Mutual Fund Investment Strategies, Styles and Performance

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BBus (Hons)

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Summary

The overall aim of this thesis is to investigate a variety of investment strategies and styles which mutual funds may employ, and the performance outcomes derived from implementation of such processes. It provides information relevant to institutional investors, advisors and market participants. The key information sources used for this research are secondary data providers, the academic literature, and academic and industry professionals. The purpose of this thesis is to provide information to guide decision-makers when constructing active equity portfolios by determining evidence as to the profitability of various investment approaches in Australia, the United States and globally. Motivation for this thesis is derived from the ongoing active versus passive management debate and the fact that the mutual fund industry is substantial in terms of the value of assets under management. Furthermore, all four research essays comprised within this thesis are driven by the desire to contribute to the academic literature. In particular, this thesis comprises original research which contributes to the literature on quality investing, style timing and global equity funds.

The first study "Portfolio Quality and Mutual Fund Performance" shows that US stocks and funds characterised by higher 'quality' provide downside protection during market downturns, although they do not generate outperformance on average. My second study "Quality Investing in an Australian Context" is an Australian application of the quality analysis, which shows that, in contrast to the US research, high quality stocks and funds outperform on average as well as during stressful market periods. In the third study, "Style Factor Timing: An Application to the Portfolio Holdings of US Fund Managers", I show that a style timing investment strategy using forecasts based on macroeconomic data is profitable at the stock level, however not at the mutual fund-of-fund level. Finally, in the fourth study, "Global Equity Fund Performance", a market-adjusted performance attribution shows that active global equity funds exhibit stock selection skill on average, whilst country selection ability is primarily found in emerging market regions. Furthermore, after controlling for size, book-to-market and momentum effects, the funds do not generate excess returns on average; however evidence of performance persistence is determined. Finally, some evidence that managers who are more style consistent outperform, is detected.

Statement of Candidate

I certify that the work in this thesis entitled "Mutual Fund Investment Strategies, Styles and Performance" has not been previously submitted for a degree, nor has it been submitted as part of the requirements for a degree to any university or institution other than Macquarie University.

I also certify that the thesis is an original piece of research and it has been written by me. Any help and assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis.

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Camille Schmidt (Student ID: 40524205)

31st January 2014

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I commenced my PhD at the University of Technology, Sydney (UTS). Whilst at UTS, Professor Terry Walter, who at the time was in the Finance Discipline Group at the UTS Business School, was my co-supervisor. I am very appreciative of Terry's wisdom, insightful suggestions and attention to detail when responding to my countless questions, and of his feedback on my work.

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Dedication

This thesis is dedicated to my mother, Clare, and to my father, Boyne, who are the most supportive, caring and generous parents any child could wish for.

Chapter 1: Introduction

"Outside of a dog, a book is man's best friend. Inside of a dog it's too dark to read"

Groucho Marx

1. Objectives of the Thesis

This thesis comprises four essays which are all related to a common theme— mutual fund investment strategies, styles and performance evaluation. Essentially, the effectiveness of key investment strategies/styles is empirically examined and all chapters focus on evaluation of performance in relation to either the specific strategy under review and/or in general. The analysis in each research study is undertaken using stock holdings data for the United States, Australian or global equity fund managers. Consideration of these three different segments of equity investment management in one thesis is unique, particularly the consideration of global equities.

Furthermore, all research in this thesis pertains to long-only active equity funds as these represent the majority of the market for equity investment strategies. Active managers build and maintain a portfolio of stocks which are selected following analytical research conducted in order to identify stocks which are over- or under-valued. The belief that stock prices deviate from their fair value is at odds with the Efficient Market Hypothesis, which emphasises that it is not possible to identify mispriced stocks, as stock market efficiency causes existing share prices to always incorporate and reflect all relevant information. Essentially, active managers seek to exceed the returns to a passive benchmark index, based on their judgement of opportunities to generate superior performance. A long-only manager invests only by purchasing stocks which are suitable for the portfolio, thus no short positions are taken in stocks which are considered to be unfavourable. Hence the investment strategies/styles analysed in this thesis focus on capturing the upside or mitigating losses on the downside.

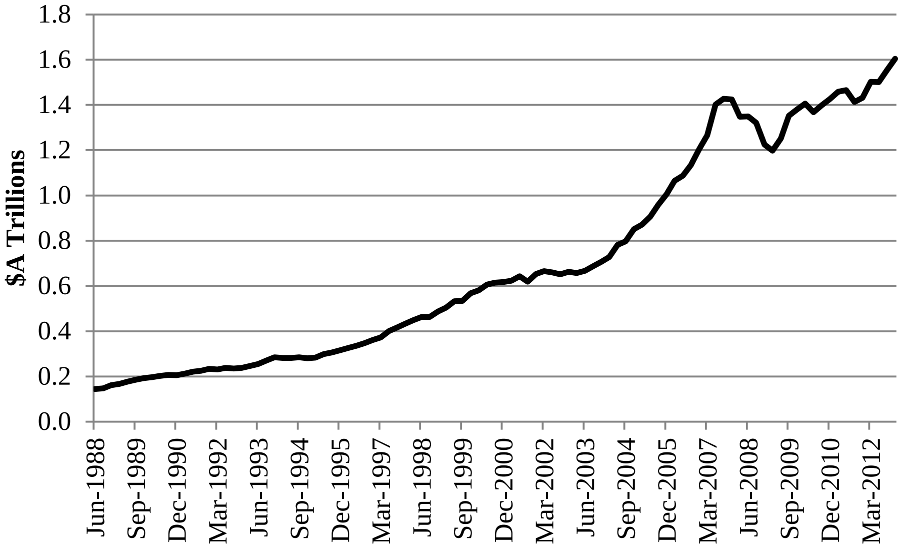
All essays present the empirical results of original research which adds to knowledge in the literature. The research topics for each chapter have been carefully selected to ensure that the area of investigation contributes to scholarship. Thus, the primary objective of this thesis is to add to knowledge that extends the mutual fund literature. This is achieved by undertaking performance evaluation studies on mutual fund investment styles/strategies where gaps in the literature have been identified.

2. Motivation for the Thesis

Motivation for the research undertaken in this thesis is derived from a number of areas. Firstly, the worldwide mutual fund industry is dominated by the United States which accounts for 49% of the $26.8 trillion in mutual fund assets worldwide, as at December 2012 (Investment Company Institute (ICI), 2013). Furthermore, 33% of total US mutual fund assets are invested in domestic equity funds. Given the sheer magnitude of the value of equity assets managed by US equity funds, it is important to ensure that the activities of these funds are continually evaluated and monitored, particularly since US households rely on mutual funds to meet their long-term personal financial objectives including preparation for retirement (ICI, 2013).

In addition, the funds management industry in Australia is unique, as superannuation contributions are compulsory and withdrawals are only allowed upon retirement. Therefore, there is a consistent source of assets over time, as demonstrated by the growth in consolidated assets of managed funds shown in Figure 1 on the next page. The consolidated assets of Australian managed fund institutions as at December 2012 were $1.6 trillion. Furthermore, Australian Shares is the asset class that accounts for the greatest proportion of investment, with a 29% allocation (Australian Bureau of Statistics (ABS), 2012). Thus, examination of the strategies and performance of equity mutual funds is essential for our understanding of the funds management industry in Australia.

Figure 1: Consolidated Assets of Managed Funds in Australia 1988-2012



Source: ABS, Managed Funds, Australia, 56550.0 *December 2012*

Global equity funds invest in both domestic stocks and stocks listed internationally. Morgan Stanley Capital International (MSCI) (2012) indicates that a new paradigm has developed characterised by a decreasing degree of home bias and increasing allocations to global equity by institutional investors. In relation to mutual funds in the US, initial funding of global equity mandates increased from 6% in 2000 to 38% of all global and international equity funding in 2009 (Kang, Nielsen and Fachinotti, 2010). The ICI (2013) states that funds in the US which primarily invest in non-US equity account for 12% of the mutual fund assets worldwide as at December 2012. Thus, given the considerable assets under management for US funds focused primarily on non-US equity, it follows that, funds around the world investing in both domestic and international equity are an important and sizeable portion of the industry. Overall, the mutual fund industry is a significant component of the economy, and analysis of funds within the US, Australia and those investing globally is vital.

The ever-growing active versus passive management debate provides further motivation for this thesis. In essence, if active equity mutual funds do not generate outperformance, then migration to passive investments is justified. However, if there are certain investment strategies or styles which managers can employ to generate superior performance, then it is important that these areas be researched in order to understand the various tenets of active investing. Hence, this thesis seeks to provide analysis on the investment style known as ‘quality’ and a style timing investment strategy, given that these have been popularised in recent years. However, academic mutual fund research in these areas is lacking. Furthermore, to my knowledge, whether active global equity mutual funds generate outperformance has not been investigated academically. Given the trend to allocate increasing values of assets to global equities, it is imperative that the capacity of global equity funds to add value be scrutinised.

More specifically, each chapter of this thesis is motivated by a variety of factors, with the common motivating issue being a dearth of literature in the relevant field. The first essay, which investigates quality in the US, is the first piece of research to examine how the quality of stock holdings relates to fund performance. Similarly, the second essay, which extends the quality analysis to Australia, provides a clear contribution, as there is no research in Australia which explicitly measures stock quality and examines an investment strategy based on stock quality. Again, the research encompasses stock holdings analysis of mutual funds. The third essay on style timing is the first study which investigates whether a style timing strategy may be exploited at the fund-of-fund level[1]. Finally, the fourth essay provides analysis of various aspects of global equity fund performance (e.g. stock selection, persistence and style drift) in order to address the significant gap in the global equity fund performance literature. The motivating forces specific to each paper are discussed further in the upcoming section— Structure and Contents of this Thesis— and in their respective chapters.

3. The Importance of Investment Strategy/Style in Performance Evaluation

Fundamentally, a fund's investment strategy is a reflection of its features such as investment objectives and risk tolerance as set out in its mandate. The investment style and buy/sell guidelines are components of the investment strategy. Thus, the investment style followed is a reflection of the fund's features and is directly linked to the fund's final returns. Essentially, the total return of a mutual fund can be decomposed into style bias, stock selection and timing skill. Previous research emphasises that the key contributor to mutual fund performance is the style that a manager follows (Daniel et al., 1997). Furthermore, in order to measure the performance of a mutual fund, it is essential to determine the universe against which the fund should be compared, based on the characteristics of its stock holdings. The investment universes with which a fund's holdings may be associated indicate the fund's style. Moreover, the development of style-specific benchmark indices by providers such as Standard and Poor's (S&P) and MSCI emphasises the role that investment style plays in performance

[1] A fund-of-funds is a fund which invests in mutual funds.

evaluation. In a similar vein, the commonly employed multi-factor models of Fama and French (1993) and Carhart (1997) attribute fund performance to portfolios of stocks designed to exhibit a range of styles e.g. value, size and momentum. Furthermore, the type of strategy employed is also of critical importance to the performance outcome. For example, whether a strategy focuses on one style, or whether a strategy rotates between a range of investment styles, will ultimately affect the total fund's return.

4. Structure and Contents of the Thesis

This section discusses how the remainder of this thesis is structured. Please note that a review of the relevant extant literature is provided within each individual chapter.

Chapter two contains the first of two studies which are on the subject of the investment style, denoted as 'quality'. The first study investigates quality investing using a sample of US mutual funds. Quality is defined following Sloan (1996) as the persistence and predictability of earnings. Quality is measured using a Q-Score which is the composite of 14 accounting metrics across four categories: profitability, operating efficiency, variability and financial health. The Q-Score developed increases the proportion of future earnings and stock returns that is explainable relative to existing stock quality measures i.e., Piotroski's (2000) F-Score and Mohanram's (2005) G-Score. Thus, this paper contributes to the literature by developing a quality score which is suitable for the universe of stocks, as the F-Score and G-Score are specific to value and growth stocks, respectively. Furthermore, this paper contributes to the mutual fund literature by establishing how the quality of the stocks held by fund managers relates to alpha. Prior work in this area is limited to Ali et al. (2008), which ties the earnings quality literature to the mutual fund literature by testing whether funds trade on the accruals anomaly. However, this paper only considers one aspect of quality, i.e., accruals. A further contribution of this paper is the univariate analysis of each of the 14 accounting metrics included in the Q-Score, using the methodology developed by Ali et al. (2008). Overall, an asymmetric relationship between quality and stock/fund returns is determined, as low quality stocks/funds underperform significantly, whilst high quality stocks/funds do not generate outperformance. A further contribution of this paper is the provision of evidence of the flight-to-quality phenomenon for equities. In summary, this paper contributes extensively to the mutual fund literature relating to earnings quality, and provides the first empirical evidence evaluating portfolio quality and fund performance.

Chapter three presents the second paper which extends the examination of quality investing to the Australian market. This study develops a Q-Score, which is the aggregate of eight of the 14 accounting variables used in the US, deemed to be suitable for Australian stocks. This paper is theoretically similar to the US study; however there are notable differences and extensions such as analysis of the stock quality strategy across size categories. There is a limited body of work pertaining to financial statement analysis and the use of accounting ratios in Australia. Notably, the literature investigates individual metrics associated with anomalies such as Return-on-Assets (ROA), asset growth, accruals, leverage and liquidity effects (Bettman, Kosev and Sault, 2011; Clinch et al., 2012; Dou, Gallagher and Schneider, 2012; Gharghori Lee and Veeraraghavan, 2009; Taylor and Wong, 2012). However, there is no empirical evidence which explicitly examines the viability of a stock quality investment strategy using a composite measure. Such an investigation is particularly important given that key industry participants use analytical software to decompose fund portfolios along style dimensions such as quality. However, there is no academic research which confirms the nature of the performance relationship. Moreover, given market trends such as Australia's ageing population and declining interest rates, it is timely to investigate the role that quality strategies could play, particularly in the provision of post-retirement products. Furthermore, the equity mutual fund literature has not explored whether mutual funds hold quality stocks and whether quality stocks are related to fund performance. Interestingly, the Australian results contrast to the US results as a symmetric relationship between stock quality and performance is identified, i.e., low (high) quality stocks under (out)-perform. Evidence of downside protection is also found, particularly during the tech-crash. In addition, weak evidence that high quality funds outperform is determined.

Chapter four contains the third essay that focuses on style timing using market and macroeconomic data to generate forecasts of style factor returns. There is a limited body of literature which focuses on timing different investment styles at the stock level using macroeconomic data (e.g. Kao and Shumaker, 1999; Levis and Liodakis, 1999 and Bird and Casavecchia, 2011). Importantly, this is the first academic paper which investigates whether a style timing strategy at the fund-of-fund level is viable. Furthermore, the style factors considered are extended beyond the ubiquitous size, value and momentum factors. Such an extension is warranted given that factors indicative of quality and low volatility have been shown to be systematically related to stock returns in recent years (e.g. Gallagher et al., 2013; Clarke, De Silva and Thorley, 2010). Thus, a comprehensive analysis of a timing strategy which considers an extensive list of style factors is a key contribution in itself. It is determined that a style rotation strategy based on size, value, momentum and return-on-equity is profitable at the stock level. However, the excess returns generated do not translate to the fund-of-fund level, primarily, because the long-only funds are by nature unable to fully exploit the long-short style factor returns. This analysis highlights the key role that factor construction plays in the return outcome, and questions the appropriateness of the use of long-short style factors in performance evaluation models.

Chapter five provides the fourth and final essay which undertakes an evaluation of global equity fund performance. Specifically, a unique dataset of stock holdings for 157 long-only active equity funds is used which allows a range of aspects of performance to be analysed. This is a significant contribution to the literature as such granular data is rarely accessible. Furthermore, given that global equity allocations are a significant portion of the US mutual fund market, which have also been increasing in recent years (Kang et al., 2010; Balkema, 2010), it is imperative that an in-depth analysis of performance is undertaken. Moreover, there is only a handful of papers which examine the performance of global or international equity funds (e.g. Gallagher and Jarnecic, 2004; Huij and Derwall, 2011). A market-adjusted performance attribution reveals that global equity funds exhibit stock selection skill on average, whilst country selection ability is predominantly found in emerging market regions. A further contribution of this paper is the construction of a set of global Daniel, Grinblatt, Titman and Wermers (DGTW) (1997)-inspired characteristic-matched benchmark portfolios. On a DGTW-adjusted basis the funds do not generate statistically significant outperformance on average, whilst substantial DGTW-adjusted performance is detected in emerging market regions. However, evidence that unadjusted and DGTW-adjusted performance is persistent is determined. Finally, the construction of the global DGTW benchmarks enables style drift analyses to be undertaken and these show some evidence that style consistent managers outperform managers that drift. Overall, this paper contributes significantly to the academic literature and provides a foundation of information from which future research directions may be identified.

Chapter six contains the conclusion, which provides closing remarks which summarise the findings of the four research essays, their limitations, and future research directions evolving from this body of work.

5. Publications Arising from this Thesis

The following publications have arisen from this thesis:

1. "Portfolio Quality and Mutual Fund Performance", Working Paper, Round 3 revisions submitted to the *International Review of Finance* (A-rated).
2. "Quality Investing in an Australian Context", forthcoming in the *Australian Journal of Management* (A-rated).
3. "Style Factor Timing: an Application to the Portfolio Holdings of US Fund Managers", forthcoming in the *Australian Journal of Management* (A-rated).
4. "Global Equity Fund Performance", Working Paper.

My co-authors for the first and second papers are Professor David Gallagher, Dr Peter Gardner and Professor Terry Walter. The third paper is co-authored with Professor David Gallagher and Dr Peter Gardner and the fourth paper is a collaboration with Professor David Gallagher, Graham Harman and Dr Geoffrey Warren. My co-authors provided feedback on topic ideas and direction, research design and interpretation of results, as well as assisted with editing. However, ultimately, the four papers are the result of my own original research which involved substantial time and effort to produce.

The academic contribution of the research conducted in this thesis is emphasised by the aforementioned acceptances (items 2 and 3 above, which are based on chapters three and four) in publications which are peer reviewed. A third round of revisions has been submitted for the paper mentioned in item 1 (chapter two), with the referee indicating that acceptance would be recommended upon their satisfactory completion. A fourth paper based on chapter five of this thesis is to be submitted in the future.

6. Summary

This thesis presents four research essays which investigate active equity mutual fund investment strategies and styles with a focus on performance. The motivation for the research is the vast size of the mutual fund industry within all three markets analysed. Furthermore, the active versus passive management debate spurs the need for examination of active equity strategies. Essentially, this thesis aims to broaden our understanding of key mutual fund investment strategies and styles by undertaking original research on topics for which there is a paucity of academic literature. The first two papers focus on quality investing, the third on style timing and the fourth on global equity. In summary, this chapter articulated the objectives of this thesis, the motivation for the research, the structure and contents of this dissertation and the publications which have arisen from this body of work.

Chapter 2: Portfolio Quality and Mutual Fund Performance

1. Introduction

Considerable research has been undertaken examining mutual fund performance, including the components of returns, the characteristics and strategies adopted by mutual fund managers, and attributes of portfolio design. This research has become possible due to the availability of quarterly portfolio holdings data that enable researchers to better detect the sources of alpha generated by fund managers. Given the recent market volatility associated with the Global Financial Crisis (GFC), the market has paid increasing attention to the quality of assets managed by professional investors (McKay, 2006; McDonald, 2007; Sechler, 2009) and the use of fundamental analysis to assess investments (Beneish, Lee and Tarpley, 2001; Nekrasov and Shroff, 2009; Sorensen, 2009). The flight-to-quality phenomenon is particularly prevalent during times of market stress. When the economy shows signs of weakening, investors might benefit if they focus on larger companies with robust businesses that are more likely to survive the rough times (McKay, 2006). Essentially, "by moving your assets toward high-quality, less-risky issues, you can potentially save investment money if the market goes into a downturn" (Tortoriello, cited in McKay, 2006, p. C1).

This study extends the mutual fund literature by examining the link between the quality of assets held by mutual funds and fund performance. Following Sloan (1996) the quality of a stock is defined based on the persistence and predictability of its earnings. Quality is measured using a Q-Score which is the composite of 14 accounting metrics selected, based on their merits as indicators of a sound investment. The Q-Score developed increases the proportion of future earnings and stock returns that is explainable relative to existing measures detailed in the literature. Mutual funds that hold portfolios of stocks which exhibit higher (lower) levels of quality are expected to exhibit higher (lower) returns and lower (higher) volatility of returns and provide greater downside protection to investors.

This study contributes to the extant literature by providing an investigation into the extent to which active fund managers hold quality stocks, and if so, how these quality dimensions relate to alpha generation. The portfolio holdings characteristic literature does not explicitly examine funds from this perspective (e.g. Grinblatt and Titman, 1989; Falkenstein, 1996; Chen, Jegadeesh and Wermers, 2000; Chan, Chen and Lakonishok, 2002; Covrig, Lau and Ng, 2006). In other related studies examining quality and stock attributes, Piotroski (2000) examines portfolio formations using a fundamental analysis strategy targeting value stocks, whereas Mohanram (2005) extends this analysis to growth stocks, and Bird and Casavecchia (2007) examine sentiment and financial health indicators for European value and growth stocks. However, the relationship between *quality* stock holdings and mutual fund performance has not yet been established. Indeed, the emphasis to date is on one measure only, namely the performance impact of accruals.[1] In the portfolio management industry, professional consulting firms now scrutinise the dimensions of portfolio holdings of fund managers, and report these attributes to trustees of pension funds. These include reporting style attributes and the factor tilts that portfolios have (including measures of quality). For example, Style Research[2] analyses a portfolio's overall tilt toward various metrics within style categories such as value, growth and quality. The quality metrics include Return-on-Equity (ROE), and measures of leverage and accruals. This implies that fund attributes are an important consideration in the assessment of funds by current and potential investors.

The evidence shows that stocks in the lowest ranked decile of quality perform particularly poorly, with a mean monthly alpha of -1.11% (-12.58% p.a.). Furthermore, there is a positive relationship between stock size and quality, while volatility is inversely related to quality (Q-Score). Evidently, stocks in the lowest quality decile perform particularly poorly amidst volatile market conditions with a mean monthly DGTW alpha 1.93% (25.73% p.a.) less than high quality stocks. Interestingly, the overall level of quality of the stocks selected by funds has increased over time, with the mean Q-Score for funds in decile 1 (decile 10)[3] increasing from -11.46 (2.34) in 1999 to -4.02 (6.37) in 2007.[4] This result is not affected by the number of stocks being measured, with the same pattern evident when scaling the mean Q-Score by the number of stocks in each decile. The funds which hold the lowest quality stocks exhibit significant underperformance. In particular, funds in decile 1 had an average adjusted return of -0.46% per month (-5.43% p.a.), significant at the 5% level. The downside protection offered by quality stocks in stressful market conditions is also evident. For example, during the time of the GFC, funds in quality decile 1 incurred a mean return of -0.72% per month (-8.30% p.a.) compared to 0.43% (5.34% p.a.) for those in decile 10. This result is consistent

[1] E.g. Sloan (1996); Dechow and Dichev (2002); Francis et al. (2005); Aboody, Hughes and Liu (2005); Chan et al. (2006); Ali et al. (2008); Resutek (2010); Wu, Zhang and Zhang (2010).
[2] Style Research: http://www.styleresearch.com/en/.
[3] Fund managers' portfolios are ranked on the Q-score from lowest to highest quality, and then form deciles.
[4] The Q-Score is calculated for nine years ranging from 1999 to 2007, and the associated DGTW alpha is examined over nine periods from July 2000 to June 2009.

with the aforementioned flight-to-quality phenomenon. Lower quality funds also have higher turnover and expenses, and are also slightly younger on average.

The remainder of this paper is organised as follows. Section two discusses the relevant extant literature and section three details the data used in the study and summary statistics. Sections four and five describe the research design employed and the empirical results for the Investing Measures and Q-Score analysis, respectively. Finally, section six provides concluding comments.

2. Literature Review

Academic research has focused on stock quality from the perspective of earnings quality as indicated by accruals. Sloan (1996) pioneered the accruals anomaly literature by emphasising that high accruals result in lower subsequent-year returns of -5.5%. Allen, Larson and Sloan (2012) extend Sloan's (1996) analysis by demonstrating that the predictable earnings changes and stock returns following extreme accruals result from the reversal of accrual measurement errors. Chan et al. (2006) and Fama and French (2006) also determine a negative relation between accruals and returns. Recently, analysis of the accruals anomaly has focused on further deconstruction of its components (Zhang, 2007) and the relationship between disclosure quality and mispricing (Drake, Myers and Myers 2009; Mashruwala and Mashruwala, 2011). However, Kraft, Leone and Wasley (2006) document that once delisting returns are accounted for, the positive returns to low accrual portfolios disappear. Similarly, Green, Hand and Soliman (2011) find that the returns to the accruals anomaly in the US have diminished. The authors attribute this to the exploitation of the anomaly by hedge funds.

Badrinath, Gay and Kale (1989) examine the relationship between institutional investment behaviour and quality characteristics of firms based on Standard and Poor's quality rankings. However, recent analysis of stock quality within the mutual fund literature is limited. Ali et al. (2008) tie the earnings quality literature to the mutual fund literature by investigating whether US mutual funds trade on the accruals anomaly by developing an 'Accruals Investing Measure'. Mutual fund stockholdings and return data are used to determine which funds pursue an accruals-based trading strategy and whether it is profitable. It is determined that few if any funds trade on the accruals anomaly, although trading on the accruals anomaly is profitable, even after taking transaction costs into account.

On evidence, the concept of stock quality and portfolio holdings has predominantly been examined in a relatively one-dimensional manner to date i.e., earnings quality.[5] Thus, a detailed analysis of the various indicators of stock quality and determination of aggregate quality levels (based on quality attributions of stocks held) associated with US equity funds is essential to allow a more complete understanding of quality as an investment style. Accordingly, the methodology employed by Ali et al. (2008) is used as a foundation to investigate 14 individual metrics deemed to be indicative of stock quality based on their use in the extant literature. This approach is extended by using a new method of aggregation to create the Q-Score. This allows us to reveal important information pertaining to overall stock and fund quality levels, the relationship between quality and performance, and how these change over time.

The classification of a stock as a 'quality' investment is subjective, and various metrics and ratings may be utilised. In this study, 14 accounting measures were selected (see Table 2) which previous studies emphasise as indicators of profitability, variability, operating efficiency and financial health. Chen and Zhang (2007) determine that profitability (ROE) is an important factor in explaining future stock price movements, more so than scale-related factors (i.e., capital investment and change in growth opportunities). In addition, ΔROE (Bird and Casavecchia, 2007), ROA[6] and ΔROA (Fairfield and Whisenant, 2000; Piotroski, 2000) are included as indicators of profitability. Furthermore, given the vast earnings quality literature, accruals and operating cash flow are included in the profitability metric category.

In terms of variability, Dichev and Tang (2009) find that the consideration of earnings volatility brings substantial improvements in the prediction of both short- and long-term earnings. Style Research emphasises both earnings volatility and sales growth volatility as stock quality indicators.

Soliman (2008) decomposes the return on net operating assets into two components: profit margin and asset turnover, using DuPont analysis. The analysis highlights the value of focusing on changes in asset turnover as a predictor of future returns. Therefore, asset turnover and change in asset turnover are included as indicators of operating efficiency.

[5] Although, Piotroski (2000), Mohanram (2005) and Bird and Casavecchia (2007) examine quality aspects associated with value and growth stocks, the analysis is conducted on a relevant universe of stocks and not applied to the stock holdings of mutual funds.
[6] Fairfield and Whisenant (2000); Piotroski (2000); Mohanram (2005); Bird and Casavecchia (2007); Chen and Zhang (2007).

It is commonly accepted that stocks with higher leverage are riskier (Fama and French, 1993). George and Hwang (2010) examine the relation between stock returns, financial distress and leverage. They find that the average return to a high (low) debt portfolio is consistently lower (higher) than that of a benchmark neutral portfolio. Lui, Markov and Tamayo (2007) also state that small, illiquid stocks with high leverage are riskier. Thus, liquidity and leverage are included as financial health signals. In addition, Bradshaw, Richardson and Sloan (2006) and Daniel and Titman (2006) document strong negative relations between measures of external financing and future stock returns. Moreover, Pontiff and Woodgate (2008) show that their share issuance variable is strongly related to future stock returns and its statistical significance is greater than that for the well-known book-to-market, size and momentum factors. Thus, analysis of changes in shares outstanding and changes in total equity are included as key indicators of financial health.

Fairfield and Whisenant (2000) state that fundamental analysis can be used to detect signals of deteriorating firm performance and that these signals contained in public information are not priced into the market. Ou and Penman (1989) use financial statement analysis to combine a large set of financial statement items into one summary measure which indicates the direction of one-year-ahead earnings changes. The strategy developed provides returns over a two-year holding period of 7% after adjusting for size and risk factors. Piotroski (2000) shows that mean returns to high book-to-market investors can be increased by at least 7.5% annually by discriminating between ex ante winners and losers. Fundamental analysis is conducted in order to categorise firms as either ‘winners’ or ‘losers’. An F-Score is calculated for firms based on nine variables across three categories: profitability (ROA, Cash Flow from Operations, ΔROA, Accruals); liquidity, leverage and source of funds (ΔLeverage, ΔLiquidity, equity offering); and operating efficiency (ΔMargin, ΔTurnover). The F-Score is the aggregate of a series of binary variables attributed to each variable, e.g. if ROA is positive, then the firm receives a value of one for this variable.

Mohanram (2005) extends this approach by developing a G-Score to discriminate between high and low quality growth stocks. A long-short strategy based on this G-Score earns significant excess returns, though most of the returns come from the short side. A contextual approach towards fundamental analysis is advised, with traditional analysis appropriate for high book-to-market stocks, and growth-oriented fundamental analysis appropriate for low book-to-market stocks. Furthermore, Bird and Casavecchia (2007) examine both value and growth stocks using 24 fundamental accounting variables across three categories: profitability, financial strength, and operating efficiency. Sentiment and financial health indicators are employed to identify growth and value stocks which are more likely to add value over the next 12 months. Over holding periods of up to 12 months, higher added value is extracted from a 'good' growth portfolio than from a 'good' value portfolio.

The basic approach implemented in these studies of value and growth stocks is extended to examine the quality of stocks, with the computation of a Q-Score for each firm. The 14 attributes incorporated in the measure are selected on the basis of a consensus in the aforementioned literature as to their merits as indicators of quality.

3. Data

3.1 Sample Selection

The equity holdings of all US mutual funds which exist in any given quarter over the period Jan. 2000 to Dec. 2009 are obtained from the Thomson Reuters Mutual Fund Holdings (s12) Database via Wharton Research Data Services (WRDS).[7] Specifically, the s12 quarterly holdings contained in the N-30D form that each fund periodically files with the SEC were obtained.

The s12 dataset contains holdings data for funds with a variety of investment objectives. The focus of this study is US active equity fund managers; therefore all international funds (Investment Objective Code (IOC) =1), municipal bonds (IOC=5), bond and preferred (IOC=6), balanced[8] (IOC=7), metals (IOC=8) and unclassified funds (IOC=9) are removed. Furthermore, funds for which the IOC is reported as missing are removed. These exclusions are consistent with Ali et al. (2008) and Barras, Scaillet and Wermers (2010), and are similar to Wermers (1999, 2000) and Kacperczyk, Sialm and Zheng (2008). Thus, the final sample includes funds with the following investment objectives: 'Aggressive Growth' (IOC = 2),

[7] Previous studies using mutual fund holdings data often merge the Thomson Reuters Mutual Fund Holdings (s12) database with the CRSP Mutual Fund Database (CMFD) using Mutual Fund Links (MFLINKS). The analysis in this paper focuses primarily on the accounting characteristics of the stocks held, and not the characteristics of the funds, for which the CMFD is often used. Furthermore, the fund returns are calculated using the stock holdings themselves, thus the monthly fund returns available from the CMFD are not required. Therefore, only the s12 database is used in order to maintain the size of the sample. The key results in this paper are presented for the merged sample obtained using MFLINKS, as a robustness test in section 5.5.

[8] Balanced funds are removed as this IOC group contains funds which invest in both stocks and bonds. 'Balanced' in this context does not refer to the investment style, which is a blend of value and growth strategies.

‘Growth’ (IOC=3) and ‘Growth and Income’ (IOC = 4)[9]. Ali et al. (2008) note that there are occurrences where funds have been misclassified, thus these funds are manually identified and removed from the sample. In addition, all funds with portfolio assets less than $5 million, and those which held fewer than ten stocks as at the end of the prior quarter are excluded (Kacperczyk et al., 2008)[10].

Stock level data are obtained from the Centre for Research in Security Prices (CRSP), also via WRDS. The universe of CRSP stocks comprises US common stocks indicated by share codes 10 and 11, and only includes stocks which are traded on the NYSE, AMEX or NASDAQ. The CRSP exchange code (EXCHCD) is used to identify stocks traded on these exchanges instead of the header exchange code (HEXCD) so as to avoid a selection bias in which firms are selected based on their *current* listing and not their listing as at the point in time being analysed (Kraft et al., 2006).

Moskowitz (2000) purports that it would be fruitful to correct for the delisting bias in the CRSP tapes when examining reported equity holdings. Accordingly, delisting returns from CRSP are used as the stock return for the month in which the firm is delisted, when available. Missing performance related (delisting codes 500 and 505-588) delisting returns are replaced by -30% for NYSE and AMEX stocks and -55% for NASDAQ stocks (Shumway, 1997; Shumway and Warther, 1999). The portfolio holdings observations are merged with the monthly CRSP data as per Kacperczyk et al. (2008) in order to obtain the data required to calculate portfolio returns, stock counts and the value of assets under management.

3.2 Summary Statistics

Table 1 reports summary data for the sample of mutual funds over the period 2000 to 2009. Panel A reports descriptive statistics as at the end of the year, for 2000, 2004 and 2009. The number of funds is highest in 2000 at 1,728 falling to 1,113 by 2009. The total number of distinct funds studied over 2000-2009 is 1,816. Calendar year reports the proportion of funds whose quarterly report dates coincide with the standard quarter-end months— March, June, September and December. Overall, the majority of funds report as per the calendar period, thus it is appropriate to classify funds into quarters based on the month of the report date, which is consistent with Wermers (2000).

[9] Grinblatt et al. (1995) provide information about the investment strategies followed, and types of securities invested in, by funds characterised by these investment objectives.
[10] Refer to appendix A for a detailed description of the database construction.

INSERT TABLE 1

The average (median) number of stocks held by each fund, per quarter, over the year is also reported. The average number of stocks held per fund increased from 87 in 2000 to 111 by 2009. The average value of assets based on the reported equity holdings has increased slightly over the sample period, growing from $964 million in 2000 to $1,110 million in 2009, despite falling from 2004 to 2009.

The average (median) asset-weighted size, book-to-market and momentum quintiles, respectively, to which the stocks are assigned based on the DGTW (1997) and Wermers (2003) approach are also reported. The value-weighted average characteristic quintile is first calculated for each fund, based on the holding value of each stock, at the end of the prior quarter. The average (median) is then calculated across the funds in each quarter. Size, book-to-market and momentum portfolios 1 (5) consist of small (large), low (high) book-to-market and low (high) prior-year return stocks, respectively.

US mutual funds hold stocks which are large, with funds holding stocks which, on average, fall above the fourth size quintile for NYSE stocks. The book-to-market ratio of stocks held by mutual funds is around the median of that for stocks listed on the NYSE. On average, mutual funds prefer stocks with momentum slightly higher than that exhibited by NYSE stocks. Specifically, the mean oscillates around the third quintile across all periods. Overall, the investment style exhibited across fund categories over time is relatively stable; this is consistent with DGTW (1997).

Panel B provides average annual fund returns during 2000 to 2009. All funds that existed during a given quarter are included, irrespective of whether or not they are subsequently active. Thus, the sample is free from survivorship-bias. The individual fund returns are calculated as the weighted-average of the returns to the stocks contained in the portfolio. The holding value of a stock as at the end of the prior quarter is the weight applied to that stock's return over the next quarter, which is consistent with Wermers (2000). Moskowitz (2000) confirms that this approach avoids the impact of end of quarter window dressing by fund managers. These stock weights are normalised across each fund snapshot so that they sum to unity. The mean gross returns for the sample of funds are calculated by first determining the mean return for each quarter using all funds that existed during that quarter. The quarterly returns are then annualised using simple compounding; both asset-weighted (AW) and equally-weighted (EW) results are presented. The asset weights are based on the reported assets held by the fund as at the end of the prior quarter and these weights are normalised across each quarter so that the sum of the asset-weights across all funds is unity.

Over the entire sample period US mutual funds underperformed the market by 13 basis points on an AW basis before costs, which is consistent with previous research (Gruber, 1996; Carhart, 1997; Wermers, 2000). The gross fund returns are adjusted using the DGTW (1997) and Wermers (2003) characteristic benchmark approach.[11] The DGTW-adjusted returns are provided on an AW and EW basis. These returns are calculated by subtracting the buy-and-hold return on a value-weighted portfolio of stocks from each stock held by a fund in a given quarter. The stocks are assigned to one of 125 benchmark portfolios in June of each year on the basis of the interaction of its size, book-to-market and momentum characteristics.[12] The sample of funds does not generate outperformance over the sample period, with negative DGTW-adjusted returns determined in all periods using either AW or EW.

4. Investing Measures Research Design and Results

Table 2 details the 14 quality signals which are selected for analysis subsequent to a review of the academic and practitioner literature. The metric values for each stock are adjusted by the relevant population median, from the prior fiscal year. The metric values are not industry-adjusted, in order to allow for the impact of industry bets executed by the fund managers.[13] The metric values are winsorised at the first and 99th percentiles to avoid the impact of extreme observations.

INSERT TABLE 2

[11] The DGTW benchmarks are available via http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm

[12] This is consistent with previous studies e.g. Ding and Wermers (2009); Alexander, Cici and Gibson (2007); Kacperczyk et al. (2008).

[13] The results for the Investing Measures are qualitatively similar for the 14 metrics if the values of each metric for each stock are scaled by the median for each stock's 2-digit Standard Industrial Classification (SIC) group for the prior fiscal year.

4.1 Research Design

Ali et al. (2008) compute an ‘Accruals Investing Measure’. This approach is extended by applying it to the 14 accounting metrics detailed in Table 2. The same method is used for each metric.

Firstly, all stocks in the Compustat database with the data required to compute each metric for the fiscal year that ends in calendar year *t-1* are identified. Stocks with Standard Industrial Classification (SIC) codes between 6000-6999 (financials) are removed.[14] The value of each metric for each stock is then adjusted by the median of all stocks in the universe for each metric, for the prior fiscal year. CRSP and DGTW data must be obtainable for the stocks to be included in the sample. Additionally, stocks must be classified as common equity (CRSP share codes 10 or 11) and traded on the NYSE, AMEX or NASDAQ (CRSP exchange codes 1, 2 and 3). In each year *t*, all sample stocks in the CRSP/Compustat/DGTW universe are sorted into equally-weighted decile portfolios based on their (adjusted) metric value for the fiscal year that ends in the calendar year *t-1*. Decile 1 (10) represents the stocks with the lowest (highest) metric values.

The Investing Measure (IM) for each metric *z* for a given fund *i* is defined as the weighted average decile rank of the individual stocks held by a fund as at June of year *t*:

$$IM_{z,i,t} = \sum_{j=1}^{N} w_{i,j,t} \times Decile\ Rank_{z,j,t} \tag{1}$$

where

- Decile $\text{Rank}_{z,j,t}$ is the decile rank of stock *j* for quality signal *z* as at June of year *t*.
- *N* is the number of stocks in the CRSP/Compustat/DGTW universe that are held by the fund in June of year *t*.
- $w_{i,j,t}$ is the value of stock *j* owned by fund *i* as a percentage of the total value of stocks the fund holds at the end of June of year *t*:

$$w_{i,j,t} = \frac{n_{i,j,t}P_{j,t}}{\sum_{j=1}^{N} n_{i,j,t}P_{j,t}} \tag{2}$$

[14] This is due to the fact that financial firms do not have the data required to compute the accruals metric, and their removal is consistent with prior accruals literature (Allen et al., 2012). Furthermore, the results for the other metrics are not qualitatively altered upon their inclusion.

where

- $n_{i,j,t}$ is the number of shares of stock j held by the fund, and $P_{j,t}$ is the market price of stock j at the end of June of year t.

The EW average IM for a given metric z in each year t across all funds N is then calculated as:

$$IM_{z,t} = \frac{\sum_{i=1}^{N} IM_{z,i,t}}{N} \tag{3}$$

A low IM indicates that funds tilt their equity holdings toward stocks with low values of a given metric z. The expected value for the IMs based on an equally-weighted average decile rank is 5.50. A low (high) IM i.e., an IM < 5.50 (> 5.50) which is significantly different from the expected value indicates that the metric is one of the key variables that explain the characteristics of the stock holdings of mutual funds.

4.2 Results

Table 3 presents the time-series average of EW and AW average IMs for each quality signal from 2000 to 2009.

INSERT TABLE 3

4.2.1 Profitability Signals

The EW IMs for ROE, ΔROE, ROA, ΔROA and OCF for the funds are above average and significantly higher than the expected value of 5.50. The ROE for IM is the highest at 7.40, whilst the IM for ΔROA is the lowest of the significant profitability signals at 6.04. Thus, mutual funds tend to tilt their portfolios toward stocks with higher values of these metrics, on average. The finding that mutual funds tend to hold stocks with higher ROE is consistent with Covrig et al. (2006). In contrast, the EW IM for ACC of 5.51 is not significantly different to the expected value, thus similar to Ali et al.'s (2008) findings: mutual funds do not trade on the accrual anomaly[15]. Furthermore, the AW results are consistent.

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[15] Ali et al. (2008) compute accruals following Sloan (1996) as Accruals = [(ΔCA −ΔCASH) − (ΔCL−ΔSTD ΔTP)− DEP]/ATA where CA is Current Assets, CASH is cash and short term investments, CL is current liabilities, STD is the debt included in current liabilities, TP is income tax payable, DEP is depreciation and amortisation and ATA is average total assets. IMs are computed on an EW and AW basis using this same method and the results are consistent with those presented and those in Ali et al. (2008). Specifically, funds do not trade on the accruals anomaly, as the EW (AW) IM is an insignificant 5.51 (5.38).

4.2.2 Variability Signals

The variability metrics exhibit a similar pattern; mutual funds tend to tilt toward stocks with lower variability relative to the expected value of 5.50, with statistically significant EW IMs of 3.96 and 4.25 reported for ROA_VAR and SG_VAR, respectively. The AW results are similar.

4.2.3 Operating Efficiency Signals

The EW IM for ATO (ΔATO) is not significantly lower (higher) than the expected value, although the difference is not economically large. Overall, operating efficiency ratios individually do not appear to be key metrics considered when forming portfolios.

4.2.4 Financial Health Signals

The IMs for LEV and ΔTE are both significantly higher than the expected value, at 6.44 and 6.27, respectively. Contrastingly, the IMs for LIQ indicate the mutual funds prefer stocks with lower working-capital-to assets ratios than expected with an average EW IM of 4.31. In contrast, mutual funds do not tilt on ΔSH with insignificant IMs for this metric.

Overall, the profitability and variability signals, namely ROE, ROA, OCF, ROA_VAR and SG_VAR, and the financial health signal LIQ, exhibit the strongest tilts. Therefore, these are the key variables with which stocks held by fund managers are associated, after examination of their portfolios.

5. Quality Score Research Design and Results

5.1 Research Design

Piotroski (2000) constructs a binary F-Score in order to differentiate value firms on the basis of quality. Similarly, Mohanram (2005) constructs a binary G-Score to differentiate between high and low quality growth firms. In these cases, the relationship between each metric and the stock return is assumed to be linear. In unreported tests (please refer to Appendix D) the variables ΔROE, ΔROA, ACC and ΔATO were found to be characterised by parabolic non-linear relationships with stock returns; these are explored further in the discussion of Table 3 based on the quadratic term β_2. Therefore, it is fruitful to extend Piotroski's (2000) and Mohanram's (2005) binary approach in order to incorporate the relative importance of each metric and allow for more complex relationships which may be inherent. Furthermore, given that there is multicollinearity between the metrics within each of the four categories, a multivariate regression approach would generate biased parameter estimates. Thus, a series of univariate regressions are performed to investigate the relationship between each metric and alpha, as per the following model[16]:

$$y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon \qquad (4)$$

where

- y represents DGTW alpha- the dependent variable
- β_0 represents the intercept
- β_1 represents the parameter estimate for the metric in question- x
- β_2 represents the coefficient estimate for the squared value of the metric in question
- ε represents the error term.

The DGTW alpha for each stock in the Compustat/CRSP/DGTW universe is regressed on the metric value for the stock as well as the metric value squared, in order to capture any non-linear relationships. The parameter estimates are interpreted as follows: for each one unit increase in ROE (ROE^2), for example, DGTW alpha changes by β_1 (β_2) per cent.

These regressions are run over rolling time periods. The first regression is run using the estimation period 1989-1998, and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score for 1999, using the metric values for 1999 as inputs into the following formula:

$$Q - Score = \sum_{i=1}^{14} \beta_{1,i}\, Metric_i \; + \; \sum_{i=1}^{14} \beta_{2,i}\, {Metric^2}_i \qquad (5)$$

The Q-Score for 1999 is then merged with the mutual fund holdings as at June of 2000, and alpha is examined from July 2000 to June 2001. Essentially, this allows the predictive capability of the Q-Score constructed to be examined without the impact of any hindsight biases. The second regression is run using data from 1989 to 1999, the third from 1989 to

[16] In order to determine whether a linear version of the model may be more appropriate for some of the metrics which didn't have a parabolic relationship with stock returns, the regressions are also run omitting the quadratic term and the adjusted R^2 values compared. All of the adjusted R^2 values for the linear model are the same or lower than those for the quadratic model. Therefore, the quadratic model is used for all of the metrics to generate the Q-Score results. Furthermore, the results are consistent with those presented when linear univariate regressions are used for each metric.

2000 and so on up to an estimation period of 1989 to 2006. Thus, the parameter estimates for each of the nine regressions are used on the associated metric values for the following year. Overall, the Q-Score is calculated for nine years ranging from 1999 to 2007 and the associated DGTW alpha is examined over nine periods from July 2000 to June 2009.

In order to demonstrate the incremental ability of the Q-Score to explain the cross-sectional difference in the persistence of earnings and the predictability of earnings and stock returns, relative to Piotroski's (2000) F-Score and Mohanram's (2005) G-Score[17], a series of multivariate Fama-MacBeth (1973) regressions are conducted. Table 4 reports the time-series average parameter estimates and adjusted R^2 for multivariate regressions including all three scores as independent variables compared to including only the F-Score and G-Score.

INSERT TABLE 4

Overall, the Q-Score augments explanatory power relative to the F-Score and G-Score with a highly significant positive relationship with future earnings, OCF, ACC and all measures of stock returns detected. The inclusion of the Q-Score as an independent variable increases the adjusted R^2 for one year-ahead earnings from 10.8% to 39.0%. Furthermore, the Q-Score has a stronger relationship with the persistent component of earnings: OCF, for which the adjusted R^2 increases from 12.9% to 42.3%, compared to 1.1% to 6.0% for ACC. In addition, the adjusted R^2 for all measures of stock returns are enhanced upon inclusion of the Q-Score in the regression.

The literature review indicates the reasons why various metrics are selected for inclusion in the computation of the Q-Score. Based on the relationship of these metrics with stock returns it is hypothesised that:

- *H1: Stocks of low quality as indicated by the Q-Score will exhibit poor DGTW-adjusted performance, on average.*

[17] Mohanram (2005) creates annual calendar year-ending financials by summing the relevant four quarterly values. Given that 70% of the stocks used in this analysis have fiscal years ending in quarter four, as well as in the interests of consistency, annual financial data has been used to construct the G-Score.

- *H2: During stressful market periods*[18] *stocks of lower quality as indicated by the Q-Score will exhibit lower levels of DGTW-adjusted performance, on average, relative to stocks of higher quality.*

It follows that:

- *H3: Funds which hold greater proportions of low quality stocks will exhibit poor DGTW-adjusted performance, on average.*
- *H4: During stressful market periods funds which hold stocks of lower quality as indicated by the Q-Score will exhibit lower levels of DGTW-adjusted performance on average, relative to funds which hold stocks of higher quality.*

5.2 Univariate Results

The average parameter estimates obtained for each metric from the nine regressions are reported in Table 3[19]. These estimates provide information about the magnitude and direction of the relationship between alpha and each metric. The profitability metrics OCF, ROA and ROE have the largest positive β_1 parameter estimates: 37.0, 21.3 and 8.8, respectively. All nine β_1 parameter estimates for these three metrics are significant at the 1% level. The importance of OCF as a determinant of mispricing and thus stock returns is highlighted by this result, which is consistent with Desai et al. (2004). ΔROE and ΔROA have a less substantial impact on alpha, with β_1 values of 3.3 (all nine are significant at the 1% level) and 3.2 (three are significant at the 1% level and four at the 5% level), respectively. ACC has an inverse relationship with alpha indicated by the negative β_1 estimate of -10.7; all nine estimates are significant at the 1% level.

The large negative β_2 estimate for ACC of -115.0 indicates that a hump-shaped relationship exists between alpha and ACC, which is comparable to the findings of Kraft et al. (2006). Similarly, a hump shape characterises the distribution of alpha for ΔROA with a β_2 estimate of -50.1 determined. All nine estimates of β_2 for ACC and ΔROA are significant at the 1% level.

The univariate analyses indicate a much stronger relationship between ROA_VAR and alpha compared to SG_VAR: β_1 is -50.8 (-1.5) for ROA_VAR (SG_VAR). Similar to Dichev and

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[18] The periods deemed to be stressful are based on market events and the National Bureau of Economic Research's (NBER) 'US Business Cycle Expansions and Contractions' reference dates (NBER, 2010).

[19] Refer to Appendix B for a detailed summary of the coefficient estimates, and their statistical significance, for each metric.

Tang (2009), the predictive capabilities of earnings volatility are highlighted. Furthermore, β_2 for ROA_VAR (SG_VAR) is moderate (zero) at 29.3 (0). All nine of the aforementioned parameter estimates for SG_VAR and ROA_VAR are significant at the 1% level.

The parameter estimates for LEV and ΔTE are trivially small, indicating that these metrics individually do not have a strong relationship with alpha. LIQ has a slight positive impact on alpha with a β_1 estimate of 6.2, in conjunction with a slight hump-shaped relationship given the β_2 estimate of -25.7. All nine estimates of both β_1 and β_2 for LIQ are significant at the 1% level. ΔSH has a negative impact on alpha with a β_1 estimate of -7.5 (all nine are significant at the 1% level), which is consistent with Bradshaw et al. (2006), Daniel and Titman (2006) and Pontiff and Woodgate (2008).

In summary, ROE, ROA and OCF are clearly positive signals and ROA_VAR and ΔSH are negative signals. Furthermore, the aforementioned IM evidence indicates that fund managers' portfolios exhibit a tilt, based on four of these five metrics. However, despite the negative impact of ΔSH, fund managers do not consider this factor to be important when constructing their portfolios.

5.3 Q-Score Summary Statistics

Table 5 presents the average returns and stock characteristics for the deciles formed based on the Q-Score[20]. Following Ali et al. (2008), portfolios are formed in June of each year *t;* this is a conservative approach to ensure that the accounting data used to compute the Q-Score are publicly available (Fama and French, 1992). The raw and DGTW-adjusted returns presented are buy-and-hold returns from July of year *t* to June of year *t+1*. The *t*-statistics are in parentheses below the average returns reported. The volatility of the returns is measured as the annualised standard deviation of the component monthly returns from July of year *t* to

[20] Given that the accounting variables which comprise the Q-Score are not independent of each other, another approach to calculating the Q-Score is undertaken as a robustness test. Principal Components Analysis (PCA) is used to reduce the 14 metrics (i.e., those for the fiscal year ending in portfolio formation $year_{t-1}$) down to a set of underlying factors which explain at least 70% of the total variance of the original variables. The analysis is updated for each of the nine periods over which the univariate regressions used to compute the standard Q-Score are run. Specifically, portfolio formation occurs from 2000 to 2008, thus returns are from July 2000 to June 2009. The PCA identifies six reduced factors which relate to profitability, changes in profitability, variability, operating efficiency, financial health, and changes in equity. Factor scores for each stock are generated for the six factors and the PCAQ-Score is the sum of these individual factor scores. Overall, the return results using the PCAQ-Score are similar to those using the standard Q-Score, as an asymmetric effect is determined i.e., a strong negative effect for low quality stocks which isn't mirrored by a strong positive effect for high quality stocks. In particular, the average return to low quality stocks (i.e., those in decile 1) is -10.27% and significant at the 10% level. Statistically significant (at the 10% level) returns of 1.67% and 2.33% are also determined for deciles 6 and 8, respectively.

June of year *t+1* for each stock in the portfolio. Panel A provides the means for the Compustat/CRSP/DGTW universe of stocks. These are computed by weighting the value of the Q-Score, for each stock, by its market capitalisation as at December of year *t-1* as a proportion of the contemporaneous total market capitalisation of all stocks in the universe.

The analysis is repeated on a subset of stocks held by the mutual funds; an active-weighting approach is developed for these stocks. Specifically, the weight applied to each stock is called the Total Weight and it is an active-weight which reflects the total underweight/overweight positions that mutual funds are taking in a given stock, adjusted for the market-capitalisation weight of the stock. The advantage of using this weight definition is that it allows the relationship between the positions that mutual funds take in a stock and the corresponding average returns and characteristics for that stock to be clearly identified[21]. Please refer to Appendix A for a detailed explanation of the computation of the Total Weight for each stock. Panel B presents the results for this analysis.

INSERT TABLE 5

Table 5 indicates that stocks with the lowest Q-Scores perform particularly poorly, with a mean DGTW alpha of -1.11% per month (-12.58% p.a.) for decile 1, significant[22] at the 5% level[23]. This is consistent with Hypothesis 1. Conversely, positive DGTW-adjusted monthly returns of 0.23% (2.83% p.a.), 0.24% (2.97% p.a.) and 0.27% (3.29% p.a.) are determined for deciles 6, 7 and 9, which are significant at the 5% level. The DGTW alpha of -0.04% per month (-0.5% p.a.) for decile 10 is not significant. Therefore, the return impact appears to be asymmetric, with a strong negative result for the poorest quality stocks which is not mirrored by a strong positive result for the highest quality stocks. In general, there is a direct (inverse) relationship between size (volatility) and the Q-Score. The Q-Scores range on average from -52.22 for decile 1 to 11.61 for decile 10, which emphasises the downside risk of lower quality stocks. The results for the mutual fund holdings analysis exhibit similar patterns, although the stocks held by funds are larger on average.

[21] The analysis is also conducted on the subset of stocks held by mutual funds weighting the stocks as per Ali et al. (2008).
[22] Statistical significance is tested using a lower (upper) one-tailed *t*-test for deciles 1-5 (6-10) as the expectation is that these deciles will under (out)-perform.
[23] The results based on 3-Factor and 4-Factor model alphas for the quality deciles are consistent with the DGTW-adjusted results presented.

Figure 1 demonstrates the average proportion of stocks in the top two and bottom two quality deciles in each portfolio formation year (PFY) $t + i$ (i=1 to 8) which are also in that same decile relative to the vintage PFY for all vintages from 2000 to 2007. The highest quality stocks exhibit the greatest level of persistence relative to the other deciles. In particular, 47% of stocks remain in decile 10 on average in PFY_{t+1}, 39% in PFY_{t+2}, and by PFY_{t+8}, 15% of the original high quality stocks remain in decile 10. The lowest quality stocks also exhibit significant persistence with an average of 45% and 31% of the same stocks found in decile 1 in PFY_{t+1} and PFY_{t+2}, respectively. However, by PFY_{t+8}, only 5% of the original decile 1 stocks persist.

INSERT FIGURE 1

Figure 2 depicts the mean DGTW-adjusted returns in each PFY for the top two and bottom two stock-sorted deciles. The PFY for 2000 comprises the four quarters commencing from July 2000 and ending in June 2001. The greatest divergence in the performance of the low and high quality stocks occurs in PFY 2001 with substantial negative returns of -4.03% per month (-38.95% p.a.) and -1.76% (-19.17% p.a.) for deciles 1 and 2, respectively, compared to positive DGTW alphas of 0.92% (11.60% p.a.) and 0.87% (10.96% p.a.) for deciles 9 and 10, respectively. This period is marred by the aftermath of the dot-com crash, with the National Bureau of Economic Research (NBER) noting March 2001 to November 2001 as a contractionary period. Interestingly, the disparity between the deciles is not as strong during the GFC period (PFY 2008), although deciles 1 and 2 perform poorly with monthly returns of -0.45% (-5.30% p.a.) and -0.73% (-8.39% p.a.) compared to small positive returns to deciles 9 and 10 of 0.17% (2.09% p.a.) and 0.19% (2.29% p.a.), respectively. In addition, a t-test of the time-series difference in means between deciles 1 and 10 amid stressful market conditions i.e., PFYs 2000, 2001, 2007 and 2008, reveals that high quality stocks outperform low quality stocks by 25.73%, which is significant at the 10% level. These results are consistent with Hypothesis 2. Interestingly, PFY 2004 exhibits significant underperformance for the low quality deciles, with DGTW-adjusted monthly returns of -2.06% (-22.08% p.a.) and -1.52% (-16.74% p.a.) for deciles 1 and 2, respectively. In contrast, deciles 9 and 10 exhibit modest positive monthly adjusted returns of 0.15% (1.76% p.a.) and 0.35% (4.30% p.a.), respectively.

INSERT FIGURE 2

Table 6 demonstrates the value-weighted average DGTW-adjusted performance of each quality decile in up versus down market months over July 2000 to June 2009. Annualised DGTW-adjusted returns based on monthly averages are provided. Months are classified as up (down) if the return on the CRSP value-weighted index including dividends was positive (negative). Then, within the up and down market classifications, months are classified into quintiles based on the extremity of the up/down market return. Up Market Quintile 1 (5) contains the lowest (highest) up market monthly returns. Similarly, Down Market Quintile 1 (5) contains the lowest (highest) down market monthly returns. Average reports the average annualised DGTW-adjusted return across all up/down market months.

