391.87	53.04%	32.13%
2005	95	55	473.86	47.02%	22.81%
2006	112	56	528.56	41.45%	26.70%
2007	125	57	528.92	61.95%	16.86%
2008	137	59	381.78	57.59%	-43.04%
2009	138	60	347.70	65.79%	43.64%
2010	133	60	454.54	54.81%	3.97%

Panel B: By Investment Style

Investment Style (Self-Declared)	Number of Funds	Average Stocks Held	Average TNA (A$million)	Portfolio Turnover	Portfolio Returns
Broad Market Neutral	39	61	508.26	58.67%	6.96%
Broad Market Value	43	62	540.20	42.47%	9.35%
Broad Market Growth	39	41	508.82	51.87%	7.49%
Broad Market GARP	18	46	385.98	56.52%	9.35%
Broad Market Quant	20	75	296.82	71.89%	5.41%
Broad Market Undeclared	12	45	275.54	53.48%	0.34%
Small-Cap Neutral	11	55	140.63	75.20%	10.19%
Small-Cap Value	10	85	166.67	55.17%	13.15%
Small-Cap Growth	6	61	118.10	57.31%	12.33%
Small-Cap GARP	3	59	129.93	47.90%	12.12%
Small-Cap Quant	2	121	242.76	40.14%	14.58%
Small-Cap Undeclared	4	66	161.69	60.93%	12.85%

TABLE 2

Returns on Benchmark Indices

Table 2 reports estimated before- and pre-tax and after-tax returns and associated tax effects for the S&P/ASX300 (Panel A) and S&P/ASX Small Ordinaries (Panel B) indices between July 2000 and December 2010. The first three columns report pre-tax returns, including contributions from dividends and capital gains. The next three columns show the annualized tax liabilities as a proportion of total benchmark value, including contributions from income tax on dividends, the value of imputation credits and capital gains tax. The next column reports the estimated after-tax alpha after all tax effects. The final column reports total tax effect, which is the sum of the three tax liability components, and also equates to the difference between after-tax and pre-tax returns. The average across all years is reported at the bottom of each panel, with the result for the year 2000 half-weighted in the calculation since only half the year is included. Estimates are based on simulating the benchmark returns and estimated tax effects from monthly snapshots of index constituents, assuming transactions occur on the first trading day of each month. Tax rates are assumed to be 15% on short-term capital gains and income and 10% on long-term capital gains, in accordance with Australian superannuation (pension) funds. A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Price level data comes from the SIRCA Australian Equities Tick History database; market capitalization from the Share Price and Price Relative (SPPR) database.

Panel A: S&P/ASX300 Index

Year	Dividends	Capital Gains	Pre-Tax Return	Income Tax	Imputation Credits	Capital Gains Tax	After-Tax Return	Total Tax Effect
2000	4.62%	-7.93%	-3.31%	-0.84%	1.11%	-0.08%	-3.13%	0.18%
2001	3.61%	6.41%	10.02%	-0.70%	1.11%	0.00%	10.43%	0.41%
2002	3.78%	-12.14%	-8.36%	-0.73%	1.17%	0.00%	-7.92%	0.44%
2003	4.64%	9.77%	14.41%	-0.90%	1.49%	0.00%	15.00%	0.59%
2004	4.59%	22.34%	26.93%	-0.88%	1.43%	0.00%	27.47%	0.55%
2005	4.49%	17.20%	21.68%	-0.86%	1.35%	0.00%	22.17%	0.49%
2006	4.24%	19.43%	23.67%	-0.83%	1.37%	-0.26%	23.95%	0.29%
2007	3.70%	12.01%	15.71%	-0.73%	1.24%	-0.65%	15.57%	-0.14%
2008	4.73%	-41.93%	-37.21%	-0.94%	1.64%	-0.02%	-36.52%	0.69%
2009	4.62%	31.54%	36.16%	-0.92%	1.60%	0.00%	36.85%	0.69%
2010	4.11%	-2.24%	1.87%	-0.81%	1.40%	0.00%	2.46%	0.59%
Average	4.27%	3.34%	7.61%	-0.83%	1.37%	-0.09%	8.05%	0.45%

