Research Working Paper Series

The Effect of Data Availability in Measuring Fund Managers’ After-Tax Alphas

Dr Zhe Chen
Research Fellow
Centre for International Finance and Regulation

Professor David Gallagher
CEO
Centre for International Finance and Regulation

Dr Geoff Warren
Research Director
Centre for International Finance and Regulation

FEBRUARY 2016
WORKING PAPER NO.084/2015 / PROJECT NO.T001

This research was supported by the Centre for International Finance and Regulation, which is a Centre of Excellence for research and education in the financial sector, funded by the Commonwealth and NSW Governments www.cifr.edu.au.
All rights reserved. Working papers are in draft form and are distributed for purposes of comment and discussion only and may not be reproduced without permission of the copyright holder.

The contents of this paper reflect the views of the author and do not represent the official views or policies of the Centre for International Finance and Regulation or any of their Consortium members. Information may be incomplete and may not be relied upon without seeking prior professional advice. The Centre for International Finance and Regulation and the Consortium partners exclude all liability arising directly or indirectly from use or reliance on the information contained in this publication.
The Effect of Data Availability in Measuring Fund Managers’ After-Tax Alphas

Zhe Chen a, b, David R. Gallagher a, b, c, d, Geoffrey J. Warren a

February 2016

a Centre for International Finance and Regulation, Sydney, N.S.W. 2000 AUSTRALIA
b UNSW Business School, UNSW Australia, Sydney N.S.W. 2052 AUSTRALIA
c Macquarie Graduate School of Management, North Ryde N.S.W. 2109 AUSTRALIA
d Capital Markets CRC Limited, Sydney N.S.W. 2000 AUSTRALIA

Abstract

We examine potential sources of measurement error when evaluating the after-tax performance of fund managers based on periodic snapshots of their holdings alone, compared to when daily transactions data are also available. To do this, we compare portfolio return estimates based on imputed trades from monthly, quarterly and semi-annual snapshots with estimates that also incorporate daily trades for a sample of active institutional equity portfolios. This method allows us to directly measure the contribution of interim trading before-tax, while more accurately estimating the tax effects associated with turnover through observing actual trade prices. Further, availability of both trade and holdings data permits the identification of how contributions and tax effects arise from income and capital gains sources, as well as how they vary across investment styles and market conditions.

JEL classification: G23

Keywords: active fund management; performance evaluation; data sources; trading; taxation

* The authors gratefully acknowledge the financial support of the Centre for International Finance and Regulation (CIFR), and the helpful comments of Scott Lawrence, Professor Clemens Sialm, and Professor Russell Wermers.

† Corresponding author. E-mail address: zhe.chen@cifr.edu.au (Z. Chen)
1. Introduction

The contribution to after-tax performance of active fund managers is an issue that is highly relevant to the bottom line of potential investors, and one that cannot be directly measured from the sources of data used in much of the prior literature. Prior studies have predominantly relied on total fund returns\(^1\), periodically captured portfolio snapshots\(^2\), or trade data. The problem with these approaches is that they present an incomplete picture when examined in isolation. Total fund returns accurately capture the pre-tax returns of active funds management, but it is not possible to identify the income from capital gains. Holdings-based analysis, on the other hand, is able to partially address the tax aspect by approximating the cost base and holding period of each position. However, trades (net) inferred from periodic holdings will very likely contain measurement error to extent that the actual prices and timing at which the measured interim trades occur deviate from the assumptions made by the researcher. Further, the scope for measurement error might be expected to increase the longer the interval between portfolio holding snapshots (e.g. quarterly intervals will be larger than monthly intervals). Indeed, Kacperczyk, Sialm and Zheng (2008) demonstrate that the returns from simulated portfolios based on disclosed holdings can materially differ from reported returns.

Access to actual trade data helps overcome issues related to data granularity, although trade data in isolation lacks a line of sight back to the overall portfolio and its performance. Reconciling trades to portfolio holdings is necessary to complete the full picture. This reconciliation is essential to determining after-tax performance, as tax effects associated with trades can only be correctly estimated through observing both trade prices and the tax basis used for capital gains tax (CGT) calculations. The ability of academic researchers to determine after-tax performance is currently limited by the availability of reliably merged trades and holdings data. Using a unique dataset of trades and holdings for a sample of active Australian fund managers, we attempt to gauge the potential for measurement error from using incomplete data, and the implications for evaluating the contributions to managers’ after-tax performance. Specifically, we identify whether a systematic relation exists between interim trading returns and underlying holdings-based performance, and the contribution of interim trading to overall tax liabilities given the potential sources of measurement error. Our results demonstrate the importance of these data-related issues, thus highlighting the need for both trade and holdings data in order to make correct inferences about the net after-tax benefits that fund managers are able to deliver.

Our approach involves contrasting performance estimates arising from simulated portfolios that utilize actual on-market trade data\(^3\), with estimates based on trades imputed from portfolios holdings observed at monthly, quarterly and semi-annual frequencies. We compare both pre-tax and after-tax alpha (i.e. excess return versus an index benchmark) to highlight how having access to both actual trade and holdings data supports identification of contributions from interim trading and related tax effects that are otherwise obscured. Further, we investigate how these contributions vary with investment style and market conditions. The significant differences in results arising from

---

1 Prominent examples include Jensen (1968), Malkiel (1995), Fama and French (2010), and Barras, Scaillet and Wermers (2010).

2 For example, see Wermers (2000), Cremers and Petajisto (2009), and Duan, Hu and McLean (2009).

3 We only observe on-market transactions; off-market trades and corporate actions are not observed in the daily-trades data set, but their effects are reflected in the changes between monthly portfolio holdings.
periodic holdings data relative to those incorporating actual trades has profound implications for the inferences about the sources of manager alpha drawn by much of the literature, which has often analyzed the sources of this alpha using less granular data such as monthly fund returns and quarterly portfolio holdings, or using trade data in isolation.

Trading activity and taxation are relevant aspects to investigate because they can both significantly contribute to total fund performance. While both aspects have received consideration in isolation, they have received relatively little empirical attention in combination, due to the paucity of suitable data. With regard to trading, we not only confirm its importance as a source of alpha generation by active fund managers, but also highlight how its after-tax contribution cannot be accurately measured without access to granular trading data. With regard to tax, a number of studies based on periodic portfolio holdings have shown substantial erosion of alpha due to tax, as well as a variation in tax burdens between different fund styles (e.g. Bergstresser and Pontiff (2013), Israel and Moskowitz (2012)). However, these studies have generally ignored the substantial returns associated with interim trading, including any related taxation effects which depend on the actual prices at which trades occur. We are able to demonstrate that interim trading generates significant alpha, but do not find evidence that the additional returns are associated with any meaningful marginal tax imposts. This indicates that interim trading is not only partially responsible for the “return gap” documented by Kacperczyk, Sialm and Zheng (2008), but is also quite tax-efficient for our sample. The combination of both trade and holdings data permits identification of substantial ‘actual’ after-tax contributions that arise from interim trading that would otherwise remain obscured.

The power and contribution of our study comes from access to a dataset that contains both monthly holdings data and aggregated daily on-market trades for 25 active Australian equity funds between 2006 and 2010 (inclusive)\(^4\). While the number of funds and sample period may be somewhat limited, it suffices to establish the importance of having access to granular trading data in order to correctly identify trading contributions and any taxation effects. Our approach involves constructing simulated portfolios updated on a daily basis, and then reconciling to reported portfolio holdings at month-end. We also simulate portfolio outcomes based on observing reported portfolios at monthly, quarterly and semi-annual intervals, rebalancing using imputed trades that are assumed to occur at observed period-end prices. Rebalancing at monthly, quarterly and semi-annual intervals reduces turnover by 12%, 29%, and 48% respectively relative to the daily-rebalanced portfolios. We compare returns on our simulated portfolios with simulated pre- and after-tax benchmarks based on the S&P/ASX300 Index. This allows us to determine the contribution that interim trading makes to total fund alpha (i.e. excess return versus the index) both pre-tax and after-tax. Although our on-market trade data only captures about two-thirds of total changes between monthly holdings, the interim trading that we can observe within the month nevertheless adds 0.41% p.a. to total pre-tax fund returns. This increases to 0.83% p.a. and 0.92% p.a. respectively when comparing portfolios rebalanced daily to those based on quarterly and semi-annual rebalancing. Considering that the daily simulated portfolios generate an average pre-tax alpha of around 0.5% p.a. (gross of management fees), and that our trading contribution estimates may be conservative given that we do not observe all trades, it is clear that interim trades make a substantial contribution to total fund alpha. With average pre-tax

\(^4\) Note we do not have access to the monthly returns of these funds, which arise from a proprietary database of holdings and transactions only for individually managed mandates.
alpha reducing to only 0.08% p.a. under monthly rebalancing and becoming negative under quarterly rebalancing, the importance of observing interim trading as an alpha source is underlined.