INSERT TABLE 6

On average, during up markets low quality stocks perform particularly well with an average DGTW-adjusted return of 1.64% per month (21.62% p.a.) compared to -0.41% per month (-4.86% p.a.) for high quality stocks. High quality stocks outperform low quality stocks when the up market performance is classified into the first and second quintiles. However, once the up market performance passes the median and is classified into the third to fifth quintiles, low quality stocks outperform. In particular, the highest average return is detected when positive market performance is at its highest, with an average monthly return of 6.23% (106.5% p.a.) for decile 1, compared to -0.75% (-8.66% p.a.) for decile 10 for quintile 5.

The down markets analysis shows that the downside protection offered by high quality stocks is substantial, with an average monthly return of 0.75% (9.32% p.a.) for stocks in decile 10, compared to -5.70% (-50.58%) for those in decile 1, both of which are significant at the 1% level. Furthermore, high quality stocks outperform low quality stocks given down markets of varying strength with greater returns across all quintiles.

5.4 Q-Score Results for the Mutual Fund Sample

Table 7 presents the mean returns to deciles containing mutual funds which have been sorted based on the weighted-average Q-Score for their portfolios. Firstly, in June of each year *t*, the Q-Score for each stock is computed and then the weighted-average Q-Score is computed for each fund based on the holding value of each stock as at June of year *t*. The funds are then ranked into deciles based on their average Q-Score. The mean returns per decile are computed in a similar fashion to the stock returns in Table 5, i.e., the Q-Score sorted deciles are formed in June of each year *t* and then the returns are calculated from July of year *t* to June of year *t+1*. All funds with holdings data available in a given quarter of each PFY are included in the calculation of the mean annual return for that PFY. Therefore, the results are free from survivorship bias as the mean return is calculated on a quarterly basis and then the annual mean is the compound of these four mean returns.

INSERT TABLE 7

The average Q-Score for decile 1 is -7.02, which indicates that mutual funds tend to avoid the extremely low quality stocks as the average Q-Score for decile 1 is -52.22 for the universe. The mean raw fund returns are all quite different but not significantly different to zero. In accord with Hypothesis 3, funds which hold the lowest quality stocks exhibit significant underperformance when raw returns are DGTW-adjusted. In particular, portfolios in deciles 1 and 3 exhibit DGTW-adjusted returns of -0.46% (-5.43% p.a.) and -0.20% per month (-2.37% p.a.), respectively, which are significant at the 5% level. Furthermore, the average monthly DGTW alpha for decile 2 is -0.13% (-1.53% p.a.) and significant at the 10% level. A *t*-test of the time-series difference in means between deciles 1 and 10 reveals that the DGTW-adjusted return to decile 10 is 0.42% (5.22% p.a.) higher than decile 1 on average, and this difference is significant at the 5% level.

The mean size, book-to-market and momentum quintiles to which the stocks are assigned based on the DGTW approach are also provided. Finally, the proportions of funds which are members of each of the three IOC groups included in the study are provided[24]. The DGTW quintile means vary based on size, with the larger stocks populating the higher Q-Score deciles. However, book-to-market ratios and momentum scores do not vary substantially across the Q-Score sorted deciles. This is likely to be due to the fact that the grouping of all funds into one aggregate group masks the differences in style characteristics (Ainsworth et al., 2008). The majority of funds are classified as 'Growth' funds across all deciles, with the higher Q-Score sorted deciles containing an almost monotonically increasing (decreasing) proportion of 'Growth and Income' ('Aggressive Growth') funds. This is consistent with the notion that funds which have a higher Q-Score are a more stable investment.

[24] The results are also generated within each IOC category and these are consistent with those presented for the complete sample for 'Aggressive Growth' and 'Growth' funds. However, the underperformance of the low quality funds is muted for the 'Growth and Income' funds, which is not surprising given that these funds are more stable and thus of higher quality.

Figure 3 demonstrates the average proportion of funds in the top two and bottom two quality deciles over each portfolio formation year (PFY) $t + i$ (i = 1 to 8) which are also in that same decile relative to the vintage PFY for all vintages from 2000 to 2007. High quality funds are particularly persistent over PFY_{t+1}, PFY_{t+2} and PFY_{t+3}, with 41%, 30% and 25% of the same funds found in decile 10, respectively. Furthermore, 12% of the funds initially in decile 10 remain in the final PFY_{t+8}, thus some managers are able to maintain a high quality portfolio over the complete sample period. In relation to the low quality funds, considerable persistence is also detected over PFY_{t+1}, PFY_{t+2} and PFY_{t+3}, with 42%, 32% and 25% of the same managers falling into decile 1 relative to the initial PFY, on average. However, only 5% of the funds exhibit a dogged inability to construct a quality fund over the complete sample period.

Table 8 provides the mean annual DGTW-adjusted fund returns per decile in each PFY over the sample period. The mean Q-Score for each decile is provided in italics below the mean return. The *t*-statistics are in parentheses below the time-series average of the yearly returns. Volatility is the standard deviation of the mean annual returns over the sample period.

INSERT TABLE 8

The downside protection offered by quality stocks amidst stressful market conditions is clearly evident. For example, during the time of the GFC, funds in decile 1 derived a mean return of -0.72% per month (-8.30% p.a.) compared to 0.43% (5.34% p.a.) for those in decile 10. In order to test this further, the mean of the returns for deciles 1 and 10 in the four stress periods[25], i.e., 2000, 2001, 2007 and 2008, are compared. Specifically, a *t*-test of the time-series difference in the means for these years reveals that funds in decile 1 earned a mean monthly return 0.96% (12.14% p.a.) lower than funds in decile 10, this difference being significant at the 10% level. This result is consistent with the flight-to-quality phenomenon previously discussed and this supports Hypothesis 4.

[25] The periods are deemed to be stressful based on market events and the NBER 'US Business Cycle Expansions and Contractions' reference dates (NBER, 2010). Specifically, PFYs 2000 and 2001 each overlap with the contraction which occurred from March 2001 to November 2001. Furthermore, PFY 2000 is affected by flow-on effects from the dot-com crash which occurred in March 2000 (Hon, Strauss and Yong, 2007). Similarly, PFYs 2007 and 2008 coincide with the contraction that occurred over December 2007 to June 2009, which is related to the Global Financial Crisis (GFC).

Interestingly, the overall level of quality attributable to the funds has increased over time with the mean Q-Score for decile 1 (10) increasing from -11.46 (2.34) in 1999 to -4.02 (6.37) in 2007. This result is not affected by the number of stocks being considered, with the same pattern evident when scaling the mean Q-score by the number of stocks in each decile[26]. On average, volatility doesn't differ substantially across the deciles although it is slightly elevated for decile 1. Furthermore, the volatility of returns is elevated for the lower quality stocks with funds in decile 1 exhibiting a monthly standard deviation of 0.51% (6.25% p.a.).

INSERT FIGURE 4

Figure 4 depicts the mean DGTW-adjusted returns in each PFY over the sample period for the top two and bottom two fund-sorted deciles. Similar to the performance of the stock-sorted deciles, the greatest disparity between the top two and bottom two portfolios is evident during times of market stress, with funds in deciles 1 and 2 performing particularly poorly during the dot-com crash.

Table 9 demonstrates the asset-weighted average DGTW-adjusted performance of each quality decile in up versus down market months over July 2000 to June 2009. Annualised DGTW-adjusted returns based on quarterly averages are provided. Quarters are classified as up (down) if the return on the CRSP value-weighted index including dividends was positive (negative). Then within the up and down market classifications, quarters are classified into quintiles based on the extremity of the up/down market return. Up Market Quintile 1 (5) contains the lowest (highest) up market quarterly returns. Similarly, Down Market Quintile 1 (5) contains the lowest (highest) down market quarterly returns.

INSERT TABLE 9

The performance of the funds does not differ dramatically on average in up markets, with low quality funds generating a DGTW-adjusted quarterly return of 0.27% (1.09% p.a.) compared to -0.41% (-1.62% p.a.) for the high quality funds. Furthermore, when up market performance is lowest, the performance of deciles 1 and 10 is similar, and when up market performance falls into quintile 2, high quality funds outperform low quality funds. However, when up

[26] This pattern is also evident if the intercept from each of the 14 univariate regressions is included in the computation of the Q-Score.

market performance is moderate to strong, the low quality funds outperform the high quality funds.

The down market analysis provides further evidence that high quality funds are a safe haven during stressful periods. Specifically, funds in decile 10 generate a significant average quarterly return of 0.49% (1.99% p.a.), whilst funds in decile 1 underperform substantially with an average quarterly return of -3.80% (-14.36% p.a.). Moreover, high quality funds outperform low quality funds irrespective of the strength of the market underperformance.

5.5 Robustness Test: Merged Dataset

The Q-Score analysis is repeated on a subset of funds in both the s12 database and the CRSP Mutual Fund database (CMFD) which are able to be linked via Mutual Fund Links (MFLINKS). The merged subset contains 1,719 unique funds over the sample period, of which 1,493 have the data required for the Q-Score analysis. This is undertaken as a robustness check, and in order to gain insight into the characteristics of the funds contained in the sample across the Q-Score sorted deciles. These results are provided in Table 10. Overall they are consistent with those reported for the s12 database sample.

The average Annual Net CRSP Returns (calculated using the CMFD) for each decile are similar to the Annual Raw Returns which are calculated using the funds' holdings. Funds holding low quality stocks exhibit particularly poor performance, with DGTW-adjusted monthly returns of -0.45% (-5.30% p.a.) and -0.19% (-2.28% p.a.) for deciles 1 and 3, significant at the 5% level. Decile 2 also incurs a negative DGTW alpha of -0.13% per month (-1.57% p.a.), which is significant at the 10% level. Furthermore, the Annual 4-Factor[27] Model alpha for decile 1 is -2.81%, significant at the 1% level[28]. In addition, a weakly significant 4-Factor alpha is detected for decile 5. A *t*-test of the time-series difference in means between deciles 1 and 10 shows that the average return to decile 10 is 0.42% (5.22% p.a.) and 0.20% (2.39% p.a.) higher than decile 1 on a DGTW-adjusted and 4-Factor model

[27] The results are consistent when using a 3-Factor Model approach. The three factors are obtained from Ken French's data library available at: http://mba.tuck.dartmought.edu/pages/faculty/ken.french/data_library/f-f_factors.html

[28] The Annual 4-Factor Model alpha is the average annual excess fund return calculated following Carhart's (1997) 4-Factor model approach. Specifically, each month the following model is run over the prior 24 months: $y = \alpha + \beta_1(Rm\text{-}Rf) + \beta_2 SMB + \beta_3 HML + \beta_4 MOM + \varepsilon$, where *y* is the monthly Net CRSP fund return in excess of the US risk-free rate, *(Rm-Rf)*, *SMB* and *HML* are the market, size and value factors obtained from Ken French's data library, and MOM is a momentum factor calculated as in Carhart (1997). The parameter estimates are then used to calculate the 4-Factor alpha for the month, and these values are annualised using simple compounding.

basis, respectively, and these differences are significant at the 10% level. The mean Q-Score, Book-to-Market, Size and Momentum quintiles and IOC breakdown also exhibit comparable magnitudes and patterns.

INSERT TABLE 10

The mean values of various fund characteristics sourced from the CMFD are also provided in Table 10, as at June of year *t*. Turnover Ratio is the minimum (of aggregated sales or aggregated purchases of securities), divided by the average 12-month Total Net Assets (TNA) of the fund. Interestingly, funds in the lowest (highest) quality deciles have the highest (lowest) turnover ratios— the average turnover ratio is 124.89% for decile 1, compared to 48.64% for decile 10.

Total Load is the sum of the front and rear loads, reported annually. The Total Load is higher for higher quality funds, with an average Total Load for decile 10 of 1.22% compared to 0.65% for decile 1. Expense Ratio is the ratio of the total investment that shareholders pay for the fund's operating expenses. Funds in the lowest Q-Score deciles are characterised by higher Expense Ratios— specifically, the mean Expense Ratio for decile 1 (decile 10) is 1.88 (1.18).

Age is the number of years since the fund was first offered. Lower quality funds are slightly younger than higher quality funds, on average. TNA is as of month-end, i.e., June of year *t*, yet this does not appear to be a distinguishing factor across the Q-Score deciles.

5.6 Robustness Test: Regression Evidence

Regression analysis is undertaken in order to demonstrate the strength of the Q-Score as a predictor of Annual Net CRSP returns. In order to isolate the incremental explanatory power of the Q-Score, the F-Score and G-Score are also included as independent variables[29]. Specifically, the year *t+1* Annual Net CRSP returns for the funds are regressed on their quality scores for year *t*. Furthermore, the regression analysis is undertaken across all years and then within down periods and up periods to determine whether the relationship is different under different market conditions. A number of fund characteristic control variables as at year *t* are also included to test whether these account for the quality scores' relationships

[29] In order to ensure that the multivariate regressions are not affected by multicollinearity, the Variance Inflation (VIF) values for the three scores are first computed. The VIF values for the Q-Score, F-Score and G-Score are 1.5, 1.1 and 1.4, respectively. Thus, the parameter estimates are not affected by multicollinearity.

with fund performance. Similar to Carhart (1997), the following control variables are used: Turnover Ratio, Total Load, Expense Ratio, the natural log of Age and the natural log of TNA, all of which are defined in Section E. Carhart (1997) determines that expense ratios, turnover and load fees are negatively related to adjusted performance, whilst age and TNA are of less importance. Furthermore, Chen et al. (2004) identify a negative relationship between fund size and Net CRSP fund returns.

INSERT TABLE 11

Table 11 shows that the Q-Score has a positive and statistically significant relationship with Net CRSP returns over the complete period. Specifically, on average a one unit increase in the Q-Score is associated with a 0.97% increase in the Net CRSP return. Furthermore, the Q-Score's positive relationship with returns is driven by the down periods and is non-existent in the up periods. In particular, beta is 0.89% in the down periods compared to -0.14% in the up periods. Furthermore, the adjusted R^2 is higher in the down periods, with a value of 11.13%, compared to 3.26% in the up periods.

The F-Score and G-Score both have statistically significant negative relationships with Net CRSP returns for the complete period; however the F-Score is positively related to fund returns in up periods. Given the sizeable magnitude of the parameter estimates for the F-Score, the distribution of the F-Scores for the funds is examined. This reveals that the F-Scores do not differ dramatically, with a value of 5.07 (7.07) for the first (99^{th}) percentile. Thus, given the F-Score's narrow distribution, it is not able to differentiate between the funds on the basis of performance.

In addition, a statistically significant negative relationship with Net CRSP returns is detected for turnover and the log of TNA, the latter being consistent with Chen et al. (2004). Overall, the multivariate regression results provide further support for the Q-Score, as it remains highly statistically significant in the presence of the other quality scores and the fund characteristic control variables.

6. Conclusion

This paper examines the portfolio holdings of US mutual funds in order to gain insight into the relationship between the quality of stocks held by a mutual fund and its performance.

Quality is defined using a Q-Score which is the composite of 14 accounting metrics. Firstly, each metric is investigated individually following the approach used by Ali et al. (2008), in which they calculate an IM to test whether mutual funds trade on the accrual anomaly. Furthermore, a new aggregation method is used to create the Q-Score, which accounts for more complex relationships than a simple binary approach would allow. The Q-Score enhances the proportion of future earnings and stock returns that is explainable relative to the existing F-Score and G-Score. The tests involving the Q-Score allow us to gain insight into the level of stock and fund quality in the US, how quality relates to performance and how this has changed over time.

This study shows that low quality stocks underperform high quality stocks and that high quality stocks offer downside protection in market declines. In addition, substantial underperformance and increased volatility is evident for funds which are characterised by holding stocks with the lowest levels of quality. Furthermore, the performance of low and high quality funds diverges substantially during times of market volatility. There are significant losses which may be incurred on the downside, however the relationship is asymmetric, as a strong positive relationship with alpha for high quality stocks is not evident. This study therefore supports the assertion that quality assets in a portfolio are important, particularly in volatile periods. Additionally, the overall level of quality of the stocks that mutual funds invest in has increased over time. Further research exploring how a timing strategy could be used to take advantage of the downside protection offered by quality stocks would be interesting.

7. Appendices

Appendix A: Database Construction

The s12 dataset provides information on mutual funds which is divided into distinct table ‘types’:

1. Section 12 (from the SEC form) Type 1 Table - Fund Characteristics
2. Section 12 Type 2 Table - Stock Characteristics
3. Section 12 Type 3 Table - Holdings
4. Section 12 Type 4 Table - Change in Holdings

In order to account for the fact that Thomson Reuters carries forward stale holdings data where subsequent quarters are missing, only the first vintage date (FDATE) with holdings data for each report date (RDATE)-fund number (FUNDNO) combination is selected (Kacperczyk et al., 2008). This data is then merged with the Type 3 holdings data table based on the FUNDNO and FDATE.

The required stock characteristic information is obtained from CRSP (via WRDS) as opposed to the s12 Type 2 table due to the fact that the stock price series in some cases are stale—representing the closing price of the prior quarter, especially in 1999 and 2000 data. The CRSP universe is limited to stocks with share codes 10 and 11 which apply to common stocks of US firms. The adjusted prices are computed by dividing the absolute value of the raw prices by the ‘Cumulative Factor to Adjust Prices’. It is necessary to take the absolute value of the price, as the negative average of the bid and ask price is used when the closing price is missing. The variable ‘Total Shares Outstanding, Adjusted (TSO)’ is computed as follows: Number of Shares Outstanding*Cumulative Factor to Adjust Shares (CFACSHR)*1,000. All values for which TSO is not greater than zero are deleted.

The CRSP dataset is merged with the holdings data by mapping the Thomson Reuters historical Committee on Uniform Security Identification Procedures (CUSIP) identifier to the CRSP unique Permanent Security Identification Number (PERMNO) when the FDATE and CRSP date are equal. The FDATE is the vintage filing date and it is not the date for which the holdings data is valid— *that* date is the RDATE. Holding adjustments are made for stock splits, stock distributions, mergers and acquisitions and other corporate events, such that the number of shares held (SHARES) values are adjusted for stock splits that occur between the RDATE and FDATE. Thus, it is necessary to adjust the SHARES values as of the FDATE. It is a well-known issue with the s12 database that the stock level adjustments are made at the end of the quarter as per the FDATE, and these adjustments cannot always be synchronised with the RDATE. In contrast, the stock price data from CRSP is linked to the holdings data using the RDATE, as this is the date for which the holdings are valid. Specifically, the adjusted shares held values are calculated by multiplying the SHARES values by the CFACSHR.

The holdings snapshots are assigned to calendar quarters based on the month of the RDATE, which is consistent with Wermers (2000), and it is appropriate given that the majority of funds report their holdings as per the calendar quarters.

The fund returns are calculated by value-weighting the returns to the stock holdings each quarter. The quarterly return for each stock is computed using simple compounding of the component month buy-and-hold returns obtained from CRSP. The weight applied to each stock is its holding value as at the end of the prior quarter, divided by the fund's contemporaneous portfolio value. Thus, these weights are normalised so that the sum of the weights equals one. Specifically, the holding value is the product of the adjusted shares held and the stock price at the end of the prior quarter, and only observations where the holding value is greater than zero are retained.

In order to compute the DGTW-adjusted fund returns, each stock is assigned to its characteristic matched benchmark portfolio and the quarterly return to this portfolio is subtracted from the stock's raw return.

Furthermore, given that the stock weights applied are as at the end of the prior quarter, the holdings snapshots are assigned to calendar quarters as follows:

- If the month of the RDATE is October, November or December of year *t-1*, then these are the stock weights used to compute the fund returns for quarter one of year *t*.
- If the month of the RDATE is January, February or March of year *t*, then these are the stock weights used to compute the fund returns for quarter two of year *t*.
- If the month of the RDATE is April, May or June of year *t*, then these are the stock weights used to compute the fund returns for quarter three of year *t*.

- If the month of the RDATE is July, August or September of year *t*, then these are the stock weights used to compute the fund returns for quarter four of year *t*.

If there is more than one holdings report filed by a fund in a given quarter, then only the most recent holdings snapshot is retained. The dollar value of assets under management at the end of the quarter and the corresponding stock counts are computed. All funds with portfolio assets less than $5 million and those which held less than ten stocks as at the end of the quarter are subsequently excluded (Kacperczyk et al., 2008). The assets and number of stocks values are winsorised at the 99th percentile, given that the minimum values are already established.

Appendix B: Rolling Regression Results

This table summarises the results from univariate regressions of alpha on each metric value and its square. The regressions are run over rolling time periods. The first regression is run using the estimation period 1989-1998 (subset 1); the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at June of 2000, and alpha is examined from July 2000 to June 2001. Essentially, this allows the predictive capability of the Q-Score constructed to be examined without the impact of any hindsight biases. The second regression is run using data from 1989 to 1999, the third from 1989 to 2000 and so on up to an estimation period of 1989 to 2006 (subset 9). Thus, the parameter estimates for each of the nine regressions are used on the associated metric values for the following year. Overall, the Q-Score is calculated for nine years ranging from 1999 to 2007, and the associated DGTW alpha is examined over nine periods from July 2000 to June 2009. The regression model is as follows: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Subset	β_1	Standard Error	*t*-statistic	p-value	β_2	Standard Error	*t*-statistic	p-value	Year β_1 & β_2 Applied to Metric Value
				Return-on-Equity (ROE)					
1	5.85***	0.86	6.81	0.00	-1.31***	0.46	-2.85	0.00	1999
2	7.96***	0.83	9.65	0.00	-0.89**	0.44	-2.04	0.04	2000
3	9.77***	0.78	12.47	0.00	-0.55	0.41	-1.34	0.18	2001
4	9.15***	0.75	12.19	0.00	-0.51	0.40	-1.28	0.20	2002
5	9.12***	0.73	12.54	0.00	-0.53	0.39	-1.36	0.17	2003
6	9.53***	0.70	13.64	0.00	-0.43	0.37	-1.15	0.25	2004
7	9.51***	0.68	14.08	0.00	-0.35	0.36	-0.96	0.34	2005
8	9.38***	0.65	14.35	0.00	-0.33	0.35	-0.94	0.35	2006
9	9.28***	0.63	14.69	0.00	-0.43	0.34	-1.28	0.20	2007
				Change in ROE					
1	2.34***	0.68	3.44	0.00	-5.96***	0.54	-10.98	0.00	1999
2	3.19***	0.65	4.89	0.00	-6.77***	0.52	-13.05	0.00	2000
3	3.51***	0.61	5.72	0.00	-7.64***	0.49	-15.75	0.00	2001
4	3.19***	0.59	5.42	0.00	-7.10***	0.47	-15.25	0.00	2002
5	3.40***	0.57	5.97	0.00	-6.94***	0.45	-15.37	0.00	2003
6	3.32***	0.55	6.03	0.00	-6.93***	0.44	-15.88	0.00	2004
7	3.68***	0.54	6.88	0.00	-6.63***	0.42	-15.64	0.00	2005
8	3.61***	0.52	6.91	0.00	-6.54***	0.41	-15.81	0.00	2006
9	3.69***	0.51	7.27	0.00	-6.64***	0.40	-16.51	0.00	2007
				Return-on-Assets (ROA)					
1	15.41***	2.09	7.38	0.00	-5.23**	2.61	-2.00	0.05	1999
2	20.69***	2.00	10.34	0.00	-1.63	2.47	-0.66	0.51	2000
3	24.24***	1.89	12.81	0.00	-0.93	2.29	-0.41	0.68	2001
4	21.40***	1.81	11.83	0.00	-1.55	2.20	-0.70	0.48	2002
5	20.87***	1.75	11.93	0.00	-2.42	2.14	-1.13	0.26	2003
6	22.54***	1.68	13.41	0.00	-1.27	2.05	-0.62	0.54	2004
7	22.01***	1.63	13.54	0.00	-2.04	1.99	-1.02	0.31	2005
8	21.93***	1.57	13.94	0.00	-2.09	1.93	-1.08	0.28	2006
9	22.50***	1.52	14.78	0.00	-1.36	1.87	-0.73	0.47	2007

Appendix B: Continued

Subset	β_1	Standard Error	*t*-statistic	p-value	β_2	Standard Error	*t*-statistic	p-value	Year β_1 & β_2 Applied to Metric Value
				Change in ROA					
1	1.21	1.70	0.71	0.48	-45.69***	3.59	-12.74	0.00	1999
2	3.17**	1.61	1.96	0.05	-50.92***	3.38	-15.05	0.00	2000
3	3.04**	1.52	2.00	0.05	-57.68***	3.11	-18.52	0.00	2001
4	2.13	1.45	1.47	0.14	-50.75***	2.94	-17.24	0.00	2002
5	3.13**	1.39	2.26	0.02	-48.94***	2.84	-17.25	0.00	2003
6	3.16**	1.33	2.38	0.02	-49.52***	2.73	-18.14	0.00	2004
7	4.17***	1.29	3.23	0.00	-48.72***	2.65	-18.35	0.00	2005
8	4.43***	1.26	3.52	0.00	49.27***	2.59	-19.00	0.00	2006
9	4.33***	1.23	3.53	0.00	-49.19***	2.53	-19.46	0.00	2007
				Operating Cash Flow					
1	31.69***	2.22	14.29	0.00	11.65***	4.49	2.59	0.01	1999
2	37.09***	2.13	17.41	0.00	17.11***	4.27	4.01	0.00	2000
3	40.96***	2.02	20.23	0.00	17.39***	4.04	4.30	0.00	2001
4	38.22***	1.92	19.87	0.00	17.64***	3.85	4.58	0.00	2002
5	37.18***	1.86	20.03	0.00	15.66***	3.73	4.20	0.00	2003
6	38.36***	1.79	21.48	0.00	16.08***	3.59	4.48	0.00	2004
7	37.06***	1.73	21.44	0.00	14.33***	3.47	4.12	0.00	2005
8	36.27***	1.67	21.67	0.00	12.37***	3.37	3.67	0.00	2006
9	36.13***	1.62	22.25	0.00	12.21***	3.26	3.74	0.00	2007
				Accruals					
1	-14.09***	2.24	-6.28	0.00	-112.66***	8.01	-14.06	0.00	1999
2	-12.45***	2.17	-5.73	0.00	118.00***	7.75	-15.22	0.00	2000
3	-10.23***	2.08	-4.91	0.00	-125.69***	7.39	-17.01	0.00	2001
4	-11.73***	2.01	-5.84	0.00	-112.16***	6.99	-16.06	0.00	2002
5	-11.37***	1.96	-5.79	0.00	-111.57***	6.80	-16.42	0.00	2003
6	-10.38***	1.91	-5.45	0.00	-112.50***	6.61	-17.03	0.00	2004
7	-9.06***	1.86	-4.88	0.00	-112.53***	6.43	-17.49	0.00	2005
8	-8.97***	1.81	-4.96	0.00	-115.58***	6.28	-18.41	0.00	2006
9	-8.40***	1.76	-4.76	0.00	-114.66***	6.11	-18.77	0.00	2007
				ROA Variability					
1	-43.85***	7.11	-6.17	0.00	25.23***	5.25	4.80	0.00	1999
2	-53.72***	6.71	-8.00	0.00	31.90***	4.96	6.43	0.00	2000
3	-61.02***	6.22	-9.80	0.00	33.53***	4.57	7.33	0.00	2001
4	-50.82***	5.77	-8.81	0.00	28.89***	4.24	6.81	0.00	2002
5	-51.17***	5.49	-9.33	0.00	29.62***	4.02	7.36	0.00	2003
6	-52.42***	5.01	-10.46	0.00	29.81***	3.64	8.19	0.00	2004
7	-49.17***	4.72	-10.42	0.00	28.62***	3.42	8.37	0.00	2005
8	-47.74***	4.53	-10.53	0.00	27.92***	3.29	8.48	0.00	2006
9	-47.66***	4.36	-10.93	0.00	27.90***	3.17	8.81	0.00	2007
				Sales Growth Variability					
1	-1.25***	0.33	-3.84	0.00	0.02***	0.01	2.89	0.00	1999
2	-1.35***	0.31	-4.34	0.00	0.03***	0.01	3.21	0.00	2000
3	-1.85***	0.29	-6.30	0.00	0.04***	0.01	4.84	0.00	2001
4	-1.47***	0.28	-5.32	0.00	0.03***	0.01	3.92	0.00	2002
5	-1.46***	0.26	-5.52	0.00	0.03***	0.01	3.97	0.00	2003
6	-1.54***	0.24	-6.28	0.00	0.03***	0.01	4.48	0.00	2004
7	-1.35***	0.23	-5.86	0.00	0.02***	0.01	4.04	0.00	2005
8	-1.45***	0.23	-6.44	0.00	0.03***	0.01	4.55	0.00	2006
9	-1.44***	0.22	-6.57	0.00	0.03***	0.01	4.67	0.00	2007
				Asset Turnover (ATO)					
1	0.74*	0.38	1.94	0.05	-0.77***	0.16	-4.97	0.00	1999
2	0.72*	0.37	1.96	0.05	-0.71***	0.15	-4.70	0.00	2000
3	1.95***	0.36	5.50	0.00	-1.04***	0.15	-7.11	0.00	2001
4	1.41***	0.34	4.11	0.00	-0.89***	0.14	-6.32	0.00	2002
5	1.68***	0.34	5.01	0.00	-0.97***	0.14	-7.00	0.00	2003
6	2.02***	0.33	6.19	0.00	-1.04***	0.13	-7.69	0.00	2004
7	2.16***	0.32	6.80	0.00	-1.06***	0.13	-8.08	0.00	2005
8	2.31***	0.31	7.47	0.00	-1.10***	0.13	-8.63	0.00	2006
9	2.25***	0.30	7.48	0.00	-1.11***	0.12	-8.96	0.00	2007

Appendix B: Continued

				Leverage					
1	-5.60	7.57	-0.74	0.46	4.16	3.26	1.27	0.20	1999
2	-3.52	6.56	-0.54	0.59	3.06	2.86	1.07	0.29	2000
3	-0.31	5.93	-0.05	0.96	1.56	2.59	0.60	0.55	2001
4	0.30	5.35	0.06	0.96	1.37	2.34	0.59	0.56	2002
5	-5.16	5.24	-0.98	0.33	3.27	2.29	1.43	0.15	2003
6	-3.21	4.79	-0.67	0.50	2.56	2.09	1.23	0.22	2004
7	-4.67	4.60	-1.02	0.31	2.51	2.01	1.25	0.21	2005
8	-3.00	4.39	-0.68	0.50	2.14	1.93	1.11	0.27	2006
9	-2.25	4.12	-0.55	0.59	1.66	1.80	0.92	0.36	2007
10	-2.36	3.86	-0.61	0.54	1.65	1.69	0.98	0.33	2008
				Liquidity					
1	0.37	6.87	0.05	0.96	-8.23	6.35	-1.30	0.20	1999
2	1.38	6.05	0.23	0.82	-7.54	5.61	-1.34	0.18	2000
3	3.47	5.42	0.64	0.52	-6.36	5.05	-1.26	0.21	2001
4	3.24	4.84	0.67	0.50	-5.52	4.54	-1.22	0.22	2002
5	1.60	4.71	0.34	0.73	-3.56	4.40	-0.81	0.42	2003
6	3.22	4.33	0.74	0.46	-3.00	4.03	-0.74	0.46	2004
7	3.19	4.11	0.78	0.44	-2.28	3.82	-0.60	0.55	2005
8	1.65	3.87	0.43	0.67	-3.50	3.61	-0.97	0.33	2006
9	1.17	3.57	0.33	0.74	-2.75	3.37	-0.82	0.41	2007
10	1.44	3.30	0.44	0.66	-2.46	3.16	-0.78	0.44	2008
				Change in Shares Outstanding					
1	21.06***	7.28	2.89	0.00	-6.43***	2.12	-3.03	0.00	1999
2	15.49**	6.17	2.51	0.01	-5.12***	1.80	-2.85	0.00	2000
3	10.90**	5.45	2.00	0.05	-3.90**	1.58	-2.47	0.01	2001
4	8.77*	4.93	1.78	0.08	-3.17**	1.43	-2.22	0.03	2002
5	7.89	4.86	1.62	0.10	-3.30**	1.42	-2.32	0.02	2003
6	6.29	4.51	1.40	0.16	-2.91**	1.32	-2.21	0.03	2004
7	8.22*	4.28	1.92	0.06	-3.26***	1.26	-2.58	0.01	2005
8	6.27	4.07	1.54	0.12	-2.76**	1.20	-2.30	0.02	2006
9	5.45	3.77	1.45	0.15	-2.36**	1.12	-2.11	0.04	2007
10	5.31	3.48	1.53	0.13	-2.24**	1.04	-2.15	0.03	2008
				Change in Total Equity					
1	-8.94***	2.42	-3.70	0.00	0.55**	0.24	2.32	0.02	1999
2	-7.39***	2.15	-3.43	0.00	0.40*	0.21	1.91	0.06	2000
3	-5.67***	1.88	-3.02	0.00	0.29	0.18	1.58	0.11	2001
4	-5.03***	1.72	-2.93	0.00	0.25	0.17	1.50	0.14	2002
5	-5.14***	1.69	-3.04	0.00	0.25	0.17	1.47	0.14	2003
6	-4.28***	1.56	-2.75	0.01	0.17	0.16	1.10	0.27	2004
7	-3.61**	1.47	-2.46	0.01	0.13	0.15	0.91	0.36	2005
8	-3.13**	1.37	-2.28	0.02	0.12	0.14	0.86	0.39	2006
9	-2.91	2.52	-1.15	0.25	0.08	0.25	0.32	0.75	2007
10	-2.28**	1.16	-1.96	0.05	0.11	0.12	0.94	0.35	2008

Appendix C*:* Active-Weighting Methodology

The active-weighting approach calculates stock level weights based on market capitalisation and the positions that mutual funds as a whole are taking in a given stock. It involves initially calculating each stock's share of the market relative to the universe of stocks, as at the end of June of each year *t* (MC-Weight$_{i,t}$).

$$\text{MC-Weight}_{i,t} = \frac{Market\ Capitalisation_{i,t}}{\sum_{i=1}^{N} Market\ Capitalisation_{i,t}}$$

where

- Market Capitalisation of stock *i*, at the end of June of year *t* = PRC*Shares
- PRC = unadjusted price of stock *i* at the end of June of year *t* from CRSP
- Shares = unadjusted number of shares outstanding for stock *i* at the end of June of year *t* from CRSP
- *N* = the number of stocks in the universe in June of year *t*

Subsequently, the total holding value of each stock *i*, per mutual fund *j* in June of each year *t* is calculated (MF-Weight$_{i,j,t}$).

$$\text{MF-Weight}_{i,j,t} = \frac{HVALUE_{i,\,t}}{\sum_{i=1}^{N} HVALUE_{i,j,t}}$$

where

- The holding value (HVALUE) of stock *i*, at the end of June of year *t* = P * Adj-Shares
- P = adjusted price of stock *i* at the end of June of year *t* from CRSP
- Adj-Shares = adjusted shares held as per the June report date of year *t* from the s12 holdings data
- *N* = the number of stocks in the universe held by fund *j* in June of year *t*

It is then possible to calculate the positions each mutual fund is taking in each stock as follows:

$$\text{Mutual Fund Position (Position)}_{i,j,t} = \text{MF-Weight}_{i,j,t} - \text{MC-Weight}_{i,t}$$

where

- Position indicates whether fund *j* is overweight/underweight stock *i* in June of year *t*
- If the fund is overweight (underweight) stock *i*, the position will be positive (negative)

The sum of the positions in stock *i* taken by all of the funds which held stock *i* in June of year *t* is calculated. The position in stock *i* taken by each fund *j* is weighted by the size of the fund, in June of year *t*.

$$SumPosition_{i,t} = \sum_{j=1}^{K} Position_{i,j,t} \times W_{j,t}$$

where

- K = the number of funds which held stock *i* in June of year *t*
- $W_{j,t} = \dfrac{Assets_{j,t}}{Total\ Assets_t}$

where

$$Assets_{j,t} = \sum_{i=1}^{N} HVALUE_{i,j,t}$$

where

N = the number of stocks held by fund *j* in June of year *t* and;

$$Total\ Assets_t = \sum_{j=1}^{K} Assets_{j,t}$$

Subsequently, the total weight to be applied to each stock *i* as at June of year *t* is able to be computed as follows:

$$\text{Total Weight}_{i,t} = \text{SumPosition}_{i,t} + \text{MC-Weight}_{i,t}$$

The Total Weight is an active-weight which reflects the total underweight/overweight positions that mutual funds are taking in a given stock, adjusted for the market-capitalisation weight of the stock. The advantage of using this weight definition is that it allows the relationship between the positions that mutual funds take in a stock and the corresponding average returns and characteristics for that stock to be clearly identified.

Appendix D: Average Returns and Characteristics of Metric sorted Deciles

Profitability Metrics																
	Panel A: Compustat/CRSP/DGTW Universe								Panel B: Mutual Fund Holdings							
	1. Return on Equity (%)								*Return on Equity (%)*							
Decile Portfolios	No. of Stocks	Size ($ Million)	Metric Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)	No. of Stocks	Size ($ Million)	Metric Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
P1	356	280	-127.41	-6.83 (-1.24)	-12.52**** (-4.60)	61.44	55.07	23.04	213	400	-124.55	-2.28 (-0.40)	-8.42*** (-3.63)	54.24	48.26	22.32
P2	356	345	-32.68	0.17 (0.03)	-6.66** (-2.31)	53.58	46.53	21.12	245	470	-32.74	0.66 (0.13)	-7.23** (-2.60)	51.88	44.67	21.10
P3	357	492	-14.07	8.79* (2.00)	-0.08 (-0.05)	42.13	36.81	19.54	267	629	-14.10	9.60** (2.12)	0.41 (0.22)	41.17	35.90	19.14
P4	356	797	-5.85	7.55* (1.85)	-2.68 (-1.45)	37.36	31.88	18.59	281	959	-5.83	6.37 (1.48)	-3.02 (-1.56)	37.35	31.81	18.72
P5	356	1,090	-0.79	8.30** (2.46)	-1.75 (-1.37)	32.01	27.56	17.69	301	1,220	-0.83	8.56** (2.63)	-1.72 (-1.58)	32.76	28.30	18.00
P6	357	1,421	2.93	9.23** (2.67)	-0.05 (-0.03)	29.42	25.85	17.28	318	1,580	2.95	9.20** (2.64)	-0.04 (-0.03)	30.15	26.52	17.48
P7	356	1,719	6.26	7.58** (2.45)	-1.67 (-1.73)	30.22	26.18	17.07	323	1,861	6.25	7.82** (2.46)	-1.70 (-1.66)	31.41	27.33	17.37
P8	356	2,384	10.35	7.95** (2.73)	-1.15 (-1.37)	29.90	25.26	17.29	327	2,555	10.34	7.74** (2.64)	-1.18 (-1.18)	30.92	26.32	17.61
P9	356	3,908	16.57	8.46** (2.72)	-0.20 (-0.17)	28.33	23.51	16.75	325	4,179	16.50	8.64** (2.68)	-0.13 (-0.11)	30.23	25.38	17.33
P10	356	3,801	37.37	8.07* (2.03)	-0.99 (-0.85)	30.37	25.23	17.41	306	4,268	37.98	7.46* (1.92)	-1.64 (-1.56)	32.70	27.51	18.04
	2. Change in Return on Equity (%)								*Change in Return on Equity (%)*							
P1	352	547	-61.25	-0.37 (-0.08)	-6.92*** (-3.17)	49.02	42.62	20.78	233	743	-61.67	1.21 (0.26)	-5.94*** (-3.02)	46.58	40.37	20.83
P2	352	898	-17.48	4.83 (1.09)	-4.11** (-2.60)	38.65	33.80	18.92	269	1,123	-17.43	5.58 (1.25)	-3.44** (-2.55)	38.91	33.86	18.88
P3	352	1,330	-7.99	6.91* (1.75)	-1.94 (-1.46)	32.73	27.46	18.10	288	1,563	-8.01	6.89* (1.74)	-2.08 (-1.42)	33.13	28.15	18.09
P4	352	1,592	-3.31	8.39*** (2.89)	-1.27 (-1.02)	29.16	25.21	17.18	304	1,794	-3.34	8.13** (2.65)	-1.53 (-1.41)	30.04	25.84	17.34
P5	352	2,147	-0.65	9.26*** (3.02)	0.21 (0.14)	25.51	22.43	16.39	313	2,352	-0.64	8.90*** (2.93)	-0.19 (-0.15)	26.59	23.56	16.67
P6	352	2,574	1.49	10.50*** (3.23)	0.56 (0.49)	27.40	23.32	16.56	316	2,830	1.47	10.87*** (3.34)	1.25* (1.74)	28.63	24.51	17.01
P7	352	2,657	3.88	8.49*** (3.02)	-0.56 (-0.52)	28.52	23.40	16.86	314	2,900	3.89	8.50*** (3.03)	-0.92 (-0.76)	30.15	25.18	17.37
P8	352	2,254	7.82	8.25** (2.42)	-0.43 (-0.30)	30.98	26.04	17.64	302	2,549	7.88	8.49** (2.46)	-0.44 (-0.35)	32.88	27.76	18.03
P9	352	1,503	16.15	5.76 (1.41)	-2.57 (-1.45)	36.68	31.28	18.11	287	1,757	16.07	5.98 (1.46)	-2.64 (-1.55)	38.02	32.53	18.72
P10	352	833	55.74	5.01 (1.14)	-4.36** (-2.50)	44.61	38.23	19.47	252	1,062	56.54	5.64 (0.21)	-3.87** (-2.46)	44.45	37.95	20.01
	3. Return on Assets (%)								*Return on Assets (%)*							
P1	356	191	-56.76	-13.88** (-2.61)	-19.65**** (-5.88)	73.67	66.47	24.40	210	271	-53.81	-9.74 (-1.64)	-16.41**** (-4.88)	67.10	59.68	23.72
P2	356	328	-15.69	-1.17 (-0.22)	-6.36* (-1.94)	55.50	48.29	21.85	243	443	-15.64	-0.22 (-0.04)	-6.60* (-1.98)	53.75	46.26	21.72
P3	357	557	-5.07	7.04 (1.42)	-1.93 (-0.79)	42.15	36.40	19.57	267	710	-5.11	7.92 (1.56)	-1.34 (-0.55)	41.56	35.93	19.32
P4	356	1,015	-1.27	10.15** (2.63)	-0.71 (-0.44)	35.40	30.40	18.39	286	1,213	-1.27	8.65** (2.24)	-1.55 (-0.93)	35.17	30.17	18.38
P5	356	1,641	0.85	8.35** (2.43)	-1.62 (-1.71)	29.11	25.61	17.26	308	1,819	0.83	8.73** (2.52)	-1.45 (-1.47)	29.71	26.21	17.47
P6	357	1,807	2.50	7.63** (2.32)	-1.55 (-1.32)	29.28	25.25	16.87	314	2,013	2.50	7.84** (2.19)	-1.51 (-1.33)	29.89	25.75	17.04
P7	356	2,012	4.31	7.41** (2.26)	-1.71 (-1.20)	28.40	24.20	16.83	318	2,208	4.31	7.85** (2.44)	-1.47 (-0.94)	29.35	25.27	17.05
P8	357	2,584	6.65	10.22*** (3.20)	0.77 (0.66)	29.16	24.65	16.97	321	2,810	6.62	10.15*** (3.19)	0.49 (0.52)	30.55	26.06	17.17
P9	356	2,911	10.11	8.76** (2.80)	0.37 (0.30)	30.09	25.36	17.31	321	3,127	10.09	8.71** (2.66)	0.33 (0.28)	32.05	27.14	18.04
P10	356	3,190	18.28	7.41* (1.88)	-1.56 (-1.09)	31.81	26.21	17.66	316	3,507	18.61	6.40 (1.67)	-2.36 (-1.72)	34.68	29.02	18.45

Profitability Metrics continued																		
	Panel A: Compustat/CRSP/DGTW Universe									Panel B: Mutual Fund Holdings								
	4. Change in Return on Assets (%)									*Change in Return on Assets (%)*								
P1	352	379	-29.93	-2.15 (-0.43)	-7.51** (-2.53)	58.35	51.45	21.92		352	512	-28.86	-0.59 (-0.12)	-6.80** (-2.56)	54.10	47.09	21.57	
P2	352	746	-8.80	2.93 (0.65)	-5.59** (-2.76)	40.80	35.21	19.11		352	947	-8.89	4.07 (0.90)	-4.84** (-2.70)	40.76	35.27	19.13	
P3	352	1,403	-3.91	6.87* (1.74)	-2.09 (-1.57)	33.05	27.99	18.11		352	1,638	-3.94	7.35* (1.81)	-1.64 (-1.16)	33.65	28.69	18.22	
P4	352	1,883	-1.61	8.72*** (2.94)	-0.53 (-0.42)	28.79	24.76	17.46		352	2,104	-1.62	8.12** (2.55)	-1.20 (-1.04)	29.69	25.57	17.45	
P5	352	2,378	-0.38	10.18*** (3.12)	0.28 (0.21)	25.58	22.40	16.39		352	2,607	-0.37	10.55*** (3.16)	0.51 (0.43)	26.45	23.30	16.62	
P6	352	3,017	0.61	9.80*** (3.06)	0.35 (0.26)	27.06	22.97	16.52		352	3,278	0.61	9.93*** (3.21)	0.28 (0.25)	28.09	24.09	16.78	
P7	352	2,568	1.82	9.28*** (3.01)	-0.37 (-0.36)	28.54	23.65	16.92		352	2,813	1.82	9.12*** (3.01)	-0.31 (-0.31)	30.23	25.41	17.50	
P8	352	1,953	3.69	6.73* (2.09)	-1.24 (-0.93)	31.88	26.58	17.42		352	2,200	3.69	7.10** (2.21)	-1.31 (-1.19)	33.50	28.15	17.92	
P9	352	1,338	7.70	5.14 (1.19)	-2.86 (-1.66)	38.45	33.01	18.74		352	1,579	7.65	6.23 (1.47)	-2.16 (-1.36)	39.67	34.18	19.34	
P10	352	668	22.47	3.98 (0.84)	-5.66** (-2.49)	49.75	42.40	20.38		352	870	22.41	3.51 (0.71)	-6.25** (-2.74)	49.46	41.77	20.97	
	5. Operating Cash Flow									*Operating Cash Flow*								
P1	356	112	-0.34	-9.64** (-2.18)	-16.55**** (-6.43)	74.30	67.31	24.04		215	168	-0.37	-5.35 (-1.18)	-13.24**** (-4.90)	68.30	60.73	23.65	
P2	356	302	-0.11	-4.66 (-0.93)	-12.66**** (-4.71)	56.55	50.07	21.08		243	346	-0.13	-2.74 (-0.55)	-10.99**** (-4.28)	52.86	46.21	20.86	
P3	357	616	-0.05	3.62 (0.92)	-4.71** (-2.62)	45.91	39.71	20.36		270	617	-0.05	3.33 (0.77)	-4.94** (-2.56)	44.77	38.43	20.36	
P4	356	1,209	-0.02	5.24 (1.38)	-3.56** (-2.65)	36.56	31.74	18.90		296	1,239	-0.02	4.31 (1.10)	-4.47*** (-3.57)	36.91	31.86	19.06	
P5	356	1,657	0.01	7.75* (2.09)	-0.63 (-0.62)	32.13	28.07	17.68		307	1,736	0.01	7.94** (2.13)	-0.87 (-0.75)	32.32	28.14	17.54	
P6	357	2,024	0.03	7.54** (2.19)	-1.55 (-1.66)	30.14	26.22	17.09		314	1,964	0.03	8.15** (2.43)	-1.14 (-1.20)	30.64	26.63	17.17	
P7	356	2,043	0.05	8.99*** (2.98)	-0.72 (-0.79)	29.84	25.78	17.06		317	2,156	0.05	8.84*** (2.88)	-1.08 (-1.18)	30.58	26.66	17.20	
P8	356	2,142	0.08	7.78** (2.63)	-1.02 (-0.96)	28.20	23.05	16.92		316	3,117	0.08	7.87** (2.51)	-1.01 (-0.91)	29.52	24.65	17.25	
P9	356	2,424	0.13	8.88*** (2.89)	0.25 (0.19)	28.59	23.97	16.81		318	3,493	0.11	9.44** (2.74)	0.81 (0.72)	30.56	25.75	17.48	
P10	356	3,606	0.23	9.03** (2.39)	-0.49 (-0.34)	31.12	26.04	17.55		309	3,274	0.19	8.68** (2.34)	-0.74 (-0.51)	33.87	28.59	18.40	
	6. Accruals									*Accruals*								
P1	356	499	-0.20	4.48** (1.09)	-4.28* (-1.81)	51.08	44.97	20.89		237	694	-0.20	4.96 (1.23)	-5.01** (-2.46)	49.07	42.91	20.99	
P2	356	1,024	-0.08	5.34** (1.42)	-3.50** (-2.18)	39.01	33.36	18.83		277	1,254	-0.08	6.27 (1.54)	-2.41 (-1.38)	39.13	33.48	19.17	
P3	357	1,736	-0.04	8.68*** (2.46)	-0.97 (-0.77)	32.12	26.91	17.91		295	2035	-0.04	9.27** (2.43)	0.04 (0.04)	33.41	28.07	18.53	
P4	356	2,253	-0.02	8.34*** (2.24)	-0.27 (-0.28)	30.64	25.42	17.29		307	2556	-0.02	9.88** (2.71)	0.58 (0.63)	31.58	26.54	17.47	
P5	356	2,561	0.00	10.55** (3.81)	1.13 (1.00)	27.10	22.84	16.33		309	2864	0.00	9.29*** (3.09)	0.20 (0.19)	28.74	24.42	16.82	
P6	357	2,324	0.02	9.61 (2.96)	0.98 (1.12)	28.25	24.71	17.09		313	2554	0.02	9.61*** (2.89)	0.77 (0.85)	29.08	25.43	17.41	
P7	356	2,293	0.03	7.57 (2.25)	-2.12* (-1.78)	28.47	24.51	16.75		309	2553	0.03	7.47** (2.21)	-1.92 (-1.52)	29.74	25.72	17.14	
P8	356	1,958	0.05	6.24 (1.63)	-2.35 (-1.50)	31.17	26.48	17.50		302	2224	0.05	5.94 (1.60)	-2.98* (-1.98)	32.26	27.70	17.67	
P9	356	1,102	0.08	3.26 (0.96)	-3.95** (-2.72)	36.67	30.74	18.88		292	1284	0.08	3.09 (0.91)	-4.48*** (-2.91)	37.93	32.11	19.07	
P10	356	484	0.18	-0.10 (-0.02)	-7.58*** (-3.23)	48.50	42.13	20.36		266	593	0.17	1.01 (0.25)	-7.06*** (-3.19)	47.11	40.51	20.45	

Variability Metrics																		
	Panel A: Compustat/CRSP/DGTW Universe									Panel B: Mutual Fund Holdings								
	1. Earnings Growth Variability (%)									*Earnings Growth Variability (%)*								
P1	273	3,824	-0.26	9.21***	-0.19	24.35	21.20	15.92		259	3,922	-0.25	9.43**	-0.14	25.33	22.14	16.49	
				(3.15)	(-0.18)								(2.85)	(-0.13)				
P2	273	3,596	-0.25	8.32**	-0.13	25.91	21.92	16.36		272	3,799	-0.25	7.90**	-0.89	26.85	23.03	16.55	
				(2.66)	(-0.14)								(2.60)	(-1.08)				
P3	274	2,852	-0.23	9.11**	-0.53	27.91	23.42	16.73		249	3,082	-0.23	9.62***	-0.17	28.60	24.27	16.99	
				(2.83)	(-0.46)								(2.97)	(-0.13)				
P4	274	2,274	-0.19	9.06**	-1.05	28.09	23.42	17.07		244	2,518	-0.19	9.34**	-0.89	29.61	25.01	17.35	
				(2.82)	(-0.71)								(2.87)	(-0.65)				
P5	273	2,065	-0.13	5.50	-3.27***	32.25	26.72	17.97		238	2,323	-0.13	5.43	-3.28***	32.86	27.62	18.18	
				(1.67)	(-2.95)								(1.54)	(-2.90)				
P6	274	1,435	-0.01	10.03****	1.76	34.01	28.86	18.37		230	1,683	-0.01	10.45***	2.04	35.31	30.00	18.48	
				(2.95)	(1.12)								(3.00)	(1.66)				
P7	274	1,329	0.22	9.67*	1.31	36.66	30.66	18.60		221	1,583	0.22	9.70*	0.63	37.81	31.88	19.16	
				(2.08)	(0.78)								(2.05)	(0.36)				
P8	274	780	0.74	5.76	-2.96*	43.45	37.84	19.36		211	952	0.74	5.66	-3.18	43.75	37.69	19.63	
				(1.29)	(-1.89)								(1.22)	(-1.71)				
P9	274	616	2.48	3.50	-5.63**	48.97	42.34	20.03		201	802	2.45	4.75	-4.74*	47.69	41.02	20.33	
				(0.63)	(-2.25)								(0.84)	(-1.93)				
P10	273	319	26.22	0.02	-7.68**	58.75	51.86	22.36		184	426	23.30	2.09	-6.63*	55.89	48.70	22.06	
				(0.00)	(-2.42)								(0.33)	(-2.00)				
	2. Sales Growth Variability (%)									*Sales Growth Variability (%)*								
P1	269	4,359	-2.67	9.09***	-0.14	24.79	21.14	16.32		250	4,630	-2.67	9.18***	-0.16	25.49	22.14	16.51	
				(3.00)	(-0.13)								(2.97)	(-0.17)				
P2	269	3,424	-2.42	8.16**	-1.02	27.13	22.60	16.36		250	3,705	-2.42	8.43**	-1.08	27.92	23.63	16.59	
				(2.63)	(-0.91)								(2.75)	(-0.95)				
P3	269	2,308	-2.11	8.40**	-0.99	28.16	23.80	16.78		239	2,569	-2.11	8.11**	-1.33	29.49	25.20	16.94	
				(2.85)	(-0.82)								(2.60)	(-0.97)				
P4	269	1,659	-1.64	10.44**	0.48	31.36	27.05	17.44		236	1,882	-1.64	9.69**	-0.27	31.61	27.31	17.48	
				(2.86)	(0.44)								(2.61)	(-0.25)				
P5	269	1,608	-0.86	7.81**	-0.42	31.24	26.94	17.74		228	1,857	-0.86	7.84**	-0.51	32.41	27.93	18.13	
				(2.57)	(-0.35)								(2.51)	(-0.43)				
P6	269	1,519	0.40	7.73**	-1.99	33.16	27.90	17.81		225	1,763	0.38	6.73*	-2.38	34.54	29.18	18.35	
				(2.37)	(-1.32)								(1.93)	(-1.58)				
P7	269	1,404	2.43	5.20	-2.27	34.58	29.06	18.41		218	1,667	2.46	6.78*	-1.57	35.93	30.46	19.01	
				(1.66)	(-1.37)								(1.75)	(-0.97)				
P8	269	1,111	6.74	8.73**	-0.25	36.12	30.58	18.23		217	1,319	6.74	9.95**	0.59	36.63	30.81	18.54	
				(2.39)	(-0.15)								(2.60)	(0.36)				
P9	269	1,298	18.61	6.28	-2.16	38.74	33.18	18.84		211	1,536	18.44	6.68	-1.76	39.57	33.54	19.16	
				(1.41)	(-1.07)								(1.36)	(-0.74)				
P10	269	699	432.50	4.43	-5.17***	43.13	37.33	19.09		196	912	400.48	5.93	-4.08**	42.34	36.49	19.09	
				(1.22)	(-2.95)								(1.53)	(-2.46)				
Operating Efficiency Metrics																		
	1. Asset Turnover									*Asset Turnover*								
P1	356	761	-0.88	4.58	-4.10*	36.16	32.18	18.64		253	1,022	-0.88	4.75	-3.91*	34.97	31.00	18.61	
				(1.14)	(-1.83)								(1.11)	(-1.74)				
P2	356	2,345	-0.67	8.62**	-0.66	29.51	25.29	16.99		298	2,693	-0.67	9.87**	0.42	29.64	25.53	17.13	
				(2.19)	(-0.51)								(2.52)	(0.34)				
P3	357	2,087	-0.44	8.36**	-0.27	30.93	26.30	17.23		297	2,395	-0.44	8.74**	0.36	31.81	27.16	17.69	
				(2.65)	(-0.29)								(2.63)	(0.36)				
P4	356	1,959	-0.23	7.44**	-0.57	31.34	26.46	17.74		300	2,242	-0.23	7.44**	-0.44	32.70	27.69	18.14	
				(2.38)	(-0.47)								(2.24)	(-0.41)				
P5	356	2,338	-0.04	6.55*	-2.42**	28.75	23.68	17.36		302	2,688	-0.05	6.50*	-2.58**	30.89	25.76	17.66	
				(1.93)	(-2.17)								(1.84)	(-2.81)				
P6	357	1,904	0.13	8.84**	-0.63	28.97	24.71	16.62		296	2,186	0.13	8.39**	-1.15	31.34	26.92	17.28	
				(2.52)	(-0.54)								(2.28)	(-0.87)				
P7	356	1,302	0.34	6.49*	-2.16	34.13	29.11	17.95		296	1,529	0.34	6.21*	-2.87*	34.94	29.82	18.11	
				(2.01)	(-1.50)								(1.98)	(-1.98)				
P8	357	997	0.61	6.33*	-1.91	36.58	31.96	18.60		295	1,148	0.61	5.71	-2.34	36.64	31.91	18.86	
				(1.91)	(-0.93)								(1.66)	(-1.06)				
P9	356	1,004	1.07	8.19**	-1.76	37.31	32.37	18.37		284	1,198	1.08	8.50**	-1.78	37.54	32.53	18.60	
				(2.32)	(-0.95)								(2.39)	(-0.90)				
P10	356	1,541	2.28	6.56**	-2.55	33.93	27.99	18.19		285	1,851	2.32	7.13**	-2.60	35.66	30.04	18.69	
				(2.18)	(-1.58)								(2.39)	(-1.53)				