Panel B: S&P/ASX Small Ordinaries Index Returns

Year	Dividends	Capital Gains	Pre-Tax Return	Income Tax	Imputation Credits	Capital Gains Tax	After-Tax Return	Total Tax Effect
2000	4.30%	-10.17%	-5.87%	-0.76%	0.85%	-1.11%	-6.88%	-1.02%
2001	3.70%	-2.53%	1.18%	-0.68%	0.89%	0.00%	1.39%	0.22%
2002	4.00%	-12.59%	-8.59%	-0.74%	1.00%	0.00%	-8.33%	0.26%
2003	4.24%	26.93%	31.18%	-0.81%	1.27%	0.00%	31.63%	0.45%
2004	4.33%	20.94%	25.27%	-0.82%	1.23%	0.00%	25.68%	0.41%
2005	4.07%	14.49%	18.56%	-0.77%	1.17%	0.00%	18.96%	0.40%
2006	4.03%	28.93%	32.96%	-0.76%	1.10%	-0.85%	32.45%	-0.50%
2007	3.70%	12.78%	16.49%	-0.70%	1.03%	-1.61%	15.21%	-1.28%
2008	4.66%	-55.77%	-51.11%	-0.85%	1.11%	-0.23%	-51.07%	0.04%
2009	3.90%	50.79%	54.68%	-0.73%	1.08%	0.00%	55.02%	0.34%
2010	3.10%	9.32%	12.41%	-0.58%	0.82%	0.00%	12.65%	0.24%
Average	3.99%	4.01%	8.00%	-0.74%	1.06%	-0.31%	8.00%	0.01%

TABLE 3

Contributions to Alpha Relative to Index by Investment Style

Table 3 reports the contributions to both pre-tax- and after-tax alpha for Australian equity funds between July 2001 and December 2010, across six self-declared fund styles. Alpha is estimated relative to the S&P/ASX300 benchmark for Broad Market funds and the S&P/ASX Small Ordinaries benchmark for Small-Cap funds. The first three columns report pre-tax returns, including contributions from dividends and capital gains. The next three columns show the annualized tax liabilities as a proportion of total benchmark value, including contributions from income tax on dividends, the value of imputation credits and capital gains tax. The next column reports the estimated after-tax alpha after all tax effects. The final two columns report two measures of tax effects. 'Tax drag' is the difference between after-tax and pre-tax alpha, and equates to the sum of the three tax liability components. 'Alpha erosion' is estimated as after-tax alpha as a proportion of pre-tax alpha (reported where the latter is positive). Estimates are based on monthly portfolio snapshots, assuming transactions occur on the first trading day of each month, and reported as returns as a proportion of funds under management. The results report average contributions relative to the benchmark, along with the statistical significance of the differences. Tax rates are assumed to be 15% on short-term capital gains and income, and 10% on long-term capital gains, in accordance with Australian superannuation (pension) funds. A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Price level data comes from the SIRCA Australian Equities Tick History database; market capitalization from the Share Price and Price Relative (SPPR) database; and book-to-market ratios are calculated from data sourced from the Aspect Huntley database.