Having access to a combination of actual trade and holdings data makes it possible to more accurately measure tax effects. After-tax performance is particularly relevant as this reflects the true value that active fund management provides to investors. Our analysis is conducted from the perspective of Australian superannuation (i.e. pension) funds. For these investors, we estimate that actively managed funds generate average after-tax alpha relative to an after-tax benchmark that is approximately 0.08% p.a. lower than their pre-tax alpha (although after-tax returns are actually around 0.36% p.a. higher than pre-tax returns as a consequence of Australia’s dividend imputation system). The reduction in alpha after-tax largely reflects the influence of the capital gains tax compared to the benchmark that arises through higher turnover and increased propensity to realize gains. Nevertheless, we find that these tax burdens are not increased appreciably by interim trading, despite a significant positive alpha contribution that can be largely traced to capital gains tax effects (specifically lower capital losses incurred over the analysis period). After-tax alpha of 0.42% p.a. can be observed in our simulated portfolios based on daily data, with after-tax alpha becoming negative when based on quarterly and semi-annual holdings data. These results further illustrate the importance of being able to observe actual trades in order to correctly evaluate any related tax effects.

The value of having access to granular trade as well as holdings data is confirmed when examining performance differences across fund investment styles. We find that Growth funds compensate for their lower dividend yield by generating superior capital gains relative to the passive benchmark through short-term trading. However, these effects are not evident when examining their quarterly holdings alone. Value funds, on the other hand, earn dividend yields in excess of the benchmark, but must manage the timing of their holdings to avoid deep capital losses relative to the benchmark. Neither the Style Neutral nor Enhanced Passive funds in our sample outperformed the benchmark. However, Style Neutral funds appear to significantly underperform the benchmark when evaluated based on their monthly holdings.

We further examine systematic differences in the measurement of contributions from interim trading and related tax effects by dividing our sample into three market states: a “bull” market (31st July 2006 to 31st October 2007); a “bear” market (1st November 2007 to 28th February 2009); and a “recovery” phase (1st March to 31st December 2010), where the market rebounded from its lows and then moved sideways. The analysis reveals that alpha contributions vary substantially across market states. We find that outperformance versus the benchmark is primarily generated during the bear market, when our sample posts average alphas of 3.33% p.a. pre-tax and 3.24% p.a. after-tax based on the daily simulated portfolios. Meanwhile, alphas are negative in the bull and recovery markets, although the latter is insignificant. More interestingly, the contribution from trading appears strongest during the bear market (0.64% p.a. difference between daily and monthly rebalanced portfolios), followed by the bull market (0.46% p.a. difference), and weakest in the recovery market (0.22% p.a. difference). The additional alpha associated with interim trading incurs meaningful increases in tax impacts only during the bull market (and then only by -0.07% p.a. going from daily to quarterly rebalancing). These findings suggest that managers may be better able to extract alpha from trading during strongly trending markets; and that trading is relatively tax efficient. The nuanced manner
in which interim trading and related tax effects varies across market states only becomes apparent through having access to both actual trade and holdings data.

The remainder of this paper is organized as follows: Section 2 provides background on existing research into active fund performance; Section 3 describes the data; Section 4 details the method; Section 5 reports the results related to the performance and tax impacts of interim trading; and Section 6 concludes.

2. Background

Many studies have focused on the ability of fund managers to capitalize on their information signals to generate excess returns. Academic support for manager skill has been mixed. There is significant evidence that managed mutual funds in the US underperform their respective passive benchmarks after fees (Jensen (1968), Malkiel (1995), Carhart (1997), Wermers (2000), Fama and French (2010), Barras, Scaillet and Wermers (2010)). However, a number of studies suggest that a group of active fund managers in the far right tail of the performance distribution do possess the ability to generate excess returns after trading costs and management fees (Kacperczyk, Sialm and Zheng (2005), Mamaysky, Spiegel and Zhang (2007), Cremers and Petajisto (2009)).

Notwithstanding the ambiguous performance based on returns, mutual fund managers appear to have stock selection skill on average. For instance, the holdings of mutual fund stocks have been shown to be predictive of future alpha (Wermers, Yao and Zhao (2012)) and generate significant positive excess returns (Wermers (2000)). In Australia, a number of studies (e.g. Pinnuck (2003), Bennett, Gallagher, Harman, Warren and Xi (2015)) reveal skill at generating pre-tax alpha based on periodic holdings returns, which our study confirms. In addition, the trades of fund managers have been found to contribute positively to performance (Puckett and Yan (2011), Anand, Irvine, Puckett and Venkataraman (2012), Pástor, Stambaugh and Taylor (2014), Bennett et al. (2015)), further confirming that managers possess skill in identifying stocks that will outperform or underperform in future. However, to the extent that outperformance exists, some recent findings suggest that it might be diminishing as manager competition increases (Duan, Hu and McLean (2009), Barras, Scaillet and Wermers (2010)).

Most studies have relied on data that only partially captures manager activities, observing either reported returns, periodic portfolio holdings data, or trades either analysed in isolation or imputed from portfolio holdings (i.e. changes between holdings snapshots). These partial or more aggregated measures of manager activity limit the ability to link decisions and related actions to overall portfolio outcomes. For example, periodically rebalanced portfolios inferred from holdings snapshots do not reflect realistic investment opportunities, as they do not account for transaction costs associated with trading large volumes on the rebalance date (Liu and Strong (2006)). Further, return contributions from trading activity cannot be accurately estimated using periodic holdings data as it is not possible to observe interim trading that occurs between portfolio reporting dates, the prices at which transactions actually occur, or to estimate the costs such as market impact associated with those trades. On the other hand, use of trade-level data in isolation cannot address issues where an overall portfolio perspective is also required. For instance, underlying tax effects (e.g. net income tax and capital gains tax) are difficult to establish without knowing both underlying holdings and the underlying prices at which

---

5 See also Cohen, Coval and Pastor (2005); Kacperczyk and Seru (2007); Cuthbertson, Nitzsche and O'Sullivan, (2008).
securities were acquired and subsequently sold. Meanwhile, returns data can accurately capture the net pre-tax and after-tax performance received by investors, but has difficulty in identifying the actions responsible for that performance.

Having access to both aggregated holdings and trade data together can more powerfully provide insights regarding managers’ actions and their contributions to performance. By using daily transactions data in conjunction with reported monthly holdings, we are able to build on past studies by addressing these shortcomings in a unified manner. The only other study of which we are aware that examines both actual trades and holdings is by Busse et al. (2015), who trace the diseconomies of scale encountered by larger funds to a tendency to invest in larger, more liquid stocks. However, these researchers use quarterly holdings data, and do not formally link trades to total performance. Nevertheless, their analysis serves to reinforce that certain research questions can be effectively addressed only by observing both actual trades and portfolio holdings.

Kothari and Warner (2001) point out that in conditions where a stock’s abnormal return is short-lived, trade-based analysis may be particularly powerful, and the benefit of more granular data is demonstrated by Elton et al. (2010) and Elton, Gruber and Blake (2011). Elton et al. (2010) investigate how the availability of monthly holdings can lead to differing results than those arising from quarterly holdings data, as well as permitting certain research questions to be more effectively investigated, including tax-motivated trading. Elton, Gruber and Blake (2011) establish that disclosure frequency (monthly vs. quarterly vs. semi-annual vs. annual) is positively related to the ability to measure historical fund performance and predict future returns. Our study takes this to the next logical level by combining even more granular daily on-market data with monthly portfolio holdings snapshots. The importance of unobserved activity that occurs between portfolio holdings snapshots is highlighted by Kacperczyk, Sialm and Zheng (2008), who find that the difference in returns from disclosed holdings and actual reported returns (the ‘return gap’) provides a persistent indication of manager ability.

Our demonstration of the importance of combining granular trade and holdings data focuses on the contribution of trading to performance, which we investigate both pre- and after-tax allowing for associated tax effects. Our study hence unifies three strands in fund management research: (a) performance of active management relative to passive benchmarks; (b) contribution from active trading; and (c) the effect of tax on fund performance. While each of these areas has been addressed individually, we highlight how having access to both daily trading data and portfolio holdings allows the intersection between all these aspects to be addressed in an integrated manner.

Addressing this intersection gets to the heart of the active/passive funds management debate. Trades undertaken by active managers are the means by which their insights are implemented. Our analysis addresses the question of whether these trades indicate the existence and nature of managerial skill, and how it contributes to the total after-tax returns that are realized by investors.

While the contribution of trading to portfolio performance is our central focus, the analysis is particularly notable for demonstrating how the combination of trade-level and holdings data supports evaluation of related tax effects. A major shortfall of the prior tax literature is that it is predominantly based on periodically reported holdings. This can lead to mis-estimation of after-tax alphas as a consequence of failing to observe actual transaction prices, which obscures the true net returns arising from interim trading after allowing for the associated tax implications.
Tax effects from active management have received only a modest level of academic attention. In the US, how tax varies with style has been a point of focus. Bergstresser and Pontiff (2013) estimate the tax burdens for a range of representative strategies. Their study finds that effective tax rates are highest on momentum, equal-weighted portfolios, small-firm portfolios and value portfolios (as opposed to value weighted portfolios, large-stock portfolios and growth portfolios). Israel and Moskowitz (2012) find momentum strategies in the US to be more tax efficient than value strategies because they generate substantial short-term losses that serve to offset long-term capital gains, as well as being exposed to lower dividend income. Another study shows that growth funds are less likely to sell positions with unrealized gains compared to balanced and income funds (Huddart and Narayanan (2002)). Finally, Longmeier and Wotherspoon (2006) demonstrate that active small-cap and emerging market managers outperform their respective benchmarks after-tax, while mid- and large-cap active managers underperform. They also find an inverse correlation between turnover and after-tax returns, except for those funds that deliberately harvest losses.