Operating Efficiency Metrics continued																		
	Panel A: Compustat/CRSP/DGTW Universe									Panel B: Mutual Fund Holdings								
	2. Change in Asset Turnover (%)									*Change in Asset Turnover (%)*								
P1	355	542	-36.33	5.70 (1.16)	-3.59** (-2.24)	39.29	33.95	19.23		245	739	-35.97	5.91 (1.23)	-3.35* (-1.96)	38.56	33.21	19.27	
P2	356	908	-14.25	7.79** (2.14)	-1.70 (-1.00)	33.62	29.55	17.71		272	1,120	-14.24	9.01** (2.29)	-0.93 (-0.48)	34.08	29.80	18.09	
P3	356	1,625	-7.65	9.66*** (3.04)	-0.54 (-0.41)	28.64	24.92	17.17		290	1,922	-7.66	9.66*** (2.97)	-0.53 (-0.39)	28.81	25.17	17.19	
P4	355	2,577	-3.81	9.17** (2.71)	-0.55 (-0.47)	26.91	22.83	16.50		303	2,931	-3.84	9.07** (2.56)	-0.45 (-0.41)	27.67	23.68	16.74	
P5	356	2,324	0.09	11.16*** (3.15)	1.36 (1.54)	27.54	23.70	16.92		306	2,642	0.10	11.08*** (3.09)	1.50* (1.91)	28.52	24.60	17.13	
P6	356	2,116	4.98	8.89*** (2.95)	0.60 (0.50)	29.73	25.04	17.21		304	2,348	4.97	9.27*** (3.04)	1.17 (0.98)	30.65	26.26	17.60	
P7	356	1,961	11.43	7.08** (2.25)	-0.84 (-0.64)	31.74	27.28	17.47		304	2,254	11.44	7.15* (2.09)	-1.32 (-1.26)	33.51	28.75	17.84	
P8	356	1,492	20.95	6.96* (1.84)	-2.17 (-1.22)	35.93	29.97	18.50		301	1,692	21.06	6.62* (1.76)	-2.44 (-1.44)	37.33	31.55	18.95	
P9	356	1,625	40.15	3.53 (1.17)	-5.20*** (-4.02)	37.08	31.64	17.90		295	1,847	40.13	4.01 (1.21)	-5.12*** (-3.92)	38.74	32.85	18.65	
P10	355	1,070	106.50	3.03 (0.67)	-5.16** (-2.15)	46.32	38.89	20.47		284	1,269	105.84	3.15 (0.75)	-5.59** (-2.34)	45.75	38.55	20.67	
Financial Health Metrics																		
	1. Leverage									*Leverage*								
P1	265	818	-0.18	10.32 (1.61)	1.47 (0.34)	43.48	38.40	20.27		161	1,046	-0.18	4.48 (0.87)	-3.81 (-1.72)	42.20	37.35	20.52	
P2	522	541	-0.14	4.92 (1.18)	-1.97 (-1.01)	44.50	38.48	19.63		418	678	-0.15	9.27 (1.15)	2.73 (0.48)	44.75	38.45	20.44	
P3	297	845	-0.13	4.00 (0.87)	-5.25*** (-2.95)	41.83	35.78	20.03		341	930	-0.13	4.44 (0.99)	-4.67*** (-2.92)	42.19	35.93	20.27	
P4	356	1,022	-0.08	7.92* (1.81)	-1.16 (-0.99)	34.31	29.17	18.35		276	1,284	-0.08	7.13 (1.72)	-1.64 (-1.50)	35.78	30.54	18.54	
P5	360	2,318	0.02	8.06** (2.48)	-0.82 (-0.60)	29.20	24.14	16.78		285	2,836	0.02	8.71** (2.52)	-0.68 (-0.47)	31.04	25.73	17.28	
P6	360	2,445	0.17	7.90** (2.16)	-0.90 (-0.71)	29.09	23.92	17.18		296	2,816	0.16	8.80** (2.48)	-0.34 (-0.29)	30.40	25.39	17.49	
P7	360	2,687	0.35	9.57*** (3.43)	-0.05 (-0.05)	28.22	23.37	16.61		309	3,081	0.35	8.61** (2.83)	-0.66 (-0.60)	30.08	25.23	17.12	
P8	360	2,285	0.60	7.90** (2.47)	-1.59 (-1.10)	28.95	25.25	17.20		316	2,520	0.60	7.81** (2.27)	-1.55 (-1.05)	29.89	26.15	17.40	
P9	360	2,020	0.98	7.62** (2.35)	-1.44 (-1.10)	28.76	25.39	16.89		315	2,219	0.98	8.09** (2.40)	-1.35 (-0.95)	28.94	25.67	16.94	
P10	360	1,421	2.64	7.20 (1.73)	-1.91 (-1.42)	35.25	30.90	18.28		296	1,637	2.67	7.66* (1.83)	-1.37 (-0.99)	34.98	30.74	18.27	
	2. Liquidity									*Liquidity*								
P1	350	3,182	-0.26	8.81** (2.69)	-0.89 (-0.59)	25.49	21.42	16.44		255	4,059	-0.26	9.41** (2.70)	-0.49 (-0.33)	25.93	22.25	16.48	
P2	351	3,091	-0.18	7.97** (2.44)	-1.26 (-0.93)	26.68	23.10	16.54		297	3,536	-0.18	8.35** (2.42)	-0.79 (-0.58)	27.50	24.06	16.76	
P3	351	2,611	-0.11	7.49** (2.35)	-0.58 (-0.56)	29.63	24.88	17.13		291	3,043	-0.11	7.56** (2.27)	-0.74 (-0.63)	30.61	25.93	17.40	
P4	351	2,002	-0.04	10.06*** (2.89)	0.58 (0.70)	31.26	26.32	17.02		294	2,304	-0.04	9.95*** (2.95)	0.25 (0.27)	31.50	26.78	17.23	
P5	351	1,569	0.03	6.73* (1.96)	-1.84 (-1.59)	33.23	27.69	17.72		297	1,795	0.03	7.72** (2.29)	-1.29 (-1.31)	34.51	29.01	18.11	
P6	351	1,092	0.10	7.82** (2.35)	-1.68 (-1.00)	35.49	30.43	18.72		294	1,251	0.10	7.37** (2.15)	-2.06 (-1.33)	36.61	31.41	18.92	
P7	351	798	0.17	5.95 (1.57)	-4.09** (-2.44)	41.30	36.12	19.08		289	924	0.17	6.82* (1.81)	-3.73** (-2.23)	41.74	36.28	19.60	
P8	351	585	0.25	5.10 (1.28)	-2.94 (-1.54)	43.98	38.71	20.30		288	680	0.25	3.91 (0.95)	-4.31** (-2.36)	44.46	38.48	20.49	
P9	351	562	0.36	4.22 (0.75)	-3.75 (-1.64)	48.96	42.02	20.66		283	660	0.36	5.61 (0.96)	-2.26 (-0.92)	48.29	40.90	21.07	
P10	350	354	0.52	3.23 (0.61)	-3.66 (-1.28)	55.08	48.19	22.49		267	433	0.52	2.37 (0.42)	-5.25 (-1.61)	52.78	45.82	22.07	

Financial Health Metrics continued																
Panel A: Compustat/CRSP/DGTW Universe									Panel B: Mutual Fund Holdings							
3. Change in Shares Outstanding (%)									*Change in Shares Outstanding (%)*							
P1	355	2,113	-6.89	11.79***	0.96	28.42	24.73	16.87	292	2,395	-7.13	12.06***	1.15	29.08	25.52	16.91
				(3.13)	(0.53)							(3.24)	(0.66)			
P2	378	3,154	-2.23	10.27***	0.49	26.27	22.31	16.33	278	3,755	-2.25	10.52***	0.92	27.00	23.11	16.63
				(3.22)	(0.40)							(3.35)	(0.83)			
P3	315	1,825	-1.15	7.82**	-1.04	26.57	22.22	16.51	283	2,274	-1.14	8.02**	-1.13	27.36	23.48	16.53
				(2.62)	(-0.73)							(2.68)	(-0.83)			
P4	375	1,350	-0.71	10.42***	-0.19	28.61	24.53	16.95	290	1,586	-0.71	10.59***	-0.12	29.76	25.56	17.38
				(3.58)	(-0.19)							(3.56)	(-0.12)			
P5	356	1,495	-0.28	9.77***	0.79	29.95	26.09	17.72	305	1,694	-0.27	10.27***	0.90	30.93	26.97	17.82
				(3.18)	(0.59)							(3.23)	(0.79)			
P6	356	1,167	0.54	10.04***	1.01	33.41	28.94	17.92	305	1,319	0.56	9.23**	0.20	34.30	29.75	18.21
				(3.00)	(0.68)							(2.80)	(0.15)			
P7	356	921	2.30	7.03*	-2.66**	37.48	32.61	18.63	297	1,071	2.31	7.51*	-1.86*	38.12	32.87	19.00
				(1.89)	(-2.23)							(1.89)	(-1.78)			
P8	356	907	7.79	4.41	-4.25**	38.22	32.90	18.91	276	1,121	7.73	4.48	-4.33***	38.72	33.32	19.30
				(1.20)	(-2.37)							(1.19)	(-2.94)			
P9	356	793	26.01	4.70	-3.48**	40.84	35.20	19.50	280	969	25.84	4.08	-4.25**	40.47	34.74	19.58
				(1.40)	(-2.25)							(1.09)	(-2.78)			
P10	355	2,561	98.79	3.46	-4.36***	35.65	29.57	18.12	296	2,995	98.94	3.76	-4.25***	36.78	30.61	18.66
				(0.89)	(-3.14)							(0.93)	(-2.88)			
4. Change in Total Equity (%)									*Change in Total Equity (%)*							
P1	356	574	-59.34	5.93*	-3.03*	39.01	34.97	19.30	232	792	-61.03	6.96*	-2.54	37.70	34.04	19.06
				(1.87)	(-1.98)							(2.10)	(-1.66)			
P2	356	911	-22.94	7.61**	-1.37	34.71	30.93	17.84	263	1,166	-23.01	8.85**	-0.47	34.34	30.55	17.85
				(2.12)	(-0.82)							(2.52)	(-0.30)			
P3	357	1,473	-11.10	10.36***	1.00	30.58	26.69	17.74	288	1,766	-11.13	9.87***	0.42	30.66	26.59	17.60
				(3.63)	(0.61)							(3.15)	(0.29)			
P4	356	1,904	-4.69	9.56***	-0.45	26.49	22.94	16.39	298	2,214	-4.74	9.33**	-0.22	27.77	24.24	16.78
				(2.90)	(-0.33)							(2.68)	(-0.16)			
P5	356	1,950	-0.43	10.63***	0.79	27.17	22.73	16.26	309	2,203	-0.42	10.69***	0.78	28.25	23.92	16.54
				(3.25)	(1.05)							(3.17)	(0.92)			
P6	357	1,985	4.15	9.60***	0.26	27.87	23.86	16.64	312	2,207	4.13	10.34***	0.82	29.06	24.98	17.07
				(3.25)	(0.20)							(3.48)	(0.64)			
P7	357	2,254	9.43	7.80**	-2.08	28.98	24.17	16.89	310	2,478	9.39	7.52**	-2.20*	30.54	25.93	17.33
				(2.43)	(-1.61)							(2.41)	(-1.92)			
P8	356	2,210	17.40	7.97**	0.25	32.50	27.26	18.14	310	2,491	17.31	8.72**	0.23	33.81	28.68	18.40
				(2.36)	(0.20)							(2.51)	(0.17)			
P9	357	1,746	36.31	5.08	-3.31**	37.70	31.74	18.64	300	1,988	36.38	5.20	-3.28*	38.44	32.38	19.21
				(1.35)	(-2.13)							(1.35)	(-2.05)			
P10	356	1,227	164.00	0.29	-7.01***	44.79	38.60	19.51	284	1,430	163.70	0.11	-7.78***	44.89	38.39	19.85
				(0.07)	(-3.85)							(0.02)	(-4.16)			

Table 1: Mutual Fund Sample

This table provides key statistics for the Thomson Reuters Institutional Holdings Database sample. Panel A reports descriptive statistics over the period 2000 to 2009. Number of Funds is the total number of funds included. Calendar Year reports the proportion of funds whose quarterly report dates coincide with the standard quarter-end months. Number Of Stocks Held is the average number of different stocks held by each fund. Assets is the average dollar value of assets (millions) held by each fund, based on the reported equity holdings. Size Quintile (Q), Book-to-Market Q and Momentum Q report the asset-weighted average size, book-to-market and momentum quintiles, respectively, to which the stocks are assigned based on the DGTW (1997) approach. The value-weighted average characteristic quintile is first calculated for each fund, based on the holding value of each stock, at the end of the prior quarter. Panel B provides average annual fund returns during 2000 to 2009. The annual returns to the CRSP value-weighted index including dividends (CRSP VWD) are also presented. The individual fund returns are calculated as the weighted-average of the returns to the stocks contained in the fund's portfolio. The holding value of a stock as at the end of the prior quarter is the weight applied to that stock's return over the next quarter. The mean gross returns for the sample of funds are calculated by first determining the mean return for each quarter using all funds that existed during that quarter. The quarterly returns are then annualised using simple compounding. Both asset-weighted (AW) and equally-weighted (EW) results are presented. The DGTW-adjusted returns are also provided on an AW and EW basis. The DGTW approach involves assigning each stock to one of 125 benchmark portfolios in June of each year on the basis of the interaction of its size, book-to-market and momentum characteristics. The DGTW-adjusted return is then calculated by subtracting the benchmark return from each stock's return.

	Panel A: Descriptive Statistics		
	2000	2004	2009
Number of Funds	1,728	1,441	1,113
Calendar Year (%)	89.45	75.50	74.95
Number of Stocks Held	86.82 (57)	102.18 (67)	110.96 (66)
Assets ($ million)	964 (205)	1134 (265)	1110 (256)
Size Quintile (Q)	4.73 (4.92)	4.52 (4.84)	4.56 (4.83)
Book-to-Market Q	2.33 (2.27)	2.63 (2.59)	2.79 (2.78)
Momentum Q	3.66 (3.69)	2.90 (2.85)	3.09 (3.08)
	Panel B: Fund Returns		
	2000-2004	2005-2009	2000-2009
CRSP VWD (%)	0.59	4.83	2.71
Gross AW (%)	1.11	4.05	2.58
Gross EW (%)	4.43	4.71	4.57
DGTW-Adj. EW (%)	-1.21	-0.28	-0.21
DGTW-Adj. AW (%)	-0.36	-0.07	-0.75

Table 2: Individual Quality Signals: Annual Frequency

This table indicates how each of the 14 metric values, across the four categories, is calculated. The metric values for each stock are adjusted by the population median, from the prior fiscal year. The metrics are not industry-adjusted in order to account for the impact of industry bets executed by the fund managers.

Category	Signal	Measurement
Profitability	Return-on-Equity (ROE)[a]	$\frac{\text{Income before Extraordinary Items}_t \text{ (IB)}}{\text{Shareholders' Equity}_{t-1} \text{ (SEQ)}}$
	ΔROE[b]	$\frac{IB_t - IB_{t-1}}{[(SEQ_{t-1} + SEQ_{t-2})*0.5]}$
	Return-on-Assets (ROA)[c]	$\frac{IB_t}{\text{Total Assets}_{t-1} \text{ (AT)}}$
	ΔROA[d]	$\frac{IB_t - IB_{t-1}}{[(AT_{t-1} + AT_{t-2})*0.5]}$
	Operating Cash Flow (OCF)[e]	$\frac{\text{Operating Activities: Net Cash Flow}_t}{[(AT_t + AT_{t-1})*0.5]}$
	Accruals (ACC)[f]	$ACC = Earnings_t - OCF_t$ where $Earnings_t = IB_t/[(AT_t + AT_{t-1})*0.5]$
Variability	Earnings Growth Variability (ROA_VAR)[g]	Variance of ROA over prior four years
	Sales Growth Variability (SG_VAR)[h]	Variance of Sales Growth over prior four years where $\text{Sales Growth}_t = (Sales_t - Sales_{t-1}) / Sales_{t-1}$
Operating Efficiency	Asset Turnover (ATO)[i]	$\frac{Sales_t}{AT_{t-1}}$
	ΔATO[j]	$\frac{SALE_t - SALE_{t-1}}{[(AT_{t-1} + AT_{t-2})*0.5]}$
Financial Health	Leverage (LEV)[k]	$\frac{\text{Long Term Debt}_t}{SEQ_t}$

Category	Signal	Measurement
Financial Health cont.	Liquidity (LIQ)[l]	$\frac{\text{Working Capital}_t}{\text{AT}_t}$ where $\text{Working Capital}_t = \text{Current Assets}_t - \text{Current Liabilities}_t$
	Δ Shares Outstanding (ΔSH)[m]	$\frac{SH_t - SH_{t-1}}{SH_{t-1}}$
	Δ Total Equity (ΔTE)[n]	$\frac{SEQ_t - SEQ_{t-1}}{SEQ_{t-1}}$

[a] Mercer Investments (2010); Chen and Zhang (2007); Bird and Casavecchia (2007); Zhang (2000)
[b] Bird and Casavecchia (2007)
[c] Chen and Zhang (2007); Bird and Casavecchia (2007); Mohanram (2005); Fairfield and Whisenant (2000); Piotroski (2000)
[d] Bird and Casavecchia (2007); Fairfield and Whisenant (2000); Piotroski (2000)
[e] Bird and Casavecchia (2007); Mohanram (2005); Piotroski (2000); Dechow and Dichev (2002)
[f] Chan et al. (2006); Piotroski (2000); Hribar and Collins (2002); Dechow and Dichev (2002)
[g] Mercer Investments (2010); Dichev and Tang (2009); Mohanram (2005)
[h] Mercer Investments (2010); Mohanram (2005)
[i] Bird and Casavecchia (2007); Soliman (2008)
[j] Soliman (2008); Bird and Casavecchia (2007); Piotroski (2000)
[k] George and Hwang (2010); Mercer Investments (2010); Lui et al. (2007); Bird and Casavecchia (2007); Fama and French (1993)
[l] Lui et al. (2007)
[m] Pontiff and Woodgate (2008)
[n] Bradshaw et al. (2006); Daniel and Titman (2006); Piotroski (2000)

Table 3: Mutual Fund Investing Measures for Quality Indicators

This table presents mean values of the mutual fund Investing Measures (IM) for each quality signal over the period 2000 to 2009. The metrics are Return-on-Equity (ROE), Change in ROE, Return-on-Assets (ROA), Change in ROA, Operating Cash Flow (OCF), Accruals (ACC), Asset Turnover (ATO), Change in ATO, Sales Growth Variability (SG_VAR), ROA Variability (ROA_VAR), Leverage (LEV), Liquidity (LIQ), Change in Shares Outstanding (ΔSH) and Change in Total Equity (ΔTE). The IM is defined as the weighted average decile rank of the individual stocks held by a fund. The time-series averages of the fund level IMs are reported. The *t*-statistic reported for the IMs is relative to an expected value of 5.50, based on an equally weighted average of the decile ranks. The Average Coefficient Estimates for each quality signal, which are used to compute the composite Q-Score developed in this paper, are also presented. The DGTW alpha for each stock in the Compustat/CRSP/DGTW universe is regressed on the metric value for the stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over nine rolling time periods, the first of which is 1989-1998, and the last estimation period is 1989-2006. The average of the nine coefficient estimates determined from 1999 to 2007 is provided.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Average Mutual Fund Investing Measures (IM)				**Average Coefficient Estimates**	
Metric	Equal-Weighted (EW) IM	EW IM *t*-statistic	Asset-Weighted (AW) IM	AW IM *t*-statistic	β_1	β_2
ROE	7.28***	39.47	7.24***	22.52	8.84	-0.59
ΔROE	5.78***	5.05	5.78***	4.34	3.33	-6.79
ROA	7.03***	38.28	6.92***	19.64	21.29	-2.06
ΔROA	7.17***	32.54	7.05***	18.46	3.20	-50.08
OCF	6.99***	53.48	6.98***	31.66	37.00	14.94
ACC	5.54	0.75	5.49	-0.23	-10.74	-115.04
ROA_VAR	4.51***	-36.73	4.42***	-25.78	-50.84	29.27
SG_VAR	4.81***	-17.44	4.70***	-18.41	-1.46	0.03
ATO	5.53	0.70	5.37***	-2.90	1.69	-0.97
ΔATO	5.59	1.10	5.60	0.99	-0.30	-3.11
LEV	5.98***	9.77	6.17***	14.47	0.38	-0.08
LIQ	4.32***	-28.03	4.07***	-29.05	6.21	-25.66
ΔSH	5.63	1.11	5.51	0.05	-7.52	0.10
ΔTE	5.91***	5.55	5.80***	3.24	-0.53	-0.74

Table 4: Fama-MacBeth Regression Evidence of the Predictability of Earnings and Stock Returns

This table provides the results from multivariate Fama-MacBeth (1973) regressions including the Q-Score, Piotroski's (2000) F-Score and Mohanram's (2005) G-Score as the independent variables, or only the latter two scores. Earnings, Operating Cash Flow and Accruals (all in millions $US) for the year *t+1* are regressed on each score for year *t*, in order to assess the ability of each to explain the cross-sectional difference in the predictability and persistence of earnings. In order to determine the incremental ability of each score to predict stock returns a similar series of regressions are run, in which the Annual Raw Return, DGTW alpha, 3-Factor alpha and 4-Factor alpha for year *t+1* are regressed on the scores for year *t*. β is the time-series average parameter estimate, Adjusted R^2 is the time-series average adjusted R^2, and No. of Observations is the number of observations included in the regression. Newey-West serial correlation adjusted *t*-statistics are reported in parentheses below the time-series means.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Earnings$_{t+1}$	**Operating Cash Flow$_{t+1}$**	**Accruals$_{t+1}$**	**Raw Return$_{t+1}$**	**DGTW-α_{t+1}**	**3-Factor α_{t+1}**	**4-Factor α_{t+1}**
Panel A: Q-Score$_t$ F-Score$_t$ and G-Score$_t$ as the Independent Variables							
Q-Score β	0.007***	0.005***	0.002***	0.003***	0.003***	0.002***	0.002**
	(16.29)	(24.24)	(5.76)	(4.42)	(5.14)	(3.89)	(2.91)
F-Score β	0.011***	0.010***	0.001	0.008	0.010***	0.011**	0.014
	(11.00)	(8.53)	(1.38)	(1.75)	(4.11)	(2.31)	(1.62)
G-Score β	0.002*	0.003***	-0.001	0.002	0.004	0.004	0.004
	(2.28)	(6.35)	(-1.56)	(0.54)	(0.93)	(1.51)	(1.72)
Adjusted R^2 (%)	39.00	42.30	6.00	3.80	2.90	2.20	2.10
No. of Observations	14,717	14,710	14,710	14,762	14,762	14,479	14,446
Panel B: F-Score$_t$ and G-Score$_t$ as the Independent Variables							
F-Score β	0.039***	0.031***	0.009***	0.021***	0.021***	0.021***	0.021**
	(30.67)	(44.07)	(10.07)	(4.41)	(6.92)	(3.50)	(2.48)
G-Score β	0.010***	0.009***	0.001	0.005	0.006	0.007**	0.006**
	(17.67)	(18.43)	(1.46)	(1.49)	(1.56)	(2.59)	(2.72)
Adjusted R^2 (%)	10.80	12.90	1.10	1.20	1.20	1.10	1.30
No. of Observations	14,717	14,710	14,710	14,762	14,762	14,479	14,446

Table 5*:* Returns and Characteristics of Stocks by Q-Score Sorted Decile Portfolios

This table reports the average stock returns and characteristics over the sample period, for the stocks comprised in decile portfolios formed by sorting the universe of Compustat/CRSP/DGTW stocks into equally-weighted portfolios in each year *t* based on their Q-Scores. Decile 1 (10) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score is computed as the average of Return-on-Equity (ROE), Change in ROE, Return-on-Assets (ROA), Change in ROA, Operating Cash Flow, Accruals, Sales Growth Variability, ROA Variability, Asset Turnover (ATO), Change in ATO, Leverage, Liquidity, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics are scaled by the median value for each metric's population in the previous fiscal year. The DGTW alpha for each stock in the Compustat/CRSP/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over rolling time periods— the first regression is run over the estimation period 1989-1998 and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score based on the metric values for 1999 as per the following formula:

Q-Score = $\sum_{i=1}^{14} \beta_{1,i} Metric_i$ + $\sum_{i=1}^{14} \beta_{2,i} {Metric^2}_i$

The Q-Score for 1999 is then merged with the mutual fund holdings as at June of 2000, and alpha is examined from July 2000 to June 2001. Overall, the Q-Score is calculated for nine years ranging from 1999 to 2007 and the associated DGTW alpha is examined over nine periods from July 2000 to June 2009. The mean values for panel A are obtained by value-weighting the returns and characteristics for each stock in the decile by its market capitalisation as at December of year *t-1*.The analysis is repeated on a subset of stocks held by at least one mutual fund in June of each year *t*, using an active-weighting approach in order to account for both a stock's share of the market and the level of exposure that mutual funds have to that stock. Panel B reports the results using this methodology. No. of Stocks is the average number of stocks contained in each decile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio. Q-Score Value is the mean value of the Q-Score per decile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from July of year *t* to June of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly CRSP returns for each stock. If a stock is delisted within the return accumulation period, the subsequent missing monthly returns are replaced by the return on the stock's DGTW benchmark portfolio. DGTW Alpha is the mean excess annual value-weighted return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. The *t*-statistics reported are in parentheses below the time-series average returns. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from July of year *t* to June of year *t+1* for each stock in the portfolio. Idiosyncratic Return Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from July of year *t* to June of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from July of year *t* to June of year *t+1* for each stock's DGTW benchmark portfolio.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Compustat/CRSP/DGTW Universe

Decile Portfolios	No. of Stocks	Size ($ Million)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
D1 (Low)	262	491	-52.22	-13.96 (-1.33)	-12.58** (-2.17)	63.06	56.08	24.64
D2	262	928	-17.95	-6.02 (-0.82)	-3.79 (-1.11)	46.06	39.78	21.87
D3	262	1,435	-8.33	-0.61 (-0.08)	-1.26 (-0.35)	45.62	38.82	20.41
D4	263	2,090	-3.88	3.89 (0.71)	1.29 (1.13)	33.70	27.93	19.06
D5	262	2,244	-1.35	1.65 (0.29)	0.33 (0.23)	31.57	27.09	18.02
D6	263	2,595	0.59	3.87 (0.73)	2.83** (2.26)	31.01	26.11	17.90
D7	263	2,514	2.31	3.92 (0.59)	2.97** (2.22)	32.22	27.34	18.17
D8	262	3,471	4.19	2.18 (0.52)	3.05 (1.29)	28.78	24.48	17.68
D9	262	4,357	6.42	4.05 (0.88)	3.29** (1.96)	28.21	24.14	17.15
D10 (High)	262	6,667	11.61	-0.11 (-0.03)	-0.51 (-0.37)	27.58	23.15	17.04

Panel B: Mutual Fund Holdings

Decile Portfolios	No. of Stocks	Size ($ Million)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
D1 (Low)	205	624	-50.43	-12.79 (-1.30)	-11.00** (-2.27)	57.78	50.99	24.19
D2	216	1,131	-18.20	-4.92 (-0.64)	-3.18 (-0.93)	45.49	39.10	21.63
D3	225	1,675	-8.36	-1.28 (-0.17)	-2.17 (-0.74)	43.69	37.19	20.32
D4	237	2,299	-3.88	2.24 (0.39)	0.32 (0.33)	34.14	28.52	19.19
D5	237	2,468	-1.33	2.36 (0.37)	1.17 (0.63)	31.84	27.41	18.13
D6	242	2,808	0.57	3.08 (0.53)	1.94* (1.60)	31.69	26.58	18.34
D7	246	2,673	2.31	3.41 (0.51)	2.76* (1.77)	33.68	28.53	18.74
D8	246	3,700	4.19	1.10 (0.22)	1.97 (0.99)	31.16	26.11	18.41
D9	248	4,572	6.41	3.24 (0.62)	3.28** (1.90)	30.16	25.92	17.97
D10 (High)	250	6,965	11.46	-0.08 (-0.02)	0.13 (0.10)	29.56	24.77	17.85

Table 6: DGTW-adjusted Performance of Stock Quality Deciles in Up vs Down Market Months

This table demonstrates the value-weighted average DGTW-adjusted performance of each quality decile in up versus down market months from July 2000 to June 2009. Annualised DGTW-adjusted returns based on monthly averages are provided. The quality deciles are formed by ranking stocks into deciles based on their Q-Score as at June of each year *t*. This decile rank is applied to the monthly returns from July of year *t* to June of year *t+1*. The returns are weighted by market capitalisation as at December of year *t-1*. Months are classified as up (down) if the return on the CRSP value-weighted index including dividends was positive (negative). There are 59 (49) up (down) market months over the sample period. Then within the up and down market classifications, months are classified into quintiles based on the extremity of the up/down market return. Up Market Quintile 1 (5) contains the lowest (highest) up market monthly returns. Similarly, Down Market Quintile 1 (5) contains the lowest (highest) down market monthly returns. Market Return is the annualised average monthly return to the CRSP value-weighted index for each quintile, and on average across all up/down months. Furthermore, Average for the Q-Score deciles is the average annualised DGTW-adjusted return across all up/down market months. *t*-statistics are provided below the decile means in parentheses.

***,** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively for one-tailed *t*-tests.

		D1 (Low)	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10 (High)**
Up Market Quintile	**Market Return (%)**					*Up Markets*					
Q1 (Low)	11.75	-4.42	-2.98	8.43	-3.48**	-1.43	-0.64	-0.08	-3.15	0.76	-1.84
Q2	23.29	-32.95***	-4.47**	-7.66***	2.61	0.32	2.38*	3.00**	7.38***	4.21***	-6.66
Q3	34.49	47.12	10.31	12.11	6.93	-0.37	2.80*	12.21***	4.38***	1.94	-1.60
Q4	61.59	13.11	27.12	83.60	3.51	5.74	2.93*	18.98***	5.49**	-1.63	-5.19
Q5 (High)	130.84	106.50	16.20	31.90	14.70	1.18	9.29***	-0.37	-8.20	-4.10	-8.66
Average	48.84	21.62	9.07	23.01	5.32	1.00	3.47***	6.37***	0.71	0.13	-4.86
		(9.58)	(6.24)	(13.72)	(5.20)	(1.04)	(4.00)	(6.71)	(0.83)	(0.16)	(-6.87)
Down Market Quintile	**Market Return (%)**					*Down Markets*					
Q1 (Low)	-73.30	-61.73***	-23.28***	-54.03***	14.83	-9.37***	-17.61	-1.86	4.97**	3.61*	12.37***
Q2	-53.37	-62.26***	-19.69***	-14.20***	2.59	17.94	4.16**	0.74	12.24***	13.61***	10.64***
Q3	-28.00	-37.99***	-19.31***	-22.44***	-2.48	-3.85**	19.12***	-2.01	14.78***	13.76***	14.65***
Q4	-18.10	-60.49***	-11.52***	-26.88***	0.94	-0.30	7.45***	-13.37	5.17***	3.05*	6.59***
Q5 (High)	-6.74	-10.17***	-15.92***	3.33	-1.23	4.22	2.71**	5.46***	-0.57	4.96***	3.44**
Average	-40.02	-50.58***	-18.10***	-25.47***	2.89	1.15	2.74***	-2.29	7.29***	7.73***	9.32***
		(-31.20)	(-12.45)	(-19.60)	(2.55)	(1.09)	(2.64)	(-2.32)	(7.17)	(8.12)	(10.24)

Table 7: Average Fund Returns and Characteristics of Q-Score sorted Deciles

This table presents the mean returns to deciles containing mutual funds in the Thomson Reuters Institutional Holdings Database sample which have been sorted based on the weighted-average Q-Score for their portfolios. The Q-Score is calculated for nine years ranging from 1999 to 2007 and the returns associated with the Q-Score portfolios are examined over nine periods from July 2000 to June 2009. Firstly, in June of each year *t*, the Q-Score for each stock is computed and then the weighted-average Q-Score is computed for each fund, based on the holding value of each stock as at June of year *t*. Subsequently, the equally-weighted mean Q-Score across the funds is computed each quarter, and then these four quarterly values are averaged each year. The time-series mean over the sample period is reported above. The deciles are formed in June of each year *t* and then the returns are calculated from July of year *t* to June of year *t+1*. All funds with holdings data available in a given quarter of each portfolio formation year are included in the calculation of the mean annual return for that portfolio formation year. Therefore, the results are free from survivorship bias, as the mean return for the funds is calculated on a quarterly basis and then the annual return is the compound of these four mean returns. The time-series means of the annual raw and DGTW-adjusted returns are reported above. The mean size, book-to-market and momentum quintiles to which the stocks are assigned based on the DGTW approach are also provided. Firstly, the asset-weighted mean quintile per quarter, each year, across the deciles, is calculated. Then the mean of the four quarterly values is calculated in each year, and finally over the sample period. The proportions of funds which are members of each of the three Investment Objective Code groups included in the study are also provided.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively for one-tailed *t*-tests.

Decile	Q-Score	Annual Raw Return (%)	Annual DGTW-Adjusted Return (%)	Size Quintile	Book-to-Market Quintile	Momentum Quintile	Aggressive Growth (%)	Growth (%)	Growth & Income (%)
D1 (Low)	-7.02	-6.09 (-0.78)	-5.43** (-2.61)	3.75	2.45	3.21	17.05	75.48	7.46
D2	-1.50	-1.33 (-0.19)	-1.53* (-1.42)	4.00	2.68	3.13	13.92	73.91	12.17
D3	0.08	-2.03 (-0.30)	-2.37** (-2.21)	4.20	2.78	3.06	11.02	72.89	16.09
D4	1.13	-1.25 (-0.20)	-1.53 (-1.55)	4.35	2.74	3.02	10.15	68.19	21.65
D5	1.95	0.20 (0.03)	-0.18 (-0.32)	4.58	2.85	2.91	6.91	65.72	27.37
D6	2.62	1.16 (0.21)	0.37 (0.70)	4.64	2.72	2.92	7.37	65.16	27.47
D7	3.25	0.15 (0.03)	-0.47 (-0.89)	4.73	2.69	2.91	6.70	62.40	30.90
D8	3.86	-0.41 (-0.08)	-0.81 (-1.60)	4.72	2.53	2.91	5.46	65.71	28.83
D9	4.62	-0.64 (-0.13)	-1.29 (-2.03)	4.77	2.53	2.88	4.45	67.35	28.19
D10 (High)	6.28	0.47 (0.10)	-0.22 (-0.27)	4.70	2.44	2.88	5.95	75.90	18.16

Table 8: Average Q-Score and DGTW-Adjusted Fund Returns over Sample Period

This table presents the mean DGTW-adjusted fund returns, per Q-Score sorted decile for a sample of active equity mutual funds in the Thomson Reuters Institutional Holdings Database. The year indicates the Portfolio Formation Year (PFY), e.g. 2000 comprises the four quarters commencing from July 2000 to June 2001. The annual return reported is the compound of the four mean quarterly returns for the year. Therefore, every fund which existed in each quarter is included, and so the mean annual return is free from survivorship bias. The corresponding mean Q-Score for the funds in each decile is also provided in italics below the mean returns for each year. N.B. the Q-Score for 1999 is associated with the DGTW-adjusted return for PFY 2000. So, the Q-Scores range from 1999 to 2007, whilst the returns range from PFY 2000 to 2008. Average Return is the time-series average of the yearly returns, and the corresponding *t*-statistics are in parentheses below the Average Return values. Volatility is the standard deviation of the mean annual returns over the sample period.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively for one-tailed *t*-tests.

	Low				**Decile**					**High**
PFY	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**
2000	-16.86	-8.47	-7.46	-7.61	-2.39	2.37	-1.97	-3.22	-4.85	-2.36
	-11.46	*-5.04*	*-3.43*	*-2.31*	*-1.46*	*-0.81*	*-0.27*	*0.28*	*0.93*	*2.34*
2001	-13.45	-5.05	-7.12	0.23	0.76	-0.52	0.86	0.72	1.89	1.88
	-10.27	*-3.20*	*-1.06*	*0.19*	*1.18*	*1.86*	*2.47*	*3.17*	*3.96*	*5.76*
2002	-0.37	-1.34	-0.80	-2.89	-1.75	-1.43	-2.64	-2.69	-2.16	-1.20
	-8.06	*-1.38*	*0.32*	*1.64*	*2.49*	*3.16*	*3.81*	*4.38*	*5.25*	*7.18*
2003	0.34	1.73	-1.03	0.48	2.34	2.03	-0.34	0.79	-0.42	-0.73
	-6.61	*-1.21*	*0.44*	*1.64*	*2.50*	*3.25*	*3.92*	*4.61*	*5.39*	*7.48*
2004	-3.41	-0.29	0.19	0.46	1.33	0.74	0.66	0.50	-0.92	-0.67
	-7.32	*-1.31*	*0.40*	*1.56*	*2.43*	*3.15*	*3.97*	*4.81*	*5.65*	*7.10*
2005	-0.42	-0.99	1.23	0.14	0.77	1.76	0.81	-1.24	-2.09	-1.65
	-5.32	*-0.11*	*1.30*	*2.09*	*2.75*	*3.43*	*4.12*	*4.72*	*5.47*	*7.10*
2006	-0.83	1.30	0.16	1.79	0.75	-1.10	0.39	-1.31	-1.61	-2.05
	-5.30	*-0.73*	*0.76*	*1.69*	*2.60*	*3.21*	*3.81*	*4.38*	*5.16*	*6.68*
2007	-8.30	0.30	-2.21	-3.78	-1.55	1.19	0.94	0.48	0.55	5.34
	-4.81	*-0.23*	*1.13*	*2.05*	*2.67*	*3.26*	*3.86*	*4.34*	*4.98*	*6.56*
2008	-5.63	-1.01	-4.23	-2.56	-1.92	-1.71	-2.97	-1.28	-1.98	-0.52
	-4.02	*-0.30*	*0.86*	*1.62*	*2.41*	*3.09*	*3.55*	*4.05*	*4.83*	*6.37*
Average	-5.43**	-1.53*	-2.37**	-1.53	-0.18	0.37	-0.47	-0.81	-1.29	-0.22
Return (%)	(-2.61)	(-1.42)	(-2.21)	(-1.55)	(-0.32)	(0.70)	(-0.89)	(-1.60)	(-2.03)	(-0.27)
Volatility (%)	6.25	3.25	3.20	2.96	1.71	1.58	1.61	1.51	1.91	2.42

Table 9: DGTW-adjusted Performance of Fund Quality Deciles in Up vs Down Market Months

This table demonstrates the asset-weighted average DGTW-adjusted performance of each quality decile in up versus down market quarters from July 2000 to June 2009. Annualised DGTW-adjusted returns based on quarterly averages are provided. The quality deciles are formed by ranking funds into deciles based on the weighted-average Q-Score for their portfolio as at June of each year *t*. This decile rank is applied to the quarterly fund returns from July of year *t* to June of year *t+1*. The returns are weighted by assets as at the end of the prior quarter. Quarters are classified as up (down) if the return on the CRSP value-weighted index including dividends was positive (negative). Then within the up and down market classifications, quarters are classified into quintiles, based on the extremity of the up/down market return. Up Market Quintile 1 (5) contains the lowest (highest) up market quarterly returns. Similarly, Down Market Quintile 1 (5) contains the lowest (highest) down market quarterly returns. It is important to note that the quarters are based on the report dates of the funds, thus the quarter end month can be any of the 12 months of the year, not simply the four standard quarter-end months, March, June, September and December. Therefore, there are 87 quarters included (out of a possible 108, if quarters ending in all months are allowed), of which 35 (52) are classified as up (down) market quarters. Market Return is the annualised average quarterly return to the CRSP value-weighted index for each quintile and on average across all up/down quarters. In addition, Average for the Q-Score deciles reports the average annualised DGTW-adjusted return across all up/down market quarters. *t*-statistics are provided in parentheses below the decile means.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively for one-tailed *t*-tests.

		D1 (Low)	D2	D3	D4	D5	D6	D7	D8	D9	D10 (High)
Up Market Quintile	**Market Return (%)**					*Up Markets*					
Q1 (Low)	2.49	5.00	3.04	3.18	0.69	2.58	4.89***	1.83**	0.38	0.71	4.83***
Q2	9.52	-4.03***	0.50	0.19	0.25	-1.13***	1.13***	1.13***	0.64**	-0.73	-0.32
Q3	18.51	-0.83	0.10	-1.35***	0.24***	1.33***	0.15***	0.49*	-2.10	-1.67	-2.11
Q4	31.99	3.96	0.57	1.27	2.19	1.56	-1.16	0.59*	-0.74	-1.97	-3.03
Q5 (High)	69.58	4.91	4.79	2.05	0.28	0.57	-0.77	-2.45	-0.33	-4.27	-4.96
Average	101.73	1.09	1.54	0.92***	0.73	0.76	0.45***	0.47***	-0.34	-1.76	-1.62
		(2.64)	(4.78)	(3.66)	(2.71)	(3.65)	(2.51)	(2.66)	(-1.90)	(-9.67)	(-6.95)
Down Market Quintile	**Market Return (%)**					*Down Markets*					
Q1 (Low)	-57.78	-9.00***	-1.79*	-5.08***	-6.85	-5.32	-2.00	-1.95	-3.32	-1.43	2.85***
Q2	-45.25	-29.35***	-20.23***	-17.60***	-4.19***	-2.95**	-2.97	-3.51	-7.52	-3.10	0.18
Q3	-35.02	-11.32***	-4.57***	-6.98***	-2.34**	4.51	1.33*	1.82**	3.63***	2.00**	6.88***
Q4	-17.57	-10.00***	-0.82	-2.08***	-6.89***	-4.11***	-0.98	-1.76	-2.42	-0.82	1.60
Q5 (High)	-6.32	-5.78***	-0.50	0.36	-0.26	2.73	2.35***	1.62***	2.74***	0.50	0.61
Average	-69.10	-14.36***	-5.73***	-5.50***	-3.57***	-0.99***	0.12	-0.31	-1.05	-0.25	1.99***
		(-23.76)	(-10.97)	(-12.09)	(-8.25)	(-2.54)	(0.40)	(-1.00)	(-3.22)	(-0.76)	(4.78)

Table 10: Mean Returns and Fund Characteristics of Q-Score sorted Deciles for MFLINKS Subset

The Thomson Reuters Institutional Holdings Database is merged with the CRSP Mutual Fund Database (CMFD) using Mutual Fund Links (MFLINKS), and these results are based on funds in the merged subset for which Q-Score data is also available: n=1,493 funds. This table presents the mean returns to deciles containing mutual funds which have been sorted based on the weighted-average Q-Score for their portfolios. The Q-Score is calculated for nine years ranging from 1999 to 2007, and the returns associated with the Q-Score portfolios are examined over nine periods from July 2000 to June 2009. Firstly, in June of each year *t*, the Q-Score for each stock is computed and then the weighted-average Q-Score is computed for each fund based on the holding value of each stock as at June of year *t*. Subsequently, the equally-weighted mean Q-Score across the funds is computed each quarter and then these four quarterly values are averaged each year. The time-series mean over the sample period is reported above. The deciles are formed in June of each year *t* and then the returns are calculated from July of year *t* to June of year *t+1*. The Annual Net CRSP Return is the annual fund return including distributions (dividends and capital gains) after total expenses, both sourced from the CMFD. All funds which existed in a given month over July of year *t* to June of year *t+1* are included when calculating the mean return for that month. The annual return is the simple compound of the 12 component mean monthly returns. Therefore, the results are free from survivorship bias. Annual 4-Factor Model Alpha is the average annual excess fund return, calculated following Carhart's (1997) 4-Factor model approach. Specifically, each month the following model is run over the prior 24 months: $y = \alpha + \beta_1(Rm\text{-}Rf) + \beta_2 SMB + \beta_3 HML + \beta_4 MOM + \varepsilon$, where y is the monthly Net CRSP fund return in excess of the US risk-free rate, *(Rm- Rf)*, *SMB* and *HML* are the market, size and value factors obtained from Ken French's data library, and *MOM* is a momentum factor calculated as in Carhart (1997). The parameter estimates are then used to calculate the 4-Factor alpha for the month and these values are annualised using simple compounding. The Annual 4-Factor Model Alpha results are based on 1,211 funds for which the data required is available. All funds with holdings data available in a given quarter of each portfolio formation year are included in the calculation of the mean Annual Raw and DGTW-adjusted Returns for that portfolio formation year. The mean return for the funds is calculated on a quarterly basis, and then the annual return is the compound of these four mean returns. The time-series means of the annual raw and DGTW-adjusted returns are reported above. The mean size, book-to-market and momentum quintiles to which the stocks are assigned based on the DGTW approach are also provided. Firstly, the asset-weighted mean quintile per quarter, each year, across the deciles is calculated. Then the mean of the four quarterly values is calculated each year. The mean quintiles reported are the time-series means over the sample period. The proportions of funds which are members of each of the three Investment Objective Code groups included in the study are also provided. Finally, the mean values of various fund characteristics sourced from the CMFD are provided, as at June of year *t*. Turnover Ratio is the minimum (of aggregated sales or aggregated purchases of securities), divided by the average 12-month Total Net Assets of the fund. Total Load is the sum of the front and rear loads, reported annually. Expense Ratio is the ratio of the total investment that shareholders pay for the fund's operating expenses. Age is the number of years since the fund was first offered. Total Net Assets is as of month-end, i.e., June of year *t*.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively for one-tailed *t*-tests.

Decile	Q-Score	Annual Raw Return (%)	Annual DGTW-Adjusted Return (%)	Annual Net CRSP Return (%)	Annual 4-Factor Model Alpha (%)	Size Quintile	Book-to-Market Quintile	Momentum Quintile	Aggressive Growth (%)	Growth (%)	Growth & Income (%)	Turnover Ratio (%)	Total Load (%)	Expense Ratio	Age (Years)	Total Net Assets ($ Millions)
D1 (Low)	-7.48	-5.92	-5.30**	-2.28	-2.81***	3.48	2.43	3.21	20.32	71.75	7.93	124.89	0.65	1.88	15.19	697
		(-0.76)	(-2.63)	(-0.31)	(-2.90)											
D2	-1.81	-1.50	-1.57*	-2.25	-1.36	3.79	2.48	3.13	16.70	75.91	7.39	114.45	0.55	1.36	13.79	873
		(-0.21)	(-1.41)	(-0.32)	(-1.38)											
D3	0.02	-2.00	-2.28**	-1.48	-1.29	4.02	2.70	3.06	13.95	66.82	19.24	107.60	0.22	1.27	16.40	1453
		(-0.30)	(-2.37)	(-0.24)	(-1.20)											
D4	1.14	-1.45	-1.53	1.13	-1.03	4.14	2.69	3.02	11.95	66.86	21.18	79.45	0.29	1.22	17.89	1485
		(-0.22)	(-1.38)	(0.20)	(-1.26)											
D5	2.01	0.50	0.00	0.14	-0.97**	4.38	2.97	2.91	10.23	62.84	26.93	81.54	0.31	1.27	17.13	1715
		(0.09)	(-0.01)	(0.02)	(-2.02)											
D6	2.72	1.14	0.42	2.60	-0.85	4.45	2.68	2.92	7.28	70.53	22.18	83.44	0.32	1.21	16.89	1843
		(0.21)	(0.81)	(0.48)	(-1.54)											
D7	3.37	0.30	-0.40	2.82	-1.70	4.66	2.57	2.91	9.40	69.03	21.58	72.10	1.69	1.23	17.95	2214
		(0.06)	(-0.78)	(0.58)	(-2.22)											
D8	4.06	-0.68	-0.93	-1.56	-1.08	4.47	2.58	2.91	5.41	66.86	27.73	73.77	1.39	1.11	18.79	969
		(-0.13)	(-1.67)	(-0.30)	(-1.66)											
D9	4.95	-0.65	-1.31	1.82	-0.92	4.65	2.58	2.88	5.94	69.27	24.80	67.16	0.61	1.16	19.08	1321
		(-0.13)	(-2.20)	(0.42)	(-1.99)											
D10 (High)	6.68	0.56	-0.08	1.57	-0.42	4.59	2.52	2.88	7.77	76.11	16.13	48.64	1.22	1.18	21.57	729
		(0.12)	(-0.08)	(0.33)	(-0.97)											

Table 11: Multivariate Regressions: Annual Net CRSP Return$_{t+1}$ as the Dependent Variable

This table presents multivariate regression evidence of the predictability of Annual Net CRSP fund returns, based on the Q-Score developed in this paper, Piotroski's (2000) F-Score and Mohanram's (2005) G-Score. Panel A provides the results for regressions of annual fund returns for year *t+1* on the three quality scores as at June of year *t*. Annual Net CRSP Return *t+1* is calculated as the simple compound of the 12 component monthly returns from July of year *t* to June of year *t+1*. Only funds which have data for all 12 months are included. The Adjusted R^2, parameter estimate (β), *t*-statistic and p-values are provided for each of the three quality scores. All Years includes all observations for year *t* from 2000 to 2008. Down Periods only includes the years deemed to be market downturns based on the NBER expansion and contraction dates, i.e., 2000, 2001, 2007 and 2008. Up Periods only includes the years deemed to be market upturns, i.e., 2002, 2003, 2004, 2005 and 2006. Panel B reports the results for the multivariate regressions including a number of common fund characteristic control variables, all as of June of year *t*. Turnover is the minimum (of aggregated sales or aggregated purchases of securities), divided by the average 12-month Total Net Assets (TNA) of the fund. Total Load is the sum of the front and rear loads. Expense Ratio is the ratio of the total investment that shareholders pay for the fund's operating expenses. Log TNA is the natural log of TNA. Log Age is the natural log of the number of months since the fund was first offered.

	All Years				Down Periods				Up Periods			
Independent Variables	**Adj. R^2 (%)**	**β**	***t*-statistic**	**p-value**	**Adj. R^2 (%)**	**β**	***t*-statistic**	**p-value**	**Adj. R^2 (%)**	**β**	***t*-statistic**	**p-value**
Q-Score$_t$	5.49	0.0097	12.12	0.00	11.13	0.0089	8.39	0.00	3.26	-0.0014	-2.11	0.04
F-Score$_t$		-0.0550	-8.06	0.00		-0.0626	-6.19	0.00		0.0312	6.19	0.00
G-Score$_t$		-0.0039	-1.44	0.15		-0.0107	-3.00	0.00		-0.0111	-5.30	0.00
Turnover$_t$		-0.0105	-2.87	0.00		-0.0378	-7.24	0.00		-0.0074	-2.76	0.01
Total Load$_t$		-0.0101	-0.05	0.96		0.6937	2.77	0.01		-0.2102	-1.47	0.14
Expense Ratio$_t$		0.4407	0.70	0.48		-2.0242	-2.39	0.02		1.1646	2.43	0.02
Log Age$_t$		0.0009	0.20	0.84		-0.0325	-5.36	0.00		0.0083	2.21	0.03
Log TNA$_t$		-0.0107	-6.36	0.00		-0.0137	-5.92	0.00		0.0005	0.41	0.68

Figure 1: Stock Quality Persistence for the Top Two and Bottom Two Q-Score sorted Stock Deciles

This figure demonstrates the average proportion of stocks in the top two and bottom two quality deciles in each portfolio formation year (PFY) $t + i$ (i=1 to 8) which are also in that same decile relative to the vintage PFY for all vintages from 2000 to 2007. The sample of stocks is all common stocks traded on the NYSE, AMEX or NASDAQ with the accounting data required to compute the Q-Score. The deciles are formed in June of the PFY_t, based on the Q-Score for the prior year.

Deciles 1 (10) and 2 (9) contain the lowest (highest) quality stocks based on the Q-Score.

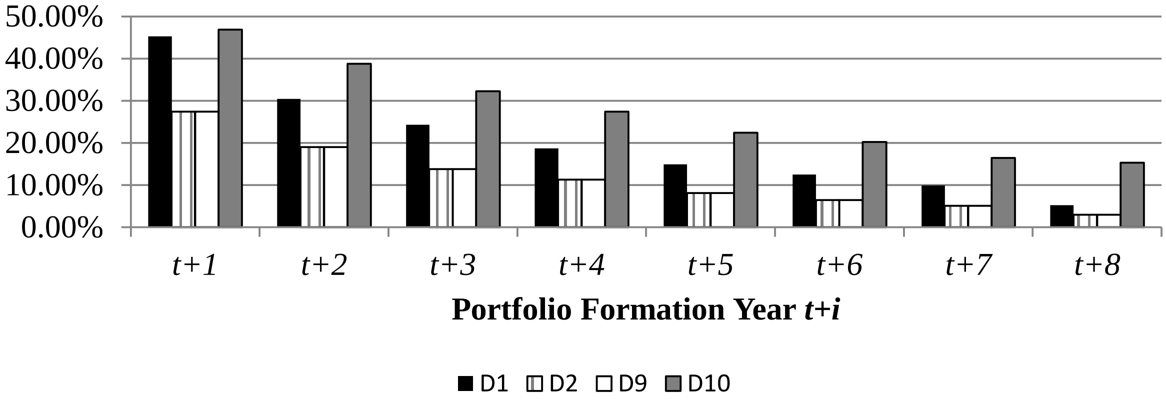


Figure 2: Average DGTW-Adjusted Returns to the Top Two and Bottom Two Q-Score sorted Stock Deciles

This figure demonstrates the DGTW-adjusted performance of the top two and bottom two deciles, which have been formed by sorting the sample of stocks based on their Q-Score. The sample of stocks is all common stocks traded on the NYSE, AMEX or NASDAQ, with the accounting data required to compute the Q-Score. The deciles are formed in June of the Portfolio Formation Year$_t$ (PFY), based on the Q-Score for the prior year, and buy-and-hold returns are computed from July of PFY$_t$ to June of PFY$_{t+1}$. For example, the return for PFY 2000 is the return from July 2000 to June 2001. The weight applied to each stock's return is its market capitalisation as at December of PFY$_{t-1}$.

Deciles 1 (10) and 2 (9) contain the lowest (highest) quality stocks based on the Q-Score.

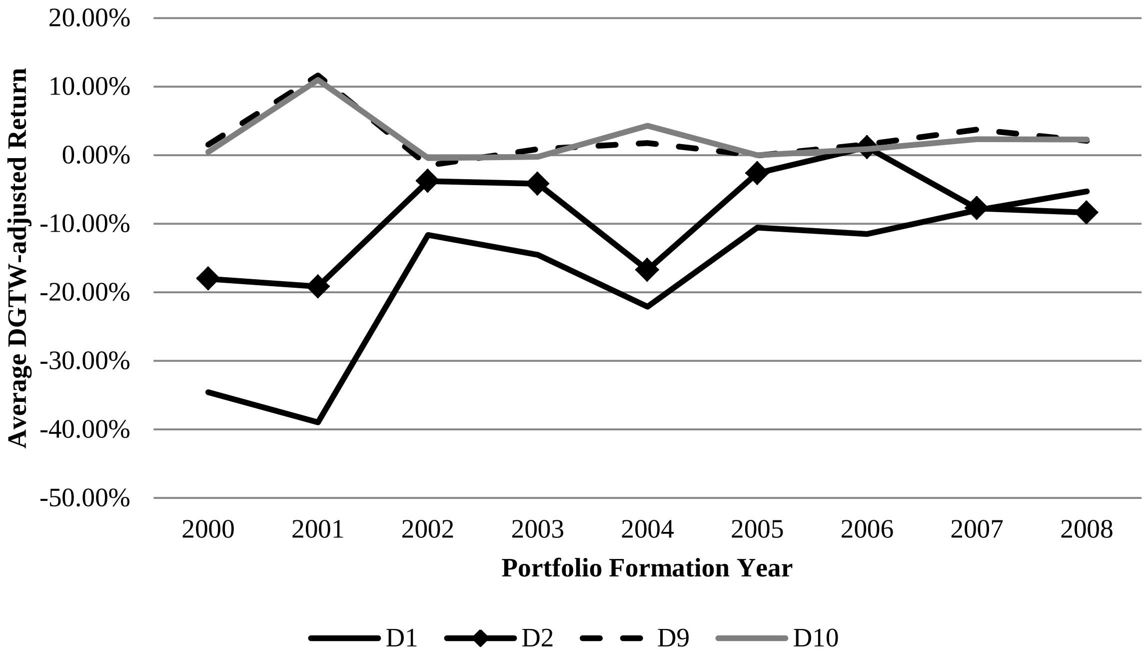


Figure 3: Fund Quality Persistence for the Top Two and Bottom Two Q-Score sorted Stock Deciles

This figure demonstrates the average proportion of funds in the top two and bottom two quality deciles in each portfolio formation year (PFY) $t + i$ (i=1 to 8) which are also in that same decile relative to the vintage PFY for all vintages from 2000 to 2007. The sample is US active equity mutual funds contained in the Thomson Reuters Institutional Holdings database. Firstly, in June of each PFY$_t$, the Q-Score for each stock is computed, and then the weighted-average Q-Score is computed for each fund, based on the holding value of each stock as at June of PFY$_t$. The funds are then ranked into deciles, based on their average Q-Score.

Deciles 1 (10) and 2 (9) contain the lowest (highest) quality funds based on the weighted-average Q-Score of the stocks contained in their portfolios.