	Dividends	Capital Gains	Pre-Tax Alpha	Income Tax	Realised Imputation	Capital Gains Tax	After-Tax Alpha	Tax Drag	Alpha Erosion
Broad Market Neutral	-0.36%***	0.97%***	0.61%***	0.07%***	-0.11%***	-0.44%***	0.12%	-0.48%***	79.8%
Broad Market Value	0.21%***	1.17%***	1.37%***	-0.04%***	0.07%***	-0.45%***	0.95%***	-0.43%***	31.0%
Broad Market Growth	-0.53%***	0.89%***	0.36%**	0.11%***	-0.18%***	-0.37%***	-0.08%	-0.44%***	121.0%
Broad Market GARP	-0.68%***	2.35%***	1.67%***	0.13%***	-0.20%***	-0.58%***	1.03%***	-0.64%***	38.4%
Broad Market Quant	0.03%**	-0.72%***	-0.69%***	0.01%**	-0.08%***	-0.51%***	-1.27%***	-0.58%***	-
Broad Market Undeclared	-0.23%***	-0.40%*	-0.63%***	0.05%***	-0.14%***	-0.31%***	-1.02%***	-0.39%***	-
All Broad Market	**-0.20%*** **	**0.95%*** **	**0.74%*** **	**0.04%*** **	**-0.08%*** **	**-0.44%*** **	**0.26%**	**-0.48%*** **	**64.6%**
Small-Cap Neutral	-0.46%***	3.68%***	3.22%***	0.05%***	0.10%***	-0.27%***	3.10%***	-0.12%***	3.6%
Small-Cap Value	0.19%***	0.86%***	1.05%***	-0.07%***	0.26%***	-0.57%***	0.67%**	-0.38%***	35.8%
Small-Cap Growth	-1.13%***	1.24%***	0.11%	0.19%***	-0.12%***	-0.64%***	-0.45%	-0.57%***	502.3%
Small-Cap GARP	0.06%**	2.13%***	2.19%***	-0.07%***	0.41%***	-0.64%***	1.90%***	-0.29%***	13.4%
Small-Cap Quant	-0.18%***	4.33%***	4.15%***	0.03%***	0.00%	-0.80%***	3.39%***	-0.77%***	18.5%
Small-Cap Undeclared	-0.47%***	3.06%***	2.60%***	0.06%***	0.09%***	-0.93%***	1.82%***	-0.78%***	30.0%
All Small-Cap	**-0.30%*** **	**2.09%*** **	**1.80%*** **	**0.02%*** **	**0.15%*** **	**-0.54%*** **	**1.43%*** **	**-0.37%*** **	**20.6%**

*** 1% significance; ** 5% significance; * 10% significance

TABLE 4

Contributions to Alpha Relative to Index by Market State

Table 4 reports the contributions to both pre-tax- and after-tax alpha for Australian equity funds between July 2000 and December 2010, across three market states. Alpha is estimated relative to the S&P/ASX300 benchmark for Broad Market funds and the S&P/ASX Small Ordinaries benchmark for Small-Cap funds. The market states encompass an "initialization" phase from 1st July 2001to 28th February 2003, a "bull" market from the 31st March 2003 to 31st October 2007, a "bear" market from 1st November 2007 to 28th February 2009, and a "recovery" market from 1st March to 31st December 2010. The first three columns report pre-tax returns, including contributions from dividends and capital gains. The next three columns show the annualized tax liabilities as a proportion of total benchmark value, including contributions from income tax on dividends, the value of imputation credits and taxes on capital gains (CGT). The next column reports the estimated after-tax alpha after all tax effects. The final two columns report two measures of tax effects. 'Tax drag' is the difference between after-tax and pre-tax alpha, and equates to the sum of the three tax liability components. 'Alpha erosion' is estimated as after-tax alpha as a proportion of pre-tax alpha (reported where the latter is positive). Estimates are based on monthly portfolio snapshots, assuming transactions occur on the first trading day of each month, and reported as returns as a proportion of funds under management. The results report average contributions relative to the benchmark, along with the statistical significance of the differences. Tax rates are assumed to be 15% on short-term capital gains and income, and 10% on long-term capital gains, in accordance with Australian superannuation (pension) funds. A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Price level data comes from the SIRCA Australian Equities Tick History database; market capitalization from the Share Price and Price Relative (SPPR) database; and book-to-market ratios are calculated from data sourced from the Aspect Huntley database.

	Dividends	Capital Gains	Pre-Tax Alpha	Income Tax	Imputation Credits	Capital Gains Tax	After-tax Alpha	Tax Drag	Alpha Erosion
Broad Market Funds									
Initialisation	-0.22%***	1.84%***	1.62%***	0.02%***	0.09%***	-0.20%***	1.53%***	-0.09%***	5.8%
Bull	-0.37%***	1.11%***	0.75%***	0.07%***	-0.09%***	-0.88%***	-0.15%	-0.90%***	120.2%
Bear	-0.12%***	-0.05%	-0.17%	0.04%***	-0.14%***	-0.08%***	-0.35%	-0.18%***	
Recovery	0.03%	0.93%***	0.96%***	0.01%*	-0.08%***	-0.05%***	0.84%***	-0.12%***	12.8%
Small-Cap Funds									
Initialisation	-0.06%***	2.88%***	2.82%***	-0.03%***	0.27%***	-0.41%***	2.65%***	-0.17%***	6.0%
Bull	-0.43%***	1.63%***	1.20%***	0.06%***	0.06%***	-1.13%***	0.18%	-1.02%***	85.2%
Bear	-0.63%***	3.13%***	2.50%***	0.07%***	0.17%***	0.37%***	3.11%***	0.60%***	-24.2%
Recovery	0.22%***	3.13%***	3.35%***	-0.08%***	0.28%***	-0.07%***	3.49%***	0.14%***	-4.2%