Our study investigates tax effects in an Australian context, where there are significant differences in the taxation of dividend income relative to the US due to Australia’s imputation system. Only a few studies examine tax effects on Australian institutional fund performance. 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, finding that funds responded by significantly increasing the proportion of long-term gains realized, albeit with significant variation across funds. Ainsworth, Fong, Gallagher and Partington (2015) find that active 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. These studies suggest that Australian institutional funds are at least aware of the tax implications of their actions, although the extent to which tax considerations affect their overall investment strategy is unclear.

In summary, the existing literature has established that trading and tax are potentially important influences on the net returns achieved by investors. However, most studies have analysed these aspects using partial or highly aggregated data that does not support an integrated view of how these effects interact. This gives rise to potential for incorrect inferences on the implications of the manager’s actions for performance. We will investigate the scope for error arising from relying on limited data, demonstrating that it is indeed a significant issue.

3. Data

We use a proprietary data set from 25 active Australian equity fund managers, spanning five years from the 1st January 2006 to the 31st December 2010 inclusive. While this data captures a limited sample of Australian active equity funds, it is nevertheless representative of the wider universe. Figure 1 demonstrates this by comparing the equal-

---

6 Australia’s imputation credit system provides a tax credit to resident shareholders with respect to the company tax paid on the earnings from which dividends are distributed. As well as preventing double-taxation on dividend income, it also provides additional rebates to resident shareholders whose marginal tax rate is less than the corporate tax rate (currently 30% on larger companies).

7 These results are largely attributable to unit trusts, which are pass-through entities for tax purposes. By contrast, this study assumes a superannuation fund, which is a tax-paying investment vehicle.
weighted average of simulated portfolio returns\textsuperscript{8} for funds in our sample with the 125+ institutional funds from the Mercer Portfolio Analytics (MPA) database. The two returns series track each other very closely, and are not statistically distinguishable from one another. This provides evidence that the funds in our sample generate returns that do not differ substantially from a much broader group that covers the majority of active domestic institutional funds in Australia. Compared to broader holdings- or returns-based data sets, our data offers the advantage of covering both holdings and daily net on-market trades.\textsuperscript{9} The availability of daily trade data is particularly pertinent within an Australian environment for a number of reasons. First, after-tax performance may be particularly sensitive to the effects of interim trading due to Australia’s unique tax landscape which includes both a 50% discount on long term capital gains and the 45-day holding rule for imputation credits. Further, evidence exists that Australian fund managers may be able to select stocks offering superior excess returns (Pinnuck (2003), Fong, Gallagher and Lee (2008)), which is indeed confirmed in our own data sample. Determining whether tax effects negate any pre-tax alpha is also an important step to establishing if active funds generate marginal value for investors.

The data was collected through custodians for funds utilized by two large multi-manager investors. The funds represent separately managed accounts within large institutional funds management companies. Table 1 provides summary statistics for our sample, with Panel A reporting the composition of funds by style and year, Panel B summarizing trading activity, and Panel C reporting average factor exposures within each style grouping. Our sample contains a total of 25 separate funds, ranging from 18 funds in 2006 to 23 funds in 2009. Investment styles are self-declared, and reflect standard investment approaches in the Australian market. Value funds are the most numerous (between seven and nine funds), and account for the largest portion of net assets in every year of the covered data period. The next most prevalent are Growth funds, Enhanced Passive funds (except in 2010), and Style Neutral funds. Funds that declare themselves as “Enhanced Passive” funds hold a substantially higher-than-average number of positions in their portfolios, but also demonstrate turnovers (see Panel B) and factor exposures (see Panel C) that are larger than might be expected for an index-tracking style. This suggests that the Enhanced Passive funds in our sample are relatively active, and somewhat removed from pure passive index tracking portfolios.

The breakdown of trade activity reported in Panel B includes the total value of purchases and sales for each fund style and year. This includes inferred trades required to reconcile the simulated portfolios with reported portfolios at month-end due to missing trades data (method described below). Our trade data is estimated to cover about two-thirds of total trades by dollar value, meaning that inferred trades are created to capture the remaining third. These “missing” trades may include off-market transactions, corporate actions such as rights issues and dividend reinvestment plans (DRPs), as well as inadvertent and deliberate omissions. We also provide turnover calculated as the lesser of purchases and sales divided by total mid-year portfolio value. Both Growth and Style Neutral funds were found to have high turnover at around the 80% p.a. mark, while Value and Enhanced Passive funds both had lower turnover closer to 60% p.a.

As a check on the self-declared styles, we estimate the factor exposures for funds in each of the fund style categories, which are reported in Panel C. The estimates are generated

\footnotesize{\textsuperscript{8} Individual portfolio returns are based on the value-weighted return of positions in each fund.}
\footnotesize{\textsuperscript{9} Unfortunately we do not have access to total returns for the funds, which are based around separately managed accounts and are not publically available.}
by simulating portfolios with the on-market trades and holdings data using the method described in the next section, and taking net changes in portfolio value (pre-tax) from month-end to month-end as a measure of returns. Funds with less than 30 monthly observations are excluded, which leaves 23 of the 25 funds remaining. Factor returns for size, book-to-market and momentum are constructed using the method described in Carhart (1997). Individual fund returns are then regressed against factor returns to infer factor exposures for each individual fund. Factor exposures are averaged across self-declared fund styles to produce mean factor exposures across each style. As expected, Growth funds exhibit a tilt towards stocks with low book-to-market ratios, while Value funds held the opposite tilt. Style Neutral funds had the most extreme tilt towards growth and large-cap stocks, even more so than Growth funds, although this may have been related to the specific period which centred around the Global Financial Crisis (GFC) of 2007-2009. All fund styles are tilted towards large stocks and away from momentum, except for Enhanced Passive funds which demonstrated a positive although statistically insignificant exposure to momentum.

To complement our daily on-market trade and portfolio holdings database, we use the Share Price and Price Relative (SPPR) database for price levels, market capitalization adjustments and dividends. Financial statement data is taken from the Aspect Huntley database.

4. Method

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

4.1 General Approach

Our general approach involves simulating the evolution of the portfolios for each fund in our sample, and hence tracking aspects such as trades, accrued dividends, income and capital gains taxes, imputation credits, brokerage, capital growth and overall returns. Simulations using daily trades track the portfolio on a day-by-day basis, and then reconcile back to month-end holdings through instigating imputed trades at monthly closing prices to account for “missing” trade data. Simulations based on monthly, quarterly and six-monthly portfolio snapshots are rebalanced using a buy-and-hold strategy as described in Kacperczyk, Sialm and Zheng (2008), with all trades imputed at end-of-period closing prices. Dividend and dilution effects are also tracked on a daily basis, and provide the source of variations in dividend yields and associated tax liabilities across rebalancing intervals.

The simulation analysis entails initializing each fund on the first June-end or December-end on which holdings data becomes available. This ensures that simulated portfolios with the longest periods between rebalancing dates (six months) can start and end on the same date as portfolios that are more frequently rebalanced. The simulation assumes that the starting positions are acquired on the initialization date. This establishes the initial tax base for all positions, with any sales within the first year taxed at the short-term CGT rate.  

Assuming that prices rise on average over time, this will understate CGT to the extent that the assumed tax base is higher than actual for stocks that have been held over an extended period; but will overstate CGT by applying short-term CGT rate in instances where the stock has actually been held for long than 12 months. The actual magnitude of the bias is unknown; although the potential for understating CGT is
simulated portfolio on a daily basis and reports accrued cash, stock positions and taxes at each month-end. Trades include reported daily trades and any inferred trades. About one-third of the trades for the daily simulated portfolios are the inferred trades required to bring simulated portfolio holdings back into alignment with reported holdings at month-end. Market events include dividends and other dilutions for which the portfolio must be adjusted, e.g. new issues. Since fund flow data is not available for our sample, we infer a net cash flow in each month equal to the trade imbalance (described in further detail in Section 4.9). 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.

Our method does not adjust for a number of factors that may influence real-world performance. With respect to imputed trades, we do not observe the actual trade prices, and do not allow for any market impact (which would vary with the specific trade algorithm implemented). We do not adjust for actual cash flows, as reliable data on cash flow and actual cash held by funds has not been available. In addition, we do not account for cash drag from any uninvested cash, which may otherwise have a negative impact on total fund returns. Nevertheless, our method serves to establish a solid basis for evaluating the importance of having access to reported trades relative to the alternative of observing holdings at periodic intervals. Effectively we are comparing estimates across measurement intervals based on the differences that are observable, while otherwise applying consistent assumptions. Further, our estimates are likely to provide a conservative estimate of the true contribution from interim trading for two reasons. First, our simulated portfolios on daily rebalancing are based on only about two-thirds of trades. Second, the observed daily trades use actual transaction prices which incorporate market impact, while the imputed trades that dominate the periodically rebalanced portfolios do not, given that they are assumed to occur at closing prices.