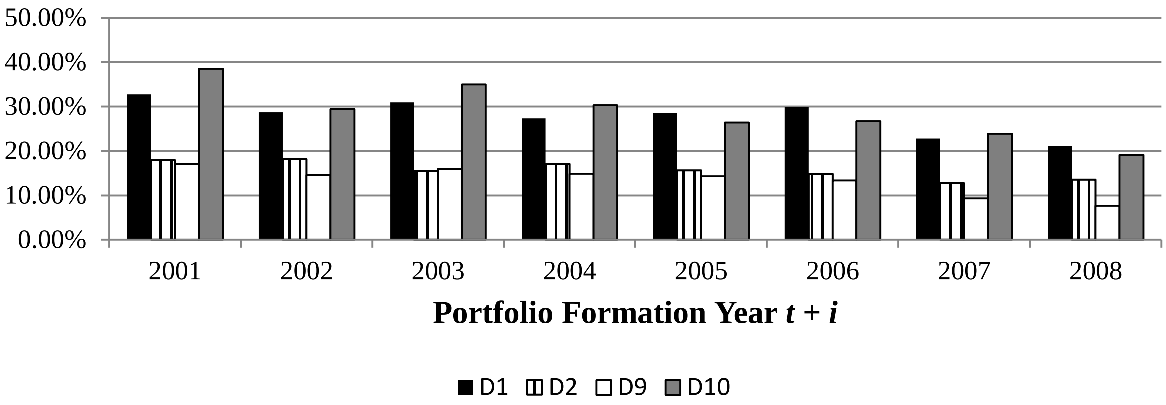
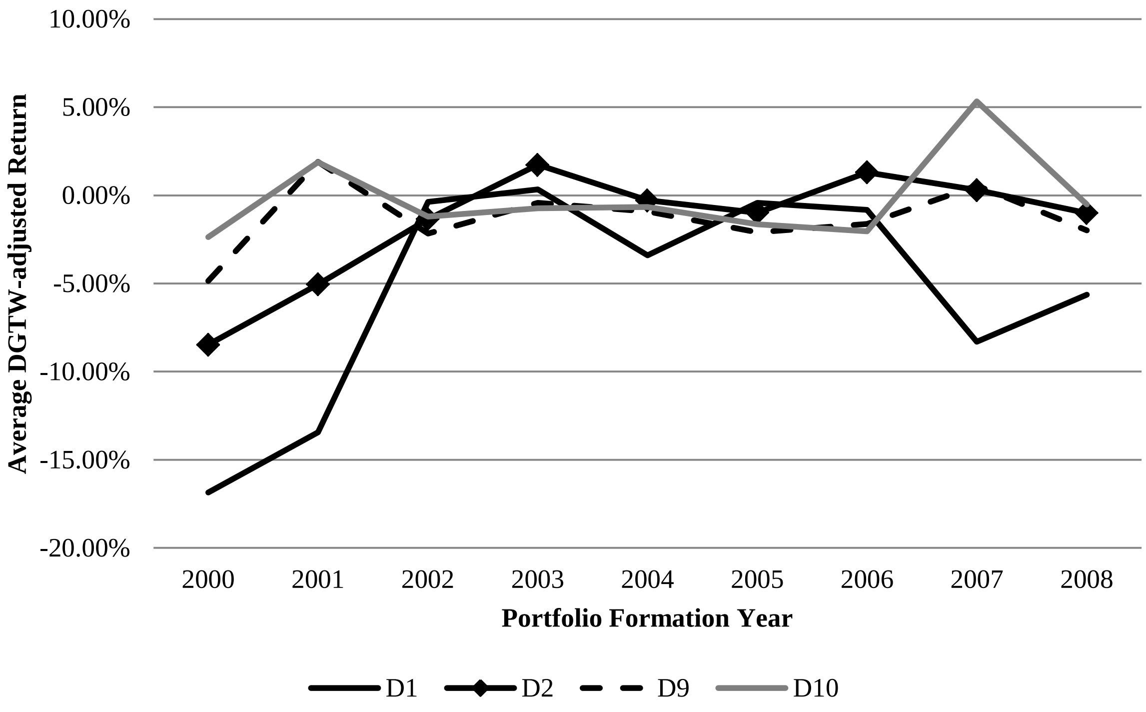


Figure 4*:* Average DGTW-Adjusted Returns to the Top Two and Bottom Two Q-Score sorted Fund Deciles

This figure demonstrates the DGTW-adjusted performance of the top two and bottom two deciles, which have been formed by sorting the sample of funds based on the Q-Score for their portfolios. The sample is US active equity mutual funds contained in the Thomson Reuters Institutional Holdings database. Firstly, in June of each Portfolio Formation Year$_t$ (PFY), the Q-Score for each stock is computed, and then the weighted-average Q-Score is computed for each fund based on the holding value of each stock as at June of PFY$_t$. The funds are then ranked into deciles, based on their average Q-Score. The mean returns are calculated from July of PFY$_t$ to June of PFY$_{t+1}$. All funds with holdings data available in a given quarter of each PFY are included in the calculation of the mean annual return for that PFY. Therefore, the results are free from survivorship bias, as the mean return is calculated on a quarterly basis, and then the annual mean is the compound of these four mean returns.

Deciles 1 (10) and 2 (9) contain the lowest (highest) quality funds based on the weighted-average Q-Score of the stocks contained in their portfolios.



Footnote 13: Mutual Fund Investing Measures for Industry scaled Quality Indicators

This table presents mean values of the mutual fund Investing Measures (IM) for each quality signal from 2000 to 2009. The metrics are Return-on-Equity (ROE), Change in ROE, Return-on-Assets (ROA), Change in ROA, Operating Cash Flow (OCF), Accruals (ACC), Asset Turnover (ATO), Change in ATO, Sales Growth Variability (SG_VAR), ROA Variability (ROA_VAR), Leverage (LEV), Liquidity (LIQ), Change in Shares Outstanding (ΔSH) and Change in Total Equity (ΔTE). The IM is defined as the weighted average decile rank of the individual stocks held by a fund. The time-series averages of the fund level IMs are reported. The *t*-statistic reported for the IMs is relative to an expected value of 5.50 based on an equally weighted average of the decile ranks. The Average Coefficient Estimates, for each quality signal which is used to compute the composite Q-Score developed in this paper, are also presented. The DGTW alpha for each stock in the Compustat/CRSP/DGTW universe is regressed on the metric value for the stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over nine rolling time periods: the first of which is 1989-1998 and the last of which is 1989-2006. The average of the nine coefficient estimates determined from 1999 to 2007 is provided.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Average
Mutual Fund Investing Measures (IM)

Metric	Equal-Weighted (EW) IM	EW IM *t*-statistic	Asset-Weighted (AW) IM	AW IM *t*-statistic
ROE	7.28***	39.47	7.24***	22.52
ΔROE	5.78***	5.05	5.78***	4.34
ROA	7.03***	38.28	6.92***	19.64
ΔROA	7.17***	32.54	7.05***	18.46
OCF	6.99***	53.48	6.98***	31.66
ACC	5.54	0.75	5.49	-0.23
ROA_VAR	4.51***	-36.73	4.42***	-25.78
SG_VAR	4.81***	-17.44	4.70***	-18.41
ATO	5.53	0.70	5.37***	-2.90
ΔATO	5.59	1.10	5.60	0.99
LEV	5.98***	9.77	6.17***	14.47
LIQ	4.32***	-28.03	4.07***	-29.05
ΔSH	5.63	1.11	5.51	0.05
ΔTE	5.91***	5.55	5.80***	3.24

Footnote 14: Mutual Fund Investing Measures for Quality Indicators including Financials

This table presents mean values of the mutual fund Investing Measures (IM) for each quality signal from 2000 to 2009. The metrics are Return-on-Equity (ROE), Change in ROE, Return-on-Assets (ROA), Change in ROA, Operating Cash Flow (OCF), Accruals (ACC), Asset Turnover (ATO), Change in ATO, Sales Growth Variability (SG_VAR), ROA Variability (ROA_VAR), Leverage (LEV), Liquidity (LIQ), Change in Shares Outstanding (ΔSH) and Change in Total Equity (ΔTE). The IM is defined as the weighted average decile rank of the individual stocks held by a fund. The time-series averages of the fund level IMs are reported. The *t*-statistic reported for the IMs is relative to an expected value of 5.50 based on an equally weighted average of the decile ranks. The sample sizes for each metric when Financials are included and excluded are also provided.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Average Mutual Fund Investing Measures (IM)				**Sample Size**	
Metric	Equal-Weighted (EW) IM	EW IM *t*-statistic	Asset-Weighted (AW) IM	AW IM *t*-statistic	Incl. Financials	Excl. Financials
ROE	7.37***	47.50	7.37***	29.86	83,144	67,709
ΔROE	6.15***	13.15	6.04***	8.77	81,355	66,874
ROA	7.18***	32.76	7.05***	18.60	83,145	67,708
ΔROA	6.12***	12.90	5.98***	7.71	81,356	66,873
OCF	7.13***	57.70	7.14***	37.82	75,793	67,699
ACC	n/a	n/a	n/a	n/a	n/a	67,699
ROA_VAR	4.47***	-13.71	4.18***	-14.56	62,058	51,963
SG_VAR	4.61***	-12.15	4.39***	-13.31	60,891	51,112
ATO	5.62*	1.89	5.36	-1.40	82,902	67,707
ΔATO	6.11***	9.52	5.85***	4.00	81,862	67,554
LEV	6.14***	14.15	6.40***	14.76	84,185	68,431
LIQ	4.31***	-31.05	3.99***	-27.05	68,602	66,627
ΔSH	5.59***	0.81	5.44	-0.42	83,435	67,622
ΔTE	6.31***	12.51	6.14***	7.51	83,159	67,720

Footnote 16a: Adjusted R^2 for Metric Regressions

This table presents the adjusted R^2 value for the quadratic regressions of DGTW alpha on each metric and its square, and also the adjusted R^2 for linear regressions of DGTW alpha on each metric.

ROE		ΔROE		ROA		ΔROA		OCF		ACC		ROA_VAR	
Adj. R^2 (%)	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*
0.49	0.48	0.34	0.03	0.64	0.63	0.47	0.04	0.87	0.86	0.52	0.01	0.18	0.10
0.70	0.69	0.46	0.06	0.86	0.86	0.63	0.09	1.11	1.08	0.54	0.00	0.26	0.13
0.95	0.95	0.64	0.09	1.20	1.20	0.90	0.14	1.42	1.39	0.63	0.00	0.44	0.28
0.84	0.83	0.55	0.08	1.00	1.00	0.71	0.11	1.23	1.19	0.51	0.00	0.30	0.17
0.82	0.82	0.53	0.08	0.99	0.99	0.68	0.11	1.21	1.18	0.51	0.00	0.30	0.16
0.89	0.89	0.53	0.07	1.09	1.09	0.69	0.10	1.31	1.28	0.52	0.00	0.38	0.22
0.87	0.87	0.50	0.08	1.10	1.10	0.69	0.12	1.26	1.24	0.52	0.01	0.33	0.18
0.85	0.85	0.49	0.08	1.11	1.11	0.71	0.12	1.27	1.25	0.55	0.01	0.31	0.16
0.87	0.87	0.51	0.08	1.14	1.14	0.71	0.12	1.28	1.27	0.55	0.01	0.32	0.17
SG_VAR		**ATO**		**ΔATO**		**LEV**		**LIQ**		**ΔSH**		**ΔTE**	
Adj. R^2 (%)	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*	*Adj. R^2 (%)*	*Adj. R^2 Linear (%)*
0.12	0.09	0.08	0.02	0.32	0.27	0.00	0.00	0.10	0.03	0.21	0.21	0.24	0.22
0.15	0.12	0.06	0.01	0.31	0.23	0.00	0.00	0.09	0.01	0.20	0.20	0.24	0.20
0.25	0.18	0.11	0.00	0.32	0.24	0.00	0.00	0.12	0.00	0.32	0.32	0.37	0.32
0.19	0.15	0.08	0.00	0.32	0.23	0.00	0.00	0.10	0.00	0.31	0.31	0.33	0.29
0.20	0.16	0.09	0.00	0.31	0.22	0.00	0.00	0.13	0.00	0.29	0.29	0.32	0.27
0.24	0.20	0.10	0.00	0.30	0.20	0.00	0.00	0.15	0.00	0.30	0.30	0.33	0.26
0.22	0.18	0.11	0.00	0.29	0.17	0.00	0.00	0.18	0.00	0.29	0.29	0.30	0.24
0.23	0.19	0.12	0.00	0.29	0.17	0.01	0.00	0.19	0.00	0.28	0.28	0.30	0.24
0.22	0.18	0.12	0.00	0.31	0.16	0.01	0.00	0.19	0.00	0.27	0.27	0.30	0.20

Footnote 16b*:* Returns and Characteristics of Stocks by Q-Score Sorted Decile Portfolios based on Linear Regressions

This table reports the average stock returns and characteristics over the sample period for the stocks comprised in decile portfolios formed by sorting the universe of Compustat/CRSP/DGTW stocks into equally-weighted portfolios in each year *t*, based on their Q-Scores. Decile 1 (10) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score is computed as the average of Return-on-Equity (ROE), Change in ROE, Return-on-Assets (ROA), Change in ROA, Operating Cash Flow, Accruals, Sales Growth Variability, ROA Variability, Asset Turnover (ATO), Change in ATO, Leverage, Liquidity, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics are scaled by the median value for each metric's population in the previous fiscal year. The DGTW alpha for each stock in the Compustat/CRSP/DGTW universe is regressed on the metric value for each stock, as per the following model: $y = \beta_0 + \beta_1 x + \varepsilon$. The regressions are run over rolling time periods. The first regression is run over the estimation period 1989-1998 and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score based on the metric values for 1999 using the following formula: Q-Score = $\sum_{i=1}^{14} \beta_{1,i} Metric_i$

The Q-Score for 1999 is then merged with the mutual fund holdings as at June of 2000, and alpha is examined from July 2000 to June 2001. Overall, the Q-Score is calculated for nine years ranging from 1999 to 2007, and the associated DGTW alpha is examined over nine periods from July 2000 to June 2009. The mean values for Panel A are obtained by value-weighting the returns and characteristics for each stock in the decile by its market capitalisation as at December of year *t-1*. The analysis is repeated on a subset of stocks held by at least one mutual fund in June of each year *t*, using an active-weighting approach in order to account for both a stock's share of the market and the level of exposure that mutual funds have to that stock. Panel B reports the results using this methodology. No. of Stocks is the average number of stocks contained in each decile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio. Q-Score Value is the mean value of the Q-Score per decile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from July of year *t* to June of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly CRSP returns for each stock. If a stock is delisted within the return accumulation period, the subsequent missing monthly returns are replaced by the return on the stock's DGTW benchmark portfolio. DGTW Alpha is the mean excess annual value-weighted return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from July of year *t* to June of year *t+1* for each stock in the portfolio. The *t*-statistics reported are in parentheses below the time-series average returns. Idiosyncratic Return Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from July of year *t* to June of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from July of year *t* to June of year *t+1* for each stock's DGTW benchmark portfolio.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Compustat/CRSP/DGTW Universe

Decile Portfolios	No. of Stocks	Size ($ Million)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
P1 (Low)	262	486	-33.63	-16.86* (-1.73)	-14.35** (-2.62)	61.90	54.04	23.90
P2	262	1,172	-11.01	-0.82 (-0.12)	0.59 (0.17)	45.40	39.57	22.06
P3	262	1,401	-4.23	3.22 (0.52)	1.75 (0.82)	38.29	31.61	19.50
P4	263	1,673	-1.33	0.68 (0.09)	-0.35 (-0.13)	38.43	31.90	19.23
P5	262	1,956	0.47	0.79 (0.13)	0.82 (0.95)	35.16	29.76	19.46
P6	263	2,338	1.83	4.07 (0.68)	1.52 (0.87)	32.51	27.44	17.75
P7	263	2,842	3.23	2.29 (0.49)	1.92 (1.30)	29.25	25.47	17.82
P8	262	3,779	4.70	2.67 (0.57)	2.31* (1.60)	29.87	25.01	17.12
P9	262	4,867	6.89	4.34 (0.89)	3.62* (1.60)	28.95	25.28	17.90
P10 (High)	262	6,275	11.79	-0.11 (-0.03)	-0.18 (-0.11)	26.98	22.68	17.19

Panel B: Mutual Fund Holdings

Decile Portfolios	No. of Stocks	Size ($ Million)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
P1 (Low)	203	620	-32.42	-15.78* (-1.52)	-12.96** (-2.15)	57.65	49.87	23.65
P2	219	1,393	-10.89	-0.28 (-0.04)	0.37 (0.13)	43.84	38.16	21.46
P3	228	1,608	-4.29	2.04 (0.31)	0.91 (0.43)	38.19	31.89	19.69
P4	234	1,880	-1.32	0.92 (0.12)	-0.17 (-0.07)	37.86	31.56	19.22
P5	240	2,125	0.47	0.73 (0.11)	0.60 (0.56)	35.35	29.86	19.63
P6	243	2,499	1.84	4.03 (0.64)	1.75 (1.06)	32.65	27.45	18.07
P7	246	3,026	3.22	2.55 (0.49)	0.68 (1.24)	30.30	26.19	18.18
P8	247	3,983	4.71	1.73 (0.33)	1.95 (1.15)	31.36	26.29	17.99
P9	246	5,161	6.90	3.63 (0.69)	3.17** (1.98)	30.69	26.39	18.36
P10 (High)	243	6,729	11.82	-0.86 (-0.20)	0.24 (0.16)	29.61	24.89	18.14

Footnote 21*:* Returns and Characteristics of Stocks by Q-Score Sorted Decile Portfolios: mutual fund subset weighted following Ali et al. (2008)

This table reports the average stock returns and characteristics over the sample period for the stocks comprised in decile portfolios formed by sorting the universe of Compustat/CRSP/DGTW stocks into equally-weighted portfolios in each year *t* based on their Q-Scores. Decile 1 (10) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score is computed as the average of Return-on-Equity (ROE), Change in ROE, Return-on-Assets (ROA), Change in ROA, Operating Cash Flow, Accruals, Sales Growth Variability, ROA Variability, Asset Turnover (ATO), Change in ATO, Leverage, Liquidity, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics are scaled by the median value for each metric's population in the previous fiscal year. The DGTW alpha for each stock in the Compustat/CRSP/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over rolling time periods. The first regression is run over the estimation period 1989-1998 and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score based on the metric values for 1999 using the following formula:

Q-Score = $\sum_{i=1}^{14} \beta_{1,i} Metric_i + \sum_{i=1}^{14} \beta_{2,i} {Metric^2}_i$

The Q-Score for 1999 is then merged with the mutual fund holdings as at June of 2000, and alpha is examined from July 2000 to June 2001. Overall, the Q-Score is calculated for nine years ranging from 1999 to 2007, and the associated DGTW alpha is examined over nine periods from July 2000 to June 2009. The mean values for Panel A are obtained by value-weighting the returns and characteristics for each stock in the decile by its market capitalisation as at December of year *t-1*.The analysis is repeated on a subset of stocks held by at least one mutual fund in June of each year *t*. These stocks are also weighted by their market capitalisation as at December of year *t-1*. Panel B reports the results for this subset. No. of Stocks is the average number of stocks contained in each decile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio. Q-Score Value is the mean value of the Q-Score per decile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from July of year *t* to June of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly CRSP returns for each stock. If a stock is delisted within the return accumulation period the subsequent missing monthly returns are replaced by the return on the stock's DGTW benchmark portfolio. DGTW Alpha is the mean excess annual value-weighted return to the stocks in each portfolio over the sample period whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from July of year *t* to June of year *t+1* for each stock in the portfolio. The *t*-statistics reported are in parentheses below the time-series average returns. Idiosyncratic Return Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from July of year *t* to June of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from July of year *t* to June of year *t+1* for each stock's DGTW benchmark portfolio.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Compustat/CRSP/DGTW Universe

Decile Portfolios	No. of Stocks	Size ($ Million)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
D1 (Low)	262	491	-52.22	-13.96 (-1.33)	-12.58** (-2.17)	63.06	56.08	24.64
D2	262	928	-17.95	-6.02 (-0.82)	-3.79 (-1.11)	46.06	39.78	21.87
D3	262	1,435	-8.33	-0.61 (-0.08)	-1.26 (-0.35)	45.62	38.82	20.41
D4	263	2,090	-3.88	3.89 (0.71)	1.29 (1.13)	33.70	27.93	19.06
D5	262	2,244	-1.35	1.65 (0.29)	0.33 (0.23)	31.57	27.09	18.02
D6	263	2,595	0.59	3.87 (0.73)	2.83** (2.26)	31.01	26.11	17.90
D7	263	2,514	2.31	3.92 (0.59)	2.97** (2.22)	32.22	27.34	18.17
D8	262	3,471	4.19	2.18 (0.52)	3.05 (1.29)	28.78	24.48	17.68
D9	262	4,357	6.42	4.05 (0.88)	3.29** (1.96)	28.21	24.14	17.15
D10 (High)	262	6,667	11.61	-0.11 (-0.03)	-0.51 (-0.37)	27.58	23.15	17.04

Panel B: Mutual Fund Holdings

No. of Stocks	Size ($ Million)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	Idiosyncratic Return Volatility (%)	DGTW Benchmark Volatility (%)
235	664	-47.30	-16.02 (-1.66)	-13.76** (-2.69)	60.71	53.88	23.47
235	1,297	-15.33	-2.42 (-0.33)	-0.97 (-0.35)	46.03	39.52	21.84
235	1,709	-6.93	0.48 (0.07)	-1.49 (-0.49)	42.24	36.17	19.90
235	2,455	-3.24	3.26 (0.61)	1.39 (0.83)	32.58	26.69	18.78
235	2,407	-0.89	2.51 (0.44)	1.24 (0.90)	31.51	27.13	18.62
235	2,909	0.90	3.99 (0.76)	2.62** (2.74)	30.70	26.04	17.22
235	2,787	2.62	3.85 (0.62)	2.86** (3.07)	31.76	27.22	18.45
235	3,881	4.44	2.45 (0.55)	2.97 (1.36)	29.12	24.50	17.34
235	4,532	6.63	3.74 (0.78)	3.27 (1.53)	28.20	24.36	17.19
235	7,153	11.72	-0.10 (-0.02)	-0.38 (-0.28)	27.44	23.00	17.02

Footnote 23: Returns for Q-Score sorted Stock Deciles using 3- and 4-Factor Models

This table presents annual 3-Factor and 4-Factor alphas for the Q-Score sorted stock deciles. The 4-Factor Alpha is the average annual excess stock return calculated, following Carhart's (1997) four-factor model approach. Specifically, each month the following model is run over the prior 36 months: $y = \alpha + \beta_1(Rm\text{-}Rf) + \beta_2 SMB + \beta_3 HML + \beta_4 MOM + \varepsilon$, where y is the monthly CRSP stock return in excess of the US risk-free rate, *(Rm-Rf)*, *SMB* and *HML* are the market, size and value factors obtained from Ken French's data library, and *MOM* is a momentum factor calculated as in Carhart (1997). The parameter estimates are then used to calculate the 4-Factor alpha for the month, and these values are annualised using simple compounding. The 3-Factor Alpha is computed using the same model, excluding the *MOM* factor.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Decile	3-Factor Alpha	*t*-statistic	4-Factor Alpha	*t*-statistic
1	-7.41*	-1.53	-5.91	-1.30
2	0.58	0.15	2.94	0.64
3	4.21	1.52	3.74	1.79
4	2.06	1.07	1.92	0.99
5	-0.58	-0.24	-0.69	-0.41
6	2.07***	3.11	2.68**	2.73
7	2.93*	1.68	4.84**	2.64
8	1.18	0.74	2.28	1.15
9	2.87*	1.81	3.49**	2.03
10	3.62**	2.04	3.75*	1.62

Footnote 24: Average Fund Returns and Characteristics of Q-Score sorted Deciles by IOC Category

This table presents the mean returns to deciles containing mutual funds in the Thomson Reuters Institutional Holdings Database sample, which have been sorted within each Investment Objective Code category, based on the weighted-average Q-Score for their portfolios. The Q-Score is calculated for nine years ranging from 1999 to 2007, and the returns associated with the Q-Score portfolios are examined over nine periods from July 2000 to June 2009. Firstly, in June of each year *t*, the Q-Score for each stock is computed and then the weighted-average Q-Score is computed for each fund, based on the holding value of each stock as at June of year *t*. Subsequently, the equally-weighted mean Q-Score across the funds is computed each quarter and then these four quarterly values are averaged each year. The time-series mean over the sample period is reported above. The deciles are formed in June of each year *t*, and then the returns are calculated from July of year *t* to June of year *t+1*. All funds with holdings data available in a given quarter of each portfolio formation year are included in the calculation of the mean annual return for that portfolio formation year. Therefore, the results are free from survivorship bias, as the mean return for the funds is calculated on a quarterly basis and then the annual return is the compound of these four mean returns. The time-series means of the annual raw and DGTW-adjusted returns are reported above. The mean size, book-to-market and momentum quintiles to which the stocks are assigned based on the DGTW approach are also provided. Firstly, the asset-weighted mean quintile per quarter, each year, across the deciles is calculated. Then the mean of the four quarterly values is calculated in each year and finally over the sample period. The proportions of funds which are members of each of the three Investment Objective Code groups included in the study are also provided.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively for one-tailed *t*-tests.

Investment Objective Code 2 Funds: Aggressive Growth

Decile	Q-Score	Annual Raw Return (%)	Annual DGTW-Adjusted Return (%)	Size Quintile	Book-to-Market Quintile	Momentum Quintile
D1 (Low)	-7.38	-5.20 (-0.77)	-3.52 (-1.75)	3.09	2.11	3.52
D2	-3.59	-8.66 (-1.10)	-6.64*** (-3.84)	3.24	2.20	3.45
D3	-1.97	-3.12 (-0.43)	-2.37 (-1.61)	3.63	2.18	3.42
D4	-0.54	-4.94 (-0.61)	-2.67 (-1.56)	3.83	2.32	3.42
D5	0.49	-2.10 (-0.28)	-1.05 (-0.81)	3.87	2.29	3.47
D6	1.38	-3.52 (-0.53)	-3.46** (-2.42)	4.10	2.34	3.48
D7	2.08	-2.44 (-0.32)	-1.36 (-0.60)	4.24	2.20	3.30
D8	3.02	-1.86 (-0.30)	-1.20 (-0.51)	4.41	2.42	3.27
D9	3.76	-0.74 (-0.12)	-0.44 (-0.50)	4.32	2.30	3.15
D10 (High)	5.52	-1.35 (-0.27)	-0.33 (-0.17)	4.50	2.35	3.08

Investment Objective Code 3 Funds: Growth

Decile	Q-Score	Annual Raw Return (%)	Annual DGTW-Adjusted Return (%)	Size Quintile	Book-to-Market Quintile	Momentum Quintile
D1 (Low)	-6.77	-6.02 (-0.76)	-4.42** (-2.72)	3.69	2.42	3.18
D2	-1.63	-0.41 (-0.06)	-1.18 (-1.37)	3.82	2.63	3.12
D3	-0.11	-2.15 (-0.31)	-2.67* (-2.23)	3.83	2.71	3.15
D4	0.94	-0.58 (-0.09)	-0.97 (-1.11)	4.12	2.60	3.12
D5	1.81	0.88 (0.16)	-0.10 (-0.15)	4.30	2.60	3.08
D6	2.52	0.37 (0.07)	0.00 (-0.07)	4.46	2.54	3.05
D7	3.23	-0.53 (-0.10)	-1.08 (-1.08)	4.60	2.52	3.00
D8	3.88	-0.23 (-0.04)	-1.03 (-1.37)	4.66	2.45	2.95
D9	4.64	-0.78 (-0.16)	-1.23 (-1.73)	4.66	2.46	2.91
D10 (High)	6.37	0.00 (0.02)	-0.45 (-0.56)	4.65	2.40	2.87

Investment Objective Code 4 Funds: Growth & Income

Decile	Q-Score	Annual Raw Return (%)	Annual DGTW-Adjusted Return (%)	Size Quintile	Book-to-Market Quintile	Momentum Quintile
D1 (Low)	-2.38	-0.59 (-0.08)	-1.32 (-0.69)	4.60	3.03	2.87
D2	0.46	1.28 (0.23)	-0.19 (-0.23)	4.79	3.17	2.70
D3	1.49	1.93 (0.34)	0.75 (0.51)	4.78	3.05	2.75
D4	2.10	2.15 (0.36)	0.52 (0.40)	4.84	3.09	2.68
D5	2.54	0.36 (0.07)	0.00 (0.03)	4.76	2.93	2.78
D6	3.06	0.91 (0.16)	-0.13 (-0.15)	4.83	2.87	2.82
D7	3.51	0.00 (0.01)	-0.20 (-0.25)	4.86	2.82	2.80
D8	3.94	-0.24 (-0.05)	-0.73 (-1.20)	4.87	2.74	2.82
D9	4.57	1.10 (0.22)	-0.35 (-0.44)	4.85	2.67	2.82
D10 (High)	5.56	0.00 (0.02)	-0.47 (-1.14)	4.85	2.55	2.82

Footnote 26: Average Q-Score over the Sample Period including the Intercept

This table presents the mean Q-Score for the funds in each decile in each Portfolio Formation Year (PFY) if the intercept term from each metric's regression is included in the computation of the Q-Score.

PFY	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
2000	-107.78	-102.04	-100.51	-99.42	-98.45	-97.81	-97.31	-96.73	-96.18	-94.86
2001	-111.87	-105.83	-103.89	-102.65	-101.73	-100.92	-100.33	-99.74	-98.88	-96.92
2002	-104.67	-99.47	-97.61	-96.40	-95.54	-94.89	-94.24	-93.62	-92.86	-90.83
2003	-101.32	-96.82	-95.15	-93.99	-93.07	-92.30	-91.67	-90.99	-90.16	-88.14
2004	-98.47	-93.06	-91.51	-90.33	-89.43	-88.75	-87.96	-87.05	-86.19	-85.00
2005	-92.18	-88.03	-86.87	-86.02	-85.45	-84.66	-83.94	-83.35	-82.49	-81.11
2006	-88.37	-84.75	-83.28	-82.44	-81.51	-80.94	-80.37	-79.74	-79.09	-77.67
2007	-83.10	-79.11	-78.01	-77.02	-76.46	-75.96	-75.19	-74.76	-74.02	-72.75
2008	-78.82	-75.23	-73.94	-73.09	-72.28	-71.68	-71.14	-70.75	-69.91	-68.60

Footnote 27: Mean 3-Factor Alpha for Q-Score sorted Deciles for Merged Dataset

The Thomson Reuters Institutional Holdings Database is merged with the CRSP Mutual Fund Database using Mutual Fund Links. The 3-Factor Fund Alpha is the average annual excess fund return calculated following Fama and French's three-Factor model approach. Specifically, each month the following model is run over the prior 24 months: $y = \alpha + \beta_1(Rm\text{-}Rf) + \beta_2 SMB + \beta_3 HML + \varepsilon$, where y is the monthly net CRSP fund return in excess of the US risk-free rate, and *(Rm-Rf)*, *SMB* and *HML* are the market, size and value factors obtained from Ken French's data library. The parameter estimates are then used to calculate the 3-Factor alpha for the month, and these values are annualised using simple compounding. The results are based on funds in the merged subset for which Q-Score data is available and for which 3-Factor alpha data is computed: n=1,211 funds.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Decile	3-Factor Fund Alpha	*t*-statistic
1	-3.55***	-3.02
2	-2.18**	-2.02
3	-1.41	-1.18
4	-1.39*	-1.49
5	-1.17**	-2.48
6	-0.45	-0.54
7	-1.58	-1.99
8	-0.88	-1.32
9	-1.33	-3.32
10	-0.06	-0.14

Chapter 3: Quality Investing in an Australian Context

1. Introduction

This study extends the US analysis of quality as an investment style (see Chapter 2) into the Australian market. The US research indicates that an asymmetric relationship between the DGTW[1]-adjusted performance of high and low quality stocks (and funds) exists on average. Specifically, low quality stocks/funds (i.e., those in decile 10) significantly underperform their characteristic-matched benchmarks, though high quality stocks/funds do not generate outperformance on average. However, high quality stocks/funds outperform low quality stocks/funds during times of market stress. This paper investigates these issues in an Australian context using a similar definition of quality and data from 2000 to 2010.

There are a number of reasons why an Australian application is fruitful. Firstly, given an ageing population who will need stable investments to fund their retirement, an understanding of suitable post-retirement equity products is important. Second, Doran, Drew and Walk (2012) suggest that "a single, poorly-timed negative return event (of around -20%) can raise the probability of [financial] ruin [of one's superannuation] from 33% to 50% for average life expectancy" (pp. 5-6). Thus, research into equities with a focus on downside protection is important. Third, Money Management (2013) states that investors are moving away from the traditional defensive investment options such as cash and Government bonds due to declining interest rates and bond yields. As a result, Equity-Income funds have emerged as a viable defensive investment option. This study investigates the role that active equity funds focusing on 'quality' investments could play in the construction of post-retirement products. Moreover, if a portfolio of high quality stocks outperforms a portfolio of low quality stocks in general then the fundamental variables included in the Quality score (hereafter Q-Score) are important measures for the Australian market. Furthermore, if high quality funds provide downside protection, then funds exhibiting the characteristics that give rise to a high Q-Score (e.g. profitability, operating efficiency and financial stability) are of interest i) when identifying funds to invest in post-retirement, and ii) when constructing a fund-of-funds to meet post-retirement objectives.

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[1] DGTW refers to the performance evaluation method developed by Daniel, Grinblatt, Titman and Wermers (1997). It involves assigning all stocks to one of 125 benchmark portfolios, based on their size, book-to-market and momentum characteristics. Adjusted returns are calculated as the excess of each stock's raw return over the value-weighted raw return to its characteristic-matched benchmark portfolio.

There is a limited body of Australian literature pertaining to accounting ratios and the usefulness of financial statement analysis (e.g. Habib, 2010; Houghton and Woodliff, 1987; Worthington, 1998; Worthington and West, 2004). The literature evaluates accounting metrics individually, for instance the asset growth effect (Bettman, Kosev and Sault, 2011; Dou, Gallagher and Schneider, 2012), profitability (Dou et al., 2012) and leverage and liquidity effect (Gharghori, Mudumba and Veeraraghavan, 2007). The use of a composite score to assess the quality of stocks (recognising that many financial ratios are correlated) and their performance, is therefore valuable. There is a limited literature which investigates accruals quality and earnings management (e.g. Coulton, Taylor and Taylor, 2005; Gray, Koh and Tong, 2009; Kent, Routledge and Stewart, 2010; Oei, Ramsay and Mather, 2008). Furthermore there are only a handful of papers which explicitly consider the relationship between earnings/accruals and stock returns (Chia, Czernkowski and Loftus, 1997; Clinch et al., 2012; Cotter, 1996; Hodgson and Stevenson-Clarke, 2000; Loftus and Sin, 1997; Taylor and Wong, 2012). Hence, exploration of quality as an investment style is of interest. Moreover, the Australian equity fund literature has not investigated 'quality' as an investment style. Its focus has been on i) manager trading (Fong et al., 2011; Pinnuck, 2003), ii) performance persistence (Humphrey and O'Brien, 2010) and iii) performance evaluation (Fong et al., 2008; Gharghori et al., 2007; Heaney, 2008). Furthermore, the quality characteristics of fund managers' holdings have not been analysed.

A Q-Score is constructed for the Australian market in a similar vein to Chapter 2. Specifically, the Q-Score is an aggregate of eight fundamental accounting ratios: ROE, ΔROE, ROA, ΔROA, OCF, Δ Asset Turnover, Δ Shares Outstanding, Δ Total Equity. These metrics are selected based on a review of the Australian and international literature on accounting ratios and stock returns (see Chapter 2, pp. 19-22 for a detailed discussion of academic papers supporting the inclusion of each metric).

The universe of stocks for which the required accounting and stock return data are available is divided into quintile portfolios. In contrast to the US analysis, a symmetric return relationship is identified whereby high (low) quality stocks outperform (underperform) on average[2]. Specifically, the average DGTW-adjusted return to the portfolio of stocks containing the highest quality stocks (i.e., quintile 5) is 6.37%, significant at the 5% level. Conversely, the

[2] In the US, an asymmetric relationship is detected, as only low quality stocks significantly underperform on average

lowest quality stocks underperform by 7.98%, also significant at the 5% level. The analysis is also repeated on a subset of stocks held by at least one mutual fund at the time of portfolio formation (March year *t*). The results are similar overall, although mutual funds appear to avoid the lowest quality stocks with an insignificant DGTW-adjusted return of -2.00% identified for quintile 1. Furthermore, low quality stocks are smaller, more volatile and more sensitive to market movements.

Upon conducting a two-way sort by first dividing stocks into one of three size groups (micro, small and large) and then on the basis of quality, it becomes clear that the result is primarily caused by small stocks. In particular, the highest quality tercile of small stocks generates a statistically significant average DGTW alpha of 14.02%, while the high quality micro and large stocks generate average returns of 5.04% and 5.72%, which are significant at the 5% and 10% levels, respectively. If stocks are first sorted on size, the strong negative performance for the low quality stocks is not identified. Specifically, small and statistically insignificant positive alphas are determined for the low quality micro, small and large stocks.

Using a unique sample of stock holdings from Russell Investments for long-only active Australian equity funds, the quality analysis is applied to the funds' portfolios. A weighted-average Q-Score is calculated for each fund in March of year *t*. On an equally-weighted basis, the top tercile of funds generates an average annual DGTW alpha of 2.09%, which is weakly significant from April 2000 to March 2010. Similarly, the bottom tercile of funds generates an average DGTW alpha of 2.17%, which is significant at the 10% level. Statistically significant equally-weighted Capital Asset Pricing Model (CAPM)-adjusted returns of approximately 3-5% are also determined for all three fund terciles. However, no statistically significant adjusted performance is detected when asset-weighting is used. This indicates that it is the smaller/boutique funds which are driving the outperformance within the terciles. Overall, performance is comparable across the terciles, thus weak evidence of the quality return premium is identified at the fund level.

Furthermore, the size and style characteristics of the funds do not differ substantially across the Q-Score sorted fund terciles. Specifically, the average Asset and DGTW[3] size, book-to-

[3] In the US, the DGTW portfolios are formed based on a five x five x five sort of stocks, given their size, book-to-market and momentum characteristics, i.e., 125 benchmark portfolios. Given the fact that there are less stocks listed on the ASX, the DGTW portfolios are formed based on a five x four x three sort, resulting in 60 benchmark portfolios, following Pinnuck (2003).

market and momentum values determined are similar. This is not surprising given that the overall level of quality of the sample of funds does not differ dramatically, e.g. the average Q-Score for tercile 1 (3) is 4.60 (8.29). Nonetheless, the results for the fund sample are interesting in the sense that, contrary to the US, statistically significant outperformance is generated by high quality funds in Australia. In the US, poor quality funds underperform, however high quality funds do not outperform.

The remainder of this paper is structured as follows. Section two discusses the extant literature, followed by the data and methodology in sections three and four, respectively. The results are provided in section five and finally section six contains the conclusion.

2. Literature Review

There are a limited number of studies in Australia which focus on financial statement analysis and the use of accounting ratios. Recently, the emphasis has been on investigating which line items on the financial statements are the most informative (Barton et al., 2010; Habib, 2010). Earnings before tax and net income are determined to have the highest explanatory power in Australia, based on the adjusted R^2 from a pooled regression of market-adjusted stock returns on each performance measure and its change, which also controls for industry and time effects. Interestingly, Worthington and West (2004) examine whether the trademarked variant of residual income known as economic value-added (EVA®) is more highly associated with stock returns than other common accounting metrics. The authors use relative information content tests which reveal that returns are more closely associated with EVA® than residual income, earnings and net cash flow, respectively. Previously, Worthington (1998) investigated financial statement analysis using mathematical programming techniques with respect to 30 Australian gold producers. The results indicate that simple ratios are unlikely to provide efficiency rankings similar to those obtained from multiple-input, multiple-output methodologies based on Data Envelopment Analysis. In addition, Houghton and Woodliff (1987) analyse 48 companies (12 failure and 36 non-failure cases) using five variables: the quick ratio, income, dividend policy, cash flow and leverage. The research focuses on both the usefulness of the ratios and whether decision makers are able to interpret them in order to predict firms with relatively higher earnings per share (EPS). The authors emphasise that the quick ratio plays a key role with respect to the successful firms. However, not one test subject significantly outperformed a random model with respect to predicting relative EPS.

In a similar vein, Cotter (1996) examines the relative ability of the accrual and cash flow accounting models to capture events which are relevant to the value of stock returns. The relationship between stock returns and earnings is found to be stronger than that for total cash flows for return intervals of between one to 10 years. Furthermore, cash flows from operations and current accruals are able to recognise value relevant events in a timely manner, while non-current and non-operating accruals only become consistently relevant when longer return intervals are considered. Further, Loftus and Sin (1997) examine the role of accruals in the relationship between stock returns and earnings for intervals of one to four years. The results suggest that accruals strengthen the association between stock returns and earnings and that they are more important for shorter intervals. Hodgson and Stevenson-Clarke (2000) indicate that a nonlinear relationship between stock returns and earnings (and stock returns and cashflows) exists. In addition, Chia et al. (1997) compare aggregated earnings and disaggregated earnings (cash from operations, accruals and non-current accruals) in terms of their association with stock returns. Disaggregated earnings are determined to have a stronger relationship with stock returns, even when using simple techniques such as linear regression.

Most recently, Clinch et al. (2012) investigate whether there is evidence of the accrual anomaly in Australia. The results generally support the existence of the anomaly, although returns to a hedged portfolio trading strategy are statistically significant only in the first year, and the results are attributable to a limited number of firm-year observations in the extreme positive tail of returns. Taylor and Wong (2012) show that evidence of an accrual anomaly in Australia is sensitive to research design specifications such as the choice of total accruals measurement, the definition of abnormal returns, how outliers are treated, and the use of value versus equal weighting of returns. Related literature indicates that other accounting anomalies such as the asset growth effect (Bettman et al., 2011; Dou et al., 2012), profitability (Dou et al., 2012), and leverage and liquidity effects (Gharghori et al., 2007) are not prevalent in the Australian equity market. Dou et al. (2012) determine that the existence of the profitability (ROA), asset growth and accrual anomalies is primarily driven by micro-capitalisation stocks.

Overall, the accounting literature has focused on profitability and financial stability metrics, though these have been studied individually. However, both the profitability metrics (ROA, accruals and operating cash flow) and the financial stability metrics (working capital/assets, leverage) are relevant to the Australian equity market. Accordingly, investigation into the relationship between stock returns and a composite measure is warranted. In addition there is support for the use of a non-linear approach.

Coulton et al. (2005) investigate earnings quality by focusing on ‘benchmark beaters’, which are Australian firms that report small profits and/or small increases in earnings, which may be considered indicative of upward earnings management. The authors use unexpected accruals to capture this ‘benchmark beating’ earnings management, and the results show that the unusual kink around zero in the distribution of earnings levels or earnings changes is not caused by earnings management. Accruals quality has also been investigated in relation to corporate governance (Kent et al., 2010); the cost of capital (Gray et al., 2009) and earnings persistence (Oei et al., 2008). However, quality as an investment style has not been researched in Australia to my knowledge.

To date, the equity mutual fund literature has not explored whether fund managers hold quality stocks and whether high quality stocks are related to fund performance. Pinnuck (2004) finds strong evidence that fund managers prefer large, liquid and low volatility stocks. Covrig, Lau and Ng (2006) analyse the portfolio holdings characteristics of foreign and domestic fund managers in 11 developed markets including Australia. The authors conclude that “both groups of managers prefer stocks with high Return-on-Equity, large turnover, and low return variability. Domestic managers also favor firms that pay large dividends, have low financial distress and high growth potential, whereas foreign managers prefer to invest in corporations that are globally well known” (p. 407).

Recent Australian equity fund research relates to manager trading and trade performance. Fong et al. (2011) aggregate manager trades over time into trade packages and find that packages which use multiple brokers are associated with less follower trades. Furthermore, they generate higher positive adjusted returns than single-broker packages over horizons up to one year. Similarly, Pinnuck (2003) examines the performance of the individual trades of Australian fund managers, determining that the stocks they buy realise abnormal returns, whereas there is no evidence of abnormal returns for sell trades.

As well, the extant equity fund literature focuses on performance persistence and evaluation. Humphrey and O’Brien (2010) find no evidence of performance persistence for Australian fund managers using the Carhart (1997) performance evaluation model. In addition, Fong, Gallagher and Lee (2008) propose adjustments to the DGTW (1997) performance evaluation methodology. In particular, the characteristic benchmarks are updated monthly and neutrality to the S&P/ASX 300 is ensured. The modified benchmarks are characterised by statistically different and lower tracking error. Interestingly, Heaney (2008) empirically tests Berk and Green's (2004) model of a superannuation fund industry with a limited population of superior fund managers and a competitive investor market. Australian Morningstar Retail and Wholesale equity fund data from 1995 to 2005 is used and support for Berk and Green's (2004) predictions is found. Finally, Gharghori et al. (2007) indicate that investors chase funds that have performed well in the past and that cash flows to funds are persistent.

There is also a body of multi-sector fund research which concentrates on performance evaluation (Gallagher, 2003; Holmes and Faff, 2004), performance persistence (Bilson, Frino and Heaney, 2005; Dempsey, 2009), fund ratings (Faff, Parwada and Poh, 2007; Gerrans, 2006), asset allocation (Benson, Gallagher and Teodorowski, 2007), time-changing alpha (Heaney et al., 2007) and tournament behaviour (Hallahan, Faff and Benson, 2008).

3. Data

The accounting data used to compute the Q-Score are sourced from the Aspect Financial database via FinAnalysis for all firms with financial year end data from January 1989 to December 2008. Table 1 outlines how each signal is calculated[4]. The individual metric values are scaled by the population median for the prior fiscal year[5]. These scaled metric values are winsorised at the first and 99th percentiles.

INSERT TABLE 1

[4] The variability metrics Sales Growth and ROA variability have not been included in the Australian analysis, as they require a four-year history of data which results in the overall Q-Score results only being able to be calculated robustly from 2002 onwards, since the first year in which the variability metrics have data is 1995 and then seven years of data are required to compute the parameter estimates (i.e., 1995-2001). These parameter estimates are used to compute the Q-Score in March 2002, hence the first period of return analysis is from April 2002 to March 2003 (whereas upon exclusion the return series commences in April 2000). Furthermore, the average β_1 and β_2 estimates for Sales Growth variability are 0, and thus this metric does not contribute to the Q-Score. Similarly, the ROA variability parameter estimates are very small, and therefore they do not have a strong impact on the Q-Score either.

[5] The results are similar when the individual metric values are scaled by the industry median for the prior fiscal year, using the Centre for Research in International Finance (CRIF) industry assignments instead of the population median.

Stock level data such as returns (which account for capitalisation changes and dividends) and market capitalisation are obtained from the Share Price and Price Relative (SPPR) database from Sirca Limited. The primary excess return computation is based on the DGTW (1997) characteristic benchmark approach[6]. DGTW benchmarks are calculated by first sorting stocks into five groups based on size (market capitalisation as at December of the year prior), then into four groups based on book-to-market (for the prior fiscal year), and then into three groups based on momentum (for prior one year, skip one month as at December of the year prior). Adjusted returns are thus calculated by subtracting the return to a stock's DGTW benchmark from its raw return. The sample consists of all stocks listed on the ASX which comprise the Aspect/SPPR/DGTW universe. Returns are computed from April 2000 to March 2010.

CAPM-adjusted returns using a 1-Factor model approach are also presented as a robustness test. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Excess returns are then calculated by subtracting the product of each stock's beta and the market return from its raw return each month.

Financial firms are excluded, given that certain metrics such as leverage and accruals are not consistent for firms in this sector (Taylor and Wong, 2012), i.e., stocks with Global Industry Classification Standard (GICS) codes between 4000 and 4099 are excluded. If the GICS code is missing, then the Centre for Research in International Finance (CRIF) industry class code is used, and stocks classified as 18 to 22 (i.e., financial firms) are excluded. Furthermore, only Ordinary Shares are included.

The mutual fund analysis is undertaken using a sample of managers from the Russell Investments research database, which contains monthly stock holdings for long-only Australian active equity fund managers. The dataset was constructed by Bennett et al. (2012)[7]. The authors state that there is no minimum survival requirement for a fund to be included in their database, thus it is unlikely to exhibit survivorship bias. The authors also indicate that selection bias is minute, establishing this by comparing the performance of new funds and pre-existing funds. Bennett et al. (2012) provide a detailed discussion of the dataset.

[6] The authors are grateful to Adrian Lee for providing valuable programming assistance to calculate the DGTW (1997) benchmarks for Australia.
[7] The number of funds used in Bennett et al. (2012) and this study differs, as the authors make various exclusions relevant to their analysis which are not made in this paper, e.g. the removal of small-capitalisation funds.

INSERT TABLE 2

Table 2 provides descriptive statistics for the sample which contains stock holdings for 232 unique funds from 2000 to 2010. The average return presented for each year is the annualised mean monthly return. The funds' DGTW-adjusted performance is strongest in 2007, with an alpha of 3.65%. Similarly, a CAPM-alpha of 3.98% is determined. However, once the GFC sets in, the funds underperform, with mean alphas of -3.54% and -3.52% using DGTW and CAPM, respectively. Furthermore, the DGTW-adjusted underperformance continues into 2009, with a return of -4.17%. The average DGTW size quintiles, book-to-market quartiles and momentum terciles are similar across the sample period years. The funds prefer large stocks as the average size quintile is about four in every year. They also prefer stocks toward the growth end of the value-growth spectrum, and stocks with moderate momentum. The number of stocks held is similar across the years, ranging from 49 to 58. The value of assets under management is relatively stable throughout the sample period.

4. Methodology

In order to calculate a Q-Score for each stock, the weights to be applied to each accounting metric must first be determined. This is achieved by using Ordinary Least Squares (OLS) regression. Recently, Zhu (2012) indicates that the use of ratios with common divisors in a multivariate regression setting can lead to spurious test statistics, as the true confidence levels differ to the standard conventions. In this study, a number of the accounting ratios have been scaled by divisors which are correlated with each other, and the divisor of returns (the dependent variable). Therefore, to ensure the results and inferences made are not spurious, a univariate regression approach is employed. Specifically, the weights to apply to each metric and its square are ascertained by running a series of expanding-window univariate regressions as per Equation (1) below:

$$y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon \qquad (1)$$

where y represents DGTW alpha- the dependent variable, β_0 represents the intercept, β_1 represents the parameter estimate for the metric in question- x, β_2 represents the coefficient estimate for the squared value of the metric in question, and ε represents the error term.

The standard financial year end month for Australia is June. However, there are still a considerable number of firms using a December financial year end. Therefore, portfolios are formed in March of each year *t*. This allows a three month gap prior to portfolio formation to ensure the accounting data are publicly available. DGTW-adjusted returns are thus computed from April of year *t* to March of year *t+1*. The annual DGTW alpha values for each stock are regressed on the accounting metrics x and x^2 for the prior fiscal year.

Expanding regressions are run over 10 subsets commencing with a historical period of 1992 to 1998, and the parameter estimates obtained are then applied to the accounting metric values for 1999, as per Equation (2) below. The final regression uses a historical period of 1992 to 2007. The parameter estimates are applied to the metric values for 2008 to compute the Q-Score. The β_1 and β_2 parameter estimates for the 10 expanding regressions are not statistically significant for ACC, ATO, LEV or LIQ, therefore, these four metrics are omitted when computing the Q-Score[8]:

$$Q\text{-}Score^{9} = \sum_{i=1}^{8} \beta_{1,i} Metric_i + \sum_{i=1}^{8} \beta_{2,i} Metric^2{}_i \qquad (2)$$

where $\beta_{1,i}$ is the parameter estimate for metric i, and $\beta_{2,i}$ is the parameter estimate for the square of metric i.

Raw and DGTW-adjusted returns for Q-Score portfolios are then examined over 10 periods. The first portfolio formation occurs in March 2000, based on the Q-Score for 1999, and returns are then examined from April 2000 to March 2001. The final portfolio formation occurs in March 2009, based on the Q-Score for 2008, and then returns are generated from April 2009 to March 2010.

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[8] ROA has insignificant parameter estimates for subsets 1 to 3 and 5 and ΔTE for subset 9; however these variables are included in the computation of the Q-Score in all periods in the interests of consistency. If the inclusion of each metric is considered on a rolling basis, then ROA and ΔTE would be excluded from the Q-Score in the aforementioned periods. These results are consistent with those presented.

[9] As a robustness test, an alternative approach to aggregating the metrics included in the Q-Score is undertaken. In a similar vein to Piotroski (2000), a binary scoring system is used. If a stock's ROE, ΔROE, ROA, ΔROA and OCF are positive then indicator variables 1 to 5 equal one, zero otherwise, and if a stock's ΔATO, ΔSH and ΔTE are negative then indicator variables 6 to 8 equal one, zero otherwise. The Q-Score is the sum of the eight indicator variables, therefore the Q-Score values range from 0 to 8. The average return results generated using this method are consistent with the results presented in this paper.

5. Results

5.1 Univariate Results

Table 3 presents average coefficient estimates for each metric based on the 10 expanding univariate regressions. Refer to Appendix A for a detailed summary of the coefficient estimates for each regression. Table 3 shows that the profitability metrics OCF, ΔROA, and to a lesser extent, ROE and ROA, have a strong positive relationship with DGTW alpha. In general, the parameter estimate results are qualitatively similar to those for the US.

INSERT TABLE 3

Interestingly, OCF is characterised by a non-linear relationship with stock returns which follow a U-shape (indicated by the positive β_2 estimate of 29.30). This is consistent with the US results. The largest average negative β_1 estimate is -11.22 for ΔATO, which is characterised by a slight inverted U-shape, thus large increases/decreases in asset turnover are not favourable, e.g. if a dramatic increase in asset turnover is fuelled by a substantial fall in product price. In contrast, the parameter estimates for ΔATO in the US (β_1= -0.30, β_2= -3.11) indicate that it does not have a strong relationship with alpha. ΔTE has a negative relationship with DGTW alpha, given its β_1 estimate of -4.84, which is consistent with Donaldson's (1961) Pecking Order Theory. In particular, if equity is considered a less preferred means to raise capital, then by issuing new equity, managers are signalling to investors that the firm is overvalued, thus an increase in TE leads to a decrease in stock returns.

5.2 Multivariate Results for Stock Universe

Table 4 reports descriptive statistics for the universe of stocks sorted into quintiles based on their Q-Score in March of each year *t*.

INSERT TABLE 4

The average Q-Score for the low quality stocks is -25, compared to 12 for the high quality stocks. On average, stocks in the lowest quality quintile perform particularly poorly, with a DGTW-adjusted return of -7.98%, which is significant at the 5% level[10]. Conversely, stocks

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[10] The quintile results are similar when the Aspect/SPPR/DGTW universe is limited to the top 500 stocks based on market capitalisation as at December year *t-1*. Furthermore, when the Top 10 stocks based on market capitalisation are removed, the results are similar and more pronounced, e.g. average DGTW alpha for Quintile 1

in the highest quality quintile outperform, generating an average DGTW-adjusted return of 6.37%, which is significant at the 5% level. Stocks in the lowest quality quintile are more sensitive to market movements, with an average beta of 1.45[11]. The CAPM-adjusted returns show a similar pattern to the DGTW-adjusted returns, although they are statistically insignificant[12]. However, a paired sample *t*-test of the difference in means between quintiles 1 and 5 reveals that the high quality stocks' market-adjusted returns are 10.17% higher on average than those for quintile 1, and this difference is significant at the 5% level. In addition, the tracking error of the quality portfolios almost monotonically decreases, moving from the low to the high quality end of the spectrum. Furthermore, there is a direct (inverse) relationship between size (volatility) and quality.

INSERT FIGURE 1

Figure 1 shows the performance of the Q-Score quintiles using the stock universe over portfolio formation years 2000-2009. Quintile 2 performs strongly in 2000, with an average DGTW alpha of 19.84%. However, in the aftermath of the dot-com crash the lower quality quintiles perform very poorly, with average returns of -25.21% and -10.23% for quintiles 1 and 2, respectively. In contrast, the higher quality quintiles provide downside protection, generating positive DGTW alphas in 2001. High quality stocks perform very well in 2003, 2004 and 2005, generating average DGTW alphas of 13.66%, 19.81% and 15.66%, respectively. In 2007, all quintiles outperform, except for the lowest quality quintile which underperforms by 9.93%. Amid the GFC in 2008, only quintiles 4 and 5 avoid negative returns, with small positive DGTW alphas of 0.79% and 0.95% determined. In 2009, quintiles 1 and 2 recover strongly, achieving alphas of 9.18% and 24.27%, respectively, whilst quintile 5 underperforms slightly with a -2.47% DGTW alpha.

INSERT TABLE 5

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(5) is -8.31% (14.45%), significant at the 5% (1%) level. The results are also consistent when only stocks with a June financial year end are used and returns are computed from October year *t* to September year *t+1*.

[11] Beta is calculated based on the following regression model estimated over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where *y* is the raw stock return and *x* is the S&P/ASX 300 return, and both *x* and *y* are in excess of the 30 day BAB rate.

[12] Furthermore, the pattern of excess returns computed using a four-factor Carhart (1997) model are also consistent with the results presented in the paper.

The analysis is also repeated on a subset of stocks which are held by at least one mutual fund in the Russell Investments universe in March of each year *t*[13]. Table 5 demonstrates that Australian mutual funds avoid the poorest quality stocks; the average Q-Score is -17 compared to -25 for the universe. Furthermore, the average excess return to quintile 1 is an insignificant -2.00%. The mutual funds also hold larger stocks on average, with the mean market capitalisation for each quintile falling above that for the universe.

INSERT FIGURE 2

Figure 2 shows the performance of the Q-Score quintiles using the subset of stocks which are held by at least one mutual fund as at March of year *t* over portfolio formation years 2000 to 2009. In general, the performance of this subset over time is similar to that for the universe.