*** 1% significance; ** 5% significance; * 10% significance

TABLE 5

Contributions to Alpha Relative to Index by Turnover

Table 5 reports the contributions to both pre-tax- and after-tax alpha for Australian equity funds between July 2001 and December 2010, with funds categorized by average turnover. Alpha is estimated relative to the S&P/ASX300 benchmark for Broad Market funds and the S&P/ASX Small Ordinaries benchmark for Small-Cap funds. Turnover is calculated as the minimum of buy and sell volume within each month as a proportion of fund value at the start of the month. Turnover for each fund is then demeaned by deducting the average turnover for all observed funds in the category (i.e. Broad Market or Small-Cap) during that month. Demeaned turnovers are averaged across time for each fund; and Broad Market funds are sorted into quintiles and Small-Cap funds into terciles based on their average demeaned turnover during their time in the sample. The first three columns report pre-tax returns, including contributions from dividends and capital gains. The next three columns show the annualized tax liabilities as a proportion of total benchmark value, including contributions from income tax on dividends, the value of imputation credits and taxes on capital gains (CGT). The next column reports the estimated after-tax alpha after all tax effects. The final two columns report two measures of tax effects. 'Tax drag' is the difference between after-tax and pre-tax alpha, and equates to the sum of the three tax liability components. 'Alpha erosion' is estimated as after-tax alpha as a proportion of pre-tax alpha (reported where the latter is positive). Estimates are based on monthly portfolio snapshots, assuming transactions occur on the first trading day of each month, and reported as returns as a proportion of funds under management. The results report average contributions relative to the benchmark, along with the statistical significance of the differences. Tax rates are assumed to be 15% on short-term capital gains and income, and 10% on long-term capital gains, in accordance with Australian superannuation (pension) funds. A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Price level data comes from the SIRCA Australian Equities Tick History database; market capitalization from the Share Price and Price Relative (SPPR) database; and book-to-market ratios are calculated from data sourced from the Aspect Huntley database.

	Mean Turnover	Dividends	Capital Gains	Pre-Tax Alpha	Income Tax	Imputation Credits	Capital Gains Tax	After-tax Alpha	Tax Drag	Alpha Erosion
Broad Market Funds										
High Turnover	106.9%	-0.14%***	0.67%***	0.53%***	0.04%***	-0.13%***	-0.77%***	-0.33%	-0.86%***	161.7%
2	65.3%	-0.22%***	0.71%***	0.49%***	0.04%***	-0.08%***	-0.43%***	0.03%	-0.46%***	93.5%
3	50.1%	-0.35%***	0.36%**	0.01%	0.07%***	-0.14%***	-0.38%***	-0.44%**	-0.45%***	4306.1%
4	38.7%	-0.19%***	1.84%***	1.65%***	0.04%***	-0.06%***	-0.44%***	1.18%***	-0.46%***	28.2%
Low Turnover	22.8%	-0.03%*	0.82%***	0.79%***	0.00%	0.02%***	-0.32%***	0.49%***	-0.30%***	37.8%
Small-Cap Funds										
High Turnover	86.1%	-0.47%***	2.36%***	1.89%***	0.06%***	0.07%***	-0.53%***	1.49%***	-0.40%***	21.2%
2	61.0%	-0.48%***	2.40%***	1.91%***	0.06%***	0.10%***	-0.60%***	1.47%***	-0.44%***	23.0%
Low Turnover	35.3%	0.09%***	2.32%***	2.42%***	-0.05%***	0.27%***	-0.48%***	2.15%***	-0.27%***	11.0%

*** 1% significance; ** 5% significance; * 10% significance

TABLE 6

Contributions to Alpha Relative to Index by Investment Style for High Tax Individuals