4.2 Dividends

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 at the previous month-end:

\[
d_T = \left( \sum_{t \in T} \sum_{s \in p_t} u_{s,t} d_{s,t} \right) \Big/ p_{T-1}
\]

- \(d_T\) 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 \(t\)
- \(p_{T-1}\) Portfolio value at the prior month-end

Estimated dividends for each portfolio will vary with the rebalancing interval, as this impacts on dividend entitlements through differences in assumed trade timing. For restricted to the extent that turnover is high (see Figure 1, Panel C). In any event, the main objective of this study is to evaluate how data availability may impact on derived estimates, rather than provide accurate measures of after-tax alpha.
example, a position that is sold cum-dividend in the daily-rebalanced portfolio may be imputed as a period-end trade under monthly rebalancing, so that a dividend is accrued only in the latter case. Conversely, a stock may be acquired cum-dividend in the daily-rebalanced portfolios, but purchased ex-dividend under the periodically rebalanced simulations.

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 at 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. For simulated portfolios that are rebalanced at quarterly and semi-annual intervals, the 45-day rule is met on all transactions.

\[ f_T = \frac{\sum \sum u_{s,t} f_{s,t}}{p_{T-1}} \]  

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

\[ f_{s,t} = \left( \frac{d_{s,t} \times C}{1 - T} \right) \times f_{s,t} \times \chi \]  

\( C \) Company tax rate (30% during the analysis period)  
\( f_{s,t} \) Franking ratio  
\( \chi \) 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 on the dividend date. The accrued tax within each month is calculated as a proportion of the portfolio value at the prior month-end.

\[ \tau_T = \frac{\sum \sum u_{s,t} (d_{s,t} + f_{s,t})}{p_{T-1}} \times \frac{1}{I} \]  

\( \tau_T \) Gross income tax within month T

---

11 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).

12 Some dividends are unfranked or partially franked. This may occur when the company earned at least part of their profits overseas. These profits are not taxed by the Australian government and hence are not eligible for franking credits.
4.5 Capital Gains Tax (CGT) Paid

On each transaction event (including inferred transaction events, which are described in Section 4.7) that results in a capital gain or loss (net of brokerage costs), 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. Where past capital losses exceed past capital gains, these net losses are carried forward but not valued as an asset until they are matched with a subsequent capital gain. 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. For each period (month, quarter, or six-months), the capital gains tax paid ($g_T$) is calculated as a proportion of the portfolio value at the end of the prior period.

4.6 Tax Rates

Taxation effects are modelled from the perspective of an Australian superannuation (i.e. pension) fund, which represents a very large investor base. We decided not to investigate a broad range of marginal tax rates to enhance the focus our study, noting that tax rates applying to retail investors in a non-superannuation context are subject to considerable variation. The following tax rates apply to Australian superannuation funds:

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

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%. 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

---

13 Australian superannuation funds managed A$2.05 trillion of retirement savings assets at March 2015, of which 25%-30% is invested in domestic equities (Source: Australian Bureau of Statistics, Catalogue 5655.0 Managed Funds, Australia). 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.

14 The 30% reflects the corporate tax rate applied to the pre-tax profits out of which the fully-franked portion of dividends is paid.
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 Transactions

Transactions must be inferred under two situations:

1. In the daily trading analysis, a portfolio is inferred at the end of each month as the reported holdings at the end of the prior month adjusted for reported intermediate on-market trades and non-dividend dilution events (e.g. stock splits). If this portfolio does not reconcile with the reported portfolio at the end of the current month, a series of inferred trades are generated to reconcile the portfolios. This accounts for non-reported trades, which may include off-market transactions and corporate actions such as DRPs and rights issues.

2. For simulated portfolios based on periodic holdings snapshots, all trades are inferred from differences in successively disclosed holdings.

In either of these cases, the inferred trades are assumed to have been executed at the close price on the last day of trading in each period without market impact. Inferred trades comprise approximately 33% of total transaction value (absolute value of buys and sells) for the daily simulated portfolios. 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 market impact). Failure to observe actual transactions could lead to underestimation of trading contributions if trading skill exists, as appears to be the case for our fund sample. On the other hand, failure to allow for market impact would contribute to overestimation of the contribution from trading. The latter is likely to lead to greater overestimation where estimates are based on imputed trades from periodic holdings, relative to the daily simulated portfolios where the majority of trades are observed.

4.8 Brokerage Commissions

The brokerage rate ($b_T$) as reported within our sample fell from 0.18% of transacted value in 2006 to 0.15% in 2010. For our analysis, we apply a constant brokerage cost of 0.15% of traded value on all transactions (actual and inferred). We consider this a parsimonious approach, noting that brokerage rate does not represent a potential source of differing estimates across differing data intervals.

4.9 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. This process assumes that cash flows are injected or removed at the end of each month, and so may lead to some distortion of pre- and after-tax returns (e.g. a cash injection at the start of the month that is immediately invested may appear to boost overall portfolio returns). However, because net cash flows within each month are, for the most part, quite small\textsuperscript{15}, this is expected to produce only a negligible effect. Inferred cash flows are not reported directly, but are used to calculate the net capital gains (see below).

4.10 Capital Gains

The capital gains within each period are calculated as the net change in portfolio value between the end of the prior period and the current period, adjusted for net cash flows.

\[
c_{g_T} = \frac{p_T - p_{T-1} - \Delta cash_T}{p_{T-1}}
\]

\(c_{g_T}\) Capital gains return in period \(T\)
\(p_T\) Portfolio equity value at period-end
\(p_{T-1}\) Portfolio equity value at the prior period-end
\(\Delta cash_T\) Inferred cash flow to/from the fund in period \(T\)

4.11 Pre-tax Return

The pre-tax return within each period is calculated as the sum of capital gains return, dividend yield, and brokerage cost.

\[
r_T = c_{g_T} + d_T + b_T
\]

\(r_T\) Pre-tax return in period \(T\)
\(c_{g_T}\) Capital gains return in period \(T\)
\(d_T\) Dividend yield in period \(T\)
\(b_T\) Brokerage in period \(T\) (a negative value representing a cost)

4.12 After-tax Return

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

\[
r_T = r_T + f_T + \tau_T + g_T
\]

\(r_T\) After-tax return in period \(T\)
\(f_T\) Franking credit yield in period \(T\)
\(\tau_T\) Income tax liability in period \(T\) (a negative value representing a cost)

\textsuperscript{15} On average, a 1% cash inflow per month is observed within the sample.
We construct pre-tax and after-tax benchmarks based on the S&P/ASX300 Index. We use a broad market index as the benchmark for a number of reasons. Firstly, market indices are the most common benchmarks by which fund managers measure themselves. Stated benchmarks are often disclosed in the funds’ Product Disclosure Statements and industry surveys. Secondly, from an investor perspective, the passive market portfolio is the most feasible alternative to active investment. This may either be implemented through Superannuation funds investing in underlying passive funds, or through direct investment in exchange traded ETFs that track the market (such as the Vanguard Australian Shares ETF). In contrast, factor-adjusted benchmark portfolios are typically hypothetical constructs and do not represent truly viable alternative investments. Tax liabilities for these paper portfolios are hence less relevant to gauge the opportunity cost of active management for end-investors.

In order to create a realistic benchmark that reflects both the brokerage required to rebalance index holdings as well as 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 manager portfolios. The benchmark portfolio, by construction, is not subjected to cash flows—cash flows (i.e. dividends, brokerage fees, and taxes) are accrued in separate accounts not subject to reinvestment. Since observations are taken as log changes at monthly intervals, this is not expected to produce a material effect in the results.

Due to the data difficulties, we find that approximately 10% of the historical S&P/ASX300 Index (by weight) cannot be accurately priced. This reflects a combination of missing price and returns data, and an 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 with the reported S&P/ASX300 returns by creating a dummy instrument that accounts for the difference between simulated and reported index returns. Further, we assume that the dummy instrument pays franked dividends at the same dividend yield as the tracked securities in the index. This method means that the pre-tax returns of the simulated benchmark portfolio, by construction, match the reported returns for that benchmark. The simulated benchmark provides additional data on the split between income and capital gains, as well as tax liabilities that cannot be inferred from the pre-tax returns series alone. Contributions to both pre-tax and after-tax returns on the simulated S&P/ASX300 portfolio are reported in Table 2.

5. Results

To demonstrate the advantage of having access to both actual trade and portfolio holdings data, we compare both pre-tax and after-tax return estimates based on simulated portfolios which draw on actual on-market trades with returns arising from periodically rebalanced portfolios. We pay particular attention to the contributions arising from intra-month trading and related tax effects that are revealed by the difference in

---

56 Passive factor-based funds are not available in Australia, as they are in the US.
estimates arising from the daily simulated portfolios and monthly holding snapshots. In addition, comparing the estimates from daily simulated portfolios with those based on quarterly and semi-annual snapshots indicates how potential for mismeasurement increases as the interval extends over which portfolio holdings are observed. The comparison with the quarterly estimates is of specific interest, given that this is the frequency of portfolio holdings data used in many US studies.

The analysis proceeds in three phases. First, we evaluate the overall effect of using more granular data by comparing returns for the daily simulated portfolios with those based on monthly, quarterly and semi-annual holdings. This analysis reveals that there exist substantial contributions from interim trading which become progressively undetectable as the observation interval increases. Second, we compare estimates based on different observation intervals across fund styles. Our findings indicate that trading contributions vary across styles, and that the estimated magnitude of the differences varies with data granularity. Third, we compare estimates across market states, including the pre-GFC bull market, the GFC bear market, and the post-GFC recovery period. This analysis reveals not only that alpha is positive only during the bear market, but that the trading contributions also vary across market states, being largest during the bear market and relatively modest during the post-GFC recovery where the market traded sideways after an initial rebound. Our results further indicate that the key differences in alpha estimates across differing data granularity primarily relate to interim trading, with minimal differences in net tax effects. The implication is that interim trading does not dilute alpha generation arising from trading, thus suggesting that trading by the managers in our sample is relatively tax-effective. The latter is a somewhat unexpected finding, which only becomes evident through accessing both actual trade and portfolio holdings data.