INSERT TABLE 6

Table 6 provides returns for the Q-Score sorted stock quintiles in up versus down market months from April 2000 to March 2010. The DGTW-adjusted performance of the quintiles does not vary greatly during up market months. However, quintile 1 (5) stocks perform the worst (best) using value-weighting (VW) or equal-weighting (EW). In particular, the return to quintile 1 (5) is 0.07% (5.98%) using VW, and -1.07% (4.37%) using EW. On a CAPM-adjusted basis, the quintile 1 stocks perform poorly, with an average return of -21.02% and -3.50% using VW and EW, respectively.

The downside protection offered by quality stocks is clear when examining the DGTW-adjusted returns across the down market months. On a VW basis, quintile 1 stocks underperform considerably, with a mean return of -16.64%, compared to quintile 5 stocks which are the only group to avoid negative returns, achieving a small positive return of 1.51%. On an EW basis, quintile 1 stocks underperform, with a return of -5.33%, compared to positive returns for the higher quality quintiles 4 and 5 of 6.44% and 3.74%, respectively. The downside protection is not as clear using CAPM-adjusted returns; however quintile 5 outperforms quintile 1 using either VW or EW.

[13] The active-weighting approach used in the US Quality paper has not been applied to the subset of stocks held by at least one mutual fund, as it is problematic given the Australian market is concentrated and dominated by a number of large stocks.

5.3 Multivariate Results for Stock Universe by Size Category

All stocks are sorted into one of three size categories: micro (<70%), small (70-90%) or large (>90%), based on their December year *t-1* market capitalisation following Dou et al. (2012)[14]. Table 7 provides average returns and characteristics for terciles of stocks within the three size group classifications.

INSERT TABLE 7

There is a greater number of micro stocks on average, followed by small and finally large stocks. The difference in size between the three groups is very clear, e.g. the average size for the high quality micro stocks is $3m, compared to $2,012m for the high quality large stocks. Furthermore, the low quality micro stocks are very poor quality, with an average Q-Score of -27, compared to -8 for the small stocks and 0 for the large stocks.

The highest quality tercile of stocks within each size group generates statistically significant positive DGTW-adjusted returns. The top quality micro stocks generate average alpha of 5.04%, which is significant at the 5% level. The highest quality small stocks perform the strongest, with a statistically significant average DGTW-adjusted return of 14.02%. Finally, tercile 3 within the large stock group generates an average DGTW alpha of 5.72%, which is significant at the 10% level. Thus, the quality return premium identified at the stock level is pervasive across the size groups. The volatility measures for the micro stocks show a similar pattern— as quality increases, volatility monotonically decreases. Furthermore, the volatilities across the quality terciles are higher for micro stocks, followed by small and then large stocks. Within the small and large size groups, the low quality stocks have higher volatilities than the high quality stocks.

The CAPM-adjusted returns across the size groups monotonically increase moving from the low to high quality terciles. A strong quality premium is evident for small and large stocks, with an average CAPM alpha of 13.56% and 7.76%, respectively significant at the 5% level. In relation to beta, the low quality micro stocks are the most sensitive to market movements, with an average beta of 1.35. Across the size categories, the tracking error is higher for the

[14] The average number of stocks in each tercile is similar to the average number in each quartile for Dou et al. (2012). Furthermore, the results are qualitatively similar when stocks are sorted into quartiles within each size group. The results are also qualitatively similar when the subset of stocks held by at least one mutual fund is used for the size breakdown analysis.

micro stocks, followed by small and then large stocks. The low quality micro stocks have the highest tracking error at 7.13%. In contrast, the tracking error is relatively similar across the quality terciles within the small and large size groups.

INSERT FIGURE 3

Figure 3 shows the performance of the quality terciles within the micro size group subset from 2000 to 2009. In 2000, stocks of moderate quality, i.e., those in tercile 2, outperform substantially with an average DGTW alpha of 14.62%. In 2001, the low-moderate quality micro stocks perform very poorly, with terciles 1 and 2 incurring average returns of -18.37% and -7.74%, respectively, compared to the highest quality stocks which generate an average return of 11.01%. All stock terciles achieve positive returns in 2007, although the low quality stocks' performance is muted compared to terciles 2 and 3. The lowest quality micro stocks underperform in 2008 by -5.55%, however they recover very strongly in 2009, with an average DGTW alpha of 31.95%. Contrastingly, the highest quality micro stocks avoid underperforming amid the GFC in 2008, yet in 2009, they underperform by -8.50%.

INSERT FIGURE 4

Figure 4 shows the performance of the quality terciles within the small size group subset over 2000 and 2009. Small stocks of moderate quality (tercile 2) underperform in 2000 by -6.95%, tercile 3 performs the strongest, with an average DGTW alpha of 17.06%. Small stocks in tercile 3 perform particularly strongly in 2001, with a mean DGTW alpha of 32.07%. All small stocks generate positive DGTW alpha in 2007. In 2008, it is the high quality small stocks which perform the worst, with an average alpha of -10.15%. However it is the top quality tercile which posts the strongest recovery in 2009, with an average DGTW alpha of 57.18%.

INSERT FIGURE 5

Figure 5 shows the performance of the quality terciles within the large size group subset over the period 2000 to 2009. The highest quality large stocks underperform slightly in 2000. However, in 2001, it's the lowest quality large stocks which underperform slightly, whilst tercile 2 stocks outperform significantly with an average DGTW alpha of 12.23%. The highest quality large stocks outperform significantly in 2003, 2004 and 2005, whilst low quality stocks underperform in 2003 and 2004. In 2007 the high quality large stocks generate the highest average DGTW alpha at 13.04%[15]. Both low and high quality stocks avoid underperforming in 2008. However, tercile 1 underperforms significantly in 2009, with an average alpha of -12.94%, whilst stocks in tercile 3 perform relatively better, incurring an average alpha of -5.80%.

In summary, the average and time-series performance of segregated stocks based on quality and on size, and then on quality, indicate two key trends. Firstly, there is a quality return premium to stocks which are of high quality as measured by the Q-Score. Secondly, quality stocks have historically provided downside protection during crises such as the dot-com crash, and to a lesser extent the GFC.

5.4 Multivariate Results for Mutual Fund Sample

The Russell Investments research database is used to test the performance of long-only Australian active equity fund managers segregated on the basis of portfolio quality. Table 8 provides return and portfolio characteristics of terciles which have been formed by sorting funds based on the weighted-average Q-Score for their portfolios in March of year *t*. The weight applied to each stock is its holding value as at March of year *t*. Returns are then examined for each tercile from April of year *t* to March year *t+1*. The average return to each tercile is computed each month using all funds which existed in that month. The annual return is then computed as the simple compound of these 12 monthly averages. Thus, the results are free from survivorship bias. Asset-weighted returns are calculated by weighting the return to each fund by its assets as at the end of the prior month.

INSERT TABLE 8

There are 204 unique funds for which Q-Scores can be computed from 2000 to 2009, whilst on average there are 33-36 funds in each tercile every month. The average Q-Scores do not differ substantially across the terciles— the mean Q-Score for tercile 1 is 4.60, compared to 8.29 for tercile 3. Furthermore, the average size of each fund is similar, with average assets of $1,248m, $1,612m and $1,463m for terciles 1, 2 and 3, respectively. Given that the Q-Scores

[15] In 2007 and 2008 no stocks are classified into Tercile 2, therefore return data for these two years is missing for Tercile 2.

and size for the terciles are similar it is perhaps not surprising that the performance of the funds does not differ substantially across the terciles. On an equally-weighted basis, the top tercile of funds generates an average annual DGTW alpha of 2.09%, which is significant at the 10% level from April 2000 to March 2010. Similarly, the bottom tercile of funds generates an average DGTW alpha of 2.17%, which is significant at the 10% level. Furthermore, on an equally-weighted CAPM-adjusted basis, terciles 1, 2 and 3 achieve statistically significant returns of 4.49%, 3.22% and 3.86%, respectively. However, upon value-weighting by assets, no statistically significant returns are identified across the terciles. Furthermore, the average DGTW size quintile, book-to-market quartile and momentum tercile for each tercile are very similar. Overall, it seems that Australian funds are quite homogeneous with respect to the quality of the stocks in which they invest.

Figure 6 shows the performance of the Q-Score sorted mutual fund terciles for portfolios formed in March of year *t* over 2000-2009. The returns presented are asset-weighted DGTW alphas from April of year *t* to March of year *t+1*. In 2001 the top quality tercile provides some downside protection given the downturn following the dot-com crash, with an average DGTW alpha of 0.99% compared to -4.27% for the low quality funds. In 2007 all terciles generate positive returns— the return to tercile 1 is 0.92%, compared to 3.55% and 0.34% for terciles 2 and 3, respectively. Amid the GFC, all terciles of funds underperform, the average DGTW alpha being -6.23%, -2.98% and -5.72%, for terciles 1, 2 and 3, respectively. The underperformance continues into 2009 for terciles 2 and 3; however the low quality funds recover slightly, with an average DGTW alpha of 0.53%.

Thus, there is weak evidence of the quality effect at the fund level on an asset-weighted basis. The level of quality of the funds across the terciles is similar, and thus similar performance is not surprising. In light of this, the fund analysis demonstrates that high quality mutual funds in Australia generate positive outperformance on an adjusted basis.

6. Conclusion

This paper provides an examination of quality as an investment style in the Australian market from April 2000 to March 2010. A symmetric relationship between DGTW alpha and quality stocks is determined with stocks in the highest (lowest) quintile achieving (incurring) an average return of 6.37% (-7.98%), which is significant at the 5% level over the sample period. Thus, a quality return premium exists in the Australian market. Furthermore, this result is pervasive throughout the market, with high quality micro, small and large stocks all exhibiting a similar effect. Analysis of the performance of quality stocks in up versus down markets reveals the downside protection offered by quality stocks. In addition, quality stocks have historically provided security during financial market crises such as the tech crash and, to a lesser extent, the GFC.

This research has a number of implications for the wealth management industry within Australia. Firstly, the research emphasises that financial statement analysis (still) plays an important role within the Australian market in terms of stock picking and investment strategy development. Moreover, the quality return premium identified confirms that the fundamental variables included in the Q-Score are important measures to consider when analysing ASX listed stocks. This is a key takeaway for Self-Managed Super Fund investors, as it provides a structured approach to analysis of stocks with the objective of generating returns and withstanding crisis environments. In relation to the development of suitable post-retirement products, (high) quality appears to be an exploitable return generating avenue, which is characterised by a sound accounting foundation and a low level of risk (particularly relative to low quality stocks).

Furthermore, given the strong stock return results both on average and over time, including during crises, quality as an investment style appears relevant to retirees, given the return/risk relationship apparent. Thus, this research provides a strong foundation for a quality focused approach to post-retirement portfolio construction. Further research is warranted investigating how investment vehicles at the stock level could be used within a portfolio developed with post-retirement objectives.

The quality analysis is also extended to a sample of stock holdings for long-only Australian active equity mutual funds. The level of quality of the funds in the sample is similar and, therefore, the performance across Q-Score sorted fund terciles does not differ substantially. However, a key insight from the investigation is that high quality funds generate statistically significant DGTW alpha (CAPM-adjusted returns) of about 2% (3-5%) on an equally-weighted basis over the sample period. However, no statistically significant DGTW- or CAPM-adjusted returns are identified when asset-weighting is used. Thus, weak evidence that the return premium also exists at the fund level is determined.

In terms of the role that quality funds could play with regard to post-retirement investments, the evidence on the performance of the funds during financial crises is mixed. In 2001 the lowest quality tercile underperforms, whilst the top two outperform. However, in 2008 during the GFC, all funds underperform. Given that funds in all terciles underperform in 2008, it appears that high quality funds are not a panacea to possible future market crises. Although the quality return premium identified is weaker at the fund level, it is worthwhile considering active equity funds along the dimensions highlighted, as important indicators of quality.

7. Appendices

Appendix A: Rolling Regression Results

This table summarises the results from univariate regressions of DGTW alpha on each metric value and its square. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998 (subset 1); the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score using the metric values for 1999. Returns are then examined from April 2000 to March 2001. Essentially, this allows the predictive capability of the Q-Score constructed to be examined, without the impact of any hindsight biases. The second regression is run using data from 1992 to 1999, the third from 1992 to 2000 and so on, up to an estimation period of 1992 to 2007 (subset 10). Thus, the parameter estimates for each of the ten regressions are used on the associated metric values for the following year. Overall, the Q-Score is calculated for ten years ranging from 1999 to 2008 and the associated DGTW alpha is examined over ten periods from April 2000 to March 2010. The regression model is as follows: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$.

***, ** and *, indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Subset	β_1	Standard Error	*t*-statistic	p-value	β_2	Standard Error	*t*-statistic	p-value	Year β_1 & β_2 Applied to Metric Value
				Return-on-Equity (ROE)					
1	15.49***	4.44	3.49	0.00	2.00	1.34	1.50	0.14	1999
2	14.99***	3.88	3.86	0.00	1.70	1.18	1.44	0.15	2000
3	13.22***	3.37	3.93	0.00	1.32	1.04	1.28	0.20	2001
4	12.55***	3.03	4.14	0.00	1.44	0.93	1.55	0.12	2002
5	12.61***	2.98	4.22	0.00	1.29	0.92	1.40	0.16	2003
6	13.03***	2.70	4.82	0.00	1.21	0.84	1.45	0.15	2004
7	11.55***	2.52	4.59	0.00	1.23	0.77	1.59	0.11	2005
8	10.80***	2.35	4.60	0.00	1.17*	0.71	1.65	0.10	2006
9	10.48***	2.17	4.83	0.00	1.36*	0.65	2.11	0.04	2007
10	8.76***	1.97	4.45	0.00	1.09*	0.59	1.86	0.06	2008
				Change in ROE					
1	8.86**	4.35	2.04	0.04	-0.51	2.04	-0.25	0.80	1999
2	8.39**	3.86	2.18	0.03	-0.73	1.81	-0.40	0.69	2000
3	6.93**	3.39	2.05	0.04	-0.85	1.58	-0.54	0.59	2001
4	6.24**	3.02	2.07	0.04	-0.86	1.43	-0.60	0.55	2002
5	7.17**	2.93	2.44	0.01	-1.19	1.39	-0.86	0.39	2003
6	6.57**	2.66	2.47	0.01	-1.74	1.26	-1.38	0.17	2004
7	5.93**	2.52	2.35	0.02	-1.49	1.19	-1.24	0.21	2005
8	5.73**	2.35	2.44	0.01	-1.79	1.11	-1.61	0.11	2006
9	5.01**	2.15	2.34	0.02	-1.74*	1.02	-1.71	0.09	2007
10	4.20**	1.92	2.19	0.03	-1.64*	0.91	-1.80	0.07	2008
				Return-on-Assets (ROA)					
1	-0.42	11.16	-0.04	0.97	-1.08	5.11	-0.21	0.83	1999
2	5.92	9.67	0.61	0.54	0.59	4.41	0.13	0.89	2000
3	13.13	8.52	1.54	0.12	3.86	3.83	1.01	0.31	2001
4	14.20*	7.49	1.90	0.06	4.26	3.42	1.25	0.21	2002
5	10.91	7.27	1.50	0.13	2.16	3.35	0.64	0.52	2003
6	11.83*	6.56	1.80	0.07	2.77	3.01	0.92	0.36	2004
7	11.71*	6.11	1.92	0.06	3.68	2.76	1.34	0.18	2005
8	12.25**	5.64	2.17	0.03	3.93	2.54	1.55	0.12	2006
9	12.47**	5.09	2.45	0.01	4.22*	2.28	1.85	0.06	2007
10	10.86**	4.56	2.39	0.02	3.74*	2.07	1.81	0.07	2008

Appendix A: Continued

Subset	β_1	Standard Error	*t*-statistic	p-value	β_2	Standard Error	*t*-statistic	p-value	Year β_1 & β_2 Applied to Metric Value
				Change in ROA					
1	29.39***	8.59	3.42	0.00	-0.74	8.45	-0.09	0.93	1999
2	28.04***	7.68	3.65	0.00	-2.52	7.65	-0.33	0.74	2000
3	24.59***	6.78	3.63	0.00	0.22	6.69	0.03	0.97	2001
4	22.26***	5.98	3.72	0.00	-0.98	5.99	-0.16	0.87	2002
5	19.50***	5.71	3.41	0.00	-4.03	5.80	-0.69	0.49	2003
6	16.91***	5.18	3.26	0.00	-5.39	5.29	-1.02	0.31	2004
7	13.66***	4.85	2.82	0.00	-5.99	4.95	-1.21	0.23	2005
8	12.80***	4.50	2.85	0.00	-6.10	4.57	-1.34	0.18	2006
9	11.30***	4.08	2.77	0.01	-5.24	4.11	-1.28	0.20	2007
10	9.19**	3.61	2.55	0.01	-4.38	3.62	-1.21	0.23	2008
				Operating Cash Flow					
1	11.64	13.54	0.86	0.39	37.28**	16.63	2.24	0.03	1999
2	15.85	11.85	1.34	0.18	35.16**	14.50	2.42	0.02	2000
3	24.89**	10.57	2.36	0.02	36.87***	12.83	2.87	0.00	2001
4	26.91***	9.42	2.86	0.00	35.87***	11.47	3.13	0.00	2002
5	20.36**	9.17	2.22	0.03	30.61***	11.06	2.77	0.01	2003
6	20.14**	8.31	2.42	0.02	25.15**	9.86	2.55	0.01	2004
7	16.11**	7.83	2.06	0.04	21.31**	9.15	2.33	0.02	2005
8	17.54**	7.34	2.39	0.02	23.24***	8.44	2.75	0.01	2006
9	19.55***	6.67	2.93	0.00	24.08***	7.70	3.13	0.00	2007
10	19.08***	6.14	3.11	0.00	23.47***	7.00	3.36	0.00	2008
				Accruals					
1	-1.21	14.52	-0.08	0.93	-10.37	21.02	-0.49	0.62	1999
2	0.23	12.79	0.02	0.99	-11.29	18.10	-0.62	0.53	2000
3	-3.41	11.58	-0.29	0.77	-12.84	16.44	-0.78	0.44	2001
4	-2.95	10.41	-0.28	0.78	-12.64	14.38	-0.88	0.38	2002
5	3.17	10.23	0.31	0.76	-3.36	14.00	-0.24	0.81	2003
6	3.95	9.37	0.42	0.67	1.27	12.56	0.10	0.92	2004
7	7.99	8.85	0.90	0.37	8.91	11.91	0.75	0.45	2005
8	7.99	8.31	0.96	0.34	5.17	11.21	0.46	0.64	2006
9	4.40	7.65	0.58	0.57	1.06	10.17	0.10	0.92	2007
10	4.47	6.96	0.64	0.52	1.51	9.18	0.16	0.87	2008
				Asset Turnover (ATO)					
1	-5.48	3.64	-1.50	0.13	1.06	1.03	1.03	0.31	1999
2	-3.68	3.21	-1.15	0.25	0.82	0.91	0.89	0.37	2000
3	-2.30	2.89	-0.80	0.43	0.84	0.81	1.04	0.30	2001
4	-0.63	2.59	-0.24	0.81	0.52	0.72	0.72	0.47	2002
5	-2.36	2.57	-0.92	0.36	0.84	0.72	1.17	0.24	2003
6	-2.10	2.37	-0.88	0.38	0.77	0.66	1.17	0.24	2004
7	-2.71	2.29	-1.18	0.24	0.78	0.63	1.24	0.21	2005
8	-2.57	2.18	-1.18	0.24	0.84	0.60	1.39	0.17	2006
9	-2.02	2.05	-0.98	0.33	0.65	0.57	1.14	0.26	2007
10	-1.81	1.93	-0.94	0.35	0.59	0.54	1.09	0.28	2008
				Change in ATO					
1	-16.76**	7.31	-2.29	0.02	5.44	3.58	1.52	0.13	1999
2	-13.46**	6.39	-2.11	0.04	4.91	3.12	1.57	0.12	2000
3	-13.76**	5.67	-2.43	0.02	6.11	2.72	2.24	0.02	2001
4	-12.31**	4.98	-2.47	0.01	5.69	2.41	2.36	0.02	2002
5	-11.37**	4.89	-2.32	0.02	4.59	2.38	1.93	0.05	2003
6	-10.27**	4.50	-2.28	0.02	4.06	2.20	1.85	0.06	2004
7	-10.93**	4.27	-2.56	0.01	3.93	2.09	1.88	0.06	2005
8	-8.89**	4.03	-2.20	0.03	3.47	1.97	1.76	0.08	2006
9	-7.07**	3.73	-1.90	0.06	3.03	1.85	1.64	0.10	2007
10	-7.36**	3.47	-2.12	0.03	3.00	1.72	1.74	0.08	2008

Appendix A: Continued

				Leverage					
1	-5.60	7.57	-0.74	0.46	4.16	3.26	1.27	0.20	1999
2	-3.52	6.56	-0.54	0.59	3.06	2.86	1.07	0.29	2000
3	-0.31	5.93	-0.05	0.96	1.56	2.59	0.60	0.55	2001
4	0.30	5.35	0.06	0.96	1.37	2.34	0.59	0.56	2002
5	-5.16	5.24	-0.98	0.33	3.27	2.29	1.43	0.15	2003
6	-3.21	4.79	-0.67	0.50	2.56	2.09	1.23	0.22	2004
7	-4.67	4.60	-1.02	0.31	2.51	2.01	1.25	0.21	2005
8	-3.00	4.39	-0.68	0.50	2.14	1.93	1.11	0.27	2006
9	-2.25	4.12	-0.55	0.59	1.66	1.80	0.92	0.36	2007
10	-2.36	3.86	-0.61	0.54	1.65	1.69	0.98	0.33	2008
				Liquidity					
1	0.37	6.87	0.05	0.96	-8.23	6.35	-1.30	0.20	1999
2	1.38	6.05	0.23	0.82	-7.54	5.61	-1.34	0.18	2000
3	3.47	5.42	0.64	0.52	-6.36	5.05	-1.26	0.21	2001
4	3.24	4.84	0.67	0.50	-5.52	4.54	-1.22	0.22	2002
5	1.60	4.71	0.34	0.73	-3.56	4.40	-0.81	0.42	2003
6	3.22	4.33	0.74	0.46	-3.00	4.03	-0.74	0.46	2004
7	3.19	4.11	0.78	0.44	-2.28	3.82	-0.60	0.55	2005
8	1.65	3.87	0.43	0.67	-3.50	3.61	-0.97	0.33	2006
9	1.17	3.57	0.33	0.74	-2.75	3.37	-0.82	0.41	2007
10	1.44	3.30	0.44	0.66	-2.46	3.16	-0.78	0.44	2008
				Change in Shares Outstanding					
1	21.06***	7.28	2.89	0.00	-6.43***	2.12	-3.03	0.00	1999
2	15.49**	6.17	2.51	0.01	-5.12***	1.80	-2.85	0.00	2000
3	10.90**	5.45	2.00	0.05	-3.90**	1.58	-2.47	0.01	2001
4	8.77*	4.93	1.78	0.08	-3.17**	1.43	-2.22	0.03	2002
5	7.89	4.86	1.62	0.10	-3.30**	1.42	-2.32	0.02	2003
6	6.29	4.51	1.40	0.16	-2.91**	1.32	-2.21	0.03	2004
7	8.22*	4.28	1.92	0.06	-3.26***	1.26	-2.58	0.01	2005
8	6.27	4.07	1.54	0.12	-2.76**	1.20	-2.30	0.02	2006
9	5.45	3.77	1.45	0.15	-2.36**	1.12	-2.11	0.04	2007
10	5.31	3.48	1.53	0.13	-2.24**	1.04	-2.15	0.03	2008
				Change in Total Equity					
1	-8.94***	2.42	-3.70	0.00	0.55**	0.24	2.32	0.02	1999
2	-7.39***	2.15	-3.43	0.00	0.40*	0.21	1.91	0.06	2000
3	-5.67***	1.88	-3.02	0.00	0.29	0.18	1.58	0.11	2001
4	-5.03***	1.72	-2.93	0.00	0.25	0.17	1.50	0.14	2002
5	-5.14***	1.69	-3.04	0.00	0.25	0.17	1.47	0.14	2003
6	-4.28***	1.56	-2.75	0.01	0.17	0.16	1.10	0.27	2004
7	-3.61**	1.47	-2.46	0.01	0.13	0.15	0.91	0.36	2005
8	-3.13**	1.37	-2.28	0.02	0.12	0.14	0.86	0.39	2006
9	-2.91	2.52	-1.15	0.25	0.08	0.25	0.32	0.75	2007
10	-2.28**	1.16	-1.96	0.05	0.11	0.12	0.94	0.35	2008

Table 1: Individual Quality Metrics

Table 1 details the 12 accounting metrics across three categories— profitability, operating efficiency and financial health, which are considered for inclusion in the Q-Score. All individual metric values are scaled by the population median for the prior fiscal year.

Category	**Signal**	**Measurement**
Profitability	Return-on-Equity[a] (ROE)	Net Income before Abnormals $(NPAT)_t$ (Shareholders' $Equity_{t-1}$ – Outside Equity $Interests_{t-1}$ (TE))
	Change in ROE[b] (ΔROE)	$NPAT_t - NPAT_{t-1} / ((TE_{t-1} + TE_{t-2})*0.5)$
	Return-on-Assets[c] (ROA)	$NPAT_t$ / Total $Assets_{t-1}$ (TA)
	Change in ROA[d] (ΔROA)	$NPAT_t - NPAT_{t-1} / ((TA_{t-1} + TA_{t-2})*0.5)$
	Operating Cash Flow[e] (OCF)	Net Cash Flow from $Operations_t$ $((TA_t + TA_{t-1})*0.5)$
	Accruals[f] (ACC)	ACC = Earnings – OCF where Earnings = $NPAT_t/((TA_t + TA_{t-1})*0.5)$
Operating Efficiency	Asset Turnover[g] (ATO)	TR_t / TA_{t-1}
	Change in ATO[h]	$TR_t - TR_{t-1} / ((TA_{t-1} + TA_{t-2})*0.5)$
Financial Health	Leverage[i] (LEV)	Non-Current $Debt_t / TE_t$
	Liquidity[j] (LIQ)	Working $Capital_t / TA_t$ where Working $Capital_t$ = Current $Assets_t$ - Current $Liabilities_t$
	Change in Shares Outstanding[k] (ΔSH)	$SH_t - SH_{t-1} / SH_{t-1}$
	Change in TE[l] (ΔTE)	$TE_t - TE_{t-1} / TE_{t-1}$

[a] Bird and Casavecchia (2007); Chen and Zhang (2007); Zhang (2000)
[b] Bird and Casavecchia (2007)
[c] Dou et al. (2012)
[d] Bird and Casavecchia (2007); Fairfield and Whisenant (2000); Piotroski (2000)
[e] Chia et al. (1997)
[f] Chia et al. (1997); Clinch et al. (2012); Cotter (1996); Loftus and Sin (1997); Taylor and Wong (2012)
[g] Bird and Casavecchia (2007); Soliman (2008)
[h] Bird and Casavecchia (2007); Piotroski (2000); Soliman (2008)
[i] Houghton and Woodliff (1987)
[j] Houghton and Woodliff (1987)
[k] Donaldson (1961); Myers and Majluf (1984)
[l] Donaldson (1961); Myers and Majluf (1984)

Table 2: Descriptive Statistics for Mutual Fund Sample

Table 2 presents summary statistics for a sample of 232 Australian active equity mutual funds over the period 2000 to 2010. Raw Return is the annualised average monthly raw fund return. The average raw return is first calculated for each fund, whereby each stock's raw return is weighted by its holding value as at the end of the prior month. The average across all funds is then calculated per month and weighted by a fund's assets, as at the end of the prior month. DGTW Alpha is the annualised average adjusted return for each fund, whereby the return to each stock held has been adjusted by the return to one of 60 benchmark portfolios with the same size, book-to-market and momentum characteristics. Stocks are first sorted into five groups based on size, then four groups based on book-to-market, and finally, three groups based on momentum. CAPM Alpha is the annualised average adjusted monthly return for each fund, whereby the return to each stock held has been adjusted using the CAPM one-factor model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Size Quintile is the asset-weighted (AW) average size quintile, B/M Quartile is the AW average book-to-market quartile, and MOM Tercile is the average AW momentum tercile into which the stocks held by a fund fall. The mean for each fund is first calculated by weighting each stock's quintile, quartile and tercile value by its holding value as at the end of the prior month. No. Stocks is the average number of stocks held each year. The AW mean No. Stocks held is first calculated for each month, and then the equally-weighted average of these monthly values is calculated each year. Assets is the AW average of assets as at the end of the prior month across each year.

Year	Raw Return (%)	DGTW Alpha (%)	CAPM Alpha (%)	Size Quintile	B/M Quartile	MOM Tercile	No. Stocks	Assets ($m)
2000	8.19	2.08	4.50	3.95	1.04	1.12	53	1314
2001	13.53	0.67	4.21	3.97	1.12	1.30	54	1977
2002	-7.24	-2.53	2.55	3.97	1.22	1.21	56	3115
2003	15.74	-0.90	2.46	3.96	1.37	1.04	56	1283
2004	27.78	2.71	-0.27	3.96	1.27	0.74	54	1121
2005	22.10	1.61	-1.20	3.96	1.52	0.96	49	1725
2006	26.23	2.02	-3.59	3.97	1.65	1.26	50	2402
2007	21.64	3.65	3.98	3.96	1.27	1.20	52	2081
2008	-40.14	-3.54	-3.52	3.97	1.54	1.35	55	1441
2009	43.62	-4.17	3.47	3.98	1.35	1.42	58	1162
2010	3.08	1.22	-0.60	3.97	1.07	0.96	58	1494

Table 3: Quality Signal Parameter Estimates

Table 3 presents mean values of the coefficient estimates for the eight quality signals included in the Q-Score. The annual DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for the stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. Alpha is measured from April year t to March year $t+1$, and the metric values are for the fiscal year ending in year $t-1$. The regressions are run over ten rolling time periods, the first of which is 1992-1998 and the last estimation period is 1992-2007. The average of the ten coefficient estimates is provided— refer to Appendix A for a detailed summary of the estimates.

Metric	β_1	β_2
Return-on-Equity	12.35	1.38
ΔROE	6.50	-1.25
Return-on-Assets	10.29	2.81
ΔROA	18.76	-3.52
Operating Cash Flow	19.21	29.30
ΔAsset Turnover	-11.22	4.42
ΔShares Outstanding	9.57	-3.55
ΔTotal Equity	-4.84	0.24

Table 4: Returns and Characteristics of Stocks by Q-Score sorted Quintile Portfolios

Table 4 reports the mean values of returns and stock characteristics over the sample period for the stocks comprised in quintile portfolios formed by sorting the universe of Aspect/SPPR/DGTW stocks into equally-weighted portfolios in each year *t* based on their Q-Scores. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of eight accounting metrics: Return-on-Equity (ROE), ΔROE, Return-on-Assets (ROA), ΔROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the median value for each metric's population in the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998, and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at March of 2000, and alpha is examined from April 2000 to March 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and *x* is the S&P/ASX 300 return, and both *x* and *y* are in excess of the 30 day BAB rate. Beta is the average beta in March of year *t* for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 92 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate Beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	158	55	-24.99	-3.80 (-0.36)	-7.98** (-2.45)	63.56	59.47	22.14	-3.01 (-0.36)	1.45	6.54	20.49
P2	159	243	-6.00	-5.14 (-0.47)	3.28 (0.72)	56.64	51.51	20.99	2.97 (0.50)	1.24	5.79	14.94
P3	159	704	0.84	5.85 (0.71)	0.82 (0.35)	38.16	32.72	18.00	6.39 (1.39)	1.21	3.65	10.89
P4	159	682	5.06	9.44 (1.40)	2.75 (1.66)	27.42	25.26	13.90	6.52 (1.21)	0.88	2.14	7.16
P5 (High)	159	1911	12.03	16.15** (2.34)	6.37** (2.44)	27.83	22.11	14.20	7.16 (1.21)	1.03	2.82	7.06

Table 5: Returns and Characteristics of Q-Score sorted Quintile Portfolios for Stocks held by Mutual Funds

Table 5 reports the mean values of returns and stock characteristics over the sample period for quintile portfolios formed by sorting stocks in the Aspect/SPPR/DGTW universe which are held by at least one mutual fund in March of year *t,* into equally-weighted portfolios based on their Q-Scores. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of eight accounting metrics: Return-on-Equity (ROE), ΔROE, Return-on-Assets (ROA), ΔROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the median value for each metric's population in the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998, and the parameter estimates obtained are then used to calculate each metric’s contribution to the Q-Score using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at March of 2000, and alpha is examined from April 2000 to March 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year t for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 53 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the one-factor model regression. The t-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	70	216	-17.07	-8.39 (-0.82)	-2.00 (-0.50)	60.37	54.70	21.22	-10.87* (-1.90)	1.50	6.40	17.49
P2	71	706	-0.55	2.57 (0.31)	-1.57 (-0.39)	38.38	33.27	18.09	-1.46 (-0.35)	1.19	4.77	11.31
P3	71	673	3.51	10.14 (1.47)	4.04 (1.54)	28.19	25.37	14.96	-0.74 (-0.29)	0.86	2.54	7.29
P4	71	961	6.55	12.32* (1.90)	5.39*** (3.80)	26.18	23.39	13.59	3.41 (1.35)	0.95	2.40	6.78
P5 (High)	71	2092	13.24	17.48** (2.40)	6.92* (2.09)	27.56	21.29	13.99	7.50** (2.60)	1.05	3.12	7.03

Table 6: Performance of Quality Quintiles in Up versus Down Markets

Table 6 presents annualised average monthly returns for Q-Score sorted quintiles of stocks in the Aspect/SPPR/DGTW universe from April 2000 to March 2010. The S&P/ASX 300 is used as the market index and the risk free rate is the 30 Day Bank Accepted Bill rate. Up (Down) market months are those when the S&P/ASX 300 return is greater (less) than the risk free rate. Returns value-weighted (VW) by a stock's market capitalisation, as at the end of the month prior and equally-weighted (EW) returns, are provided. DGTW-Adj. is the average monthly excess return, whereby each stock's return has been adjusted by the return to one of 60 benchmark portfolios assigned, based on a stock's size, book-to-market and momentum characteristics. CAPM-Adj. is the annualised average adjusted monthly return for each fund, whereby the return to each stock held has been adjusted using the CAPM one-factor model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate.

	Up Market Months				*Down Market Months*			
Q-Score Quintile	**DGTW-Adj. VW (%)**	**DGTW-Adj. EW (%)**	**CAPM-Adj. VW (%)**	**CAPM-Adj. EW (%)**	**DGTW-Adj. VW (%)**	**DGTW-Adj. EW (%)**	**CAPM-Adj. VW (%)**	**CAPM-Adj. EW (%)**
1	0.07	-1.07	-21.02	-3.50	-16.64	-5.33	7.77	3.46
2	5.22	2.96	-4.30	2.16	-2.11	1.58	12.32	13.17
3	2.12	2.69	-3.49	4.48	-0.64	1.98	9.14	15.02
4	1.79	1.71	3.21	4.09	-1.44	6.44	0.01	9.92
5	5.98	4.37	4.08	2.70	1.51	3.74	9.37	9.64

Table 7: Returns and Characteristics of Q-Score sorted Tercile Portfolios within Size Groups

Table 7 reports the mean values of returns and stock characteristics over the sample period for stocks in the Aspect/SPPR/DGTW universe which are classified into one of three size groups: micro (<70%), small (70-90%) or large (>90%), based on their market capitalisation as at December of year *t-1*. Then within each size group, tercile portfolios are formed by sorting stocks into equally-weighted portfolios based on their Q-Scores as at March year *t*. Tercile 1 (3) contains stocks with the lowest (highest) values of the Q-Score. The means are obtained by value-weighting the returns and characteristics for each stock in the tercile by its market capitalisation as at December of year *t-1*. No. Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year *t* for each stock in the portfolio, where beta has been calculated using the aforementioned model. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Size Group	Q-Score Tercile	No. Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
Micro	1	142	2	-26.74	8.20 (0.43)	2.45 (0.59)	72.37	67.58	28.77	-2.38 (-0.34)	1.35	7.13	24.16
Micro	2	246	3	-2.96	11.76 (1.03)	0.65 (0.15)	63.34	59.61	24.98	3.51 (0.73)	1.11	5.70	19.59
Micro	3	167	3	11.47	34.27* (2.09)	5.04** (2.27)	54.45	52.12	23.32	6.32 (1.09)	0.93	4.66	16.43
Small	1	54	24	-8.26	-4.69 (-0.58)	1.09 (0.34)	54.19	50.93	19.41	-2.90 (-0.87)	1.23	5.17	15.66
Small	2	62	28	4.12	9.62 (1.14)	4.94 (1.40)	38.32	37.14	16.12	5.46 (1.31)	0.93	3.51	10.59
Small	3	43	26	13.74	21.03* (2.09)	14.02** (2.36)	38.35	36.32	17.34	13.56** (2.80)	1.00	3.58	11.67
Large	1	24	819	-0.18	0.55 (0.06)	1.35 (0.45)	34.05	29.14	17.12	-2.28 (-0.65)	1.20	3.62	9.47
Large	2	36	834	4.55	11.41 (1.50)	3.54 (1.73)	27.99	24.62	14.62	4.99 (1.87)	0.89	2.06	7.11
Large	3	27	2012	11.24	14.64* (2.09)	5.72* (1.93)	26.23	20.26	14.18	7.76** (2.72)	1.05	2.71	6.68

Table 8: Returns and Characteristics for Q-Score sorted Tercile Portfolios of Mutual Funds

Table 8 presents average returns and characteristics for tercile portfolios formed by sorting a sample of Australian active equity mutual funds based on the weighted-average Q-Score for their portfolios in March of each year *t* from 2000 to 2009. The Q-Score for each stock held by a fund is weighted by the stock's holding value as at March year *t*. Funds are then sorted into terciles, and returns are measured from April year *t* to March year *t+1*. Monthly returns for each fund are calculated as the average of the return to the stocks contained in the portfolio, weighted by a stock's holding value as at the end of the month prior. Average tercile returns are calculated for each month, and then the annual return presented is the time-series mean of these 12 monthly returns, thus the results are free from survivorship bias. Asset-weighted (AW) and equally-weighted (EW) results are provided. No. Funds is the time-series mean of the average number of funds in each tercile portfolio over the 12 months of each return accumulation period. Q-Score Value is the time-series AW mean of the average Q-Score in March year *t* for funds in each tercile. Assets is the time-series AW average assets of funds in each tercile portfolio over the 12 months of each return accumulation period. Raw Return is the average annual raw fund return. DGTW-Adj. Return is the average adjusted fund return, whereby the return to each stock held has been adjusted by the return to one of 60 benchmark portfolios with the same size, book-to-market and momentum characteristics. Stocks are sorted into five groups based on size, then into four groups based on book-to-market, and finally into three groups based on momentum. CAPM Adj. Return is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Size Quintile is the time-series AW mean of the average size quintile, B/M Quartile is the time-series AW mean of the average book-to-market quartile, and MOM Tercile is the time-series AW mean of the average momentum tercile for funds in each tercile portfolio, computed over the 12 months of each return accumulation period. The means for each fund each month are first calculated by weighting each stock's quintile, quartile and tercile value by its holding value as at the end of the prior month. *t*-statistics are provided in parentheses below the mean returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Tercile	No. Funds	Q-Score Value	Assets ($m)	Raw Return AW (%)	Raw Return EW (%)	DGTW-Adj. Return AW (%)	DGTW-Adj. Return EW (%)	CAPM-Adj. Return AW (%)	CAPM-Adj. Return EW (%)	Size Quintile	B/M Quartile	MOM Tercile
1	33	4.60	1248	11.13	14.74	-0.33	2.17*	0.91	4.49**	3.89	1.35	1.15
				(1.36)	(1.74)	(-0.27)	(1.90)	(0.61)	(2.54)			
2	36	7.04	1612	13.67*	10.84*	1.11	1.61	2.24	3.22*	3.98	1.35	1.13
				(1.94)	(2.00)	(1.19)	(1.75)	(1.39)	(2.03)			
3	35	8.29	1463	12.78	14.80*	0.06	2.09*	2.05	3.86**	3.97	1.32	1.19
				(1.71)	(1.93)	(0.06)	(2.11)	(1.25)	(2.39)			

Figure 1: Average DGTW-adjusted Return by Q-Score sorted Quintiles for Stock Universe

Figure 1 demonstrates the DGTW-adjusted return to each Q-Score sorted quintile from 2000 to 2009. The universe comprises stocks listed on the ASX for which SPPR, Aspect and DGTW data are available. The quintiles are formed in March of each year *t*, based on the Q-Score for the prior year, and buy-and-hold returns are computed from April of year *t* to March of year *t+1*. For instance, the return for 2000 is the return from April 2000 to March 2001. The weight applied to each stock's return is its market capitalisation as at December of Year *t-1*. Quintile 1 (5) contains low (high) quality stocks.

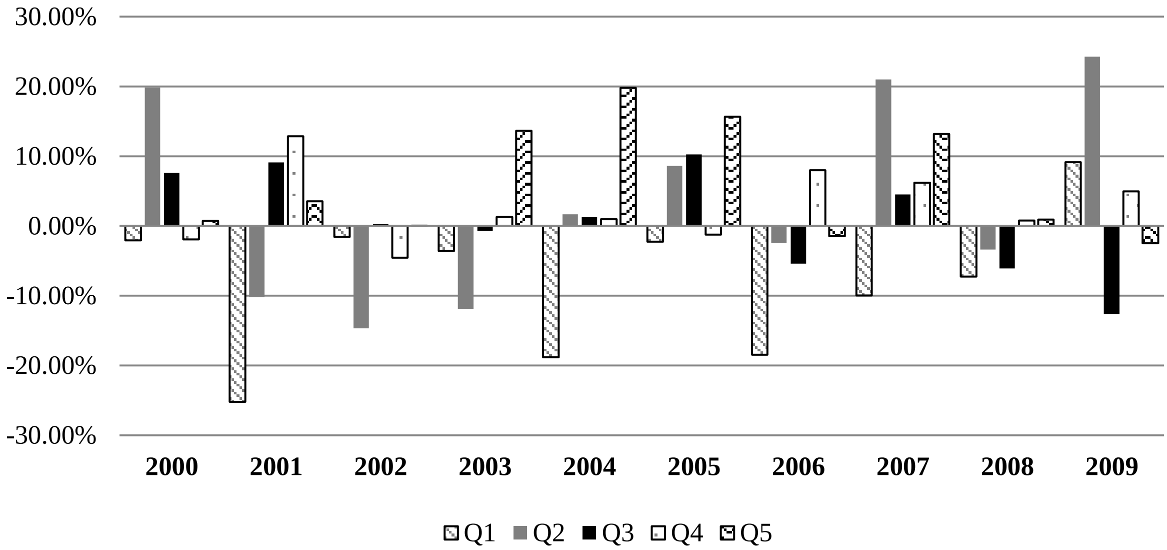


Figure 2: Average DGTW-adjusted Return by Q-Score sorted Quintiles for a subset of Stocks held by at least one Mutual Fund as at March of year *t*

Figure 2 demonstrates the DGTW-adjusted return to each Q-Score sorted quintile from 2000 to 2009. The sample comprises stocks listed on the ASX for which SPPR, Aspect and DGTW data are available, and which are held by at least one mutual fund in March of year *t*. The quintiles are formed in March of each year *t*, based on the Q-Score for the prior year, and buy-and-hold returns are computed from April of year *t* to March of year *t+1*. For instance, the return for 2000 is the return from April 2000 to March 2001. The weight applied to each stock's return is its market capitalisation as at December of Year *t-1*. Quintile 1 (5) contains low (high) quality stocks.

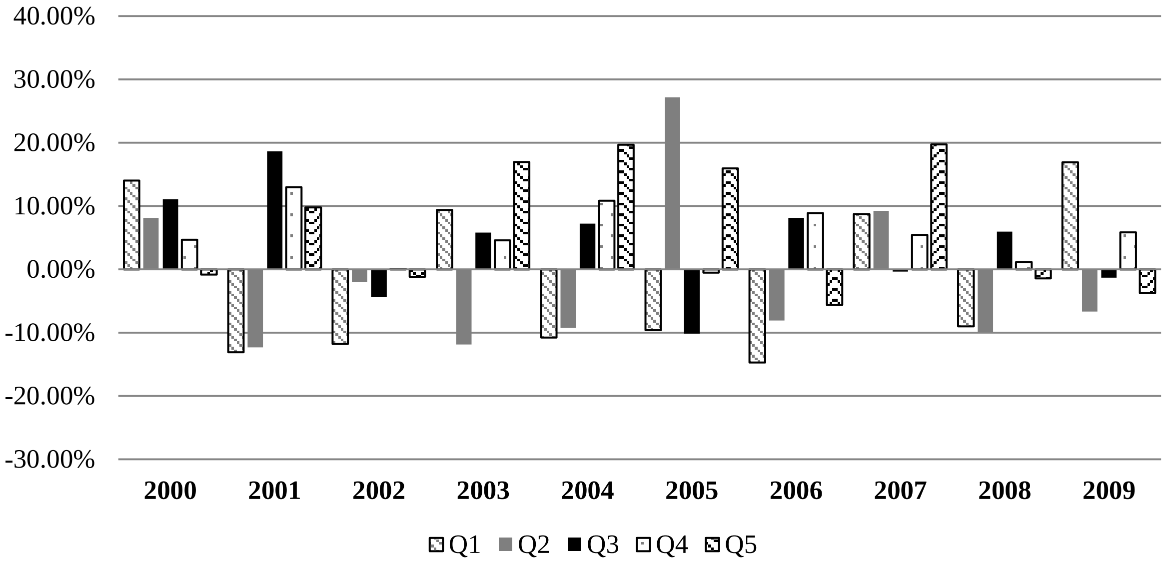


Figure 3: Average DGTW-adjusted Returns to Q-Score sorted Terciles formed using Micro Stocks over 2000-2009

Figure 3 demonstrates the DGTW-adjusted return to each Q-Score sorted tercile from 2000 to 2009. The sample is micro stocks listed on the ASX for which SPPR, Aspect and DGTW data are available. Stocks are classified as micro if their market capitalisation for December of year *t-1* is less than the 70th percentile. The terciles are formed in March of each year *t*, based on the Q-Score for the prior year, and buy-and-hold returns are computed from April of year *t* to March of year *t+1*. For instance, the return for 2000 is the return from April 2000 to March 2001. The weight applied to each stock's return is its market capitalisation as at December of year *t-1*. Tercile 1 (3) contains low (high) quality stocks.

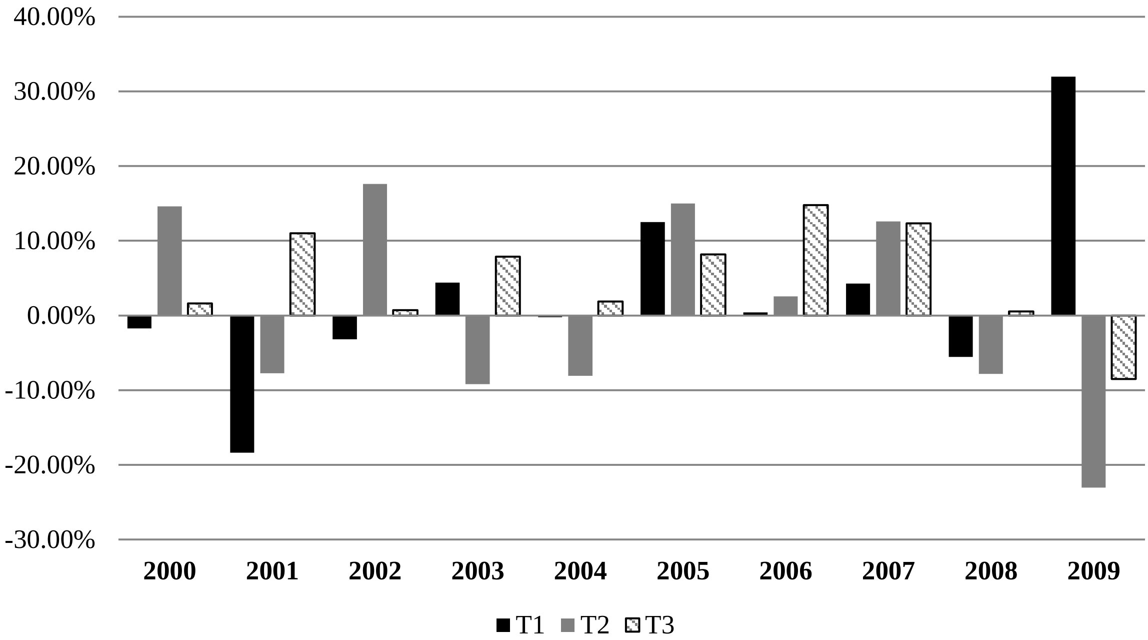


Figure 4: Average DGTW-adjusted Returns to Q-Score sorted Terciles formed using Small Stocks over 2000-2009

Figure 4 demonstrates the DGTW-adjusted return to each Q-Score sorted tercile from 2000 to 2009. The sample is small stocks listed on the ASX for which SPPR, Aspect and DGTW data are available. Stocks are classified as small if their market capitalisation for December of year *t-1* is between the 70th and 90th percentiles. The terciles are formed in March of each year *t*, based on the Q-Score for the prior year, and buy-and-hold returns are computed from April of year *t* to March of year *t+1*. For instance, the return for 2000 is the return from April 2000 to March 2001. The weight applied to each stock's return is its market capitalisation as at December of year *t-1*. Tercile 1 (3) contains low (high) quality stocks.

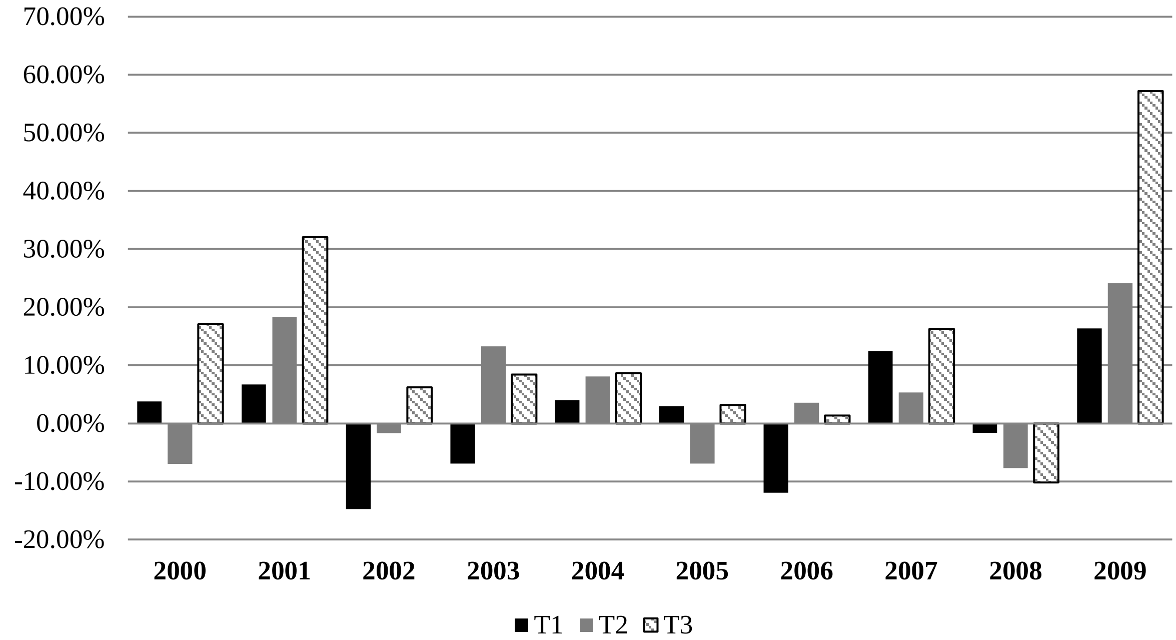


Figure 5: Average DGTW-adjusted returns to Q-Score sorted Terciles formed using Large Stocks over 2000-2009

Figure 5 demonstrates the DGTW-adjusted return to each Q-Score sorted tercile from 2000 to 2009. The sample is large stocks listed on the ASX for which SPPR, Aspect and DGTW data are available. Stocks are classified as large if their market capitalisation for December of year *t-1* is greater than the 90th percentile. The terciles are formed in March of each year *t*, based on the Q-Score for the prior year, and buy-and-hold returns are computed from April of year *t* to March of year *t+1*. For instance, the return for 2000 is the return from April 2000 to March 2001. The weight applied to each stock's return is its market capitalisation as at December of year *t-1*. Tercile 1 (3) contains low (high) quality stocks.

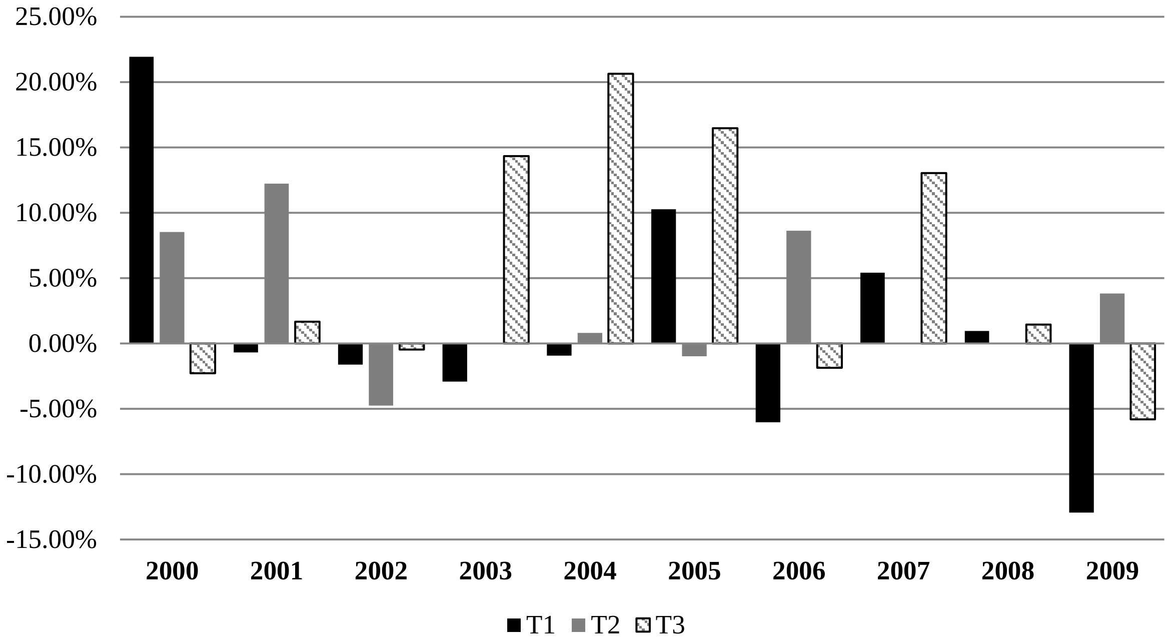
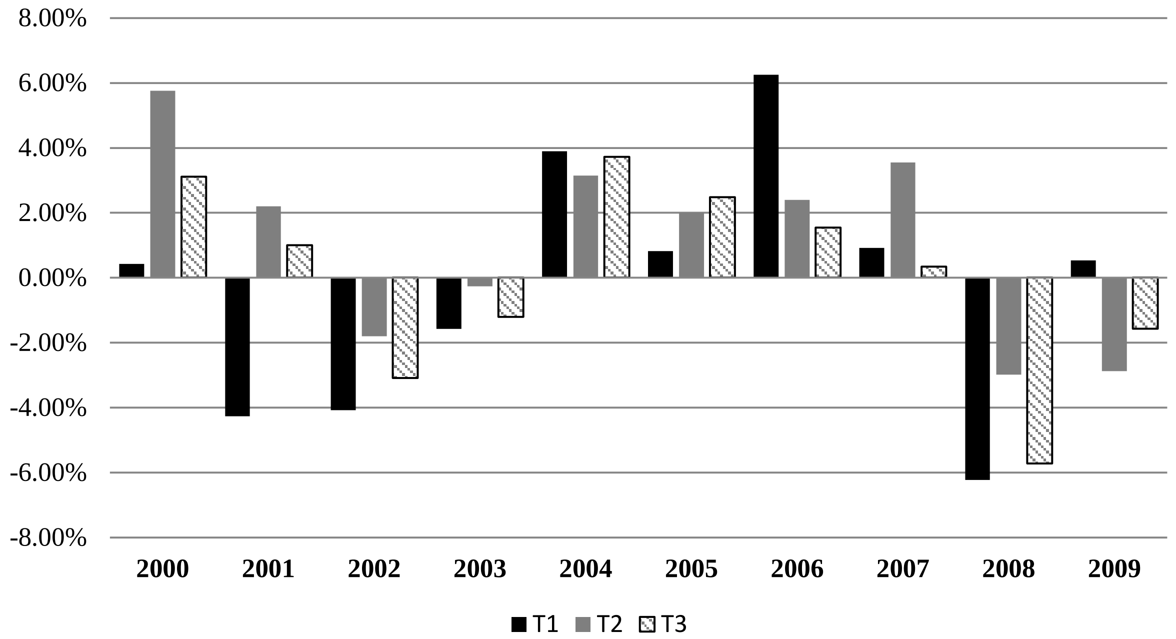


Figure 6: Average DGTW-adjusted Returns to Mutual Funds sorted into Terciles based on the average Q-Score for their Portfolios over 2000-2009

Figure 6 demonstrates the DGTW-adjusted return to each Q-Score sorted fund tercile from 2000 to 2009. The sample is long-only active Australian equity funds. Firstly, in March of each year *t*, the weighted-average Q-Score is computed for each fund, based on the holding value of each stock as at March of year *t*. The funds are then ranked into terciles based on their average Q-Score. The mean returns are calculated from April of year *t* to March of year *t+1*. All funds with holdings data available in a given quarter are included in the calculation of the mean annual return for that year. Therefore, the results are free from survivorship bias, as the mean return is calculated on a quarterly basis, and then the annual mean is the compound of these four mean returns. Tercile 1 (3) contains low (high) quality funds.