Table 6 reports the contributions to both pre-tax- and after-tax alpha for Australian equity funds between July 2001 and December 2010, across six self-declared fund styles with tax estimated for an Australian individual investor on the top marginal tax rate. Alpha is estimated relative to the S&P/ASX300 benchmark for Broad Market funds and the S&P/ASX Small Ordinaries benchmark for Small-Cap funds. The first three columns report pre-tax returns, including contributions from dividends and capital gains. The next three columns show the annualized tax liabilities as a proportion of total benchmark value, including contributions from income tax on dividends, the value of imputation credits and taxes on capital gains (CGT). The next column reports the estimated after-tax alpha after all tax effects. The final two columns report two measures of tax effects. 'Tax drag' is the difference between after-tax and pre-tax alpha, and equates to the sum of the three tax liability components. 'Alpha erosion' is estimated as after-tax alpha as a proportion of pre-tax alpha (reported where the latter is positive). Estimates are based on monthly portfolio snapshots, assuming transactions occur on the first trading day of each month, and reported as returns as a proportion of funds under management. The results report average contributions relative to the benchmark, along with the statistical significance of the differences. Tax rates are assumed to be 47% on short-term capital gains and income, and 23.5% on long-term capital gains, in accordance with an individual tax payer on the projected top marginal tax rate at the time of the analysis (of 45% plus the 2% Medicare levy, excluding the temporary 2% budget repair levy). A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Price level data comes from the SIRCA Australian Equities Tick History database; market capitalization from the Share Price and Price Relative (SPPR) database; and book-to-market ratios are calculated from data sourced from the Aspect Huntley database.

	Dividends	Capital Gains	Pre-Tax Return	Income Tax	Realised Imputation	Capital Gains Tax	After-tax Return	Tax Drag	Alpha Erosion
Broad Market Neutral	-0.36%***	0.97%***	0.61%***	0.22%***	-0.11%***	-1.26%***	-0.54%***	-1.15%***	188.8%
Broad Market Value	0.21%***	1.17%***	1.37%***	-0.13%***	0.07%***	-1.24%***	0.07%	-1.31%***	95.4%
Broad Market Growth	-0.53%***	0.89%***	0.36%**	0.33%***	-0.18%***	-1.04%***	-0.52%***	-0.88%***	244.6%
Broad Market GARP	-0.68%***	2.35%***	1.67%***	0.41%***	-0.20%***	-1.65%***	0.24%	-1.43%***	85.7%
Broad Market Quant	0.03%**	-0.72%***	-0.69%***	0.02%**	-0.08%***	-1.48%***	-2.23%***	-1.54%***	
Broad Market Undeclared	-0.23%***	-0.40%*	-0.63%***	0.17%***	-0.14%***	-0.90%***	-1.50%***	-0.87%***	
All Broad Market	**-0.20%*** **	**0.95%*** **	**0.74%*** **	**0.13%*** **	**-0.08%*** **	**-1.25%*** **	**-0.46%** **	**-1.20%*** **	161.5%
Small-Cap Neutral	-0.46%***	3.68%***	3.22%***	0.17%***	0.10%***	-0.94%***	2.54%***	-0.68%***	21.06%
Small-Cap Value	0.19%***	0.86%**	1.05%***	-0.21%***	0.26%***	-1.58%***	-0.48%	-1.53%***	145.6%
Small-Cap Growth	-1.13%***	1.24%***	0.11%	0.59%***	-0.12%***	-1.81%***	-1.23%***	-1.34%***	1191.6%
Small-Cap GARP	0.06%**	2.13%***	2.19%***	-0.22%***	0.41%***	-1.63%***	0.75%***	-1.44%***	65.6%
Small-Cap Quant	-0.18%***	4.33%***	4.15%***	0.08%***	0.00%	-2.37%***	1.87%***	-2.28%***	55.0%
Small-Cap Undeclared	-0.47%***	3.06%***	2.60%***	0.18%***	0.09%***	-2.59%***	0.27%	-2.32%***	89.6%
All Small-Cap	**-0.30%*** **	**2.09%*** **	**1.79%*** **	**0.07%*** **	**0.15%*** **	**-1.55%*** **	**0.46%**	**-1.33%*** **	74.3%

*** 1% significance; ** 5% significance; * 10% significance

FIGURE 1

Market States