5.1 Overall Effect of Observation Interval

Here we demonstrate how having access to granular trade data in combination with portfolio holdings allows contributions from interim trading and related tax effects to be revealed, which are otherwise obscured by analysis of imputed trades based on periodic holdings data. This is achieved by comparing contributions from trading to after-tax returns under daily simulated portfolios with portfolios created from sampling holdings at one-, three- and six-month intervals. One-month holdings intervals are sampled at the last trading day of each month; three-month holdings intervals are sampled on the last trading day of each quarter (March, June, September and December); and six-month holdings intervals are sampled on the last day of June and December each year. Our daily-simulated portfolios exploit our trade data to more accurately identify the timing and price at which interim on-market trades are undertaken, at least with respect to the two-thirds of trades that our data explicitly identifies.

The advent of the GFC within our sample results in fund returns that are significantly lower than long-term equity returns in Australia. However, this provides the advantage of allowing us to examine the performance of active fund managers in a period of significant financial market distress. We use the pre-tax and after-tax benchmarks described in Section 4.12 to provide baselines against which gross fund performance and the tax effectiveness of the daily-rebalanced portfolios can be measured (Table 2, Panel A). The average fund manager in our sample appears to generate positive but not statistically significant alpha both before and after tax, relative to the S&P/ASX300 benchmark portfolio.
Table 2, Panel B reveals that interim trading makes a statistically and economically significant contribution to performance which is substantially obscured when trades are imputed from periodic portfolio snapshots. The daily simulated portfolio generates pre-tax alpha of 0.5% p.a., while alphas measured from periodically rebalanced portfolios are significantly lower. Interim trading appears to add 0.46%, 0.94% p.a. and 1.08% p.a. over imputed trades estimated at monthly, quarterly and semi-annual intervals. Recall that while all estimates are inclusive of brokerage costs, only the daily trades account for market impact through observing actual trade prices. The fact that returns from our daily simulated portfolios incur greater costs from higher turnover and potentially market impact serves to reinforce the presence of considerable trade timing ability within our sample of fund managers. Apparently, the positive contribution from trading provides a primary source of alpha generation, and acts as a counterbalance against the underperformance of their long-term holdings over the period. Establishing this finding, however, depends on the ability to observe the actual trades.

Our results are contrary to those reported by Kacperczyk, Sialm and Zheng (2008), who find the returns gap to be statistically insignificant across the average of all funds. In this regard, our findings are more consistent with the findings of Puckett and Yan (2011), who report positive returns to interim trading. The differences between our findings and those of Kacperczyk, Sialm and Zheng (2008) may be attributable to a number of factors. Whereas Kacperczyk, Sialm and Zheng (2008) use a broad universe of US managers, we only have access to a limited sample of Australian managers. While we believe our funds to be generally representative of the Australian funds management industry (see Figure 1), structural differences between the US and Australian markets may mean that it is easier for Australian managers to exhibit short-term timing skill. Further, we do not observe actual fund returns directly, but rather infer them from daily-rebalanced portfolios. This means that we do not measure the effects of non-stock positions in cash and derivatives. Wermers (2000) shows that non-stock holdings account for up to 0.7% p.a. in returns drag; this likely reflects some of Kacperczyk, Sialm and Zheng’s (2008) return gap, which our study does not capture.

Table 2 also reports the equivalent results on an after-tax basis. We find that tax effects reduce the average alpha for the daily-simulated portfolios by 0.08%, although returns on both the portfolio and the index are higher after-tax than pre-tax largely as a consequence of imputation credits. Compared to the after-tax index benchmark portfolio, actively managed portfolios incur higher CGT while earning very marginally lower imputation credits on their dividends.

The differences in tax drag (the combined impact of CGT, gross income taxes, and imputation credits) between daily-rebalanced and less frequently rebalanced portfolios is economically small (0.02% p.a. or lower) and not statistically significant. This suggests that interim trading itself, on average, is not a strong driver of tax liabilities. The implication is that the additional turnover associated with interim trading does not add to tax liabilities, relative to what is implicit within the index and henceforth an indexed fund. This further suggests that managers are relatively effective at managing tax impacts from their trading activities. This finding disputes the perception that active management generates higher tax impacts through greater turnover: a result that is only accessible through having access to trade and portfolio data in combination.

17 E.g. there is a larger presence of overseas investors, who have different benchmarks to local investors, in the Australian market compared to US markets.
One of the main areas of uncertainty is the impact of the ‘missing trades’ that have been inferred in the holdings reconciliation process. Effectively these ‘missing trades’ are being given the same treatment under the estimates based on both daily simulated and monthly holdings, as in both cases trades are imputed at end-month. To the extent that these unobserved trades might have also contributed to outperformance, our results would further underestimate the performance contributions and tax impacts associated with interim trading. Under the assumption that the missing trades are of similar characteristics to the explicit trades, the understatement could be up to about 50%. Moreover, as the monthly estimates are based entirely on imputed trades without accounting for potential market impact, the difference between the daily and monthly estimates could be further understated. As such, we present our results as a conservative estimate of the effect that interim trading has on fund returns.

5.2 By Fund Style

This section reports on the estimates of contributions from interim trading and related tax effects across different investment styles. Funds of different styles may vary in their investment and trading patterns. Hence, by examining each fund style in isolation, systematic biases within each style may be identified. We separate funds into four self-declared investment styles of Growth, Style Neutral, Value, and Enhanced Passive; and compare the performance of the daily-simulated portfolio with portfolios based on monthly, quarterly and semi-annual holdings snapshots and associated imputed trades. Results are reported in Table 3. The two funds in the ‘Other’ category are excluded from the analysis, as they were the sole representing fund in their respective groups.

Growth funds in our sample are characterized by lower dividend yield, higher turnover, and higher capital gains compared to the passive benchmark. They generate substantial value from their interim trading. The daily simulated portfolios for Growth funds earn additional pre-tax alpha of 0.82% p.a. relative to the monthly rebalanced portfolios, and 1.21% versus the quarterly rebalanced portfolios. The bulk of this additional alpha arises from the capital gains component. The Growth fund pre-tax alpha of 1.93% based on daily-simulated portfolios is highly statistically and economically significant, but greatly reduced when estimated from periodic portfolio snapshots. Growth funds generate after-tax alpha of 1.73%, indicating tax drag of around 0.2% p.a. relative to the after-tax benchmark. This is primarily comprised of higher capital gains tax liabilities and the realization of fewer imputation credits, though these effects are partially offset by lower income tax liabilities relative to the benchmark. While Growth portfolios simulated from less frequently sampled portfolio holdings earn significantly lower alphas than those that are updated daily, we actually do not observe a commensurate drop in marginal tax liabilities. This is in line with the tendency for fund managers in our sample to be relatively tax-efficient in their interim trading.

Style Neutral funds generate statistically insignificant, negative pre-tax alpha of -0.20% p.a. based on their daily-rebalanced portfolios, but underperform by a further -0.68% p.a. when only their monthly holdings are observed. Like Growth funds, Style Neutral funds receive a lower dividend yield, incur higher brokerage and CGT liabilities, receive fewer imputation credits and pay less income tax than the passive benchmark. Style Neutral funds incur a net tax drag of around 0.12% p.a. relative to the after-tax benchmark, which further exacerbates their underperformance. This tax drag is present even in the semi-annually rebalanced portfolios, and hence is likely to be a product of longer-term
rebalancing rather than short-term trading. In the case of Style Neutral funds, having access to only monthly holdings may have led to the erroneous conclusion that Style Neutral funds significantly underperformed, whereas the alpha is statistically insignificant either way under daily rebalancing.

Value funds, in line with their investment paradigm, overweight stocks with high dividend yields. However, excess dividend returns relative to the benchmark are mostly eroded by higher turnover and lower capital gains, leading to pre-tax alphas that are not significantly different from zero. Estimates for Value funds based on quarterly or semi-annual holdings generate significantly negative capital losses, leading to negative pre-tax alphas that are economically significant (and statistically significant at 10% for the semi-annual estimates). Meanwhile, pre-tax alpha based on daily-simulated portfolios is positive but not statistically significant. Again, incorrect inferences could have been made about the skill of Value managers based on periodic portfolio holdings. In contrast to Growth funds, which earn substantial returns through intra-month trading, Value funds trade with less urgency and generate marginal returns through intra-quarter trading. However, unlike other fund types, Value funds do incur some additional tax drag through interim trading. Observed performance of Value funds, based on less frequent portfolio observations, underestimate both capital gains and capital gains taxes relative to daily-rebalanced portfolios.