Footnote 4: Univariate Regression Results for Variability Metrics

This table summarises the results from univariate regressions of DGTW alpha on each metric value and its square for the variability metrics which are omitted from the Australian Q-Score and included in the US Q-Score. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998 (subset 1); the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score using the metric values for 1999. Returns are then examined from April 2000 to March 2001. Essentially, this allows the predictive capability of the Q-Score constructed to be examined without the impact of any hindsight biases. The second regression is run using data from 1992 to 1999, the third from 1992 to 2000 and so on up to an estimation period of 1992 to 2007 (subset 10). Thus, the parameter estimates for each of the ten regressions are used on the associated metric values for the following year. The variability metrics only have the data required to compute the parameters from subset 4 onwards, thus they are not included in the computation of the Q-Score. Overall, the Q-Score is calculated for ten years ranging from 1999 to 2008, and the associated DGTW alpha is examined over ten periods from April 2000 to March 2010. The regression model is as follows: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$.

Subset	β_1	Standard Error	*t* -statistic	*p* -value	β_2	Standard Error	*t* -statistic	*p* -value	Year β_1 & β_2 Applied to Metric Value
				Sales Growth Variability					
1	.	.	.	.	.	.	.	.	1999
2	.	.	.	.	.	.	.	.	2000
3	.	.	.	.	.	.	.	.	2001
4	0.00	0.00	-1.32	0.19	0.00	0.00	1.20	0.23	2002
5	0.00	0.00	-0.61	0.54	0.00	0.00	0.55	0.58	2003
6	0.00	0.00	-0.96	0.33	0.00	0.00	0.90	0.37	2004
7	0.00	0.00	-0.95	0.34	0.00	0.00	0.92	0.36	2005
8	0.00	0.00	-1.48	0.14	0.00	0.00	1.43	0.15	2006
9	0.00*	0.00	-1.65	0.10	0.00	0.00	1.64	0.10	2007
10	0.00	0.00	-1.64	0.10	0.00	0.00	1.61	0.11	2008
				Return on Assets Variability					
1	.	.	.	.	.	.	.	.	1999
2	.	.	.	.	.	.	.	.	2000
3	.	.	.	.	.	.	.	.	2001
4	-1.90	4.05	-0.47	0.64	0.04	0.18	0.20	0.84	2002
5	-2.95	3.97	-0.74	0.46	0.07	0.17	0.41	0.68	2003
6	-2.94	3.62	-0.81	0.42	0.08	0.16	0.47	0.63	2004
7	-2.72	3.40	-0.80	0.42	0.07	0.15	0.48	0.63	2005
8	-3.13	3.20	-0.98	0.33	0.09	0.14	0.62	0.53	2006
9	-2.47	2.87	-0.86	0.39	0.07	0.13	0.54	0.59	2007
10	-2.69	2.55	-1.06	0.29	0.08	0.11	0.71	0.48	2008

Footnote 5: Returns and Characteristics of Stocks by Q-Score sorted Quintile Portfolios using Industry Scaled Metric Values

This table reports the mean values of returns and stock characteristics over the sample period for the stocks comprised in quintile portfolios formed by sorting the universe of Aspect/SPPR/DGTW stocks into equally-weighted portfolios in each year *t* based on their Q-Scores. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of 8 accounting metrics: Return-on-Equity (ROE), ∆ROE, Return-on-Assets (ROA), ∆ROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the median value for each stock's industry in the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992 to 1998, and the parameter estimates obtained are then used to calculate each metric’s contribution to the Q-Score using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at March of 2000, and alpha is examined from April 2000 to March 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year t for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 92 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return minus, the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate Beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	156	93	-27.83	3.21 (0.26)	-5.62 (-1.19)	60.60	56.33	22.47	-4.92 (-0.60)	1.33	4.09	19.71
P2	156	764	-6.12	2.34 (0.26)	0.33 (0.31)	36.58	31.26	17.42	2.59 (0.43)	1.07	3.75	9.70
P3	156	963	0.46	1.84 (0.28)	-3.33 (-1.15)	28.30	24.60	16.19	6.19 (1.15)	1.02	3.13	7.40
P4	156	530	6.32	8.24 (1.33)	7.87*** (3.83)	31.22	28.51	14.96	8.46 (1.59)	0.88	3.69	7.93
P5 (High)	156	1951	20.65	18.93* (2.45)	7.03** (2.52)	29.72	23.72	14.49	8.62 (1.47)	1.11	5.08	7.53

Footnote 8: Returns and Characteristics of Stocks by Q-Score sorted Quintile Portfolios based on a Q-Score computed by excluding variables iteratively

This table reports the mean values of returns and stock characteristics over the sample period for the stocks comprised in quintile portfolios formed by sorting the universe of Aspect/SPPR/DGTW stocks into equally-weighted portfolios in each year *t* based on their Q-Scores. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of 8 accounting metrics: Return-on-Equity (ROE), ΔROE, Return-on-Assets (ROA), ΔROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the median value for each stock's industry in the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods - the first regression is run using the estimation period 1992-1998, and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at March of 2000, and alpha is examined from April 2000 to March 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year t for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 92 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate Beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	158	49	-24.04	-2.13 (-0.21)	-6.30** (-2.63)	61.31	57.50	22.04	-2.54 (-0.31)	1.39	4.09	19.38
P2	159	417	-5.23	-4.72 (-0.47)	3.83 (0.93)	53.90	47.65	20.86	2.79 (0.47)	1.26	3.75	14.73
P3	159	775	1.09	5.85 (0.67)	1.82 (0.84)	35.37	30.78	17.25	6.70 (1.47)	1.13	3.13	9.92
P4	159	639	4.98	9.71 (1.48)	3.18 (1.81)	27.63	25.58	13.98	6.47 (1.18)	0.88	3.69	7.19
P5 (High)	159	1922	11.77	16.17** (2.34)	6.15** (2.31)	27.96	22.18	14.21	6.62 (1.12)	1.03	5.08	7.07

Footnote 9: Average Q-Score Quintile Returns for Piotroski (2000) inspired Binary Q-Score

This table presents average returns to quintile portfolios of stocks formed on the basis of a Piotroski (2000) inspired Q-Score from 2000 to 2010. In a similar vein to Piotroski (2000), a binary scoring system is used: if a stock's Return-on-Equity (ROE), ∆ROE, Return-on-Assets (ROA), ∆ROA and Operating Cash Flow is positive then indicator variables one to five equal one, zero otherwise, and if a stock's Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity is negative, then indicator variables six to eight equal one, zero otherwise. The Q-Score is the sum of the eight indicator variables, therefore the Q-Score values range from zero to eight.

***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Q-Score Quintile	Raw Return (%)	DGTW-alpha (%)	CAPM-alpha (%)
1	3.21	-9.69*	-4.40
	(0.26)	(-2.01)	(-0.53)
2	2.34	0.09	4.08
	(0.26)	(0.02)	(0.52)
3	1.84	-0.45	3.57
	(0.28)	(-0.14)	(0.65)
4	8.24	2.62	6.79
	(1.33)	(1.17)	(1.59)
5	18.93**	6.46***	10.45**
	(2.45)	(3.93)	(2.37)

Footnote 10a: Returns and Characteristics of Stocks by Q-Score sorted Quintile Portfolios using a Universe Limited to the Largest 500 Stocks each year

This table reports the mean values of returns and stock characteristics over the sample period for the stocks comprised in quintile portfolios formed by sorting the 500 largest Aspect/SPPR/DGTW stocks into equally-weighted portfolios in each year *t*, based on their Q-Scores. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of eight accounting metrics: Return-on-Equity (ROE), ΔROE, Return-on-Assets (ROA), ΔROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the population median for the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998, and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score, using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at March of 2000, and alpha is examined from April 2000 to March 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation, as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year t for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 92 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate Beta. The t-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	100	206	-18.92	-7.86 (-0.74)	-2.41 (-0.66)	61.22	55.70	22.02	-7.14 (-1.27)	1.42	6.28	18.33
P2	100	358	-1.86	0.08 (0.01)	2.96 (0.68)	44.14	40.13	18.11	-0.84 (-0.26)	1.03	5.09	12.65
P3	100	717	2.72	6.50 (0.90)	1.78 (1.17)	31.92	27.89	16.33	1.97 (0.49)	1.02	2.83	8.45
P4	100	912	6.04	11.10 (1.74)	4.26** (2.48)	26.60	23.86	13.86	8.22* (1.96)	0.92	2.25	6.89
P5 (High)	100	1988	13.02	16.59** (2.40)	5.85* (1.88)	27.63	21.79	13.99	9.81* (1.89)	1.02	2.97	7.05

Footnote 10b: Returns and Characteristics of Stocks by Q-Score sorted Quintile Portfolios using a Universe excluding the Largest 10 Stocks each year

This table reports the mean values of returns and stock characteristics over the sample period for the stocks comprised in quintile portfolios formed by sorting the universe of Aspect/SPPR/DGTW stocks into equally-weighted portfolios in each year *t*, based on their Q-Scores. The largest 10 stocks in each year are excluded. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of eight accounting metrics: Return-on-Equity (ROE), ΔROE, Return-on-Assets (ROA), ΔROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the population median for the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998, and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score, using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at March of 2000, and alpha is examined from April 2000 to March 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation, as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year t for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 92 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate Beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	156	55	-25.22	-3.91 (-0.36)	-8.31** (-2.58)	63.86	59.81	22.22	20.696	1.46	6.58	20.70
P2	157	63	-6.00	-4.11 (-0.42)	1.09 (0.27)	56.42	53.47	20.47	15.382	1.22	5.46	15.38
P3	157	182	0.85	6.15 (0.71)	1.19 (0.47)	38.30	35.89	16.37	11.086	1.03	3.76	11.09
P4	157	313	4.96	9.90 (1.39)	2.73 (1.27)	29.48	27.97	14.15	7.77	0.85	2.36	7.77
P5 (High)	157	243	12.40	19.35** (2.66)	14.45*** (3.28)	32.52	30.56	14.77	9.142	0.92	2.69	9.14

Footnote 10c: Returns and Characteristics of Stocks by Q-Score sorted Quintile Portfolios using a Universe of Stocks with a June Fiscal Year end

This table reports the mean values of returns and stock characteristics over the sample period for the stocks comprised in quintile portfolios formed by sorting the universe of Aspect/SPPR/DGTW stocks into equally-weighted portfolios in each year *t*, based on their Q-Scores. Only stocks with a fiscal year end month of June are included. Quintile 1 (5) contains stocks with the lowest (highest) values of the Q-Score. The Q-Score has been computed as the aggregate of eight accounting metrics: Return-on-Equity (ROE), ΔROE, Return-on-Assets (ROA), ΔROA, Operating Cash Flow, Change in Asset Turnover, Change in Shares Outstanding and Change in Total Equity. All of the individual metrics have been scaled by the population median for the previous fiscal year. The DGTW alpha for each stock in the Aspect/SPPR/DGTW universe is regressed on the metric value for each stock, as well as the metric value squared, in order to capture any non-linear relationships, as per the following model: $y = \beta_0 + \beta_1 x + \beta_2 x^2 + \varepsilon$. The regressions are run over expanding time periods. The first regression is run using the estimation period 1992-1998, and the parameter estimates obtained are then used to calculate each metric's contribution to the Q-Score using the metric values for 1999. The Q-Score for 1999 is then merged with the mutual fund holdings as at September of 2000, and alpha is examined from October 2000 to September 2001. The means are obtained by value-weighting the returns and characteristics for each stock in the quintile by its market capitalisation, as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from October of year *t* to September of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from October of year *t* to September of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from October of year *t* to September of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from October of year *t* to September of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$ where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in September of year t for each stock in the portfolio, where beta has been calculated using the aforementioned model. Importantly, there is a number of missing beta values, so the mean No. of Stocks in each quintile is only 92 for this variable. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate Beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Quintile Portfolios	No. of Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
P1 (Low)	130	46	-27.69	0.03 (0.00)	-9.05** (-3.25)	63.24	58.31	24.38	-2.49 (-0.46)	1.51	6.32	20.51
P2	130	255	-7.06	5.66 (0.61)	4.50 (0.86)	61.33	55.84	22.75	2.22 (0.54)	1.28	6.19	16.05
P3	130	706	0.10	13.16 (1.49)	-4.41 (-1.54)	43.73	37.63	19.93	6.49 (1.53)	1.31	3.99	11.78
P4	130	686	4.93	11.58** (2.28)	2.75 (1.23)	28.08	25.45	14.58	8.09* (1.86)	0.86	2.35	7.06
P5 (High)	130	2178	11.72	16.12** (2.55)	6.29** (2.79)	27.49	22.55	14.77	7.95 (1.33)	0.97	2.68	7.10

Footnote 12: Returns of Stocks by Q-Score sorted Quintile Portfolios

This table presents the average Carhart (1997) alpha for Q-Score sorted Quintile portfolios from 2000 to 2010. Carhart-alpha is the average annual excess stock return calculated following Carhart's (1997) four-Factor model approach. All Stocks in the SPPR database are used to form factors (i.e., all listed stocks on the ASX). Specifically, each month the following model is run over the prior 60 months: $y = \alpha + \beta_1(Rm\text{-}Rf) + \beta_2 SMB + \beta_3 HML + \beta_4 MOM + \varepsilon$, where y is raw stock return in excess of the yield on 13 Week Treasury note; *(Rm-Rf)* is the value weighted return of all stocks in the SPPR database in excess of the yield on 13 Week Treasury notes; *SMB* and *HML* are formed following Fama and French (1993) except that portfolios are formed in June, and *MOM* is a momentum factor calculated as in Carhart (1997). The parameter estimates are then used to calculate the four-factor alpha for each month, and these values are annualised using simple compounding for the period July of year t to June of year $t + 1$.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Q-Score Quintile	Carhart-alpha (%)
1	-7.51*** (-3.58)
2	-1.57 (-0.34)
3	-1.55 (-0.42)
4	5.32 (1.37)
5	5.90** (3.24)

Footnote 14a: Returns and Characteristics of Q-Score sorted Quartiles Portfolios within Size Groups

This table reports the mean values of returns and stock characteristics over the sample period for stocks in the Aspect/SPPR/DGTW universe which are classified into one of three size groups: micro (<70%), small (70-90%) or large (>90%), based on their market capitalisation as at December of year *t-1*. Then, within each size group quartile, portfolios are formed by sorting stocks into equally-weighted portfolios based on their Q-Scores as at March year *t*. Quartile 1 (4) contains stocks with the lowest (highest) values of the Q-Score. The means are obtained by value-weighting the returns and characteristics for each stock in the quartile by its market capitalisation as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quartile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quartile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year *t* for each stock in the portfolio, where beta has been calculated using the aforementioned model. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Size Group	Q-Score Quartile	No. Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
Micro	1	142	2	-26.74	8.20 (0.43)	2.45 (0.59)	72.37	67.58	28.77	-10.99 (-1.67)	1.35	2.88	24.16
Micro	2	135	3	-6.03	6.92 (0.60)	4.18 (0.78)	66.23	62.40	26.23	-0.90 (-0.19)	1.17	2.40	21.13
Micro	3	133	3	0.81	21.69 (1.60)	-0.40 (-0.11)	60.80	57.19	23.53	3.69 (0.63)	1.04	2.64	18.13
Micro	4	145	3	13.58	35.13* (2.07)	2.61 (1.08)	56.87	54.10	23.84	10.02* (2.05)	0.96	3.16	17.12
Small	1	35	23	-12.24	-13.17* (-1.88)	-1.27 (-0.42)	57.93	54.42	19.95	-13.85** (-2.51)	1.28	3.13	16.76
Small	2	34	26	0.71	8.63 (0.87)	6.63 (1.73)	44.75	42.97	16.92	2.48 (0.49)	1.04	1.09	12.76
Small	3	46	28	4.93	12.44 (1.42)	5.31 (1.50)	36.44	35.16	15.99	3.04 (1.26)	0.90	1.26	10.20
Small	4	43	26	13.74	21.03* (2.09)	14.02** (2.36)	38.35	36.32	17.34	11.64* (2.13)	1.00	4.18	11.67
Large	1	14	776	-2.93	1.32 (0.15)	-2.21 (-0.63)	37.47	31.08	18.21	-7.14 (-1.38)	1.36	4.78	11.35
Large	2	38	804	4.15	7.55 (0.94)	5.19** (3.59)	28.37	24.84	14.47	2.87 (1.01)	0.94	1.41	6.86
Large	3	32	799	5.10	15.76 (1.67)	2.07 (0.58)	24.96	23.36	12.80	6.64 (1.49)	0.79	6.17	7.22
Large	4	27	2012	11.24	14.64* (2.09)	5.72* (1.93)	26.23	20.26	14.18	5.53 (1.68)	1.05	2.92	6.68

Footnote 14b: Returns and Characteristics of Q-Score sorted Tercile Portfolios within Size Groups for a Subset of Stocks held by Mutual Funds

This table reports the mean values of returns and stock characteristics over the sample period for stocks in the Aspect/SPPR/DGTW universe which are held by at least one mutual fund in March of year *t* and which are classified into one of three size groups: micro (<70%), small (70-90%) or large (>90%), based on their market capitalisation as at December of year *t-1*. Then, within each size group, tercile portfolios are formed by sorting stocks into equally-weighted portfolios based on their Q-Scores as at March year *t*. Tercile 1 (3) contains stocks with the lowest (highest) values of the Q-Score. The means are obtained by value-weighting the returns and characteristics for each stock in the tercile by its market capitalisation as at December of year *t-1*. No. of Stocks is the average number of stocks contained in each quintile portfolio over the sample period. Size is the mean market capitalisation of each stock in the portfolio, as at December of year *t-1*. Q-Score Value is the mean Q-Score per quintile portfolio over the sample period. Raw Return is the average unadjusted buy-and-hold return from April of year *t* to March of year *t+1* to the stocks in the portfolio. The annual returns are calculated by compounding the monthly SPPR returns for each stock. DGTW Alpha is the mean excess annual return to the stocks in each portfolio over the sample period, whereby each stock's raw return is adjusted by the return on an appropriate DGTW benchmark portfolio. Raw Return Volatility is the mean annualised standard deviation of the unadjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Alpha Volatility is the average annualised standard deviation of the DGTW-adjusted monthly returns from April of year *t* to March of year *t+1* for each stock in the portfolio. DGTW Benchmark Volatility is the mean annualised volatility of the monthly returns from April of year *t* to March of year *t+1* for each stock's DGTW benchmark portfolio. CAPM Alpha is the average annual excess return calculated using a one-factor market model approach. Specifically, each month the following model is run over the prior 60 months: $y = \beta_0 + \beta_1 x + \varepsilon$, where y is the raw stock return and x is the S&P/ASX 300 return, and both x and y are in excess of the 30 day BAB rate. Beta is the average beta in March of year *t* for each stock in the portfolio, where beta has been calculated using the aforementioned model. Tracking Error is the average of the square root of the squared monthly deviations of the raw return, minus the return on the S&P/ASX 300. Idiosyncratic Volatility is the standard deviation of the error term over the prior 60 months, based on the same regression used to calculate beta. The *t*-statistics are in parentheses below the average returns reported.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Size Group	Q-Score Tercile	No. Stocks	Size ($m)	Q-Score Value	Raw Return (%)	DGTW Alpha (%)	Raw Return Volatility (%)	DGTW Alpha Volatility (%)	DGTW Benchmark Volatility (%)	CAPM Alpha (%)	Beta	Tracking Error (%)	Idiosyncratic Volatility (%)
Micro	1	60	13	-18.16	-3.20 (-0.34)	-0.70 (-0.13)	60.25	55.79	22.53	-10.82 (-1.71)	1.43	4.74	18.58
Micro	2	107	15	0.60	13.03 (1.27)	4.99 (1.28)	45.18	42.48	18.38	2.70 (0.62)	0.94	2.12	13.33
Micro	3	80	16	12.62	25.36* (2.08)	11.00 (2.21)	40.46	37.35	18.55	11.12* (2.21)	1.03	2.45	12.73
Small	1	19	87	-2.90	2.11 (0.21)	-2.12 (-0.62)	43.12	40.95	17.08	-3.15 (-0.92)	1.22	3.31	11.97
Small	2	31	101	4.67	12.38 (1.38)	5.04 (1.36)	31.32	30.61	14.83	2.12 (0.58)	0.94	1.93	8.62
Small	3	20	98	12.10	14.01 (1.58)	20.13* (2.05)	30.16	28.56	14.03	9.81* (2.13)	0.85	1.42	8.34
Large	1	12	1168	1.29	10.83 (0.90)	3.78 (1.74)	32.64	26.08	17.20	-2.21 (-0.84)	1.13	1.76	8.28
Large	2	16	787	4.78	15.70** (2.70)	1.70 (0.65)	23.03	20.43	12.03	6.59* (1.99)	0.87	1.75	6.48
Large	3	13	2252	11.72	16.66** (2.40)	4.82 (1.50)	26.07	19.63	13.67	5.27 (1.47)	1.05	3.40	6.56

Chapter 4: Style Factor Timing: An Application to the Portfolio Holdings of US Fund Managers

1. Introduction

Since the seminal papers on market timing by Treynor and Mazuy (1966) and Henriksson and Merton (1981), a number of studies investigate whether investment styles can be timed (Bird and Casavecchia, 2011; Chen and De Bondt, 2004; Copeland and Copeland, 1999; Desrosiers, L'Her and Plante, 2004; Kao and Shumaker, 1999; Knewtson, Sias and Whidbee, 2010; Levis and Liodakis, 1999). The emphasis has been on the popularised four factors: market, size, value and/or (to a lesser extent) momentum (Carhart, 1997; Fama and French, 1993; Jegadeesh and Titman, 1993). Recently, industry participants have been focusing on timing the underlying style factors, i.e., 'Factor Timing', using fundamental and/or macroeconomic information. The results indicate that style rotation strategies can exhibit significant timing ability, which translates into better performance when incorporated into the strategies of their mutual fund portfolios (Luo et al., 2010; Smith and Malin, 2010). Moreover, Levis and Liodakis (1999) determine that style consistency is not ideal, with style rotation able to improve fund returns. Similarly, Wermers (2012) finds that style-consistent managers often underperform their more style-cavalier counterparts.

The motivation of this chapter is two-fold. Firstly, a style rotation model is developed based on market and macroeconomic variables at the stock level over the period 1981 to 2011. Secondly, this study extends academic research in this area by testing the prescriptions from the model on the portfolio holdings of a large sample comprising 1,856 US active equity mutual funds from 1981 to 2010. As a result, information as to whether a mutual fund-of-funds (FoF) timing strategy is implementable is provided. A FoF is defined as a fund which invests in other mutual funds.

The academic literature focuses on determining whether individual styles can be timed and whether fund managers (in the US and globally) exhibit market and/or style timing skill (Bollen and Busse, 2005; DGTW, 1997; Glassman and Riddick, 2006; Kacperczyk, Van Nieuwerburgh and Veldkamp 2011; Kao, Cheng and Chan, 1998; Shukla and Singh, 1997; Swinkels and Tjong-A-Tjoe, 2007). This paper contributes to the style timing literature by analysing a broader range of investment styles than previously, across seven style categories: value, growth, quality growth, quality stability, momentum, size and low volatility. Previous research supports the extension of the opportunity set of style factors[1]. A representative underlying style factor is selected for analysis from each category. The style timing strategy developed analyses the style factors simultaneously, which contrasts to previous literature in this area which tests timing strategies for each style separately. In addition, this paper contributes to the mutual fund literature by analysing whether the portfolio holdings of US mutual funds may be used to implement a long-only FoF timing strategy. In the portfolio holdings literature, DGTW (1997) use the stock holdings of funds to investigate whether managers have style timing skill, on average. However, the FoF literature has not been linked to the portfolio holdings literature in order to test the efficacy of a fund timing strategy[2]. Thus, this paper provides information relating to portfolio construction which is particularly relevant to industry parties such as investment managers, advisors and consultants.

The style factors selected for analysis are: Book-to-Market (B/M), Dividend-to-Price (D/P), Net Profit Margin (NPM), ROE, ROA Variability (ROA VAR), Momentum (MOM), SIZE and Stable-minus-Volatile (SMV)[3]. A multivariate forecasting model is developed, and the independent market/macroeconomic variables[4] included are updated every five years, i.e., there are six forecasting models used over the sample period, and these are unique to each style factor. As a result, a time-series of forecast style factor returns is developed for each style factor over the period 1981 to 2011. The forecasts are made each quarter, for the return on a 12-month buy-and-hold investment in the style factor commencing in two quarters' time. The structure of the strategy is designed to be exploitable by an investor in real time, therefore only data which are publicly available at each point in time over the sample period are used.

Investing in the style factor which has the maximum forecast each quarter generates an average annual excess return of 7.26%, which is statistically significant at the 1% level. The timing strategy's average return is greater than the return to the B/M, ROE and SIZE factors;

[1] Ang et al. (2006); Bali, Demirtas and Tehranian (2008); Barbee, Mukherji and Raines (1996); Basu (1983); Bird and Casavecchia (2007); Chan, Hamao and Lakonishok (1991); Chan, Karceski and Lakonishok (1998); Chen and Zhang (2007); Clarke, De Silva and Thorley (2010); Davis (1994); Dechow and Dichev (2002); Dichev and Tang (2009); Fairfield and Whisenant (2000); Fama and French (1988); Gallagher et al. (2013); George and Hwang (2010); Lakonishok, Shleifer and Vishny (1994); Lie and Lie (2002); Lockwood and Prombutr (2010); Lui, Markov and Tamayo (2007); Mercer Investments (2010); Mohanram (2005); Piotroski (2000); Zhang (2000).

[2] Extant mutual FoF research focuses on diversification benefits (Brands and Gallagher, 2005), style characteristics (Stein and Rachev, 2009) and performance (Bertin and Prather, 2009).

[3] The forecasts generated for D/P, NPM, ROA VAR and SMV are not statistically significant when compared to the actual returns. Therefore, these factors are omitted from the stock and fund timing strategy tests.

[4] A set of 25 potential market/macroeconomic variables to include in the forecasting models is selected, following an in-depth review of the literature. Refer to Appendix A.

while MOM achieves a slightly higher average return of 7.90%. However, investing in MOM alone incurs a higher level of risk, and as a result, the Sharpe Ratio is 17% lower than the timing strategy. In the interests of reducing turnover, an annual strategy based on the quarterly forecasts is also tested. It involves rebalancing once a year in Q_i (where $1 \leq i \leq 4$), e.g. to invest in each calendar year, the Q_3 forecasts are used. Investing in any of the four annual investment options yields a statistically significant, average annual excess return over the sample period, which ranges from 6.59% to 9.01%. In summary, a style timing strategy using a range of style factors based on market and macroeconomic data is profitable over the sample period.

Given that a stock selection strategy using the style factor forecasts generates outperformance, this study tests whether a similar timing strategy using the mutual funds based on the style forecasts also generates outperformance. In Q_3 of each year *t*,[5] a weighted-average quintile rank ($WRank_{j,t}$) is computed for each fund *j* based on its stock holdings, in order to identify the funds which have the greatest exposure to the style factor which has the highest forecast. Funds are sorted into quintiles based on their exposure to the preferred style as indicated by $WRank_{j,t}$ in Q_3 of each year *t*. The first year for which holdings data is available is 1980, thus portfolio formation occurs from 1980 to 2009. The average returns to the quintiles are examined over year $t+1$, i.e., from 1981 to 2010. Quintile 5 (1) contains funds with the greatest (lowest) exposure to the preferred style, i.e., the preferred (unpreferred/out-of-favour) funds. The average annual market-adjusted and DGTW-adjusted returns are all statistically insignificant. Thus, a style timing strategy at the aggregate fund level (i.e., from a FoF management perspective) does not generate statistically significant outperformance over the sample period. Furthermore, this result is consistent when broken down by style category.

Further investigations as to why the performance identified at the stock level does not translate to the fund level are conducted. The preferred funds' exposures to the preferred style factor decrease over the investment horizon, and the funds are also highly exposed to the other factors. Moreover, alternative implementation methods do not improve the fund level results. However, as the funds in the sample are long-only in nature, the factor timing strategy is modified using long-only style factor forecasts. After the long-only constraint is applied at the factor level, the earlier significance disappears. Therefore, the result is primarily due to the fact that the funds are long-only in nature, and thus unable to attain the long-short style factor

[5] Thus, an annual strategy is tested using the Q_3 forecasts which cover the following calendar year.

return. It follows that the use of long-short style factor portfolios in relation to long-only mutual funds, in order to undertake tasks such as performance evaluation, may not be appropriate.

The remainder of this paper is organised as follows. A review of the extant literature is provided in section two. Sections three and four outline the data used and the relevant summary statistics, respectively. Section five describes the research methodology developed, and then in section six the results are discussed. Finally, concluding remarks are provided in section seven.

2. Literature Review

Treynor and Mazuy (TM) (1966) pioneered the market timing literature examining 57 US mutual funds over the period 1953-1962 at yearly intervals. No statistical evidence that investment managers of any of the 57 funds successfully predicted the direction of the market is identified. Henriksson and Merton (HM) (1981) provide an alternative model to that used in TM to test for market timing, however, the overall concept is similar. Interestingly, Sharpe (1992) proposes a linear Asset Class Factor Model to decompose a fund's return into selection ability and exposures to specific asset classes or styles. This method is used extensively by investment management practitioners, and from this paper stemmed a series of further academic research focusing on style timing[6].

Kao and Shumaker (1999) find that timing strategies using macroeconomic variables based on asset class and size provide more opportunity for outperformance than those based on value versus growth, albeit with similar information ratios. Similarly, Levis and Liodakis (1999) examine size and value versus growth style rotation strategies in the United Kingdom. The authors link the style spreads to a number of business cycle variables, and assess trading rules built on their ex-ante predictions. The findings provide strong support for small versus large, but not value versus growth style rotation strategies. Recently, Bird and Casavecchia (2011) developed a style rotation model for European value and growth stocks based on macroeconomic data. The excess returns generated by investing as per the forecasts from the model, enable performance to be realised well above that which could be achieved by restricting investment to either a value/growth portfolio each month.

[6] Kao and Shumaker (1999); Levis and Liodakis (1999); Copeland and Copeland (1999); Chen and De Bondt (2004); Desrosiers, L'Her and Plante (2004); Knewtson et al. (2010); Bird and Casavecchia (2011).

Chen and De Bondt (2004) show that a style momentum strategy which takes a long (short) position in past winner (loser) style portfolios over ranking periods of three to 12 months earns positive excess returns. The most successful strategies select stocks based on prior 12 month returns and hold for three, six, nine or 12 months. Chen and De Bondt's (2004) strategy follows a similar method to Jegadeesh and Titman (1993), although this 'style momentum' is shown to be distinct from price and industry momentum. The authors suggest that this phenomenon may be related to cyclical/structural changes in the macro economy, or from a behavioural standpoint, how investors interpret macroeconomic information. Thus, it may be that there are predictable and lasting biases in how investors interpret macroeconomic data.

In recent years, industry research has focused on style timing using the underlying style factors combined with fundamental, market and macroeconomic data. Smith and Malin (2010) develop a Macro Factor Rotation Model and present results for Asia, ex Japan. The aim of this factor model is to rotate through the style factors as signalled by the state of the macroeconomic environment. They focus on 14 macroeconomic/sentiment indicators and split them into six potential states- rising/falling, high/low and post-peak/post-trough. Following on from theoretical states created with perfect hindsight, they create 'tradeable states' using only backward-looking information. A suite of 32 factors is tested over the period 1993-2010. The authors state the approach is subject to errors as it is hard to determine, in particular, peaks and troughs without the benefit of hindsight, but the results still provide support for a style rotation strategy. Similarly, Luo et al. (2010) use macroeconomic, capital market and seasonal patterns, and test 10 style prediction models including linear regression, Markov switching, and sophisticated non-linear models. The results show that simpler models actually tend to perform better out-of-sample— the linear regression model exhibits the highest style timing skill. Furthermore, models based on time series properties such as factor momentum and reversal have poor predictive power, and the authors state that style timing models need exogenous variables (e.g. macroeconomic and capital market factors) to have meaningful predictive power. Overall, the results indicate that style rotation strategies can exhibit significant timing ability, which translates into better portfolio performance.

Since the development of the TM and HM models, a number of papers investigate manager skill in this area. Shukla and Singh (1997) analyse the timing ability of US and global funds by comparing their performance in up versus down markets using the HM model. Both groups of funds have betas < 1 in up markets, whereas global funds have a beta > 1 in down markets, which is counter to what should be expected of good market timers. The negative timing ability is confirmed by the HM model results. Kao et al. (1998) examine the selectivity and market timing ability of 97 international mutual funds. The results show that managers possess good selectivity skills and overall performance, however market timing is poor. Consistent with US research, a negative correlation between selectivity and market timing is determined. Glassman and Riddick (2006) investigate the market timing ability of US global equity fund managers from 1985 to 1990. They examine both portfolio weights and returns to distinguish between world market timing (movements of funds between all equity markets and cash) and national market timing (movements out of one country's equity market into one or more other countries' equities). Evidence of national market timing is found, but no world market timing ability is determined. Kacperczyk et al. (2011) estimate manager skill for US funds separately in booms and recessions, and find that the extent to which managers focus on stock picking or market timing fluctuates with the state of the economy. Stock picking (market timing) is more prevalent in booms (recessions).

Furthermore, a number of papers investigate manager skill in relation to style timing. DGTW (1997) propose a 'Characteristic Timing' measure which shows whether fund managers are able to time the size, book-to-market and momentum factors. Essentially, if managers increase their portfolio weight in a stock prior to stocks with similar style characteristics performing well, then this is indicative of style timing skill. They find no evidence of Characteristic Timing ability. Bollen and Busse (2005) extend the TM and HM timing models and include the three additional explanatory variables in Carhart's (1997) four-factor model to look at stock selection and timing. They show that mutual funds exhibit significant timing ability more often in daily tests than in monthly tests, and thus previous studies may understate the timing ability of fund managers. Swinkels and Tjong-A-Tjoe (2007) investigate the ability of fund managers to successfully rotate between investment styles based on characteristics such as market capitalisation, valuation ratios and momentum. They use daily returns and the TM and HM models. They find evidence in favour of market timing and evidence in favour of funds being able to predict the direction of the valuation and momentum style returns, but not their magnitude. Funds in the sample did not exhibit an ability to rotate, based on size.

However, to my knowledge, the viability of a timing strategy has not been conducted at the aggregate fund level. The existing FoF literature investigating equity mutual funds is relatively sparse, although there are a few relevant papers in this area. Brands and Gallagher (2005) investigate diversification benefits based on the number of active equity funds in a FoF portfolio. Stein and Rachev (2009) indicate that FoFs may benefit from investing in a style-neutral portfolio of value and growth funds, but only given that FoF managers are able to select the well-performing funds of the respective styles. Bertin and Prather (2009) find that the performance and characteristics of mutual FoFs compare favourably to traditional equity mutual funds.

Thus, this paper develops a style rotation strategy based on a multivariate linear regression forecasting model. Given the recent investigations into style/factor timing, a comprehensive list of style factors is compiled. Then, the market and macroeconomic data used as the exogenous variables are selected, following an in-depth review of the aforementioned style timing literature and research investigating predictive variables (refer to Appendix A). Moreover, an interesting extension in this area is to test the implementability of a FoF timing strategy using the portfolio holdings of US active equity mutual funds.

3. Data

3.1 Style Factor Data

The style factors considered for inclusion in this study are selected following a review of the academic literature. Table 1 outlines the 19 variables considered— within the value, growth, quality, momentum, size and low volatility categories— and how each variable is calculated. The required stock price and accounting data are sourced from CRSP and Compustat, respectively, via WRDS.

INSERT TABLE 1

The style factors are constructed in a similar fashion to the Factor Mimicking Portfolios of Chan, Karceski and Lakonishok (1998), which are inspired by the work of Fama and French (1993). All common stocks listed on the NYSE, AMEX and NASDAQ are included, however, stocks are assigned to portfolios based on the breakpoints for NYSE stocks only. The style factors which are constructed using accounting metrics are calculated as follows. In June of each year *t*, firms are sorted into quintiles based on the value of the metric in question for the fiscal year ending in year *t-1*. Returns are then computed from July of year *t* to June of year *t+1*. For the value metrics, firms with zero or negative values of the numerator are excluded. Size is measured as the value of market equity as at June of each year *t*. The value/growth (size) factors are constructed as the difference between the value-weighted average return of firms in the top (bottom) quintile, and the value-weighted average return of those in the bottom (top) quintile. The quality factors may be considered as two distinct groups: quality growth factors (ROE, ROA and Operating Cash Flow (OCF)), and quality stability factors (Leverage (LEV), Sales Growth Variability (SG VAR) and ROA VAR). Financial firms (SIC 6000-6999) are excluded from the quality portfolios, as metrics such as leverage may have a different meaning than those for nonfinancial firms (Kisgen, 2009). The quality growth factors are calculated as per the value and growth factors. In contrast, the quality stability factors are calculated as the difference between the value-weighted average return of firms in quintiles one to four, and the value-weighted average return of those in the top quintile. This method is used for these stocks as the performance relationship is one-sided, with firms in the top quintile experiencing poor performance; however, stocks in the bottom quintile do not experience strong performance.

The momentum factor is calculated in a similar vein to the Carhart (1997) PR1YR factor. It is constructed as the value-weighted average of firms with the highest 20 percent 11-month returns lagged one month, minus the value-weighted average of firms with the lowest 20 percent 11-month returns lagged one month. Portfolios are rebalanced monthly.

Currently, the academic literature emphasises that portfolios created from stocks with low idiosyncratic volatility have higher returns than those comprising stocks with high idiosyncratic volatility (Ang et al., 2006). The low volatility factor, SMV, is thus created as the value-weighted average return to the lowest quintile of stocks based on historical idiosyncratic volatility, minus the value-weighted average return to the highest quintile of stocks based on historical idiosyncratic volatility. Quintiles are formed at the end of each month and weighted by market-capitalisation at the portfolio formation date. Historical idiosyncratic volatility is calculated each month as the standard deviation of the error term over the prior 60-months, from an OLS regression of the stock's return in excess of the risk-free rate on the market return in excess of the risk-free rate, consistent with Clarke, De Silva and Thorley (2010).

3.2 Market and Macroeconomic Data

The academic literature emphasises a myriad of market and macroeconomic variables as relevant for stock and fund returns. A comprehensive list of 25 potential variables to include as independent variables in the forecasting models is provided in Appendix A. Furthermore, Appendix B provides summary statistics for the variables.

The Bureau of Economic Analysis (BEA) has made a number of ex-post revisions to the export and import data used to compute the Balance of Trade (BOT). Given that the ex-post data is not available ex-ante to investors, the original data are collected from the historical Survey of Current Business publications. The unemployment rate data are original data. The output gap is computed following Cooper and Priestley (2009), who collect original industrial production data in order to calculate the output gap. The authors state that the results are not affected when using either the revised or original data. Therefore, use of the revised data for industrial production to compute the output gap in this paper is not considered an issue. In order to minimise the impact of revisions for the other variables, the approach Pesaran and Timmerman (1995) use is followed. Specifically, for the remaining economic variables, a moving average over the prior four quarters is first computed for each quarter, and then the year-on-year change is calculated.

3.3 Mutual Fund Holdings Data

The dataset used is created by merging the Thomson Reuters Mutual Fund Common Stock Holdings[7] (s12) Database with the CRSP Mutual Fund Database (CMFD), using Mutual Fund Links (MFLINKS). Refer to Appendix C for a detailed description of the dataset construction. The s12, CMFD and MFLINKS tables which facilitate the data merge are all sourced from WRDS. The s12 data is sourced from the SEC N-30D filings that funds are required to file semi-annually with the SEC. Up until 1985 funds were required by the SEC to file this data on a quarterly basis (WRDS, 2008). About 60% of funds continue to provide this data quarterly (WRDS, 2012). The s12 database contains quarterly stock holdings data for US mutual funds, and the CMFD contains monthly fund returns as well as fund characteristics. This study is interested in US active equity fund managers, thus various exclusions are made to both datasets.

[7]Also known as the CDA/Spectrum s12 database.

Firstly, only funds with the following self-stated investment objective classifications are included: Aggressive Growth (IOC=1), Growth (IOC=2), and Growth and Income (IOC=3). Following Kacperczyk, Sialm and Zheng (2008), funds which held less than ten stocks and with portfolio assets less than $5m as at the end of the month prior are also removed.

The s12 dataset contained 2,409 unique funds prior to the merge with the CMFD. After merging the datasets, 2,047 unique funds remain. Subsequent to merging the two databases, a manual check of the funds' names was undertaken to ensure misclassified funds are not included (Ali et al., 2008)[8]. Following removal of the misclassified funds, of which there are 191 in total, the final sample contains 1,856 funds from 1980 to 2010.

4. Descriptive Statistics

4.1 Style Factors

Table 2 provides a summary of the annualised average monthly returns to the style factors over the complete sample period and various subset periods. The associated annualised standard deviations are also provided in parentheses.

INSERT TABLE 2

In summary, the various style factors perform differently to an extent within the style categories, but clearly over time and in differing market conditions. Therefore, employing a time-series forecasting model based on these style factors is warranted, given that their performance exhibits time-varying characteristics which may be exploited. In order to narrow down the 19 possible factors listed in Table 2, a representative factor is selected from the Value, Growth, Quality Growth and Quality Stability categories. Chan et al. (1998) emphasise that the importance of a style factor is directly proportional to the standard deviation of its returns. Thus, the representative style factors selected are those which have the greatest standard deviation over the forecast period (1981 to 2011). The chosen factors are as follows: D/P for Value, NPM for Growth, ROE for Quality Growth and ROA VAR for Quality Stability. Furthermore, B/M is included in the Value category, given its prominence in the academic literature. Therefore, the eight style factors' returns which are forecast are: D/P, B/M, NPM, ROE, ROA VAR, MOM, SIZE and SMV.

[8] Funds in the following categories are removed from the sample: Passive funds (n=72), Foreign-based and US-based international funds (n=62), real estate funds (n=29), balanced funds (n=15), variable annuity funds (n=10), convertible funds (n=one) and options funds (n=two).

4.2 Mutual Fund Sample

Table 3 reports summary statistics for the sample of US active equity mutual funds over the period 1980 to 2010. Average values of fund characteristic variables and returns are provided, the median is in parentheses. The average number of stocks held by the funds has increased from about 70 stocks between 1980 and 1990 to 111 from 2001 to 2010. The average age of the funds is 15 years over the complete sample period. Turnover is an annual variable which represents the minimum of aggregated purchases and sales, divided by the average 12-month Total Net Assets of the Fund. Turnover remained relatively stable over the sample period, with the average oscillating around 80%.

INSERT TABLE 3

Expenses represents the annual expense ratio, which is approximately 1% from 1980 to 1990, increasing to about 1.25% from 1991 to 2000 and 2001 to 2010. Equity Proportion is the average proportion of the fund that is invested in common equity, and it's calculated over the life of the fund. The majority of the funds’ assets are invested in common equity, i.e., 87% from 1980 to 2010, which is not surprising given the data screens applied. TNA is the fund's month end Total Net Asset Value, in millions. TNA grew over the sample period, with the most dramatic increase of approximately 150% between 1980 and 1990 and 1991 and 2000.

Total Load is the sum of the front and rear loads, reported annually. The average Total Load fell from 3.5% from 1980 to 1990 to 0.87%, a decrease of 300%. It decreased further, settling at an average of 0.34% from 2001 to 2010. Management Fee (Mgt Fee) is only available from 1998 to 2010 and is the ratio of Management Fee ($) divided by Average TNA ($) reported as a percentage. Management Fees are very stable, with the same mean and median reported over the periods 1998-2001 and 2001-2010.

CRSP Raw Ret is the annual CRSP fund return, including distributions (dividends and capital gains) *before* total expenses. CRSP Net Ret is the annual CRSP fund return from CRSP, including distributions (dividends and capital gains) *after* total expenses. The annual mean is the simple compound of the 12 monthly means for all funds existing in each month. Raw Holdings Ret is the annual raw fund return calculated using the quarterly stock holdings from the s12 database. The annual mean is the simple compound of the four quarterly means for all funds existing in each quarter. DGTW-adj. Ret is the annual excess fund return whereby, the return of each stock in the portfolio has been adjusted by the return on a portfolio of stocks with similar book-to-market, size and momentum characteristics. Value-weighted[9] returns are provided.

The raw/net average returns are comparable in magnitude and follow a similar pattern over the three sub-periods. There is a clear fall in returns over the period 2001-2010, which is not surprising, given that this period encompasses the tech wreck and GFC. Overall, the sample of mutual funds did not generate outperformance, with an average DGTW-adjusted return over the complete period of -0.04%. Small positive excess returns of 0.69% and 0.77% are reported from 1980 to 1990 and 1991 to 2000, respectively. However, from 2001 to 2010, funds incurred an average annual excess return of -1.66%.

5. Methodology

5.1 Selecting Independent Variables

In order to identify the market/macroeconomic variables with the greatest predictive ability, a series of univariate regressions of each style factor on each market/macroeconomic variable are run in a similar manner to Kao and Shumaker (1999). Specifically, the annual return for each style factor (SF) is regressed on the quarterly value of each market/macroeconomic variable (EV), lagged two quarters. The use of the second lag is to ensure that the economic data is available prior to the start of the investment horizon being forecast, which is consistent with Cooper and Priestley (2009). The annual SF returns are calculated as the simple compound of the relevant monthly SF returns, using value-weighted portfolios of stocks, based on market-capitalisation as at the end of the month prior.

$$SF_{i,t-t+4} = \propto_{j,t} + \beta_{j,t} EV_{j,t-2} + \varepsilon_{j,t} \quad (1)$$

Fama and French (1992) emphasise that the pre-1962 data on Compustat suffer from a serious selection bias, as they are tilted toward big historically successful firms. Furthermore, the book value of shareholders' equity is not available before 1962, which is an input for the computation of ROE. Therefore, the start of the historical period ensures the sample is not affected by this bias and that data for all of the SFs is available.

[9] The returns are similar when equal-weighting is used.

The approach used to generate quarterly forecasts of the performance of each SF for the following 12 months over the period 1981-2011 involves first segregating the data into six subsets. Therefore, six unique forecasting models are used to forecast the return of each SF over the next five years (six years for Subset 6). Within these subsets, regressions are run over six separate rolling historical periods for each SF, in order to select the EVs to be used in the forecasting model for each SF, for the six associated forecasting periods. The periods associated with Subset 1 are explained in detail.

Firstly, univariate regressions are run on a rolling basis, with the first regression using five years of data i.e., Q_1 1964 – Q_3 1968, and then the historical period increases iteratively by one quarter, with the final regression using 15 years of data, i.e., Q_1 1964 – Q_3 1978. Therefore, the historical period ends with the EV for Q_3 1978 forecasting the SF return from Q_1 to Q_4 1979, which ensures there is no overlap with the period for which the forecasts are generated, i.e., Q_1 1981- Q_4 1985.

The EVs included in the forecasting model are selected based on the results of these univariate regressions. Selection is based on a frequency count of the number of significant *t*-statistics (at a 5% confidence level) for beta, for each EV. Firstly, all EVs with a significant beta count of at least 40% of the total are identified. Secondly, the correlations between these EVs over the complete historical period are computed. Starting at the lowest count end, if the correlation between two EVs is 0.60 or greater, then only the EV with the higher count is retained. If two EVs have the same count, then the EV with the more favourable correlations with the other EVs selected for inclusion in the forecasting model is retained. Favourability is determined as follows. The two correlated EVs are compared in relation to each EV selected for inclusion in the forecasting model. The EV which has the smallest positive/largest negative correlation with each EV is given a score of one, and the other EV a score of zero. The most favourable EV is the one with the greatest total score based on these comparisons. If their scores are even, then the EV with the smallest average positive, or largest average negative, correlation across the EVs selected for inclusion in the forecasting model, is selected. Furthermore, if all three spread variables are selected— book-to-market spread, market-to-book spread and value spread— then only the one with the higher count is retained. If two spread variables have the same count, then the same process detailed above is followed to select the one to include in the model.

5.2 Forecasting Style Factor Returns

In order to obtain a forecast return for each style factor, an econometric forecasting model is used. It is adapted from the forecasting model used by Bird and Casavecchia (2011) to forecast the value premium for European stocks:

$$E_t(F_{t+2}) = \alpha_t + \varphi_t F_t + \sum_{j=1}^{N} \beta_{j,t} Z_{j,t} \qquad (2)$$

where $E_t(F_{t+2})$ is the expected value in quarter t of the factor return for the 12 months commencing at the start of quarter $t+2$, α_t is the intercept in quarter t, $\varphi_t F_t$ represents the sensitivity to the SF return for the 12 months ending in quarter t, and $\sum_{j=1}^{N} \beta_{j,t} Z_{j,t}$ represents the sum of the sensitivity in quarter t to the *jth* lagged market/macroeconomic variable Z.

The forecasting regression model is run on a rolling basis initially using the previous 15 years of data. In relation to Subset 1, the first regression is run using the EVs selected for inclusion and the associated SF returns from Q_3 1964 to Q_2 1979. The dependent variable associated with the Q_2 1979 EV's is the SF return from Q_4 1979 to Q_3 1980. To ensure there is no hindsight bias, the parameter estimates obtained are then applied to the SF return for the 12 months ending with Q_3 1980 and EV values for Q_3 1980. As a result, the forecast for Q_1 1981, which is for the 12 month return from Q_1 to Q_4 1981, is obtained. The last regression is run using the selected EVs and the associated SF returns from Q_3 1964 to Q_1 1984. The parameter estimates obtained are applied to the EV values for Q_2 1985 to obtain the forecast for Q_4 1985.

Table 4 provides a summary of the model fit statistics for a regression of the forecast SF returns generated using the model above, versus the actual SF returns from 1981 to 2011.

INSERT TABLE 4

The forecasts generated for B/M[10] and SIZE are the strongest over the complete sample period. Specifically, the forecasts for these two styles are statistically significant at the 1% level and the adjusted R^2 values are moderate[11] at 10.78% and 8.69%, respectively. The

[10] Five outlier observations (Q_3 1999-Q_3 2000), which include returns during the technology crash (i.e., Q_1 2000-Q_4 2001) which commenced in March 2000, have been excluded from the B/M model fit tests.

[11] Pesaran and Timmerman (1995) state that an adjusted R^2 in this context of 20% is high.

forecasts for MOM and ROE are also statistically significant at the 5% level, with adjusted R^2 values of 4.63% and 4.26%, respectively. Therefore, all further tests will only use these four style factors which have statistically significant forecasts.

The Mean Absolute Error (MAE) for these four style factors ranges from 15% for B/M to 22% for ROE. Furthermore, the Root Mean Squared Error (RMSE) ranges from 22% for B/M to 28% for ROE. This indicates the difficulty to forecast the magnitude of the style factor returns with a high level of precision. However, SIZE, MOM and B/M are characterised by the highest success rates, which are 67.77%, 61.98% and 60.33%, respectively. Thus, the style factor forecast return predicts the direction correctly more often than not. In contrast, the success rate for ROE is lower at 48.76%. However, it is included to represent the quality category in the interests of completeness[12].

Figure 1 provides a graphical representation of the quarterly forecast SF returns versus the actual SF returns, from 1981 to 2011 for the four SFs.

INSERT FIGURE 1

Panel A shows that the forecasts for B/M are similar to the actuals over the majority of time period subsets, except for during the technology boom and bust and over the period 2005-2010. The forecasts fall short of the actual returns, which soared over the late 1990s during the time of the technology boom, which is not surprising given that this period was an anomalous market bubble. Panel B shows that the ROE forecasts from 1995 to 2000 are well aligned with the period. However, there are a series of spikes in the forecasts over the complete period. These are due to large changes in the EVs, which the parameter estimates have not yet adjusted to. Panel C shows that the MOM forecasts are closest to the actuals in the latter two time period subsets. Panel D demonstrates that the Size forecasts show a similar pattern to the actuals overall, despite disparity between the two in the late 1990s and early 2000s.

[12] Please refer to Appendices D to K for summaries of the EVs which are included in the forecasting model in each period, and for model fit statistics for the forecasts versus the actual returns for B/M, D/P, NPM, ROE, ROA VAR, SIZE, SMV and MOM, respectively.

6. Results

6.1 Stock Selection Strategy

Table 5 reports average excess return results for investment strategies based on the four style factor forecasts from 1981 to 2011.

INSERT TABLE 5

The results for univariate strategies investing in either the style factor with the maximum (Max FC) or minimum forecast (Min FC), and a strategy which is long (short) the Max FC (Min FC), are provided in Table 5. The 'All Quarters' return is the average actual annual return that is earned if the investment is made each quarter, and held for the following 12 months. The results for annual strategies developed in the interest of reducing turnover are also provided. The 'Annual (Q_i)' returns are for strategies which invest based on the forecasts made only in each Q_i where $1 \leq i \leq 4$ over the sample period. For example, to invest in each calendar year, the Q_3 forecasts are used.

A strategy which involves investing in the style which has the maximum forecast each quarter generates an average annual return of 7.26%, significant at the 1% level. In addition, using any of the four annual investment options produces a statistically significant average annual excess return ranging from 6.59% to 9.01%. Conversely, investing in the style factor which has the minimum forecast generates small negative returns on average, none of which are statistically significant. A long/short strategy based on the maximum and minimum forecasts generates average excess returns ranging from 7.13% to 10.14%, across the investment options, all of which are statistically significant, except for the Annual Q_4 strategy.

The MAE indicates that the difference between the actual SF return, and the forecast SF return, is 24% on average for the All Quarters strategy. The RMSE is 29%, which further reflects the difficulty to forecast with a high level of accuracy, the magnitude of the SF returns included in the strategy. However, the direction of the return for the preferred SF is predicted correctly in more than two-thirds of the quarters. The results for the annual strategies are similar.

Table 6 provides portfolio characteristics for the individual SFs upon which the timing strategy is based, as well as the timing strategy.

INSERT TABLE 6

The timing strategy generates an average annual return for 'All Quarters' which is higher than the mean for B/M, ROE and SIZE, yet slightly lower than the average return for MOM. However, given the lower risk associated with the timing strategy, the Sharpe Ratio is 17% higher than that for MOM alone. The return difference is strongest upon comparison with SIZE and ROE. In particular, the average return to the timing strategy is about 2% higher on average, and this difference is statistically significant at the 5% level. The Annual Q_i strategies show a similar pattern, the timing strategy generates the highest Sharpe Ratio when investing only in Q_1, Q_2 and Q_3, and an equal Sharpe Ratio to MOM for Q_4 is identified. Therefore, depending on an investor's combined risk/return objectives, a stock return timing strategy based on macroeconomic information is fruitful.

6.2 Fund Selection Strategy

Given that a stock selection strategy using the SF forecasts generates outperformance, an extension is to determine whether a timing strategy using the mutual funds based on the style forecasts generates outperformance. The annual strategy using Q_3 forecasts is selected for adaptation to the funds as it is the most intuitive, given that the forecast periods encompassed are for calendar year returns over the sample period[13].

In order to identify the funds which have the greatest exposure to the style factor, which has the highest forecast in Q_3 of each year *t*, a weighted-average quintile rank is computed for each fund based on its stock holdings:

$$WRank_{j,t} = \sum_{i=1}^{N} Quintile\ Rank_{i,t} * W_{i,j,t} \qquad (3)$$

where $WRank_{j,t}$ is the weighted-average quintile rank for fund *j* in Q_3 of year *t*, $Quintile\ Rank_{i,t}$ represents the quintile rank for stock *i* in year *t* for the preferred style factor, and $W_{i,j,t}$ is the weight of stock *i* in fund *j* for Q_3 of year *t*.

[13] The results are also generated for a strategy based on the Q_2 year *t* stock holdings, and these are quantitatively similar to those presented in the body of this paper. Use of the Q_1 year *t* holdings is not feasible, given that the stock quintile allocations do not occur until June of year *t*, and then use of the Q_4 year *t* holdings is not considered relevant, given that the fund returns for this strategy occur into year *t+2*, which is considered too far ahead relative to the stock quintile assignments.

The quintile ranks applied to each stock are essentially consistent with the quintile ranks used to create the SF portfolios which the SF returns are based on. Specifically, quintiles for the accounting metrics (B/M and ROE) are formed in June of year *t* using the value of the metric in question, for the fiscal year ending in year *t-1*. The Size quintiles are formed based on the stocks' market capitalisation values as at the end of June of year *t*. Given that the MOM portfolios are rebalanced monthly, the quintile ranks applied are for the same month as the holdings, i.e., July, August or September of year *t*. The only difference is that the quintile ranks are assigned so that quintile 5 always contains the preferred stocks. In relation to Size, the preferred stocks are those with the smallest market capitalisations. These stocks are in quintile 1 for the SF portfolios. In order to ensure that the construction of the $WRank_{j,t}$ is consistent across the styles, the quintile ranks are now re-assigned so that the small stocks are located in quintile 5.

The weight applied to each stock is the stock's holding value, relative to the total holding value of all stocks in the portfolio as at the end of the prior quarter, following Wermers (2000). Therefore:

$$W_{i,j,t} = \frac{HVALUE_{i,j,t}}{\sum_{i=1}^{N} HVALUE_{i,j,t}} \tag{4}$$

where $HVALUE_{i,j,t}$ is the number of adjusted shares held of stock *i* in fund *j* in Q_3 year *t*, multiplied by the price of stock *i* as at the end of the prior quarter, i.e., Q_2 year *t*.

Funds are sorted into quintiles based on their exposure to the preferred style as indicated by $WRank_{j,t}$ in Q_3 of each year *t*. The first year for which holdings data is available is 1980, thus, portfolio formation occurs from 1980 to 2009. The average returns to the quintiles are examined over year *t+1*, i.e., over the period 1981 to 2010. Table 7 presents average annual returns to the quintiles of funds- quintile 5 (1) contains funds with the greatest (lowest) exposure to the preferred style, hence they are the 'preferred' ('unpreferred') funds.

INSERT TABLE 7

The average annual raw returns are all statistically significant at the 1% level and they do not differ substantially across the quintiles[14]. The average annual raw return for quintile 5 is less than the raw return for quintile 1 at 9.80%, compared to 12.71%. However, a *t*-test of the difference in the annual raw returns for the preferred and unpreferred funds is not statistically significant. The raw returns are adjusted using the CRSP value-weighted index, including dividends. The average market-adjusted return for the preferred funds is -1.93%, compared to 0.98% for the unpreferred funds. However, these returns are not statistically distinguishable from 0 (nor are those for the other quintiles). The average annual DGTW-adjusted return is -1.08% (0.72%) for quintile 5 (1), although the DGTW-adjusted returns are also all statistically insignificant.

Thus, a style timing strategy at the aggregate fund level does not generate statistically significant outperformance over the sample period[15]. The performance of the strategy is also investigated, depending on which style factor is selected as the preferred factor. Specifically, Table 8 provides asset-weighted average returns and quintile ranks for the $WRank_{j,t}$ sorted quintiles, broken down by style.

INSERT TABLE 8

Overall, the results do not differ substantially when broken down by style group. Interestingly, the actual average SF return for ROE is negative over the selected years, therefore the lack of performance for this group is not surprising[16]. In unreported results, the average market-adjusted return for SIZE is positive at 5.15% for the preferred funds, which is some weak evidence that the strategy is successful at beating the market for this style category. Table 8 shows that funds in quintile 5 are not exposed enough to the preferred style with the asset-weighted average $WRank_{j,t}$, i.e., the *QRank* for quintile 5 funds, falling well

[14] Given that the average raw CRSP and raw holdings based returns in Table 3 are consistent, only the holdings based raw returns are included in Table 7.

[15] A 'test of perfect information' is also conducted, which involves using the actual SF returns instead of the forecast SF returns to generate the fund application strategy results. The spread of raw returns across the quintiles is clearer, with the highest (lowest) raw returns to funds in quintile 5 (1). The DGTW-adjusted returns are all statistically insignificant, except for a weakly significant return of 1.31% at the 10% level, for funds in quintile 5. Thus, even with perfect information the FoF strategy does not generate strong results.

[16] Given that ROE contributes negatively to the timing strategy, and in light of the evidence in Table 4, which shows that the forecasts for ROE are negatively correlated with the actual returns and the success rate for ROE is less than 50%, a timing strategy which excludes ROE is tested. Overall, the stock and fund level results are qualitatively consistent with the results presented. More specifically, the stock level results improve, with an average DGTW-adjusted return over the period 1981 to 2011 of 10.52%, which is significant at the 1% level. Furthermore, no statistically significant outperformance is detected for the fund level strategy, with average DGTW-adjusted returns of 0.91% and -1.11% determined for quintiles 1 and 5, respectively.

below five on average at 3.88. Furthermore, the funds in quintile 1 are much more exposed than expected for their quintile assignment group, with an average *QRank* of 2.13. Evidently, the funds identified as preferred and unpreferred do not have the desired characteristics of these two groups (quintile 5 contains essentially quintile 4 funds, and quintile 1 contains essentially quintile 3 funds). The SFs are calculated as the difference between quintiles 5 and 1; therefore, the fund application does not reflect this construction.

Figure 2 shows the change in exposure to the preferred style factor over the investment horizon for funds in quintile 1 (out-of-favour funds) and quintile 5 (preferred funds). The change in exposure is calculated relative to the exposure as at quintile formation in Q_3 of year *t*. Specifically, the change in exposure is calculated for each quarter over the investment horizon, i.e., as at Q_1, Q_2, Q_3 and Q_4 of year *t+1*. Over the investment horizon the preferred (out-of-favour) funds tend to decrease (increase) their exposure to the preferred style.

6.3 Robustness Tests

Given that the performance identified at the stock level did not translate to the fund level, further investigations are warranted. In addition to the use of the $WRank_{j,t}$ to sort funds into quintiles, three alternative methods of fund selection are discussed, in order to determine whether the results are specific to this approach.

6.3.1 Net Exposure Rank

Given that the SF returns are generated as the excess of the return to the preferred stocks relative to the unpreferred stocks, a method of fund selection is developed in a similar vein. Specifically, a $Q5\_Q1WRank_{j,t}$ is calculated, which involves calculating each fund's exposure to the preferred stocks, net of their exposure to stocks least characterised by the preferred style:

$$Q5\_Q1WRank_{j,t} = Q5\ Weight_{j,t} - Q1\ Weight_{j,t} \tag{5}$$

where $Q5\ Weight_{j,t} = \frac{\sum_{i=1}^{N} Adjusted\ Shares\ Held\ for\ Stocks\ in\ Quintile\ 5_{i,j,t}}{\sum_{i=1}^{N} Adjusted\ Shares\ Held_{i,j,t}}$ and

$Q1\ Weight_{j,t} = \frac{\sum_{i=1}^{N} Adjusted\ Shares\ Held\ for\ Stocks\ in\ Quintile\ 1_{i,j,t}}{\sum_{i=1}^{N} Adjusted\ Shares\ Held_{i,j,t}}$

The return results for funds sorted into quintiles based on the $Q5\_Q1WRank_{j,t}$ are consistent with the $WRank_{j,t}$ results. The results for this approach are omitted in the interest of brevity.

6.3.2 Correlation Approach

In order to determine whether the use of the holdings is not adequate[17] to identify funds with an affinity to the preferred SF in each period, funds are selected based on the correlation of their monthly raw return from CRSP with the preferred SF portfolio. For example, if B/M is the preferred style based on the Q_3 forecast in 1980, then the correlation of a fund's returns with value stocks, i.e., Quintile 5 stocks, is computed over the 24 months ending with September 1980. Similarly, if MOM is the preferred style based on the Q_3 forecast in 1981, then the correlation of a fund's returns with high price momentum stocks, i.e., Quintile 5 stocks, is computed over the 24 months ending with September 1981. The funds are sorted into quintiles in Q_3 of each year *t*, based on the value of this correlation. The results are consistent with the $WRank_{j,t}$ results.

6.3.3 Optimisation Approach

In unreported analysis, the preferred funds are found to be highly exposed to factors other than the preferred factor. Given that mutual funds are exposed to a number of SFs in any period, a strategy which isolates funds which are highly exposed to the preferred factor and *not* to the other factors is also investigated. In particular, a FoF portfolio is developed using funds in quintile 5. The weights to apply to each of these funds in order to maximise the exposure to the preferred factor, are determined by solving for the global optimum, subject to a number of constraints, in each quarter. It is required that the weights sum to one, that the average quintile exposures to the seven other SFs are between 2.5 to 3.5, and the maximum weight for each individual fund is less than or equal to 5%[18]. The average number of funds in this optimal portfolio is 19, and the average DGTW-adjusted return to this strategy is 0.07% from 1981 to 2011[19]. Therefore, the poor results are not a reflection of the implementation method[20].

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[17] Similarly, in order to determine that the result is not due to a 'Return Gap' type influence, the results are also generated using a subset of funds for which the number of stocks used to calculate the $WRank_{j,t}$ is within 80-110% of the number of stocks used to calculate the fund's return (Kacperczyk et al. 2008). The results are indeed consistent.

[18] Although, in order to determine a solution in which the sum of the weights equals one the maximum weight constraint is relaxed in 25% of the quarters. As such the maximum weight for these quarters ranges from 6% to 36% and in one case there is no weight constraint.

[19] The year 1992 is not included, as solutions are not obtainable for the four quarters of this year.

[20] In addition, a subset of funds which are in quintile 5 for the preferred factor, and in quintile 4 or less for all of the other SFs, is created. There are 27 funds in this portfolio on average over the sample period, and the average

6.3.4 Long-Only Style Factor Forecasts

The investigations above confirm that timing the mutual funds using their stock holdings and the SF forecasts as signals does not generate outperformance. This section seeks to explain why the stock level performance does not translate to the FoF level.

Given that the sample consists of long-only funds, a set of long-only SF forecasts is generated, in order to determine whether a timing strategy using long-only forecasts is better able to reflect the stock level performance obtainable by the funds. Long-only SFs are constructed by subtracting the return to the CRSP VW Index from the Top performing portfolio as defined in the sub-section Style Factor Data of the Data section. Table 9 shows that the average returns to all style factors are muted relative to the long-short portfolios, which highlights the outperformance attributable to the short side. The same process is followed to develop the time-series of SF return forecasts from 1981 to 2011. The eight SFs selected, based on their standard deviations over the period 1981 to 2011, are B/M, D/P, Trailing Sales Growth (TRSG), Operating Cash Flow (OCF), ROA VAR, SIZE, MOM and SMV. Table 10 reports the model fit statistics for a regression of the long-only forecast SF returns versus the actual SF returns over the period 1981-2011.

INSERT TABLE 9

Evidently the long-only SF forecast returns are only statistically significant for SIZE. Therefore, a stock level or fund level timing strategy is not able to be developed using these forecasts. Furthermore, the correlations between the forecast and actual returns for all SFs other than SIZE, are close to zero, although the success rates are greater than 50% for all of the SFs, except D/P.

Overall, this is an interesting result, given that the extant literature focuses on long-short SF returns, particularly to evaluate the performance of long-only mutual funds, although there is a growing body of academic literature which investigates the suitability of style factor returns as benchmarks. Cremers, Petajisto and Zitzewitz (2012) use the standard Fama-French and Carhart factor return portfolios to evaluate the performance of passive benchmark indices

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annual DGTW-adjusted return to these funds is -0.87% and not statistically significant. This is consistent with the main results presented for the preferred funds. Furthermore, by requiring that funds fall in quintile 5 for the preferred factor, and quintile 3 or less for all other SFs, a complete time series of returns is not able to be generated over the sample period, as there are not enough funds which meet these criteria.

such as the S&P 500 and the Russell 2000. Statistically significant non-zero alphas are determined for the indices, and small methodological changes to the factors are proposed to eliminate the non-zero alphas. Furthermore, Blitz and Huij (2012) evaluate the performance of actively managed equity funds against a set of passively managed index funds, to determine whether investors are better off investing in index funds, given the high level of performance attributable to systematic style factors. However, the active funds generate returns that are 3% to 5% p.a. higher than the passive fund portfolio. Therefore, given that the significance of the long-short factor returns does not translate to long-only returns, this paper contributes to the academic literature which questions the suitability of factor returns as benchmarks for mutual funds. Essentially, the benchmarking approach used needs to be a fair indication of what managers can actually implement in practice.

In addition, the role that methodological choices play in the determination of results is highlighted. In this case, the use of a long-only constraint proves problematic, whilst other studies show that decisions such as incorporation of transaction costs, equal versus value weighting, and the treatment of outliers, can lead to differing outcomes. Bettman, Kosev and Sault (2011) examine the asset-growth effect in Australia, and emphasise that their results differ when using equal versus value weighting of returns. Similarly, Bettman, Maher and Sault (2009) show how the returns to a momentum strategy in Australia change when short-sale constraints are imposed and bid-ask spreads are included. Furthermore, Taylor and Wong (2012) demonstrate how the returns to an accruals factor vary, given a variety of methodological decisions. Hence, researchers need to be careful when developing style factors that are unable to be implemented by long-only fund managers, yet then judging the performance of fund-managers against these factors.

7. Conclusion

This paper develops a model which successfully predicts style factor returns using market and macroeconomic variables. The US mutual funds which are most exposed to the predicted ‘preferred’ style factor do not significantly outperform. Furthermore, this result does not differ when broken down by style. The preferred funds also exhibit decreasing exposures to the preferred style over the investment horizon, and are found to be highly exposed to factors other than the preferred SF. Alternative portfolio construction methods yield similar results. Long-only SFs are also constructed which highlight that the poor performance of the strategy is primarily due to the majority of the outperformance of the SFs being attributable to the short-side, which the long-only funds are, by structure, unable to take advantage of. Furthermore, generation of long-only SF forecasts is unsuccessful. This raises the question as to the appropriateness of the use of long-short SF returns to assess the performance of long-only mutual funds.

Overall, developing a FoF portfolio designed purely to take advantage of style cycles is not a profitable strategy. The evidence in this paper suggests that the benefits of a timing strategy are best exploited alternatively, for example, by including a fund implementing a style timing strategy within a FoF portfolio to augment performance. However, verification of this approach is best left to further research. Developing a base portfolio with specific style characteristics and then augmenting/adjusting the structure and characteristics of the portfolio to take advantage of movements in style cycles, e.g. by adding a value manager when value is expected to outperform, is an alternative approach also worthy of further research. Moreover, a FoF could use factor Exchange Traded Funds (ETFs) or futures to gain exposure to different styles more effectively than by switching managers. Thus, the fund could obtain alpha from its manager in one style, whilst being exposed to the beta from another style and the factor timing.

Appendix A: Market and Macroeconomic Variables

This table details the market and macroeconomic variables considered for selection for the style factor forecasting models.

Variable	**Measurement**	**Source**	**A priori**
	Conditioning Financial Variables		
T-Bill[a]	One-month Annualised Treasury Bill Yield	CRSP Fama T-Bill Structures via Wharton Research Data Services (WRDS)	Pesaran and Timmermann (1995) state the T-Bill is the only variable included in all versions of their dynamic model used to forecast the market return from 1960 to 1992.
CRSP Dividend Yield[b]	Dividend Yield for the CRSP value-weighted index including dividends (CRSP VWD) over the prior 12 months	CRSP via WRDS	Ferson and Schadt (1996) use the CRSP Dividend Yield as a conditioning information variable when evaluating fund performance.
Treasury Yield Spread[c]	Yield on a Constant Maturity 10-year Bond (CM10B) – the three month Treasury Bill Yield	Federal Reserve Bank of St Louis (FRB)	Kao and Shumaker (1999) found that the treasury yield spread is positively correlated with the value-growth spread.
Corporate Bond Yield Spread[d]	Moody's Seasoned BAA Corporate Bond Yield – Moody's AAA Corporate Bond Yield	FRB via WRDS	Kao and Shumaker (1999) determined that the credit spread is an important factor in explaining style spreads in a multivariate context.
Log of Market Value[e]	Log of combined value of NYSE, AMEX & NASDAQ securities used in the CRSP VWD	CRSP via WRDS	Flannery and Protopapadakis (2002) use the Log of Market Value as a conditioning information variable.
	Other Financial Variables		
Market Return[f]	Quarterly Return to the CRSP VWD for NYSE, AMEX & NASDAQ stocks	CRSP via WRDS	Fama and French (1993) identify the market return as a common risk factor relevant to stock returns.

Variable	Measurement	Source	A priori
Market Turnover[g*]	Value-weighted (by MC_{t-1}) Turnover of NYSE, AMEX & NASDAQ common stocks $Turnover_t$ = # Shares $Traded_t$ /Adj. Shares $Outstanding_{t-1}$	CRSP via WRDS	Baker and Stein (2004) determine that increases in liquidity, e.g. higher turnover, predict lower subsequent returns for firm-level and aggregate data, and so, liquidity acts like a sentiment index.
Market Volatility[h]	Standard Deviation of return on the CRSP VWD over prior 12 months	CRSP via WRDS	Ang et al. (2006) show that market volatility is a significant cross-sectional asset pricing factor.
Earnings Yield Gap[i]	Earnings-to-Price Ratio of the S&P 500 – CM10B	Shiller data	Kao and Shumaker (1999) find that the Earnings Yield Gap had the highest R^2 of the six variables they examined, and it was the only one that had a negative relationship with the value-growth spread.
Book-to-Market (B/M) Spread[j]	Average B/M Ratio Decile 10 – Average B/M Ratio Decile 1 *where* average B/M Ratio = Sum Book Value/Sum Market Equity for all stocks in the decile	Ken French data	Lu and Zhang (2008) state it is a counter-cyclical variable which tends to predict aggregate stock returns positively.
Market-to-Book Spread[k]	Average M/B Ratio Decile 1 – Average M/B Ratio Decile 10 *where* average M/B Ratio = Sum Market Equity/Sum Book Value for all stocks in the decile	Ken French data	Lu and Zhang (2008) state it is a pro-cyclical variable which tends to predict aggregate stock returns negatively.
Value Spread[l]	Log of B/M Ratio Decile 10 – Log of B/M Ratio Decile 1	Ken French data	Cohen, Polk and Vuolteenaho (2003) show that the expected return on value minus growth strategies is atypically high at times when their spread in book-to-market ratios is wide.
Macroeconomic Variables			
Actual CPI[m]	YoY** Change CPI, All Items, Seasonally	Bureau of Labour	Flannery and Protopapadakis (2002) state that

Variable	Measurement	Source	A priori
	Adjusted (SA), 2005 = base year	Statistics (BLS)	CPI affects the level of the market portfolio's returns.
Actual GDP[n]	YoY** Change in GDP, Current Prices, SA	US Bureau of Economic Analysis (BEA)	Kao and Shumaker (1999) state that "GDP growth reflects corporate profit cycles. During expansionary periods when corporate profit growth is high, operating leverage contributes disproportionately to value stocks' profitability; hence, value stocks are likely to outperform during those periods" (p.42).
Output Gap[o]	Estimated from a regression of the log of industrial production on a linear and a quadratic time trend- the output gap is the error term from this regression	FRB	Cooper and Priestley (2009) emphasise that the output gap is a strong predictor of US stock returns.
Growth in Industrial Production[p]	YoY** Change in Volume Index, SA	FRB	Pesaran and Timmermann (2000) state that industrial production is linked to company earnings and earnings are an important determinant of stock returns.
Change in Consumption[q]	YoY** Change in Total Personal Consumption Expenditures , CP, SA	BEA	Baker and Wurgler (2006) orthogonalise the Sentiment Index they created on a few relevant economic variables, of which one is consumption.
Change in Manufacturing Index[r]	YoY** Change in Manufacturing Index, SA	Institute for Supply Management (ISM)	Cevik, Korkmaz and Atukeren (2012) find that developments in the ISM manufacturing index affect regime switching probabilities in both bull and bear stock market periods.

Variable	Measurement	Source	A priori
Change in Oil Prices[s]	YoY** Change in Producer Price Index (PPI)-Crude Petroleum, Not SA	BLS	Chen, Roll and Ross (1986) state that it is often argued that oil prices must be included in any list of the systematic factors that influence stock market returns and pricing.
PPI[t]	YoY** Change in PPI- Finished Goods, SA	FRB	Flannery and Protopapadakis (2002) state that PPI affects the market portfolio's returns.
Balance of Trade[u]	Total Exports – Total Imports, CP, SA (original data)	BEA	Flannery and Protopapadakis (2002) find that the Balance of Trade affects the market returns' conditional volatility.
Growth in Employment[v]	YoY** Change in Total Non-Farm Employees, SA (in thousands)	BLS	Flannery and Protopapadakis (2002) find that Employment affects the market returns' conditional volatility.
Unemployment Rate[w]	Unemployed Persons aged 16 and over, SA (original data)	BLS	Flannery and Protopapadakis (2002) find that Unemployment affects the market returns' conditional volatility.
Housing Starts[x]	YoY** Change in Total: New Privately Owned Housing Units Started, SA, Annual Rate (thousands of units)	US Department of Commerce: Census Bureau	Housing starts are commonly used as leading indicators of changes in macroeconomic activity (OECD, 1987).
Monetary Aggregate [y] (M1)	YoY** Change in M1, CP, SA	US Banking Survey, IMF	Flannery and Protopapadakis (2002) find that M1 affects the level of market returns and its conditional volatility.

*MTO has been included as a sentiment proxy. The Baker and Wurgler (2006) sentiment index was considered as an alternative; however there is a one year lag in its release. Various industry-generated indices were also considered (e.g. State Street Confidence Index), however they don't have adequate data history and/or aren't publicly available.

**A moving average over the prior four quarters is first computed for each quarter; the YoY change is based on these averages.

[a] Chen et al. (1986); Ferson and Schadt (1996); Pesaran and Timmermann (1995)
[b] Bird and Casavecchia (2011); Ferson and Schadt (1996)
[c] Bird and Casavecchia (2011); Chan et al. (1998); Chen et al. (1986); Elton, Gruber and Blake (1995); Ferson and Schadt (1996); Kao and Shumaker (1999)
[d] Bird and Casavecchia (2011); Chan et al. (1998); Chen et al. (1986); Elton et al. (1995); Ferson and Schadt (1996); Kao and Shumaker (1999)
[e] Flannery and Protopapadakis (2002)
[f] Chen et al. (1986); Elton et al. (1995); Ferson and Schadt (1996)
[g] Baker and Stein (2004); Statman, Thorley and Vorkink (2006)
[h] Ang et al. (2006)
[i] Kao and Shumaker (1999)
[j] Lu and Zhang (2008)
[k] Lu and Zhang (2008)
[l] Campbell and Vuolteenaho (2004); Cohen et al. (2003)
[m] Chen et al. (1986); Flannery and Protopapadakis (2002); Kao and Shumaker (1999)
[n] Kao and Shumaker (1999)
[o] Cooper and Priestley (2009)
[p] Baker and Wurgler (2006); Chan et al. (1998); Chen et al. (1986); Pesaran and Timmermann (2000)
[q] Baker and Wurgler (2006); Chen et al. (1986)
[r] Cevik et al. (2012)
[s] Chen et al. (1986)
[t] Flannery and Protopapadakis (2002)
[u] Flannery and Protopapadakis (2002)
[v] Flannery and Protopapadakis (2002)
[w] Flannery and Protopapadakis (2002)
[x] Flannery and Protopapadakis (2002); OECD (1987)
[y] Flannery and Protopapadakis (2002)

Appendix B: Summary Statistics for Market/Macroeconomic Variables

This table presents summary statistics for 25 market and macroeconomic variables used in this study. The summary statistics are based on the quarterly values of the variables from Q_3 1980 to Q_3 2010, which are used forecast style factor returns from Q_1 1981 to Q_4 2011. All macroeconomic variables indicating a percentage change are measured as the year-on-year change, using a moving average over the prior four quarters as the value for each quarter, to decrease the impact of historical data revisions. Appendix A provides specific measurement details for each variable.

Variable	Mean	Median	Std Dev.	Min	Max.
T-Bill (%)	0.36	0.39	0.31	0.00	1.22
CRSP Dividend Yield (%)	2.63	2.46	1.08	1.06	5.55
Treasury Yield Spread (%)	1.84	2.06	1.26	-2.65	4.42
Corp. Bond Yield Spread (%)	1.11	0.95	0.50	0.55	3.09
Log Market Value	12.77	12.79	0.40	12.06	13.33
Market Return (%)	2.99	3.70	8.77	-23.81	21.29
Market Turnover (%)	32.58	24.50	25.14	3.65	150.98
Market Volatility (%)	4.24	4.09	1.68	1.53	9.45
Earnings Yield Gap (%)	-1.24	-1.50	1.46	-4.44	3.75
B/M Spread	1.82	1.23	2.59	0.28	22.62
M/B Spread	6.72	5.74	3.89	1.93	23.29
Value Spread	2.33	2.21	0.70	0.82	4.67
Δ CPI (%)	3.61	3.04	2.37	-0.77	13.71
Δ GDP (%)	5.80	5.91	2.54	-2.77	12.22
Output Gap	-0.01	0.00	0.06	-0.20	0.10
Δ Industrial Production (%)	1.83	2.46	3.99	-12.31	10.04
Δ Consumption (%)	6.25	6.24	2.35	-2.22	11.22
Δ Manufacturing (%)	1.28	-1.24	14.46	-23.60	55.58
Δ Oil Prices (%)	7.94	5.06	28.87	-49.40	101.98
Δ PPI (%)	2.67	2.21	2.89	-3.36	13.60
Balance of Trade ($bn)	-78.23	-44.63	66.27	-218.61	-2.83
Δ Employment (%)	1.23	1.67	1.82	-4.44	4.62
Unemployment Rate (%)	6.27	5.80	1.64	3.90	10.80
Housing Starts (%)	-1.43	1.42	17.91	-45.40	59.99
Δ Monetary Aggregate: M1 (%)	5.19	5.18	4.78	-4.25	15.61

Appendix C: Mutual Fund Dataset Construction

The dataset used is created by merging the Thomson Reuters Mutual Fund Common Stock Holdings (s12) Database with the CRSP Mutual Fund Database (CMFD), using the Mutual Fund Links (MFLINKS) tables. The s12, CMFD and MFLINKS tables which facilitate the data merge are all sourced from Wharton Research Data Services (WRDS). The s12 data is sourced from the SEC N-30D filings which funds are required to file semi-annually with the SEC. Up until 1985 funds were required by the SEC to file this data on a quarterly basis (WRDS, 2008). About 60% of funds continue to provide this data quarterly (WRDS, 2012). The s12 database contains quarterly stock holdings data for US mutual funds, and the CMFD contains monthly fund returns as well as fund characteristics such as Total Net Assets (TNA), Date the Fund was First Offered, Turnover, Expense Ratios, Management Fees and Loads. This study is interested in US Active Equity Fund Managers, so in order to identify only these funds, various exclusions are made to both datasets.

Prior to the database merge, funds in the CMFD with the following Policy classifications were excluded: Canadian and International ('C & I'), Balanced ('Bal'), Bonds ('Bonds'), Preferred Stocks ('Pfd'), Bond and Preferred Stocks ('B & P'), Government Securities ('GS'), Money Market ('MM') and Tax-Free Money Market ('TFM'). The universe of US Active Equity Managers from the CMFD is further refined by including only those funds with the following classification codes:

- <u>Wiesenberger Fund Type Codes</u>: Growth (G), Growth and Current Income (GCI), Growth-Income (G-I), Long-Term Growth (LTG), Maximum Capital Gains (MCG) and Small-Capitalisation Growth (SCG).
- <u>Strategic Insight Objective Code</u>: Equity USA Aggressive Growth (AGG), Equity USA Midcaps (GMC), Equity USA Growth & Income (GRI), Equity USA Growth (GRO), Equity USA Income & Growth (ING), and Equity USA Small Companies (SCG).
- <u>Lipper Classification Code:</u> Equity Income (EIEI), Growth (G), Large-Cap Core (LCCE), Large-Cap Growth (LCGE), Large-Cap Value (LCVE), Mid-Cap Core (MCCE), Mid-Cap Growth Funds (MCGE), Mid-Cap Value (MCVE), Multi-Cap Core (MLCE), Multi-Cap Growth (MLGE), Multi-Cap Value (MLVE), Small-Cap Core (SCCE), Small-Cap Growth (SCGE) and Small-Cap Value (SCVE).

If a fund is missing a Policy classification, Wiesenberger Fund Type Code, Strategic Insight Objective Code and Lipper Classification Code, yet between 80%-105% of the fund's assets are invested in equity, then it is included.

A single Wharton Financial Institution Code Number (WFICN) identifier may be linked to a number of funds in the CMFD; however this is due to the fact that the same WFICN identifier is used for funds which have a number of share classes. Multiple share classes for the same fund are aggregated using the TNA for the month prior as the weight applied to all variables for each share class.

The s12 dataset contained 2,409 unique funds prior to the merge with the CMFD. After merging the datasets, there are 2,047 unique funds, thus 85% of the funds are linked. Subsequent to merging the two databases, a manual check of the funds' names was undertaken to ensure misclassified funds are not included (Ali et al., 2008). There are 2,047 unique funds in the merged dataset after removing the misclassified funds of which there are 191 in total. The final sample contains 1,856 funds over the period 1980-2010.

Appendix D: Book-to-Market Forecasts

This table presents the average parameter estimates for Book-to-Market for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Book-to-Market	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	.	.	3.71*** (11.97)	.	.	.
CRSP Div. Yield	.	.	.	.	.	.
Treasury Yield Spread	.	.	1.72*** (21.30)	.	-0.241 (-0.42)	0.476 (0.48)
Corp. Bond Yield Spread	.	.	.	.	.	.
Log Market Value	.	.	.	.	.	.
Market Return	.	.	.	.	.	.
Market Turnover	.	.	.	.	.	.
Market Volatility	.	.	3.01*** (36.34)	.	.	.
Earnings Yield Gap	.	.	.	-1.567*** (-120.99)	-6.553*** (-11.38)	-9.066*** (-75.61)
B/M Spread	.	.	.	.	.	.
M/B Spread	.	.	.	.	.	.
Value Spread	.	.	0.07*** (16.66)	-0.010*** (-6.26)	.	.
Δ CPI	.	.	.	.	.	.
Δ GDP	-0.922*** (-14.03)	.	-1.254*** (-25.36)	.	.	.
Output Gap	.	.	.	0.070*** (11.57)	.	.
Δ Industrial Prod.	.	.	-0.035 (-1.53)	.	.	.
Δ Consumption	.	2.097*** (29.47)	.	.	.	.
Δ Manufacturing	.	.	.	.	0.749*** (15.90)	0.949*** (61.04)
Δ Oil Prices	.	.	.	.	.	.
Δ PPI	.	0.490*** (21.31)	.	.	2.147*** (15.49)	3.687*** (18.03)
Balance of Trade ($bn)	.	.	0.007*** (77.76)	.	.	-0.002*** (-19.97)
Δ Employment	1.394*** (29.93)	.	.	.	0.354 (1.22)	0.650*** (3.31)
Unemployment Rate	4.672*** (44.55)	4.545*** (104.62)	1.296*** (19.96)	6.985*** (128.13)	.	.
Δ Housing Starts	.	.	0.235*** (97.04)	0.033*** (12.10)	.	.
Δ M1	.	.	0.933*** (29.82)	.	.	.
Forecast versus Actual Returns Model Fit Statistics						
Correlation	0.39	-0.14	0.62	-0.55	0.55	0.04
Adjusted R^2	10.63%	-3.40%	35.31%	26.62%	26.63%	-5.12%
F statistic	3.26*	0.38	11.37***	7.89**	7.90**	0.03

Appendix E: Dividend-to-Price Forecasts

This table presents the average parameter estimates for Dividend-to-Price for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dividend-to-Price	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	.	.	.	.	.	.
CRSP Div. Yield	.	-12.825***	-15.702***	.	.	.
		(67.07)	(-30.24)			
Treasury Yield Spread	.	.	.	.	0.780*	3.232***
					(1.93)	(24.24)
Corp. Bond Yield Spread	.	.	13.506***	.	5.258***	.
			(26.31)		(3.68)	
Log Market Value	0.910***	.	.	.	0.098***	.
	(36.07)				(4.38)	
Market Return	.	.	.	.	.	.
Market Turnover	.	0.742***	.	.	.	.
		(3.06)				
Market Volatility	.	.	1.016***	.	.	.
			(6.69)			
Earnings Yield Gap	.	.	.	-4.032***	-3.499***	-4.546***
				(-101.06)	(-8.45)	(-100.32)
B/M Spread	.	.	.	.	.	.
M/B Spread	0.024***	.	-0.020***	.	.	0.015***
	(36.99)		(-10.46)			(38.27)
Value Spread	.	.	.	0.012***	.	.
				(6.73)		
Δ CPI	.	.	.	.	.	.
Δ GDP	.	.	-0.805***	.	.	.
			(5.55)			
Output Gap	0.214***	.	.	.	.	.
	(3.29)					
Δ Industrial Prod.	.	.	-0.476***	.	.	.
			(-33.41)			
Δ Consumption	.	6.625***	.	.	.	.
		(148.41)				
Δ Manufacturing	.	.	.	.	0.274***	0.081***
					(12.46)	(7.45)
Δ Oil Prices	0.363***	.	0.223***	.	.	.
	(19.34)		(12.86)			
Δ PPI	.	.	.	.	.	.
Balance of Trade ($bn)	0.031***	-0.0004	.	.	.	-0.001***
	(23.90)	(-0.29)				(-30.57)
Δ Employment	.	-5.123***	.	1.789***	.	1.367***
		(-29.19)		(63.48)		(28.49)
Unemployment Rate	.	.	.	5.637***	.	.
				(66.25)		
Δ Housing Starts	.	.	.	-0.057***	.	.
				(-13.59)		
Δ M1	.	-1.404***	.	.	.	.
		(-16.18)				
Forecast versus Actual Returns Model Fit Statistics						
Correlation	0.13	-0.23	-0.34	0.53	-0.67	-0.21
Adjusted R^2	-3.81%	0.07%	6.56%	24.48%	42.09%	-0.42%
F statistic	0.3	1.01	2.33	7.16**	14.81***	0.92

Appendix F: Net Profit Margin Forecasts

This table presents the average parameter estimates for Net Profit Margin for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Net Profit Margin	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	.	-6.548***	.	.	42.09***	.
		(-10.91)			(14.19)	
CRSP Div. Yield	.	-5.565***	.	-3.817***	.	.
		(-9.00)		(-15.28)		
Treasury Yield Spread	3.232***	.	-0.448	.	.	.
	(24.24)		(-1.54)			
Corp. Bond Yield Spread	.	.	.	.	.	.
Log Market Value	.	.	0.102**	-0.103***	0.227***	.
			(2.79)	(-5.88)	(6.52)	
Market Return	.	.	.	.	.	.
Market Turnover	5.440***	0.476***			0.112***	
	(3.95)	(3.05)			(8.37)	
Market Volatility	.	.	.	.	-4.725***	-4.729***
					(-46.73)	(-52.86)
Earnings Yield Gap	-0.670***	-1.850***	-1.536***	.	.	-5.452***
	(-5.67)	(-9.20)	(-9.45)			(-41.35)
B/M Spread	.	-0.013***	-0.018***	0.001	.	.
		(-24.58)	(-54.56)	(0.66)		
M/B Spread	0.020***	.	.	.	.	0.000
	(31.85)					(0.59)
Value Spread	.	.	.	.	.	.
Δ CPI	.	.	-0.214	.	.	.
			(-1.42)			
Δ GDP	.	.	.	.	.	.
Output Gap	.	.	.	.	.	.
Δ Industrial Prod.	.	.	.	.	.	.
Δ Consumption	.	.	.	.	.	.
Δ Manufacturing	-0.049*	.	0.013	.	.	-0.090***
	(-1.81)		(1.26)			(-10.04)
Δ Oil Prices	.	.	.	.	.	0.295***
						(39.50)
Δ PPI	.	0.482***	.	.	.	.
		(14.01)				
Balance of Trade ($bn)	0.013***	.	.	.	.	.
	(10.90)					
Δ Employment	-1.860***	.	.	.	.	0.729***
	(-23.64)					(9.31)
Unemployment Rate	.	.	.	.	.	-5.263***
						(-22.52)
Δ Housing Starts	0.212***	0.187***	.	0.266***	-0.576***	.
	(12.26)	(10.37)		(86.25)	(22.68)	
Δ M1	5.437***	.	.	.	0.083	.
	(48.36)				(0.94)	
Forecast versus Actual Returns Model Fit Statistics						
Correlation	-0.06	-0.43	-0.84	-0.86	-0.32	0.07
Adjusted R^2	-5.15%	13.69%	69.43%	73.33%	5.50%	-4.68%
F statistic	0.07	4.01*	44.15***	53.23***	2.11	0.11

Appendix G: Return-on-Equity Forecasts

This table presents the average parameter estimates for Return-on-Equity for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Return-on-Equity	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	8.820***	6.544***	0.229***	.	.	.
	(13.24)	(3.87)	(5.93)			
CRSP Div. Yield	.	.	.	.	.	.
Treasury Yield Spread	.	.	.	.	.	.
Corp. Bond Yield Spread	.	.	.	-11.752***	.	.
				(-12.94)		
Log Market Value	.	.	.	-0.313***	0.203***	.
				(-14.44)	(4.20)	
Market Return	.	.	.	.	.	.
Market Turnover	4.017***	0.399***	.	.	0.198***	.
	(4.32)	(3.19)			(13.52)	
Market Volatility	.	.	-0.983***	-1.440***	-3.157***	.
			(-25.84)	(-12.85)	(-75.82)	
Earnings Yield Gap	1.334***	.	.	.	.	-2.171***
	(10.43)					(-14.21)
B/M Spread	.	.	.	0.001	.	0.030***
				(0.99)		(6.66)
M/B Spread	.	.	0.000	.	.	.
			(-0.50)			
Value Spread	.	.	.	.	.	.
Δ CPI	.	.	.	.	7.990***	.
					(14.13)	
Δ GDP	-1.888***	.	.	.	3.626***	.
	(-33.60)				(15.18)	
Output Gap	.	.	.	.	.	.
Δ Industrial Prod.	.	.	0.460***	0.875***	.	.
			(15.21)	(23.54)		
Δ Consumption	.	-1.441***	.	.	.	.
		(-71.65)				
Δ Manufacturing	0.126***	.	.	.	.	-0.070***
	(5.94)					(-10.66)
Δ Oil Prices	-0.159***	.	.	.	.	.
	(-5.17)					
Δ PPI	.	-0.193***	.	.	.	3.431***
		(-3.15)				(12.96)
Balance of Trade ($bn)	.	.	0.001	.	.	.
			(1.52)			
Δ Employment	-1.093***	.	.	.	.	3.866***
	(-4.31)					(46.86)
Unemployment Rate	.	.	.	.	.	-1.095***
						(-4.41)
Δ Housing Starts	0.099***	.	0.106***	0.180***	.	-0.285***
	(5.06)		(10.67)	(29.50)		(-7.01)
Δ M1	.	.	.	-1.312***	-0.252**	.
				(-33.62)	(-2.19)	
Forecast versus Actual Returns Model Fit Statistics						
Correlation	-0.34	-0.50	-0.85	-0.20	-0.03	-0.32
Adjusted R^2	6.37%	20.79%	70.86%	-1.41%	-5.45%	5.26%
F statistic	2.29	5.99**	47.19***	0.73	0.02	2.11

Appendix H: Return-on-Asset Variability Forecasts

This table presents the average parameter estimates for Return-on-Asset Variability for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Return-on-Asset Variability	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	-19.778*** (-12.17)	.	.	.	.	.
CRSP Div. Yield	.	-3.979*** (-13.30)	-3.188*** (-2.88)	.	.	.
Treasury Yield Spread	.	.	1.252*** (12.69)	0.481*** (8.27)	3.291*** (27.74)	.
Corp. Bond Yield Spread	8.999*** (91.42)	.	.	.	.	.
Log Market Value	.	.	.	-0.153*** (17.93)	.	.
Market Return	.	.	.	.	.	-0.079*** (-4.69)
Market Turnover	3.646*** (7.82)	.	.	.	0.202*** (8.15)	.
Market Volatility	.	0.230 (1.41)	.	.	.	.
Earnings Yield Gap	-1.532*** (-18.29)	-3.167*** (-50.82)	-3.124*** (128.03)	-2.362*** (-36.10)	.	.
B/M Spread	.	.	.	.	.	.
M/B Spread	-0.001*** (-3.66)	0.001* (1.94)	-0.021*** (-22.11)	.	0.003** (2.14)	.
Value Spread	.	.	.	.	.	.
Δ CPI	.	.	.	.	.	.
Δ GDP	.	.	.	.	4.016*** (23.70)	.
Output Gap	.	.	-0.087* (-2.06)	.	.	.
Δ Industrial Prod.	.	0.405*** (12.11)	.	.	.	.
Δ Consumption	.	.	.	.	.	.
Δ Manufacturing	.	0.102*** (16.60)	.	.	.	.
Δ Oil Prices	.	.	.	.	.	.
Δ PPI	.	0.918*** (90.63)	.	.	.	2.552*** (22.18)
Balance of Trade ($bn)	0.022*** (45.67)	-0.002*** (-5.05)	.	.	.	.
Δ Employment	.	.	.	.	.	.
Unemployment Rate	.	.	-0.716*** (-5.30)	.	.	.
Δ Housing Starts	0.042*** (11.17)	.	.	0.051*** (23.67)	.	-0.102*** (-9.69)
Δ M1	6.579*** (57.11)	-0.904*** (-4.19)	.	.	.	.
Forecast versus Actual Returns Model Fit Statistics						
Correlation	-0.30	-0.57	-0.48	-0.44	-0.03	-0.34
Adjusted R^2	3.94%	28.57%	19.17%	15.11%	-5.49%	6.71%
F statistic	1.78	8.60***	5.51**	4.38*	0.01	2.44

Appendix I: Size Forecasts

This table presents the average parameter estimates for Size for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Size	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	.	.	-16.088*** (-44.72)	.	.	-19.365*** (-27.06)
CRSP Div. Yield	.	-1.532*** (-3.45)	.	.	.	.
Treasury Yield Spread	.	.	.	-1.093*** (-4.62)	2.417*** (4.88)	.
Corp. Bond Yield Spread	.	.	.	.	.	.
Log Market Value	.	.	.	0.732*** (23.36)	0.396*** (47.70)	.
Market Return	.	.	.	.	.	.
Market Turnover	-4.422*** (-4.06)	.	.	.	.	.
Market Volatility	.	.	.	.	.	6.506*** (95.49)
Earnings Yield Gap	1.226*** (16.00)	1.193*** (23.65)	.	.	-3.547*** (-9.57)	0.336*** (8.02)
B/M Spread	.	.	.	0.013*** (3.94)	.	.
M/B Spread	-0.031*** (-37.13)	-0.042*** (-53.93)	.	.	.	0.010*** (38.89)
Value Spread	.	.	.	.	.	.
Δ CPI	-1.697*** (-8.83)	.	.	.	.	.
Δ GDP	.	.	.	.	.	.
Output Gap	.	.	.	.	-1.494*** (-12.33)	.
Δ Industrial Prod.	.	.	.	.	.	.
Δ Consumption	.	1.512*** (11.72)	.	.	.	.
Δ Manufacturing	0.343*** (27.89)	.	.	.	.	0.234*** (27.39)
Δ Oil Prices	.	.	.	0.100*** (31.36)	.	.
Δ PPI	.	.	1.766*** (223.89)	.	.	.
Balance of Trade ($bn)	-0.021*** (-18.78)	0.005*** (11.05)	.	.	.	.
Δ Employment	0.370 (1.09)	.	.	.	0.968** (2.21)	.
Unemployment Rate	.	.	.	.	.	1.614*** (9.68)
Δ Housing Starts	-0.433*** (-13.90)	-0.086*** (-5.32)	.	-0.308*** (-24.97)	.	.
Δ M1	-8.852*** (-38.24)	.	-0.095** (-2.63)	1.777*** (25.22)	.	.
Forecast versus Actual Returns Model Fit Statistics						
Correlation	0.22	-0.55	-0.40	0.60	0.24	0.51
Adjusted R^2	-0.64%	26.65%	11.60%	31.97%	0.56%	22.54%
F statistic	0.88	7.90**	3.49*	9.93***	1.11	6.82**

Appendix J: Stable-minus-Volatile Forecasts

This table presents the average parameter estimates for Stable-minus-Volatile for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Stable-minus-Volatile	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	.	.	.	.	.	.
CRSP Div. Yield	.	-3.240***	.	.	.	.
		(-11.13)				
Treasury Yield Spread	.	.	.	-1.878***	.	.
				(-8.20)		
Corp. Bond Yield Spread	.	.	.	.	.	-21.297***
						(-17.26)
Log Market Value	.	.	.	.	.	.
Market Return	.	.	.	.	.	.
Market Turnover	5.172***	0.256**	0.635***	0.161***	.	.
	(5.95)	(2.16)	(131.04)	(5.59)		
Market Volatility	5.422***	.	3.626***	.	.	-6.773***
	(38.42)		(43.89)			(-34.94)
Earnings Yield Gap	-2.726***	-3.302***	-4.528***	-1.298***	.	-5.615***
	(-16.23)	(27.24)	(-209.12)	(-22.04)		(-24.98)
B/M Spread	.	.	.	.	.	.
M/B Spread	0.028***	0.022***	.	.	-0.014***	.
	(26.29)	(22.72)			(-7.03)	
Value Spread	.	.	.	0.013*	.	.
				(2.03)		
Δ CPI	.	.	2.511***	.	.	.
			(25.36)			
Δ GDP	.	.	.	.	.	.
Output Gap	.	.	.	.	.	.
Δ Industrial Prod.	.	.	.	.	.	.
Δ Consumption	.	-3.461***	.	.	.	.
		(-53.98)				
Δ Manufacturing	.	.	.	.	.	.
Δ Oil Prices	.	.	.	.	.	0.578***
						(39.12)
Δ PPI	.	1.992***	.	.	.	.
		(49.50)				
Balance of Trade ($bn)	0.021***	-0.005***	.	-0.002***	0.001	.
	(16.87)	(-8.56)		(-4.46)	(1.33)	
Δ Employment	.	.	2.380***	.	6.773***	.
			(18.52)		(14.64)	
Unemployment Rate	.	.	.	.	.	0.046
						(0.15)
Δ Housing Starts	0.238***	0.288***	0.406***	0.300***	.	.
	(42.35)	(40.99)	(36.67)	(19.85)		
Δ M1	7.540***	.	.	.	.	.
	(59.39)					
Forecast versus Actual Returns Model Fit Statistics						
Correlation	0.41	0.09	-0.60	-0.83	-0.56	0.30
Adjusted R^2	12.10%	-4.79%	31.99%	67.66%	27.62%	3.99%
F statistic	3.62*	0.13	9.94***	40.75***	8.25**	1.83

Appendix K: Momentum Forecasts

This table presents the average parameter estimates for Momentum for the independent variables selected, and model fit statistics for the six forecasting period subsets.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Momentum	**Forecasting Time Period Subset**					
Economic Variables	**1981-1985**	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2011**
T-Bill	-17.517***					
	(-9.42)					
CRSP Div. Yield	4.252***					
	(32.40)					
Treasury Yield Spread	-1.320***	-0.939***				
	(-4.21)	(-9.54)				
Corp. Bond Yield Spread			-13.942***			
			(-58.90)			
Log Market Value		-0.252***				
		(20.27)				
Market Return				-0.241***		
				(-38.82)		
Market Turnover			-0.373***		-0.363***	
			(-23.59)		(-24.39)	
Market Volatility						
Earnings Yield Gap						
B/M Spread						
M/B Spread						
Value Spread			0.000	-0.027***		
			(-0.03)	(-4.67)		
Δ CPI		-0.191**			2.131***	
		(-2.82)			(15.27)	
Δ GDP				1.062***		
				(11.06)		
Output Gap				0.036		
				(1.41)		
Δ Industrial Prod.			0.653***		0.529***	
			(28.22)		(6.42)	
Δ Consumption			1.638***			
			(7.96)			
Δ Manufacturing	0.533***		-0.062***			
	(61.19)		(-4.83)			
Δ Oil Prices			-0.011**			-0.179***
			(-2.19)			(-21.74)
Δ PPI						
Balance of Trade ($bn)						
Δ Employment						
Unemployment Rate				-2.050***		
				(102.76)		
Δ Housing Starts	0.073***	0.229***				
	(6.94)	(25.37)				
Δ M1				-1.200***	-0.773***	
				(-15.77)	(-30.35)	
Forecast versus Actual Returns Model Fit Statistics						
Correlation	0.15	-0.40	-0.19	0.04	0.43	0.45
Adjusted R^2	-3.16%	11.43%	-1.84%	-5.36%	13.84%	16.33%
F statistic	0.42	3.45*	0.66	0.03	4.05*	4.90**

Table 1: Style Factor Measurement

This table indicates how each of the style factors across the various style categories is measured.

Style Category	Signal	Measurement
Value	Book-to-Market Ratio[a] (B/M)	Book $Equity_t$/Market Equity as at $December_{t-1}$ (ME) N.B. Book Equity is measured as per Davis, Fama and French (2000)
	Dividend-to-Price Ratio[b] (D/P)	Common $Dividends_t$/ME
	Earnings-to-Price[c] (E/P)	Income before Extraordinary $Items_t$ (IB)/ME
	Sales-to-Price Ratio[d] (S/P)	$Sales_t$/ME
	Cash Flow-to-Price Ratio[e] (C/P)	Cash $Flow_t$/ME N.B. Cash Flow is measured following the definition on Ken French's website 2012
	EBITDA-to-Enterprise Value Ratio[f] (EBITDA/EV)	$EBITDA_t$/Enterprise $Value_t$ N.B. Enterprise Value is measured following the definition on Ken French's website 2012
Growth	Trailing Earnings Growth[g] (TREG)	Average Earnings Growth (EG) over prior three years where EG = $(IB_t – IB_{t-1})/IB_{t-1}$
	Net Profit Margin[h] (NPM)	$IB_t/Sales_t$
	Trailing Sales Growth[i] (TRSG)	Average Sales Growth (SG) over prior three years where SG = $(Sales_t - Sales_{t-1}) /Sales_{t-1}$
	Sustainable Growth Rate[j] (SGR)	Return-on-Equity (ROE)*(1 – Dividend Payout Ratio (DPR)) where ROE = see below and DPR = Total $Dividends_t/IB_t$
Quality-Growth	ROE[k]	IB_t/Shareholders' $Equity_{t-1}$ (SEQ)
	Return-on-Assets[l] (ROA)	IB_t/Total $Assets_{t-1}$ (AT)
	Operating Cash Flow[m] (OCF)	$\frac{\text{Operating Income before } Depreciation_t – \text{Capital } Expenditures_t}{((AT + AT_{t-1})*0.5)}$
Quality- Stable	Leverage[n] (LEV)	Long Term $Debt_t$ /SEQ_t
	SG Variability[o] (SG VAR)	Variance of SG over prior four years
	Earnings Growth Variability[p] (ROA VAR)	Variance of ROA over prior four years
Momentum	Momentum[q] (MOM)	Prior 11-month return lagged one month measured as the simple compound of the component monthly returns

Style Category	Signal	Measurement
Size	Size[r]	Market Equity as at June$_t$
Low Volatility	Historical Idiosyncratic Volatility[s] (VOL)	Standard Deviation of ε_t over prior 60-months where ε_t = (Stock Return$_t$ – Risk-Free Rate$_t$) - $\alpha - \beta$*(CRSP Value-Weighted Index Return$_t$ – Risk-Free Rate$_t$) N.B. α and β estimated using the 60-month history of returns

[a] Fama and French (1992; 1993); Lakonishok, Shleifer and Vishny (1994); Davis (1994); Chan et al. (1998)
[b] Fama and French (1988); Chan et al. (1998)
[c] Basu (1983); Davis (1994); Lakonishok et al. (1994); Chan et al. (1998)
[d] Barbee, Mukherji and Raines (1996)
[e] Chan, Hamao and Lakonishok (1991); Lakonishok et al. (1994); Davis (1994); Chan et al. (1998)
[f] Lie and Lie (2002)
[g] Bali, Demirtas and Tehranian (2008)
[h] Lockwood and Prombutr (2010)
[i] Lakonishok et al. (1994)
[j] Lockwood and Prombutr (2010)
[k] Gallagher et al. (2013); Taylor (2010, pers. comm., 10 Mar); Mercer Investments (2010); Chen and Zhang (2007); Bird and Casavecchia (2007); Zhang (2000)
[l] Gallagher et al. (2013); Taylor (2010, pers. comm., 10 Mar); Chen and Zhang, (2007); Bird and Casavecchia (2007); Mohanram (2005); Fairfield and Whisenant (2000); Piotroski (2000)
[m] Gallagher et al. (2013); Bird and Casavecchia (2007); Mohanram (2005); Piotroski (2000), Dechow and Dichev (2002)
[n] Gallagher et al. (2013); George and Hwang (2010); Mercer Investments (2010); Lui et al. (2007); Bird and Casavecchia (2007)
[o] Gallagher et al. (2013); Mercer Investments (2010); Mohanram (2005)
[p] Gallagher et al. (2013); Mercer Investments (2010); Dichev and Tang (2009); Mohanram (2005)
[q] Jegadeesh and Titman (1993); Carhart (1997)
[r] Banz (1981); Fama and French (1992; 1993); Chan et al. (1998)
[s] Ang et al. (2006); Clarke et al. (2010)

Table 2: Historical Performance of Style Factors

This table presents a summary of the annualised percentage performance of the style factors included in this study. In addition, the annualised standard deviation of the monthly returns is provided in parentheses. The value factors are: book-to-market (B/M), dividend-to-price (D/P), earnings-to-price (E/P), cash flow-to-price (C/P), sales-to-price (S/P) and EBITDA-to-enterprise value (EBITDA/EV). The growth factors are: trailing three-year earnings growth (TREG), net profit margin (NPM), trailing three-year sales growth (TRSG) and the sustainable growth rate (SGR). The quality growth factors are: return-on-equity (ROE), return-on-assets (ROA) and operating cash-flow (OCF). The quality stability factors are leverage (LEV), sales-growth-variability (SG VAR) and ROA variability (ROA VAR). The factors based on accounting metrics are formed by sorting stocks into quintiles in June of each year *t*, based on the value of the metric in question for the fiscal year ending in year *t-1*. Size is the value of market equity as at June of each year *t*. Returns are computed from July of year *t* to June of year *t+1*. For the value, growth, and quality growth (size) categories, the monthly factor return is the average return to the highest (lowest) quintile of stocks minus the lowest (highest) quintiles of stocks, while, the quality stability factors are calculated as the monthly difference between the average return of firms in quintiles one to four, and the average return of those in the top quintile. Momentum is constructed as the average of firms with the highest 20 percent 11-month returns lagged one month, minus the average of firms with the lowest 20 percent 11-month returns lagged one month. Portfolios are rebalanced monthly. The volatility factor is calculated each month as the average return to the lowest quintile of stocks based on historical idiosyncratic volatility, minus the average return to the highest quintile of stocks based on historical idiosyncratic volatility. Average returns to the quintiles are value-weighted for all of the style factors. Up (Down)-market months are those in which the CRSP value-weighted index return is greater (less) than the T-Bill rate. There are 330 (240) up (down)-market months.

	All	1981-1991	1992-2001	2002-2011	Up-Markets	Down-Markets
Value						
B/M	5.43 (11.47)	5.91 (10.79)	5.50 (13.39)	4.83 (10.14)	-2.26 (10.07)	17.83 (12.63)
D/P	5.07 (13.94)	6.59 (13.98)	3.88 (15.30)	4.61 (12.50)	-11.32 (11.59)	34.47 (14.02)
E/P	6.45 (10.84)	5.69 (11.39)	9.61 (11.93)	4.20 (10.81)	-0.18 (9.30)	17.01 (12.30)
C/P	4.52 (12.69)	4.21 (12.75)	3.91 (15.21)	5.47 (9.57)	-8.56 (11.64)	27.05 (12.04)
S/P	6.48 (11.49)	3.68 (9.77)	8.11 (12.84)	8.00 (11.86)	7.65 (10.26)	4.78 (13.13)
EBITDA/EV	6.52 (10.20)	4.86 (9.31)	7.53 (11.99)	7.35 (9.21)	-1.09 (9.28)	18.76 (10.69)
Growth						
TREG	0.21 (7.00)	-0.14 (6.52)	-2.98 (7.61)	3.89 (6.78)	-1.13 (6.85)	2.23 (7.20)
NPM	1.59 (12.90)	2.40 (10.32)	3.43 (16.55)	-1.10 (11.25)	-12.44 (11.22)	26.14 (12.65)
TRSG	-1.02 (8.83)	-2.11 (9.44)	-0.98 (9.14)	0.14 (7.83)	4.91 (8.67)	-9.24 (8.51)
SGR	-0.41 (9.28)	0.33 (8.97)	0.72 (9.76)	-2.33 (9.15)	-3.08 (8.59)	3.68 (10.12)
Quality (Growth)						
ROE	2.85 (11.94)	4.26 (8.81)	3.34 (15.32)	0.86 (11.13)	-7.83 (10.58)	20.76 (12.32)
ROA	3.07 (11.34)	5.59 (8.53)	3.07 (13.49)	0.37 (11.72)	-6.63 (10.26)	19.14 (11.57)
OCF	4.80 (11.77)	9.19 (6.93)	5.02 (15.80)	-0.06 (11.23)	-5.53 (10.39)	21.98 (12.33)
Quality (Stability)						
LEV	0.55 (5.61)	3.03 (4.76)	0.15 (6.37)	-1.71 (5.61)	1.25 (5.51)	-0.47 (5.75)
SG VAR	1.68 (8.83)	6.38 (6.99)	-1.16 (9.89)	-0.49 (9.40)	-7.59 (8.18)	16.97 (8.16)
ROA VAR	2.42 (12.74)	6.38 (8.38)	-1.49 (18.30)	2.12 (9.57)	-11.69 (11.91)	27.13 (11.25)
Momentum	7.51 (19.45)	7.37 (13.89)	11.40 (21.62)	3.90 (22.30)	3.13 (20.57)	14.31 (17.58)
Size	1.20 (15.39)	-5.23 (11.36)	5.81 (21.12)	4.02 (11.99)	8.41 (16.16)	-8.66 (13.70)
Low Volatility	5.72 (24.85)	13.79 (14.57)	2.46 (34.86)	0.57 (21.65)	-22.07 (23.87)	63.77 (20.25)

Table 3: Summary Statistics for the Mutual Fund Sample

This table reports summary statistics for the sample of mutual funds obtained by linking the Thomson Reuters Common Stock Holdings Mutual Fund Data with the CRSP Mutual Fund Database (CMFD), using the Mutual Fund Links tables. There are 1,856 US Active Equity funds examined over the period 1980-2010. Only funds classified as 'Aggressive Growth', 'Growth', or 'Growth and Income' are included. Average values of fund characteristic variables and returns are provided; the median is in parentheses. No. Stocks is the number of stocks held by a fund as of the end of the month. Age is relative to the date the fund was first offered, and is in years. Turnover is an annual variable which represents the minimum of aggregated sales or aggregated purchases of securities, divided by the average 12-month Total Net Assets of the Fund. Expenses represents the annual expense ratio. Equity Proportion is the average proportion of the fund that is invested in common equity, and is calculated over the life of the fund. TNA is the fund's month end Total Net Asset Value, in millions. Total Load is the sum of the front and rear loads, reported annually. Management Fee (Mgt Fee) is only available from 1998 to 2010. It is the ratio of Management Fee ($), divided by Average Total Net Assets ($) reported as a percentage. CRSP Raw Ret is the annual fund return, including distributions (dividends and capital gains), before total expenses. CRSP Net Ret is the annual fund return including distributions (dividends and capital gains), after total expenses. Both of these are sourced from the CMFD. Raw Holdings Ret is the annual raw fund return calculated using the quarterly stock holdings from the s12 database. The annual mean is the simple compound of the four quarterly means for all funds existing in each quarter. DGTW-adj. Ret is the annual excess fund return, whereby the return of each stock in the portfolio has been adjusted by the return on a portfolio of stocks with similar book-to-market, size and momentum characteristics. Value-weighted returns are provided.