Like Value funds, Enhanced Passive funds also exhibit a higher dividend yield compared to the benchmark, but give this back through higher turnover and relative capital losses. Consequently, pre-tax alphas for Enhanced Passive funds are nominally negative but mainly insignificantly different from zero. Further, Enhanced Passive funds actually appear to incur lower CGT than the benchmark itself due to their lower capital gains; this results in a nominal performance boost from net tax effects. As a result, while after-tax alphas are also not significantly different from zero, they underperform the benchmark less after-tax. Enhanced Passive funds appear to exhibit some trade timing ability within the month, but this dissipates at longer intervals. Hence, monthly-rebalanced portfolios underperform the daily-rebalanced portfolios, but the difference is not statistically significant when the latter is compared to quarterly- and semi-annually rebalanced portfolios. This suggests that, for at least some funds, the relationship between trading returns and frequency of rebalancing is not monotonic, and hence cannot be reliably inferred by looking at the trend across differing rebalancing intervals.

The use of granular trading data in conjunction with holdings data allows us to examine how funds of different styles utilize trading to generate performance, and to gauge any related tax effects. Growth funds compensate for their lower dividend yield by generating capital gains substantially in excess of the benchmark through interim trading. On the other hand, while Value funds earn dividend yields in excess of the benchmark, they must manage the timing of their trades to avoid deep capital losses relative to the benchmark. High granularity data is crucial for not only identifying these different methods of generating alpha, but also for evaluating their success at implementation. Our results further show that neither Style Neutral nor Enhanced Passive funds generate statistically significant alphas in their daily-rebalanced portfolios. However, Style Neutral funds appear to underperform the benchmark when evaluated on alpha estimates based on monthly portfolio holding snapshots, which may lead to erroneous conclusions regarding their ability.

5.3 By Market State
In this section, we examine the systematic differences in the way funds generate returns across three market states: a “bull” market from the beginning of the sample period (31st July 2006) 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. Identification of market states is straightforward for the particular sample period, which spanned the GFC. Figure 2 plots the S&P/ASX300 price index over the period, with the three states identified. The bull and bear market states contain strongly trending markets; while the recovery state involves an initial rebound from the GFC low, followed by a sideways movement.

Table 4 compares the performance of daily-simulated portfolios against those based on monthly, quarterly, and semi-annual holdings across the three market states. The first theme to emerge is that the sample of funds outperforms the benchmark only in the bear market, generating significant pre-tax alpha of 3.33% p.a. The funds underperform by -1.27% p.a. during the bull market and -0.33% p.a. during the post-GFC recovery state, although only the former is statistically significant. Closer examination reveals that the funds provide superior capital preservation during the bear market, as compared to the benchmark. In contrast, the bull market was characterized by capital gains underperformance (-1.16%) relative to the S&P/ASX300 benchmark. In the recovery phase, fund performance was characterized by marginally higher dividend yield and lower capital gains relative to the benchmark.

Second, comparison of the returns from the daily simulated and periodically rebalanced portfolios reveals that the contributions from interim trading vary noticeably, and are indeed the primary source of alpha variation across the market states. During the bear market, interim trading contributes 0.64% p.a. within the month and 1.46% p.a. within the quarter, virtually all of which can be traced to differences in capital gains (or lower capital losses) relative to the benchmark. This indicates that managers in our sample possess significant trading skill that contributed to capital preservation during the bear market. The trading contribution is not effectively captured in the quarterly estimates. Lesser but still substantial contributions from interim trading are also observed during the bull market, where the daily simulated portfolios outperform the monthly-simulated portfolios by 0.48% p.a. and quarterly-simulated portfolios by 1.18% p.a. In the recovery phase, the contributions from interim trading are modest (0.22% p.a. based on comparison of daily with both the monthly and quarterly estimates). These results imply that trading contributions were greater in the states where markets trended strongly: a finding that is only visible through the benefit of having access to daily trade data.

The third theme is that tax effects are relatively modest and adversely affected by interim trading in bull markets, but not in other market states. In the bull market, increased CGT liabilities appear to be evident in trading within the quarter and semi-annual periods, rather than intra-month trading. In other market states, interim trading generates substantial contributions through capital gains (or lower capital losses) that were not associated with any meaningful increase in CGT. Again, this finding is only visible by virtue of access to both trade and holdings data.

6. Conclusion
We demonstrate the importance of having access to granular trade data in combination with portfolio holdings to identify the sources of alpha generation, and hence the existence of manager skill. Our analysis demonstrates that trading can potentially make a significant contribution to manager performance; and linking this contribution to income and capital gains captured in funds’ periodically reported holdings can only be achieved with access to both holdings and trade data. Further, data on both portfolio holdings and the timing and price of trades is required to correctly evaluate associated tax effects.

Using our illustrative sample of Australian equity managers, we find that the pre-tax contribution from interim on-market trading may be understated if trades are imputed from monthly holdings, and the understatement could increase if quarterly holdings are employed, as is the case for many US studies. The contribution from interim trading explains the bulk of the alpha we observe in our fund sample. Our analysis also illustrates how the availability of both actual trade and holdings data makes it possible to correctly estimate the tax effects that accompany trading activity. While turnover is generally perceived to accelerate the realization of capital gains compared to a taxed ASX300 index portfolio, and hence result in a higher CGT, we find that higher turnover associated with daily rebalancing in our sample did not generate substantial additional tax imposts compared to less frequently rebalanced portfolios. Having access to actual trade data allows us to demonstrate that daily trading itself is not significantly tax-inefficient.

Finally, we show that estimates based on periodic holding snapshots may yield misleading pre- and post-alpha estimates, and may fail to capture differences in value-add through interim trading across style groupings and market states.

Our study has a number of academic and practical implications. We show that the data sets used in much of fund management research may not be very effective at identifying the implications of manager actions, and hence the identification of skill in making a case for or against active funds management. Manager skill can be revealed by the manner in which trades manifest into a portfolio and subsequent performance, but lack of data has hampered the capacity of researchers to observe actual trades and link them to portfolio performance. This problem has been compounded for the many US studies that have only had access to coarse quarterly holding data, which has in turn been used to impute trades. As our analysis demonstrates, imputed net trades may miss a sizeable portion of returns that accrue from interim trading, and hence can significantly underestimate the value proposition presented by active fund managers. Some prior literature has had access to trade-level data, finding that returns from trading may be substantial and can be an important component of manager skill. Our analysis confirms these findings.

However, studies based on transactions data alone may potentially mis-estimate the value that flows on to investors because they cannot reconcile back to the overall portfolio, and are missing the tax drag component. Meanwhile, studies based on reported returns are unable to effectively look inside performance to isolate its sources. Whereas these studies can calculate the difference between pre-tax and after-tax, the contributions from trading and related tax impacts cannot be reliably disentangled without additional data, such as the timing information on the funds’ realization of losses and gains, or the split between the holdings’ income and capital gains returns.

In sum, access to trade and holdings data is required to properly identify the sources of manager performance. Our analysis of a unique dataset of daily trades and monthly holdings allows us to demonstrate the nature and potential magnitude of the challenges. It illustrates the insights that may be uncovered if they can be overcome. Our access to both daily on-market trades and holdings data allows us to show how interim trading and
related tax impacts can be linked to fund performance, with far more precision than is available using either periodic holdings data or trade data in isolation. The ability to observe trading skill and to properly evaluate active and passive investment options after-tax should substantially improve investment outcomes, particularly over the long-term.
References


Figure 1: Sample returns

Average simulated portfolio returns across our data sample are compared to the 125+ funds tracked in the Mercer Portfolio Analytics (MPA) database.
Table 1: Summary statistics for the data sample.
Panel A shows the number of funds that were present in each category in each year, as well as the total net asset value and average number of positions for all funds in each category. Values are taken on June 30th of each year. The “Other” category includes one fund for which the style is unknown, and another that follows a Growth at a Reasonable Price (GARP) style. Panel B shows the total value of purchases and sales for each fund style and year. Turnover is calculated as the lesser of buys and sells divided by mid-year portfolio value. Panel C presents a summary of factor exposures in the different style groups, using a four-factor model based on the method of Carhart (1997). Funds with less than 30 monthly observations are excluded, leaving 19 of the 25 funds remaining. Regression coefficients are then averaged across funds in each of the groups and those averages presented. 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.

### Panel A: Holdings Summary

<table>
<thead>
<tr>
<th>Date</th>
<th>Growth</th>
<th>Style Neutral</th>
<th>Value</th>
<th>Enhanced Passive</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Count</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>$3.74b</td>
<td>$1.71b</td>
<td>$7.46b</td>
<td>$1.76b</td>
<td>$2.85b</td>
</tr>
<tr>
<td></td>
<td>Positions</td>
<td>32</td>
<td>47</td>
<td>58</td>
<td>92</td>
<td>117</td>
</tr>
<tr>
<td>2007</td>
<td>Count</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>$4.15b</td>
<td>$2.19b</td>
<td>$9.24b</td>
<td>$2.26b</td>
<td>$3.56b</td>
</tr>
<tr>
<td></td>
<td>Positions</td>
<td>34</td>
<td>48</td>
<td>59</td>
<td>105</td>
<td>121</td>
</tr>
<tr>
<td>2008</td>
<td>Count</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>$3.49b</td>
<td>$2.13b</td>
<td>$7.35b</td>
<td>$2.16b</td>
<td>$4.61b</td>
</tr>
<tr>
<td></td>
<td>Positions</td>
<td>34</td>
<td>42</td>
<td>57</td>
<td>123</td>
<td>101</td>
</tr>
<tr>
<td>2009</td>
<td>Count</td>
<td>6</td>
<td>4</td>
<td>9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>$3.16b</td>
<td>$2.25b</td>
<td>$6.36b</td>
<td>$1.63b</td>
<td>$4.16b</td>
</tr>
<tr>
<td></td>
<td>Positions</td>
<td>34</td>
<td>39</td>
<td>60</td>
<td>133</td>
<td>89</td>
</tr>
<tr>
<td>2010</td>
<td>Count</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>$3.87b</td>
<td>$1.96b</td>
<td>$7.63b</td>
<td>$1.45b</td>
<td>$4.37b</td>
</tr>
<tr>
<td></td>
<td>Positions</td>
<td>33</td>
<td>42</td>
<td>61</td>
<td>156</td>
<td>90</td>
</tr>
</tbody>
</table>
## Panel B: Trades Summary

<table>
<thead>
<tr>
<th></th>
<th>2006***</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Growth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy</td>
<td>$3.36b</td>
<td>$3.09b</td>
<td>$3.64b</td>
<td>$2.82b</td>
<td>$3.18b</td>
</tr>
<tr>
<td>Sell</td>
<td>$3.16b</td>
<td>$3.48b</td>
<td>$3.21b</td>
<td>$2.83b</td>
<td>$2.54b</td>
</tr>
<tr>
<td>Turnover</td>
<td>84.58%</td>
<td>74.62%</td>
<td>92.00%</td>
<td>89.16%</td>
<td>65.57%</td>
</tr>
<tr>
<td><strong>Style Neutral</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy</td>
<td>$1.34b</td>
<td>$2.14b</td>
<td>$2.84b</td>
<td>$2.10b</td>
<td>$1.24b</td>
</tr>
<tr>
<td>Sell</td>
<td>$1.1b</td>
<td>$1.83b</td>
<td>$2.18b</td>
<td>$1.98b</td>
<td>$1.13b</td>
</tr>
<tr>
<td>Turnover</td>
<td>64.44%</td>
<td>83.33%</td>
<td>102.46%</td>
<td>88.01%</td>
<td>57.49%</td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy</td>
<td>$3.7b</td>
<td>$5.25b</td>
<td>$6.21b</td>
<td>$4.64b</td>
<td>$4.06b</td>
</tr>
<tr>
<td>Sell</td>
<td>$3.84b</td>
<td>$4.39b</td>
<td>$5.77b</td>
<td>$4.19b</td>
<td>$3.89b</td>
</tr>
<tr>
<td>Turnover</td>
<td>49.68%</td>
<td>47.56%</td>
<td>78.59%</td>
<td>65.88%</td>
<td>50.99%</td>
</tr>
<tr>
<td><strong>Enhanced Passive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy</td>
<td>$1.28b</td>
<td>$1.50b</td>
<td>$1.62b</td>
<td>$1.26b</td>
<td>$0.86b</td>
</tr>
<tr>
<td>Sell</td>
<td>$1.16b</td>
<td>$1.36b</td>
<td>$1.50b</td>
<td>$1.22b</td>
<td>$0.75b</td>
</tr>
<tr>
<td>Turnover</td>
<td>65.64%</td>
<td>60.12%</td>
<td>69.31%</td>
<td>74.76%</td>
<td>51.88%</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy</td>
<td>$0.56b</td>
<td>$0.78b</td>
<td>$3.20b</td>
<td>$1.23b</td>
<td>$1.04b</td>
</tr>
<tr>
<td>Sell</td>
<td>$0.30b</td>
<td>$0.36b</td>
<td>$0.83b</td>
<td>$1.65b</td>
<td>$0.79b</td>
</tr>
<tr>
<td>Turnover</td>
<td>10.46%</td>
<td>9.98%</td>
<td>17.98%</td>
<td>29.58%</td>
<td>18.03%</td>
</tr>
</tbody>
</table>

## Panel C: Factor Exposures

<table>
<thead>
<tr>
<th></th>
<th>Alpha (Annualized)</th>
<th>Market</th>
<th>SmB</th>
<th>HmL</th>
<th>Prlyr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Growth</strong></td>
<td>0.0304***</td>
<td>1.0233***</td>
<td>-0.1118***</td>
<td>-0.0681***</td>
<td>-0.0402***</td>
</tr>
<tr>
<td><strong>Style Neutral</strong></td>
<td>0.0541***</td>
<td>1.0037***</td>
<td>-0.1337***</td>
<td>-0.1098***</td>
<td>-0.0410***</td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td>0.0206***</td>
<td>0.9937***</td>
<td>-0.0725***</td>
<td>0.0785***</td>
<td>-0.0594***</td>
</tr>
<tr>
<td><strong>Enhanced Passive</strong></td>
<td>0.0181***</td>
<td>0.9878***</td>
<td>-0.0550***</td>
<td>-0.0522**</td>
<td>0.0160</td>
</tr>
</tbody>
</table>

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

---

**Note:** Reported trade value and turnover in 2006 since is based on the last 6 months of trade data in the year and doubled to aid comparison to later years.
Table 2: Returns and taxes on simulated portfolios

Portfolio returns are simulated on a pre-tax and after-tax basis for both funds in the sample, and for a simulated S&P/ASX300 benchmark. ‘Daily’ estimates are based on daily reported net trades, along with reconciliation back to reported holdings at month-end, with inferred trades implemented where differences exist. Other estimates are based on periodic portfolio holding snapshots, with Monthly assuming transactions occur on the first trading day of each month; Quarterly assuming transactions occur on the first trading day January, April, July and October; and Semi-Annual assuming transactions occur on the first trading day of January and July. Panel A reports the return of the benchmark and fund excess returns relative to the benchmark. Panel B reports the opportunity cost of rebalancing at monthly, quarterly and semi-annual intervals compared to daily rebalancing. Commissions are calculated based on a static brokerage rate equal to 0.15% of transacted value. Tax rates are assumed to be 15% on short-term capital gains and income, and 10% on long-term capital gains. A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Results are presented as annualized percentages of net equity value in the fund. Dividends and tax effects are calculated as arithmetic averages since these do not compound over multiple periods. Returns are calculated as geometric averages.

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.

### Panel A: Benchmark returns and simulated portfolio alphas

<table>
<thead>
<tr>
<th></th>
<th>Dividends</th>
<th>Commissions</th>
<th>Capital Gains</th>
<th>Pre-Tax Return</th>
<th>Income Tax</th>
<th>Imputation Credits</th>
<th>CGT</th>
<th>Total Tax Effect</th>
<th>After-Tax Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmark Daily</td>
<td>4.32%</td>
<td>-0.12%</td>
<td>-1.35%</td>
<td>2.84%</td>
<td>-0.85%</td>
<td>1.48%</td>
<td>-0.18%</td>
<td>0.44%</td>
<td>3.28%</td>
</tr>
<tr>
<td>Benchmark Monthly</td>
<td>0.08%</td>
<td>-0.11%</td>
<td>0.53%</td>
<td>0.50%</td>
<td>-0.01%</td>
<td>-0.02%</td>
<td>-0.05%</td>
<td>-0.08%</td>
<td>0.42%</td>
</tr>
<tr>
<td>Benchmark Quarterly</td>
<td>0.10%</td>
<td>-0.08%</td>
<td>0.08%</td>
<td>0.10%</td>
<td>-0.01%</td>
<td>-0.01%</td>
<td>-0.05%</td>
<td>-0.07%</td>
<td>0.02%</td>
</tr>
<tr>
<td>Benchmark Semi-Annual</td>
<td>0.11%</td>
<td>-0.03%</td>
<td>-0.40%</td>
<td>-0.32%</td>
<td>-0.02%</td>
<td>0.01%</td>
<td>-0.05%</td>
<td>-0.06%</td>
<td>-0.38%</td>
</tr>
</tbody>
</table>

### Panel B: Excess returns of periodically rebalanced portfolios relative to daily rebalanced portfolios

<table>
<thead>
<tr>
<th></th>
<th>Dividends</th>
<th>Commissions</th>
<th>Capital Gains</th>
<th>Pre-Tax Alpha</th>
<th>Income Tax</th>
<th>Imputation Credits</th>
<th>CGT</th>
<th>Total Tax Effect</th>
<th>After-Tax Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>0.01%***</td>
<td>0.03%***</td>
<td>-0.45%***</td>
<td>-0.41%***</td>
<td>0.00%***</td>
<td>0.01%***</td>
<td>0.00%</td>
<td>0.01%***</td>
<td>-0.40%***</td>
</tr>
<tr>
<td>Quarterly</td>
<td>0.03%*</td>
<td>0.08%***</td>
<td>-0.93%***</td>
<td>-0.83%***</td>
<td>0.01%***</td>
<td>0.03%***</td>
<td>0.00%</td>
<td>0.02%***</td>
<td>-0.81%***</td>
</tr>
<tr>
<td>Semi-Annual</td>
<td>0.02%</td>
<td>0.11%***</td>
<td>-1.06%***</td>
<td>-0.92%***</td>
<td>-0.01%**</td>
<td>0.03%***</td>
<td>0.00%</td>
<td>0.02%***</td>
<td>-0.90%***</td>
</tr>
</tbody>
</table>

*** 1% significance; ** 5% significance; * 10% significance
Table 3: Contributions relative to benchmark by investment style

Average contributions relative to a simulated S&P/ASX300 benchmark are reported for funds within four self-declared investment style categories of Growth, Style Neutral, Value, and Enhanced Passive. ‘Daily’ estimates are based on daily reported net trades, along with reconciliation back to reported holdings at month-end, with inferred trades implemented where differences exist. Other estimates are based on periodic portfolio holding snapshots, with Monthly assuming transactions occur on the first trading day of each month; Quarterly assuming transactions occur on the first trading day January, April, July and October; and Semi-Annual assuming transactions occur on the first trading day of January and July. Panel A reports fund excess returns relative to the benchmark. Panel B reports the opportunity cost of rebalancing at monthly, quarterly and semi-annual intervals compared to daily rebalancing. Brokerage and tax rates are as described in the text.

Panel A: Simulated fund alphas

<table>
<thead>
<tr>
<th>Dividends</th>
<th>Commissions</th>
<th>Capital Gains</th>
<th>Pre-Tax Alpha</th>
<th>Income Tax</th>
<th>Imputation</th>
<th>CGT</th>
<th>Total Tax Effect</th>
<th>After Tax Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth</td>
<td>-0.47***</td>
<td>-0.16***</td>
<td>2.56***</td>
<td>1.93***</td>
<td>0.09***</td>
<td>-0.15***</td>
<td>-0.14***</td>
<td>-0.20***</td>
</tr>
<tr>
<td>Style Neutral</td>
<td>-0.24***</td>
<td>-0.15***</td>
<td>0.19%</td>
<td>-0.20%</td>
<td>0.05***</td>
<td>-0.12***</td>
<td>-0.05***</td>
<td>-0.12***</td>
</tr>
<tr>
<td>Value</td>
<td>0.53***</td>
<td>-0.09***</td>
<td>-0.17%</td>
<td>0.27%</td>
<td>-0.10***</td>
<td>0.10***</td>
<td>-0.08***</td>
<td>-0.07***</td>
</tr>
<tr>
<td>Enhanced Passive</td>
<td>0.23***</td>
<td>-0.09***</td>
<td>-0.32%</td>
<td>-0.17%</td>
<td>-0.04***</td>
<td>0.01%***</td>
<td>0.10***</td>
<td>0.08***</td>
</tr>
</tbody>
</table>

Panel B: Excess returns of periodically rebalanced portfolios relative to daily rebalanced portfolios

<table>
<thead>
<tr>
<th>Dividends</th>
<th>Commissions</th>
<th>Capital Gains</th>
<th>Pre-Tax Alpha</th>
<th>Income Tax</th>
<th>Imputation</th>
<th>CGT</th>
<th>Total Tax Effect</th>
<th>After Tax Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly</td>
<td>0.05***</td>
<td>0.04***</td>
<td>-0.84***</td>
<td>-0.75***</td>
<td>-0.01***</td>
<td>0.02***</td>
<td>0.01%</td>
<td>0.02%**</td>
</tr>
<tr>
<td>Quarterly</td>
<td>0.07***</td>
<td>0.08***</td>
<td>-1.29***</td>
<td>-1.13***</td>
<td>-0.02***</td>
<td>0.04***</td>
<td>-0.04%</td>
<td>-0.01%</td>
</tr>
<tr>
<td>Semi-Annual</td>
<td>0.08***</td>
<td>0.12***</td>
<td>-1.36***</td>
<td>-1.15***</td>
<td>-0.02***</td>
<td>0.04***</td>
<td>-0.03%</td>
<td>-0.01%</td>
</tr>
<tr>
<td>Style Neutral Funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly</td>
<td>0.03***</td>
<td>0.04***</td>
<td>-0.75***</td>
<td>-0.68***</td>
<td>-0.01***</td>
<td>0.02***</td>
<td>0.00%</td>
<td>0.01%**</td>
</tr>
<tr>
<td>Quarterly</td>
<td>0.06***</td>
<td>0.10***</td>
<td>-0.42***</td>
<td>-0.26%</td>
<td>-0.02***</td>
<td>0.05***</td>
<td>-0.03%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Semi-Annual</td>
<td>0.08***</td>
<td>0.15***</td>
<td>-0.33%</td>
<td>-0.10%</td>
<td>-0.02***</td>
<td>0.05***</td>
<td>-0.02%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly</td>
<td>0.01%**</td>
<td>0.03***</td>
<td>-0.35***</td>
<td>-0.31%</td>
<td>0.00%***</td>
<td>0.01%**</td>
<td>0.00%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Quarterly</td>
<td>0.02%</td>
<td>0.07***</td>
<td>-1.32***</td>
<td>-1.23%</td>
<td>-0.01%***</td>
<td>0.03%***</td>
<td>0.04%</td>
<td>0.06%**</td>
</tr>
<tr>
<td>Semi-Annual</td>
<td>0.03%</td>
<td>0.11***</td>
<td>-1.66***</td>
<td>-1.53%</td>
<td>-0.01%**</td>
<td>0.03%***</td>
<td>0.04%</td>
<td>0.06%*</td>
</tr>
<tr>
<td>Enhanced Passive Funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly</td>
<td>-0.05***</td>
<td>0.03***</td>
<td>-0.11%</td>
<td>-0.12%</td>
<td>0.01%***</td>
<td>-0.01%***</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Quarterly</td>
<td>-0.07***</td>
<td>0.08***</td>
<td>-0.10%</td>
<td>-0.09%</td>
<td>0.01%***</td>
<td>0.00%</td>
<td>-0.01%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Semi-Annual</td>
<td>-0.08***</td>
<td>0.12%***</td>
<td>0.08%</td>
<td>0.11%</td>
<td>0.01%***</td>
<td>0.00%</td>
<td>-0.02%</td>
<td>-0.01%</td>
</tr>
</tbody>
</table>

*** 1% significance; ** 5% significance; * 10% significance
Figure 2: Market states based on the S&P/ASX300 price index
Table 4: Contributions relative to benchmark across market states

Average contributions relative to a simulated S&P/ASX300 benchmark are reported for bull, bear and recovery market states. We define the bull market as between 31st July 2006 to 31st October 2007, the bear market as between 1st November 2007 to 28th February 2009, and the recovery market as between 1st March 2009 to 31st December 2010 (refer Figure 2). Results are based on observations per month and per fund, aggregated across all fund types. ‘Daily’ estimates are based on daily reported net trades, along with reconciliation back to reported holdings at month-end, with inferred trades implemented where differences exist. Other estimates are based on periodic portfolio holding snapshots, with Monthly assuming transactions occur on the first trading day of each month; Quarterly assuming transactions occur on the first trading day January, April, July and October; and Semi-Annual assuming transactions occur on the first trading day of January and July. Panel A reports the return of the benchmark and fund excess returns relative to the benchmark. Panel B reports the opportunity cost of rebalancing at monthly, quarterly and semi-annual intervals compared to daily rebalancing. Brokerage and tax rates are as described in the text. A company tax rate of 30% is assumed for the purpose of calculating imputation credits. Results are presented as annualized percentages of net equity value in the fund. Dividends and tax effects are calculated as arithmetic averages since these do not compound over multiple periods. Returns are calculated as geometric averages. 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.

**Panel A: Simulated fund alphas**

<table>
<thead>
<tr>
<th></th>
<th>Dividends</th>
<th>Commissions</th>
<th>Capital Gains</th>
<th>Pre-Tax Alpha</th>
<th>Income Tax</th>
<th>Imputation</th>
<th>CGT</th>
<th>Total Tax Effect</th>
<th>After Tax Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bull Market</strong></td>
<td>-0.01%***</td>
<td>-0.10%***</td>
<td>-1.16%***</td>
<td>-1.27%***</td>
<td>0.00%***</td>
<td>-0.01%***</td>
<td>-0.06%***</td>
<td>-0.07%***</td>
<td>-1.34%***</td>
</tr>
<tr>
<td><strong>Bear Market</strong></td>
<td>-0.01%</td>
<td>0.03%***</td>
<td>-0.48%***</td>
<td>-0.46%***</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.01%</td>
<td>-0.45%***</td>
</tr>
<tr>
<td><strong>Recovery Market</strong></td>
<td>-0.02%*</td>
<td>0.07%***</td>
<td>-1.18%***</td>
<td>-1.13%***</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.06%</td>
<td>0.07%*</td>
<td>-1.06%***</td>
</tr>
</tbody>
</table>

**Panel B: Excess returns of periodically rebalanced portfolios relative to daily rebalanced portfolios**

<table>
<thead>
<tr>
<th></th>
<th>Dividends</th>
<th>Commissions</th>
<th>Capital Gains</th>
<th>Pre-Tax Alpha</th>
<th>Income Tax</th>
<th>Imputation</th>
<th>CGT</th>
<th>Total Tax Effect</th>
<th>After Tax Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bull Market</strong></td>
<td>-0.01%</td>
<td>0.03%***</td>
<td>-0.48%***</td>
<td>-0.46%***</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.01%</td>
<td>-0.45%***</td>
</tr>
<tr>
<td><strong>Bear Market</strong></td>
<td>-0.02%*</td>
<td>0.07%***</td>
<td>-1.18%***</td>
<td>-1.13%***</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.06%</td>
<td>0.07%*</td>
<td>-1.06%***</td>
</tr>
<tr>
<td><strong>Recovery Market</strong></td>
<td>-0.01%</td>
<td>0.11%***</td>
<td>-1.50%***</td>
<td>-1.39%***</td>
<td>0.00%</td>
<td>0.01%*</td>
<td>0.14%***</td>
<td>0.15%***</td>
<td>-1.25%***</td>
</tr>
</tbody>
</table>

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