	All	**1980-1990**	**1991-2000**	**2001-2010**
No. Stocks	98.94 (69.00)	69.94 (53.00)	96.80 (68.00)	109.70 (76.00)
Age	15.01 (10.08)	20.11 (17.00)	12.41 (7.08)	16.54 (13.00)
Turnover (%)	81.91 (62.66)	76.43 (59.00)	82.29 (62.00)	85.23 (66.00)
Expenses (%)	1.20 (1.15)	1.02 (0.99)	1.24 (1.20)	1.25 (1.21)
Equity Proportion (%)	86.77 (91.09)	79.33 (86.81)	85.45 (90.01)	90.23 (93.12)
TNA	1242.41 (250.00)	371.72 (121.90)	935.20 (185.20)	1625.57 (367.30)
Total Load	1.41 (0.00)	3.50 (2.00)	0.87 (0.00)	0.34 (0.00)
Mgt Fee	0.73 (0.74)	-	-	0.73 (0.74)
CRSP Raw Ret (%)	13.85 (17.15)	17.04 (19.65)	18.85 (20.32)	5.35 (10.35)
CRSP Net Ret (%)	13.19 (16.60)	16.34 (18.94)	17.87 (19.17)	5.05 (9.99)
Raw Holdings Ret (%)	12.63 (15.98)	16.19 (20.18)	19.46 (19.26)	1.87 (5.55)
DGTW-adj. Ret (%)	-0.04 (-0.26)	0.69 (-0.26)	0.77 (0.71)	-1.66 (-0.52)

Table 4: Reliability of Style Factor Forecast Returns

This table provides a summary of model fit statistics and forecast accuracy measures for quarterly style factor forecast returns, compared to the actual style factor returns over the period 1981-2011. The style factors included are Book-to-Market (B/M), Dividend-to-Price (D/P), Net Profit Margin (NPM), Return-on-Equity (ROE), Return-on-Asset Variability (ROA VAR), Momentum (MOM), SIZE, and Stable-minus-Volatile (SMV). Correlation is the correlation between the time-series of quarterly forecast and actual style returns. Adj. R^2, F-stat, and p-value are the model fit statistics from a regression of the forecast returns on the actual style factor returns. MAE is the Mean Absolute Error, which is the average of the absolute value of the forecast error— the difference between the actual and the forecast return in each quarter. SDAE is the Standard Deviation of the Absolute Error. RMSE is the Root Mean Squared Error, which is the square root of the average of the squared difference between the actual and forecast return in each quarter. Success Rate is the proportion of quarters in which the direction of the forecast was accurate.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Factor	Correlation	Adj. R^2 (%)	F-stat	p-value	MAE	SDAE	RMSE	Success Rate (%)
B/M	0.34	10.78	14.90	0.00***	14.94	16.51	22.22	60.33
D/P	-0.12	0.62	1.74	0.19	18.08	16.10	24.17	51.24
NPM	-0.10	0.15	1.18	0.28	24.60	20.35	31.87	37.19
ROE	-0.23	4.26	6.35	0.01**	22.02	17.90	28.33	48.76
ROA VAR	-0.05	-0.63	0.24	0.62	15.71	14.40	21.27	56.20
MOM	0.23	4.63	6.83	0.01**	18.45	12.70	22.37	61.98
SIZE	0.31	8.69	12.41	0.00***	20.51	19.31	28.12	67.77
SMV	0.06	-0.53	0.36	0.55	29.35	25.90	39.07	55.37

Note: Five outlier observations (Q_3 1999-Q_3 2000) which include returns during the technology crash (i.e., Q_1 2000-Q_4 2001) which commenced in March 2000 have been excluded from the B/M model fit tests.

Table 5: Characteristics of Investment Strategies based on the Style Factor Forecasts over the period 1981-2011

This table presents average annual returns over the period 1981-2011 to investment strategies based on style factor forecasts generated using macroeconomic and market information. The forecasts are made each quarter for the 12 month return commencing in two quarters' time. The first forecast is in Q_3 1980 for the buy-and-hold return over Q_1-Q_4 1981. The results for univariate strategies investing in either the style factor with the maximum (Max FC) or minimum forecast (Min FC), and a strategy which is long (short) the Max FC (Min FC), are provided. The 'All Quarters' return is the average actual annual return that is earned if the investment is made each quarter and held for the following 12 months. The 'Annual (Q_i)' returns also presented are for strategies which invest, based on the forecasts made only in each Q_i, where $1 \leq i \leq 4$ over the sample period. For example, to invest in each calendar year the Q_3 forecasts are used. *t*-statistics are provided in parentheses below the returns. Forecast accuracy measures are also provided for the Max FC investment strategy. Specifically, MAE is the Mean Absolute Error, which is the average of the absolute value of the forecast error, which is the difference between the actual and the forecast return in each quarter. SDAE is the Standard Deviation of the Absolute Error. RMSE is the Root Mean Squared Error, which is the square root of the average of the squared difference between the actual and forecast return in each quarter. Success Rate is the proportion of quarters in which the direction of the forecast was accurate.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Max FC	**Min FC**	**Long/Short**	**MAE**	**SDAE**	**RMSE**	**Success Rate (%)**
All Quarters	7.26*** (5.04)	-1.30 (-0.74)	8.55*** (3.60)	23.90	17.11	29.35	65.29
Annual (Q_1)	9.01** (2.68)	-1.13 (-0.32)	10.14* (1.97)	28.29	19.28	34.05	66.67
Annual (Q_2)	6.72** (2.65)	-1.43 (-0.39)	8.15* (1.70)	22.14	13.76	25.95	63.33
Annual (Q_3)	6.59** (2.50)	-2.20 (-0.72)	8.79** (2.18)	20.76	16.41	26.29	66.67
Annual (Q_4)	6.72** (2.20)	-0.41 (-0.10)	7.13 (1.36)	24.53	18.36	30.46	63.33

Table 6: Portfolio Characteristics for the Individual Style Factors and the Style Timing Strategy over the period 1981-2011

This table provides portfolio characteristics for the individual style factors upon which a style timing strategy is developed over the period 1981-2011. Book-to-Market (B/M), Return-on-Equity (ROE), Momentum (MOM) and SIZE are the style factors included. The 'All Quarters' return is the average actual annual return that is earned if the investment is made each quarter and held for the following 12 months. The 'Annual (Q_i)' returns also presented are for strategies which invest, based on the forecasts made only in each Q_i where $1 \leq i \leq 4$ over the sample period. Mean is the average annual return. *t*-statistic is the Student's *t*-statistic for a paired sample *t*-test of the difference in means between the timing strategy and the alternative of constant investment in each of the style factors. Std Dev. is the standard deviation of the annual returns, and the Sharpe Ratio is the Mean divided by the Std Dev.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	B/M	ROE	MOM	SIZE	Timing Strategy
			All Quarters		
Mean	5.76	3.20	7.90	2.44	7.26
t- statistic	0.61	2.08**	-0.38	2.16**	
Std Dev.	17.69	14.68	20.21	17.62	15.84
Sharpe Ratio	0.33	0.22	0.39	0.14	0.46
			Annual (Q_1)		
Mean	5.78	3.10	8.17	2.97	9.01
t- statistic	0.59	1.67	0.30	1.11	
Std Dev.	18.51	13.84	22.63	19.38	18.44
Sharpe Ratio	0.31	0.22	0.36	0.15	0.49
			Annual (Q_2)		
Mean	4.98	3.41	8.64	2.00	6.72
t- statistic	0.41	0.96	-0.47	1.15	
Std Dev.	15.83	15.65	21.32	15.65	13.87
Sharpe Ratio	0.31	0.22	0.41	0.13	0.48
			Annual (Q_3)		
Mean	5.89	2.98	7.36	1.43	6.59
t- statistic	0.17	0.93	-0.21	1.30	
Std Dev.	16.27	13.17	19.19	15.57	14.69
Sharpe Ratio	0.36	0.23	0.38	0.09	0.45
			Annual (Q_4)		
Mean	6.37	3.32	7.46	3.41	6.72
t- statistic	0.06	0.72	-0.26	0.75	
Std Dev.	20.66	16.60	18.50	20.25	16.70
Sharpe Ratio	0.31	0.20	0.40	0.17	0.40

Table 7: Average Returns to Quintiles of Funds formed based on their Exposure to the Preferred Style Factor

This table presents average annual returns to funds sorted into quintiles based on their exposure to the preferred style factor. The sample of mutual funds is based on a merged dataset of funds in both the Thomson Reuters Common Stock Holdings Database and the CRSP Mutual Fund Database, using Mutual Fund Links. Results are presented when fund holdings for Q_3 year *t* are used over the period 1980-2009. The associated investment horizon is from Q_1-Q_4 year *t+1*, i.e., from 1981 to 2010. The asset-weighted raw and DGTW-adjusted returns presented are calculated using the stock holdings of the funds. The asset-weight applied is based on fund assets as at the end of the prior quarter. The weight applied to each stock is its holding value as at the end of the prior quarter. The average quarterly returns are first computed for each quintile— the annual returns are the simple compound of these four quarterly values. The market-adjusted return is also provided. This is based on the CRSP value-weighted index, including dividends. *t*-statistics are provided in parentheses below the returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile	N	Raw Return	Market-adj. Return	DGTW-adj. Return
1	30	12.71***	0.98	0.72
		(3.89)	(0.59)	(1.09)
2	30	10.89***	-0.85	-0.42
		(3.36)	(-0.76)	(-0.55)
3	30	11.35***	-0.39	0.07
		(3.37)	(-0.34)	(0.09)
4	30	12.22***	0.48	0.16
		(3.24)	(0.33)	(0.15)
5	30	9.80***	-1.93	-1.08
		(2.66)	(-1.38)	(-1.26)

Table 8: Average Returns and Quintile Ranks by Style

This table presents average annual returns over the years in which each style factor (SF) is selected as the preferred style, i.e., the years in which it has the maximum forecast return. The styles included are Book-to-Market (B/M), Return-on-Equity (ROE), Momentum (MOM) and SIZE. Funds are sorted into quintiles based on their exposure to the preferred style factor in Q_3 year *t*. The fund returns are examined over Q_1-Q_4 year *t+1*, i.e., 1981 to 2010. The results are provided for the preferred (unpreferred) funds which are in quintile 5 (1), i.e., those with the greatest (lowest) exposure to the preferred style quintile. A fund's exposure to the preferred style is calculated as the weighted-average quintile rank of the stocks in its portfolio, whereby each stock's quintile rank is weighted by its holding value. *QRank* is the asset-weighted average quintile rank ($WRank_{j,t}$) across all funds in the quintile. The asset-weight applied is based on fund assets as at the end of the prior quarter (Q_2 year *t*). N.B. The SF quintile assignments for each stock are the same as those used to create the portfolios which the SF returns are based on. Raw Return is the annual raw fund return calculated, using the quarterly stock holdings from the Thomson Reuters Common Stock Holdings database. The annual mean is the simple compound of the four quarterly means for all funds existing in each quarter. The DGTW-adj. Return is the annual excess fund return, whereby the return of each stock in the portfolio has been adjusted by the return on a portfolio of stocks with similar book-to-market, size, and momentum characteristics. The time-series means are also provided for all years; *t*-statistics are in parentheses below these means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Factor	Q1 Raw Return	Q1 DGTW-adj. Return	Q1 QRank	Q5 Raw Return	Q5 DGTW-adj. Return	Q5 QRank	Q5-Q1 Raw Return	Q5 - Q1 DGTW-adj. Return	Q5 - Q1 Rank	Actual SF Return
B/M	7.67	1.74	1.47	5.56	-1.37	3.13	-2.11	-3.11	1.66	6.24
ROE	13.19	1.03	2.71	8.11	-1.36	4.12	-5.08	-2.39	1.41	-5.09
MOM	16.16	-0.22	2.68	11.72	-0.77	4.19	-4.44	-0.55	1.51	12.81
SIZE	13.06	0.85	1.14	18.21	-0.95	3.45	5.15	-1.80	2.31	15.40
All Years	12.71***	0.72	2.13***	9.80***	-1.08	3.88***	-2.91	-1.81	1.75***	7.52**
	(3.89)	(1.09)	(9.26)	(2.66)	(-1.26)	(-11.82)	(-1.18)	(1.67)	(25.81)	(2.57)

Years in which the forecast return indicates each factor is the preferred style (for year *t+1*):

- B/M = 1980, 1982, 1985, 1989, 1990, 1991, 2005, 2006, 2007
- ROE = 1986, 1987, 1992, 1993, 2004, 2008
- MOM = 1981, 1983, 1988, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2003, 2009
- SIZE = 1984, 2001, 2002

Table 9: Historical Performance of Long-Only Style Factors

This table presents a summary of the annualised percentage performance of the style factors included in this study. In addition, the annualised standard deviation of the monthly returns is provided in parentheses. The value factors are: book-to-market (B/M), dividend-to-price (D/P), earnings-to-price (E/P), cash flow-to-price (C/P), sales-to-price (S/P) and EBITDA-to-enterprise value (EBITDA/EV). The growth factors are: trailing 3-year earnings growth (TREG), net profit margin (NPM), trailing 3-year sales growth (TRSG) and the sustainable growth rate (SGR). The quality growth factors are: return-on-equity (ROE), return-on-assets (ROA) and operating cash-flow (OCF). The quality stability factors are leverage (LEV), sales-growth-variability (SG VAR) and ROA variability (ROA VAR). The factors based on accounting metrics are formed by sorting stocks into quintiles in June of each year *t*, based on the value of the metric in question for the fiscal year ending in year *t-1*. Size is the value of market equity as at June of each year *t*. Returns are then computed from July of year *t* to June of year *t+1*. For the value, growth, and quality growth (size) categories the monthly factor return is the average return to the highest (lowest) quintile of stocks, minus the return to the CRSP value-weighted index, including dividends (CRSP VWD), while, the quality stability factors are calculated as the monthly difference between the average return of firms in quintiles one to four and the CRSP VWD. Momentum is constructed as the average of firms with the highest 20 percent 11-month returns lagged one month, minus the CRSP VWD. Portfolios are rebalanced monthly. The volatility factor is calculated each month as the average return to the lowest quintile of stocks based on historical idiosyncratic volatility, minus the CRSP VWD. Average returns to the quintiles are value-weighted for all of the style factors. Up (Down)-market months are those in which the CRSP VWD is greater (less) than the T-Bill rate. There are 330 (240) up (down)-market months.

	All	1981-1991	1992-2001	2002-2011	Up-Markets	Down-Markets
Value						
B/M	3.37 (8.79)	5.09 (6.80)	1.71 (10.36)	3.17 (9.50)	-2.09 (7.62)	11.97 (9.85)
D/P	2.88 (11.00)	3.89 (9.90)	2.11 (13.36)	2.56 (10.43)	-9.66 (7.62)	24.40 (11.22)
E/P	3.91 (8.28)	2.88 (6.55)	5.02 (10.89)	3.95 (6.92)	1.47 (7.30)	7.63 (9.48)
C/P	2.73 (9.45)	3.59 (7.23)	0.30 (13.04)	4.24 (7.09)	-6.60 (8.44)	18.10 (9.44)
S/P	3.94 (9.31)	1.81 (6.84)	4.23 (11.09)	6.02 (9.76)	5.79 (8.55)	1.25 (10.33)
EBITDA/EV	4.23 (7.87)	3.19 (5.13)	4.40 (10.60)	5.22 (7.18)	0.14 (7.02)	10.57 (8.73)
Growth						
TREG	-0.11 (5.21)	-0.58 (4.84)	-2.08 (4.90)	2.44 (5.84)	4.04 (4.47)	-5.97 (5.74)
NPM	-0.53 (5.22)	0.64 (4.62)	-0.85 (7.04)	-1.50 (3.40)	-4.88 (5.00)	6.23 (4.95)
TRSG	-0.39 (5.39)	-0.41 (5.36)	-1.27 (5.73)	0.53 (5.10)	4.82 (4.82)	-7.66 (5.47)
SGR	-1.17 (5.22)	-1.08 (5.82)	-1.33 (5.17)	-1.10 (4.58)	1.21 (4.90)	-4.59 (5.53)
Quality (Growth)						
ROE	-0.34 (5.31)	0.64 (5.09)	-1.88 (6.17)	0.14 (4.58)	-1.08 (5.09)	0.78 (5.61)
ROA	-0.33 (5.20)	1.16 (5.06)	-1.72 (5.91)	-0.55 (4.56)	-0.15 (5.18)	-0.59 (5.24)
OCF	1.46 (5.41)	4.08 (4.25)	-0.69 (7.00)	0.79 (4.59)	-0.82 (5.25)	4.93 (5.50)
Quality (Stability)						
LEV	-0.15 (2.43)	0.64 (1.59)	-1.85 (2.78)	0.72 (2.75)	-0.70 (2.26)	0.67 (2.65)
SG VAR	0.47 (3.82)	1.77 (1.83)	-1.33 (5.39)	0.86 (3.51)	-3.32 (3.39)	6.33 (3.84)
ROA VAR	0.64 (4.38)	1.55 (1.85)	-1.06 (6.58)	1.36 (3.52)	-3.88 (3.75)	7.68 (4.51)
Momentum	2.81 (7.77)	1.99 (6.27)	4.15 (8.17)	2.37 (8.81)	6.61 (7.55)	-2.59 (7.85)
Size	-0.75 (12.85)	5.03 (9.27)	-4.36 (17.58)	-3.26 (10.33)	-4.97 (13.54)	5.80 (11.57)
Low Volatility	0.73 (6.65)	2.78 (3.46)	0.31 (9.77)	-1.06 (5.34)	-6.95 (6.00)	13.17 (6.12)

Table 10: Reliability of Style Factor Forecast Returns for Long-Only Factors

This table provides a summary of model fit statistics and forecast accuracy measures for quarterly style factor forecast returns, compared to the actual style factor returns over the period 1981 to 2011. The style factors included are Book-to-Market (B/M), Dividend-to-Price (D/P), Trailing Sales Growth (TRSG), Operating Cash Flow (OCF), Return-on-Asset Variability (ROA VAR), Momentum (MOM), SIZE, and Stable-minus-Volatile (SMV). Correlation is the correlation between the time-series of quarterly forecast and actual style returns. Adj. R^2, F-stat and p-value are the model fit statistics from a regression of the forecast returns on the actual style factor returns. MAE is the Mean Absolute Error, which is the average of the absolute value of the forecast error, which is the difference between the actual and the forecast return in each quarter. SDAE is the Standard Deviation of the Absolute Error. RMSE is the Root Mean Squared Error, which is the square root of the average of the squared difference between the actual and forecast return in each quarter. Success Rate is the proportion of quarters in which the direction of the forecast was accurate.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

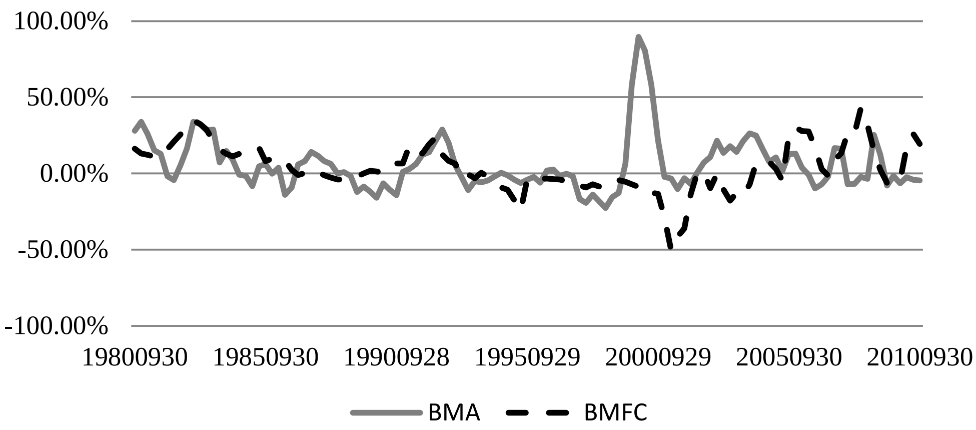
Factor	**Correlation**	**Adj. R^2 (%)**	**F-stat**	**p-value**	**MAE**	**SDAE**	**RMSE**	**Success Rate (%)**
B/M	0.09	-0.10	0.89	0.35	13.11	15.17	19.99	58.97
D/P	-0.02	-0.79	0.06	0.80	16.68	19.99	25.97	48.76
TRSG	0.00	-0.84	0.00	1.00	7.02	7.82	10.49	51.24
OCF	0.06	-0.47	0.44	0.51	8.63	7.08	11.14	60.33
ROA VAR	-0.04	-0.69	0.18	0.67	4.76	4.67	6.65	57.85
MOM	0.06	-0.45	0.47	0.50	7.20	6.09	9.41	66.12
SIZE	0.26	6.13	8.84	0.00***	22.52	26.90	34.99	63.64
SMV	0.01	-0.83	0.01	0.91	8.81	9.00	12.56	52.07

Note: Five outlier observations (Q_3 1999- Q_3 2000) which include returns during the technology crash (i.e., Q_1 2000- Q_4 2001) which commenced in March 2000 have been excluded from the B/M model fit tests.

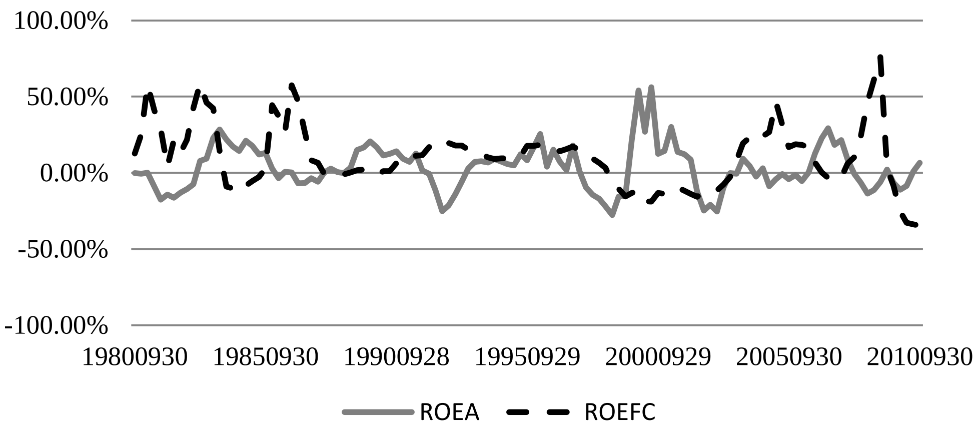
Figure 1: Style Factor Returns Forecasts versus Actuals

Figure 1 demonstrates the actual return and forecast return for the four style factors included in the style timing model over the period 1981-2011. The forecast for 1981 (2011) is determined at the end of September 1980 (2010). Panels A, B, C and D show the quarterly returns for Book-to-Market, Return-on-Equity, Momentum and Size, respectively.

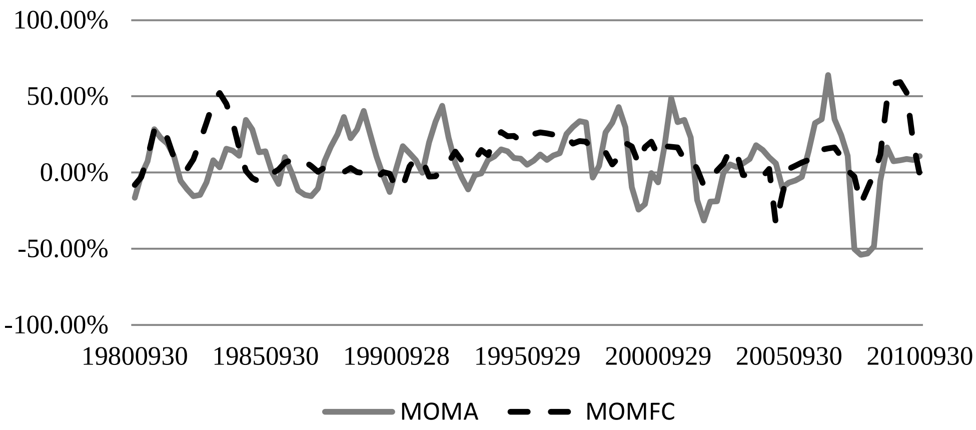
Panel A: Book-to-Market Forecast vs Actual 1981-2011



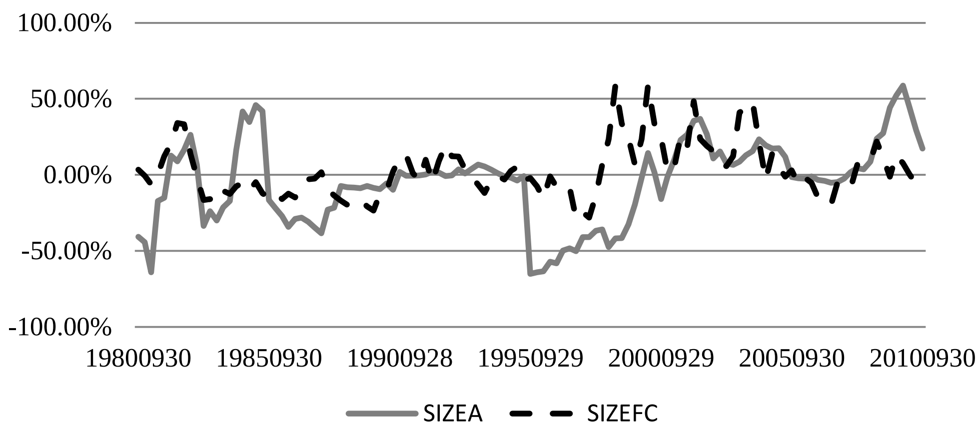
Panel B: Return-on-Equity Forecast vs Actual 1981-2011



Panel C: Momentum Forecast vs Actual 1981-2011



Panel D: Size Forecast vs Actual 1981-2011



Footnote 9: Summary Statistics for the Mutual Fund Sample including Equally-Weighted Returns

This table reports summary statistics for the sample of mutual funds obtained by linking the Thomson Reuters Common Stock Holdings Mutual Fund Data with the CRSP Mutual Fund Database (CMFD), using the Mutual Fund Links tables. There are 1,856 US Active Equity funds examined over the period 1980-2010. Only funds classified as 'Aggressive Growth', 'Growth', or 'Growth and Income' are included. Average values of fund characteristic variables and returns are provided; the median is in parentheses. No. Stocks is the number of stocks held by a fund as of the end of the month. Age is relative to the date the fund was first offered, and is in years. Turnover is an annual variable which represents the minimum of aggregated sales or aggregated purchases of securities, divided by the average 12-month Total Net Assets of the Fund. Expenses represents the annual expense ratio. Equity Proportion is the average proportion of the fund that is invested in common equity, and is calculated over the life of the fund. TNA is the fund's month end Total Net Asset Value, in millions. Total Load is the sum of the front and rear loads, reported annually. Management Fee (Mgt Fee) is only available from 1998 to 2010. It is the ratio of Management Fee ($), divided by Average Total Net Assets ($) reported as a percentage. CRSP Raw Ret is the annual fund return, including distributions (dividends and capital gains); before total expenses and CRSP Net Ret is the annual fund return including distributions (dividends and capital gains), after total expenses. Both of these are sourced from the CMFD. Raw Holdings Ret is the annual raw fund return calculated using the quarterly stock holdings from the s12 database. The annual mean is the simple compound of the four quarterly means for all funds existing in each quarter. DGTW-adj. Ret is the annual excess fund return, whereby the return of each stock in the portfolio has been adjusted by the return on a portfolio of stocks with similar book-to-market, size, and momentum characteristics. Value-weighted (VW) and equally-weighted (EW) returns are provided.

	All	1980-1990	1991-2000	2001-2010
No. Stocks	98.94 (69.00)	69.94 (53.00)	96.80 (68.00)	109.70 (76.00)
Age	15.01 (10.08)	20.11 (17.00)	12.41 (7.08)	16.54 (13.00)
Turnover (%)	81.91 (62.66)	76.43 (59.00)	82.29 (62.00)	85.23 (66.00)
Expenses (%)	1.20 (1.15)	1.02 (0.99)	1.24 (1.20)	1.25 (1.21)
Equity Proportion (%)	86.77 (91.09)	79.33 (86.81)	85.45 (90.01)	90.23 (93.12)
TNA	1242.41 (250.00)	371.72 (121.90)	935.20 (185.20)	1625.57 (367.30)
Total Load	1.41 (0.00)	3.50 (2.00)	0.87 (0.00)	0.34 (0.00)
Mgt Fee	0.73 (0.74)	-	-	0.73 (0.74)
CRSP Raw Ret VW (%)	13.85 (17.15)	17.04 (19.65)	18.85 (20.32)	5.35 (10.35)
CRSP Raw Ret EW (%)	13.69 (14.83)	16.29 (15.60)	18.69 (18.02)	5.83 (10.37)
CRSP Net Ret VW (%)	13.19 (16.60)	16.34 (18.94)	17.87 (19.17)	5.05 (9.99)
CRSP Net Ret EW (%)	12.78 (13.78)	15.20 (14.44)	17.49 (16.63)	5.42 (9.96)
Raw Holdings Ret VW (%)	12.63 (15.98)	16.19 (20.18)	19.46 (19.26)	1.87 (5.55)
Raw Holdings Ret EW (%)	13.64 (13.34)	16.83 (15.59)	19.82 (18.36)	3.96 (7.72)
DGTW-adj. Ret VW (%)	-0.04 (-0.26)	0.69 (-0.26)	0.77 (0.71)	-1.66 (-0.52)
DGTW-adj. Ret EW (%)	0.15 (0.12)	0.51 (0.09)	1.13 (0.62)	-1.21 (-0.68)

Footnote 13: Average Returns to Quintiles of Funds formed based on their Exposure to the Preferred Style Factor using Stock Holdings for Quarter 2 of $Year_t$

This table presents average annual returns to funds sorted into quintiles based on their exposure to the preferred style factor. The sample of mutual funds is based on a merged dataset of funds in both the Thomson Reuters Common Stock Holdings Database and the CRSP Mutual Fund Database, using Mutual Fund Links. Results are presented when fund holdings for Q_2 year *t* are used over the period 1980-2009. The associated investment horizon is from Q_4-Q_3 year *t+1*, i.e., from Q_4 1981 to Q_3 2010. The asset-weighted raw and DGTW-adjusted returns presented are calculated using the stock holdings of the funds. The asset-weight applied is based on fund assets as at the end of the prior quarter. The weight applied to each stock is its holding value as at the end of the prior quarter. The average quarterly returns are first computed for each quintile. The annual returns are the simple compound of these four quarterly values. The market-adjusted return is also provided. This is based on the CRSP value-weighted index, including dividends. *t*-statistics are provided in parentheses below the returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile	N	Raw Return	Market-adj. Return	DGTW-adj. Return
1	30	13.99***	1.32	0.45
		(3.59)	(0.72)	(0.46)
2	30	13.53***	0.86	-0.20
		(3.52)	(0.74)	(-0.23)
3	30	12.88***	0.21	-0.24
		(3.26)	(0.22)	(-0.44)
4	30	13.65***	0.98	0.14
		(2.96)	(0.55)	(0.09)
5	30	13.45***	0.79	-0.45
		(2.95)	(0.43)	(-0.47)

Footnote 15: Average Returns to Quintiles of Funds formed based on their Exposure to the Preferred Style Factor using Actual Style Factor Returns

This table presents average annual returns to funds sorted into quintiles based on their exposure to the preferred style factor. The sample of mutual funds is based on a merged dataset of funds in both the Thomson Reuters Common Stock Holdings Database and the CRSP Mutual Fund Database, using Mutual Fund Links. Results are presented when fund holdings for Q_3 year *t* are used over the period 1980-2009. The associated investment horizon is from Q_1-Q_4 year *t+1*, i.e., from 1981 to 2010. The asset-weighted raw and DGTW-adjusted returns presented are calculated using the stock holdings of the funds. The asset-weight applied is based on fund assets as at the end of the prior quarter. The weight applied to each stock is its holding value as at the end of the prior quarter. The average quarterly returns are first computed for each quintile. The annual returns are the simple compound of these four quarterly values. The market-adjusted return is also provided. This is based on the CRSP value-weighted index, including dividends. *t*-statistics are provided in parentheses below the returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile	N	Raw Return	Market-adj. Return	DGTW-adj. Return
1	30	8.22**	-3.52**	-1.03
		(2.30)	(-2.58)	(-1.09)
2	30	9.12**	-2.62**	-1.09
		(2.69)	(-2.34)	(-1.38)
3	30	11.24***	-0.49	-0.03
		(3.42)	(-0.43)	(-0.04)
4	30	13.00***	1.26	0.06
		(3.82)	(1.16)	(0.09)
5	30	15.62***	3.89***	1.31*
		(4.73)	(2.79)	(1.74)

Footnote 16a: Characteristics of Investment Strategies based on the Style Factor Forecasts over 1981-2011, excluding ROE

This table presents average annual returns over the period 1981-2011 to investment strategies based on style factor forecasts generated using macroeconomic and market information. The forecasts are made each quarter for the 12 month return commencing in two quarters' time. The first forecast is in Q_3 1980 for the buy-and-hold return from Q_1 to Q_4 1981. The results for univariate strategies investing in either the style factor with the maximum (Max FC) or minimum forecast (Min FC), and a strategy which is long (short) the Max FC (Min FC), are provided. The 'All Quarters' return is the average actual annual return that is earned if the investment is made each quarter and held for the following 12 months. The 'Annual (Q_i)' returns also presented are for strategies which invest based on the forecasts made only in each Q_i, where $1 \leq i \leq 4$ over the sample period. For example, to invest in each calendar year, the Q_3 forecasts are used. *t*-statistics are provided in parentheses below the returns. Forecast accuracy measures are also provided for the Max FC investment strategy. Specifically, MAE is the Mean Absolute Error which is the average of the absolute value of the forecast error, which is the difference between the actual and the forecast return in each quarter. SDAE is the Standard Deviation of the Absolute Error. RMSE is the Root Mean Squared Error, which is the square root of the average of the squared difference between the actual and forecast return in each quarter. Success Rate is the proportion of quarters in which the direction of the forecast was accurate.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Max FC	**Min FC**	**Long/Short**	**MAE**	**SDAE**	**RMSE**	**Success Rate (%)**
All Quarters	10.52*** (6.93)	0.11 (0.06)	10.41*** (4.01)	18.22	13.28	22.51	68.60
Annual (Q_1)	13.33*** (3.68)	1.64 (0.34)	11.69* (1.93)	20.10	14.16	24.45	73.33
Annual (Q_2)	7.83*** (2.81)	-2.41 (-0.66)	10.24** (2.28)	18.22	12.65	22.06	60.00
Annual (Q_3)	8.33*** (3.43)	-2.29 (-0.79)	10.62*** (2.87)	17.55	12.72	21.55	63.33
Annual (Q_4)	12.66*** (3.92)	3.58 (0.76)	9.09 (1.42)	18.22	13.28	21.92	76.67

Footnote 16b: Average Returns to Quintiles of Funds formed based on their Exposure to the Preferred Style Factor, excluding ROE

This table presents average annual returns to funds sorted into quintiles based on their exposure to the preferred style factor. The sample of mutual funds is based on a merged dataset of funds in both the Thomson Reuters Common Stock Holdings Database and the CRSP Mutual Fund Database, using Mutual Fund Links. Results are presented when fund holdings for Q_3 year *t* are used over the period 1980-2009. The associated investment horizon is from Q_1-Q_4 year *t+1*, i.e., from 1981 to 2010. The asset-weighted raw and DGTW-adjusted returns presented are calculated using the stock holdings of the funds. The asset-weight applied is based on fund assets as at the end of the prior quarter. The weight applied to each stock is its holding value as at the end of the prior quarter. The average quarterly returns are first computed for each quintile. The annual returns are the simple compound of these four quarterly values. The market-adjusted return is also provided. This is based on the CRSP value-weighted index, including dividends. *t*-statistics are provided in parentheses below the returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile	N	Raw Return	Market-adj. Return	DGTW-adj. Return
1	30	12.65***	0.91	0.24
		(3.97)	(0.55)	(0.36)
2	30	11.96***	0.22	0.09
		(3.45)	(0.16)	(0.09)
3	30	11.42***	-0.32	0.02
		(3.37)	(-0.28)	(0.02)
4	30	11.46***	-0.28	-0.07
		(3.23)	(-0.21)	(-0.09)
5	30	9.35***	-2.38	-1.11
		(2.45)	(-1.63)	(-1.10)

Footnote 17: Average Returns to Quintiles of Funds formed based on their Exposure to the Preferred Style Factor using subset of stocks unaffected by a Return Gap Effect

This table presents average annual returns to funds sorted into quintiles based on their exposure to the preferred style factor. The sample of mutual funds is based on a merged dataset of funds in both the Thomson Reuters Common Stock Holdings Database and the CRSP Mutual Fund Database, using Mutual Fund Links. Results are presented when fund holdings for Q_3 year *t* are used over the period 1980-2009. The associated investment horizon is from Q_1-Q_4 year *t+1*, i.e., from 1981 to 2010. The asset-weighted raw and DGTW-adjusted returns presented are calculated using the stock holdings of the funds. The asset-weight applied is based on fund assets as at the end of the prior quarter. The weight applied to each stock is its holding value as at the end of the prior quarter. The average quarterly returns are first computed for each quintile. The annual returns are the simple compound of these four quarterly values. The market-adjusted return is also provided. This is based on the CRSP value-weighted index, including dividends. *t*-statistics are provided in parentheses below the returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Quintile	N	Raw Return	Market-adj. Return	DGTW-adj. Return
1	30	12.30***	0.56	0.49
		(3.76)	(0.30)	(0.58)
2	30	12.20***	0.47	-0.72
		(3.58)	(0.27)	(-0.67)
3	30	12.36***	0.62	-0.15
		(3.58)	(0.52)	(-0.22)
4	30	14.07***	2.33	0.41
		(3.79)	(1.69)	(0.42)
5	30	11.94***	0.20	-0.50
		(3.41)	(0.16)	(-0.43)

Chapter 5: Global Equity Fund Performance

1. Introduction

This study examines various aspects of global equity fund performance over the period 2002 to 2012. There is a myriad of literature which focuses on the performance of US equity funds, however there is only a handful of papers which examine the performance of global or international equity funds (e.g. Huij and Derwall, 2011; Turtle and Zhang, 2012; Gallagher and Jarnecic, 2004; Cumby and Glen, 1990). Investigation of global equity funds is important given that global equity allocations are a significant portion of the institutional market for US funds, which has been increasing in recent years (Kang, Nielsen and Fachinotti, 2010; Balkema, 2010). Moreover, in light of the sizeable exposures to equity worldwide, performance has been less than stellar. Specifically, Standard and Poor's (S&P) (2012) report that 61.6% of global equity funds domiciled in the US underperformed the S&P 700 over the five years to December 2012. Hence, concerns over value creation are leading investors to question whether migration to passive alternatives is the answer. Therefore, it is important to investigate whether global equity funds outperform the market. This is undertaken using a Brinson and Fachler (1985)-inspired market-adjusted performance attribution to examine stock and country selection. In particular, excess returns to stock and country selection are decomposed into a local currency and a currency component. Essentially, it is important to understand the sources of performance for the funds, as such information guides decision-makers when constructing portfolios. The market-adjusted return attribution reveals that the global equity funds exhibit stock selection skill, on average, whilst country selection does not contribute significantly to excess returns, on average. However, a regional decomposition reveals that emerging markets contribute strongly to market-adjusted returns yet these regions only account for a small proportion of fund holdings. The analyses undertaken in this study are facilitated by a unique dataset of stock holdings for 157 funds, which allows us to more closely examine managerial skill and the sources of performance.

In addition, in order to measure style-adjusted performance, a set of global DGTW (1997)-inspired characteristic-matched benchmark portfolios are developed. As a result, it is possible to determine whether global equity funds exhibit stock selection skill after controlling for size, book-to-market and momentum effects. In addition, this paper contributes to the literature by investigating whether performance is persistent for global equity funds. The construction of the characteristic-matched benchmarks allows style drift analyses to be conducted using portfolio holdings data. There is a limited body of literature which investigates how style drift relates to US/Australian fund performance (e.g. Ainsworth, Fong and Gallagher, 2008; Brown, Van Harlow and Zhang, 2009; Cumming, Fleming and Schwienbacher, 2009 and Wermers, 2012). Thus, examination of the performance relationship for global equity managers that drift, versus those that are more style consistent, is a further contribution of this study.

The extant literature which investigates global equity fund performance is sparse, and dominated by the use of multivariate regression techniques. Recently, Huij and Derwall (2011) determine that US-domiciled global equity funds which have higher levels of portfolio concentration outperform their more diversified counterparts. However, Gallagher and Jarnecic (2004) indicate that international equity funds based in Australia do not outperform their passive benchmarks. Additionally, recent papers including Fama and French (2012) and Hou, Karolyi and Kho (2011) analyse what factors drive global stock returns, and whether multi-factor models can be developed to explain returns using common factors. However, determining which factors to include, and how to construct the selected factors, is problematic.

DGTW (1997) emphasise that regression-based approaches are less accurate than their benchmarking method. Therefore, a global application is fruitful in order to provide an alternative approach to evaluate the performance of global equity fund managers. In this study, style-adjusted returns are computed by creating global DGTW benchmarks using MSCI All-Country World Index (ACWI) constituents. Fama and French (2012) use regional breakpoints to assign stocks to global factor portfolios in order to account for differences in accounting systems. This approach is adopted when forming the DGTW benchmark portfolios. Specifically, at the end of June, all stocks in the index within each region are sorted into four portfolios based on size, then four portfolios based on book-to-market, and finally into four portfolios based on momentum, resulting in 64[1] benchmark portfolios for each region. The Global DGTW benchmark portfolio is then formed by aggregating all stocks within the same benchmark portfolio across regions. The adjusted return for each stock is calculated by subtracting the return to its characteristic-matched global benchmark. This adjusted return is referred to as the Characteristic-Selectivity (CS) Attribute, or DGTW-adjusted return. Consistent with the US results[2], on average, global equity mutual funds do

[1] A four x four x three sort resulting in 48 benchmark portfolios and a five x four x four sort resulting in 80 benchmark portfolios yield similar results.
[2] For example, Carhart (1997); Fama and French (2010); Gruber (1996); Jensen (1968).

not generate outperformance. In particular, the average equally-weighted DGTW-adjusted return over the period 2002 to 2012 is -0.04%, and not statistically significant. However, upon segmentation into regions, it is determined that the funds generate statistically significant positive DGTW-adjusted returns in emerging markets. However, as previously mentioned emerging markets account for a small proportion of fund managers' portfolios. In contrast, statistically insignificant average negative (positive) returns are determined for the developed markets of Japan and North America (Europe and the Middle East), which dominate managers' portfolios.

Furthermore, to my knowledge the 'hot hands' phenomenon has not been investigated for global equity funds, whereas there is a substantial body of US research (e.g. Busse, Goyal and Wahal, 2010; Cuthbertson, Nitzsche and O'Sullivan, 2010; Bollen and Busse, 2005; Wermers, 2003; Christopherson, Ferson and Glassman, 1998; DGTW, 1997; Grinblatt and Titman, 1992). In order to assess how persistent the performance of the funds is, they are sorted into quintiles based on their average quarterly raw and DGTW-adjusted returns at the end of each year *t*. The raw and DGTW-adjusted performance of these quintiles is then measured over the following year. Evidence of performance persistence is determined using both ranking approaches. In particular, the DGTW-return rank results show that the average equally-weighted quarterly DGTW-adjusted return to quintile 5 (1) over year *t+1* is 0.77% (-0.40%), and significant at the 1% (5%) level. Furthermore, a paired sample *t*-test of the difference in means between the top and bottom quintiles shows that this difference of 1.15%[3] (4.68% annually) is significant at the 1% level. Whereas, DGTW (1997) and Busse et al. (2010) find little to no evidence of persistence once momentum is controlled for. These results have direct implications for the funds management industry in terms of multi-manager portfolio construction and investment consulting advice. For example, if global equity managers that outperform over the prior year continue to outperform over the following year then this provides justification for addition/retention of a manager in a multi-manager portfolio within such a time-frame.

Following Wermers (2012), a measure of Total Style Drift (TSD) is computed using the global DGTW benchmarks. TSD indicates the change in the size, book-to-market and momentum characteristics of a portfolio over time. TSD is also decomposed into passive and

[3] Please note that the difference of 1.15% is based on a paired sample *t*-test of the difference in means between the quintile 5 and quintile 1, pooled average returns. This value does not exactly equate to the difference in the average return to quintile 5 and quintile 1, i.e., 1.17% (4.76% annually).

active components. Passive Style Drift (PSD) is due to changes in the style characteristics of the stocks held over time, whilst Active Style Drift (ASD) is due to trading by the fund manager, which results in the fund containing stocks which have different style characteristics to those already in the portfolio. In order to test the relationship between style drift and performance, funds are sorted into quintiles based on their TSD and ASD in year *t-1*. The average equally-weighted quarterly performance over year *t* is then computed for the quintiles. In relation to the TSD results, the funds which exhibit the highest style drift (quintile 5 funds) underperform the funds exhibiting the least style drift (quintile 1 funds). Specifically, a paired sample *t*-test of the difference in means between the two quintiles reveals that the style-consistent funds outperform the style-cavalier funds by 0.58% (2.30% annually), and this is significant at the 5% level. The direction and magnitude is consistent when using raw returns, however the difference between the quintiles is not statistically significant. Moreover, when ranking on ASD, the difference in the performance of the funds exhibiting high and low style drift is muted, and not statistically significant on a DGTW-adjusted basis. However, the raw return results are consistent, and the difference between quintiles 1 and 5 is statistically significant.

Overall, weak evidence that funds that are more style consistent outperform is determined, which is consistent with Brown et al. (2009). In contrast, Wermers' (2012) results indicate the reverse relationship for US funds i.e., that style drifters outperform. Brown et al. (2009) emphasise that managers that attempt to time styles are more likely to make stock selection errors. Therefore, the differing result between this study and Wermers (2012) may be due to the perceived increased difficulty for global equity managers to correctly identify opportunities across a range of styles, given that their investment universe is not limited to one market. In addition, it's likely that managers exhibiting a high level of active drift have higher portfolio turnover, which results in higher transaction costs and thus, lower returns (Brown et al., 2009).

The remainder of this paper is organised as follows. Section two summarises the relevant literature, and section three describes the data employed. Section four discusses the benchmark attribution and results. Then, sections five and six encompass the DGTW methodology and results, respectively. Finally, section seven presents the style drift methodology and results and section eight provides concluding remarks.

2. Literature Review

An attribution of global equity fund performance is provided, in a similar vein to the seminal work of Brinson and Fachler (1985). Brinson and Fachler (1985) demonstrate how the market-adjusted performance of non-US equity portfolios can be decomposed into Asset Allocation, Stock Selection and an Interaction term. Asset Allocation indicates the value added based on the weighting decision across asset classes i.e., $(w_p - w_B)*r_B$ where w_p is the portfolio weight, w_B the benchmark index weight and r_B the benchmark index return. Stock Selection is the value added due to superior stock picking and is measured as $(r_p - r_B)*w_B$ where r_p is the portfolio return and the other terms are defined as per Asset Allocation. The Interaction term accounts for decisions not attributable to Asset Allocation or Stock Selection i.e., $(w_p - w_B)(r_p - r_B)$. Furthermore, Brinson and Fachler (1985) demonstrate how the weighting decision for a particular group can be assessed by comparing the return differential between each group's value-add and the total return. Specifically, they assess manager skill in different industries. In related research, Brinson, Hood and Beebower (1986) and Brinson, Singer and Beebower (1991) differentiate between the contribution of investment policy, i.e., asset class selection, and investment strategy, to the performance of US pension plans. Investment strategy is shown to be composed of timing, security selection and the effects of a cross-product term. The results indicate that investment policy dominates investment strategy as it explains 94% of the variation in total plan returns. Ankrim and Hensel (1994) extend Brinson and Fachler's (1985) approach by decomposing Country Allocation into a forward premium effect and a currency surprise component.

This study focuses on the equity portion of funds' holdings, thus, an attribution across asset classes is not undertaken. In particular, the market-adjusted performance of the funds is decomposed into Stock Selection and Country Selection. In the Brinson-Fachler model Stock Selection is measured as the return on a portfolio in excess of that for a benchmark index, multiplied by the benchmark weight. In this paper, portfolio weights are used instead of benchmark weights in order to more clearly identify the effect of the managers' decisions. Furthermore, in order to isolate Stock Selection due to manager skill, and that due to currency effects, a Stock Selection (Local Currency), and Stock Selection (Currency), component is computed. Similarly, Country Selection is investigated by decomposing Total Country Selection into a Country Selection (Local Currency), and a Country Selection (Currency), component.

Ankrim (1992) details how to incorporate a risk-adjustment into the attribution procedure, using historical beta estimates. Similarly, Clarke, De Silva and Thorley (2005) show how a regression-based attribution system can be used to link the information content of a manager's security rankings to the actual contribution of the security. Recently, Hsu, Kalesnik and Myers (2010) provide a framework to isolate the contribution of static and dynamic factor exposures within the 'Allocation Effect'. Evidently, the performance attribution literature is not vast, thus an attribution using the global equity funds over a recent sample period is valuable.

DGTW (1997) develop a holdings-based benchmarking approach by constructing characteristic-matched portfolios based on size, book-to-market, and momentum. Essentially, DGTW (1997) is a performance attribution approach which assesses stock selection relative to a style-matched portfolio of stocks, instead of a market benchmark. Specifically, stocks are first sorted into five portfolios based on size; then within these quintiles stocks are sorted into five portfolios based on book-to-market; and finally, the stocks are further sub-divided into quintiles based on momentum. Thus, a set of 125 possible benchmark portfolios are created. Each stock is assigned to a benchmark portfolio in June of each year *t* based on its style characteristics. Using these passive benchmarks, the performance of US mutual funds is examined and some evidence of stock selection skill is determined.

A number of mutual fund papers have employed the DGTW approach to evaluate fund performance. In particular, Wermers (2000) assesses the performance of US funds using a merged dataset comprising holdings in the CDA Investment Technologies database (s12) and the CRSP mutual fund characteristics database. On average, over the period 1975 to 1994, the funds generate statistically significant DGTW-adjusted performance of 0.71% and 1.01% on an asset-weighted and equally-weighted basis, respectively. Since then, the DGTW (1997) performance evaluation method has become solidified within the literature (Chen, Jegadeesh and Wermers, 2000; Pinnuck, 2003; Ainsworth et al., 2008).

Fama and French (2012) explore whether the value, size and momentum return premiums exist in international equity stock returns. In particular, they investigate stocks in 23 developed markets across four regions; North America, Europe, Japan and Asia-Pacific, over the period 1989-2011. The results indicate that there are common patterns in the returns. Specifically, the value premium is identified in all four regions and excluding Japan, value premiums are larger for small stocks. Momentum is also found in stock returns for all regions except Japan and momentum also decreases with size. Fama and French (2012) also examine whether empirical asset pricing models can be developed using international and local factor portfolios. They find that a four-factor model using local factor portfolios i.e., each stock is matched to a factor portfolio for its region is relatively successful at capturing the size-value effect, but not the size-momentum effect. In a similar vein, Hou et al. (2011) determine that a global multifactor model which includes cash-flow-to-price and momentum provides a better fit for stock returns across 49 countries than the global CAPM or a global model including size and book-to-market factors.

There is a multitude of literature which focuses on US fund performance evaluation[4], however the global equity fund performance space is limited. Huij and Derwall (2011) investigate the performance of 536 global equity funds domiciled in the US in relation to portfolio concentration. The results indicate that funds with higher levels of tracking error outperform their more diversified counterparts and this result is mainly driven by exposure to a number of market segments. In particular, funds with a high level of tracking error that are exposed to only one or two segments do not display outperformance, and might even display underperformance. Moreover, funds with lower levels of tracking error that are exposed to all three segments (styles, sectors and countries) do not display any underperformance at all. Recently, Turtle and Zhang (2012) determine that the performance of international (developed and emerging market) funds located in the US varies, given different market regimes. Furthermore, Cumby and Glen (1990) investigate the performance of 15 international diversified equity funds based in the US and find no evidence that the funds outperform the market. In addition, Gallagher and Jarnecic (2004) use a sample of 95 international equity funds based in Australia and a conditional CAPM-approach to investigate performance. The active funds do not generate outperformance, and fund flows are determined to impact negatively on returns. The aforementioned papers all employ a returns-based approach, thus a key contribution of this paper is the use of holdings data to investigate performance. The use of holdings-data allows analysis on a more granular level to be conducted, e.g. examination of fund returns by region. Additionally, Huij and Derwall (2011) is the only paper which assesses global equity fund performance (to my knowledge) the other papers focus on international equity funds. Moreover, the sample is not limited to funds based in the US; it comprises 98 US-domiciled funds and 59 non-US domiciled funds. Thus, given the

[4] Carhart (1997); Fama and French (2010); Gruber (1996) and Jensen (1968) investigate domestic equity funds, the results of which do not support active management. In contrast, Grinblatt and Titman (1989); Kosowski et al. (2006) and Wermers (2000) determine evidence of positive risk-adjusted performance for domestic US equity funds.

prominence of global equity funds and the paucity of literature in this area a key contribution of this paper is a detailed investigation into whether or not active global equity funds add value.

To my knowledge, the ‘hot-hands’ phenomenon has not been examined using global equity mutual funds. DGTW (1997) show that on an unadjusted basis, US funds that outperform over the year prior, continue to outperform in the following year. However, once returns are adjusted using the DGTW benchmarks, the result is insignificant, with the authors indicating that the persistence detected can be explained by the momentum anomaly. Similarly, Busse et al. (2010) indicate little to no evidence of persistence after controlling for momentum. Furthermore, Wermers (2003) finds strong evidence of persistence in CRSP net returns, and presents evidence of the role that consumer flows play in this relationship. Performance persistence is attributed in part to high fund inflows from consumers which are targeting past performers. As a result, managers then purchase past winner stocks with the additional resources. Grinblatt and Titman (1992) find evidence of positive persistence in performance, that can’t be explained by inefficiencies in the benchmark relating to firm size, dividend yield, past returns, skewness, interest rate sensitivity or firm beta. More recently, Cuthbertson et al. (2010) show that the performance of past winner funds persist when portfolio formation is less than one year and when using sophisticated sorting rules, although the economic value is small. Past US loser-funds are also found to remain losers. Likewise, Christopherson et al. (1998) use a conditional performance evaluation method to show that underperforming US pension fund managers generate poor future returns. Bollen and Busse (2005) also find evidence of short term persistence, but not long term persistence. Thus, this study contributes to the persistence literature by providing an investigation of performance persistence for global equity funds.

The style drift literature remains in its infancy, with only a handful of papers devoted to this area. Most recently, Wermers (2012) uses a holdings-based approach to show that style consistent managers in the US underperform, relative to managers who exhibit style drift. Similarly, Cumming et al. (2009) find some evidence of a positive relationship between style drift and performance for private equity funds. In contrast, Brown et al. (2009) use holdings-based and returns-based techniques to show that style-consistent funds produce higher total and relative returns than less consistent funds. Ainsworth et al. (2008) test the relationship using a sample of Australian funds, and are unable to provide support for either of the conflicting US results. Interestingly, Idzorek and Bertsch (2004) develop a style drift score;

however, they do not test how style drift relates to performance. Therefore, given the development of the global DGTW benchmarks, a further extension in this paper, is to undertake a test of how style drift relates to fund performance using the stock holdings data.

3. Data

3.1 Fund Dataset

This study employs a unique sample of quarterly stock holdings for 157 global active equity large-cap long-only funds. Specifically, each fund is a separately managed institutional strategy. The coverage of holdings is limited to the equity portion of the fund and does not include cash, derivatives or other non-stock holdings data. A benchmark index is assigned to each fund using a benchmark identifier obtained from Russell Investments[5] and regression analysis. Appendix A provides a detailed discussion of the benchmark assignment process. Each fund is assigned to one of six benchmarks, i.e., MSCI World, MSCI World Growth, MSCI World Value, MSCI ACWI, MSCI Europe, Australasia and Far East (EAFE) or MSCI Europe.

The data is accessed via Russell Investments in Australia. However, it is collected by BNY Mellon, which acts as a 3rd party service provider. There is one other paper to my knowledge namely Christopherson et al. (1998)[6], which uses data from a related source— Russell Data Services (RDS) within Russell Investment Group[7] in the United States. The authors indicate that their dataset of 273 Institutional Equity Pension Fund managers suffers from a selection bias, as managers only enter the database once they attract attention from Russell Investment Group and its clients. In contrast, the dataset used in this paper does not suffer from such a selection bias, as funds are not selected for inclusion following interest from Russell Investments or its clients. BNY Mellon also collects and maintains a database of funds' stock holdings in order to provide companies such as Russell Investments with a representative dataset upon which to conduct analysis. A representative portfolio is a sample of a fund's stock holdings; however the holdings values are indicative of the weight of each stock in the fund and do not constitute the actual value of assets invested in each stock. Specifically, BNY Mellon contacts funds, requesting managers to supply a representative portfolio of stock

[5] A subsidiary of Russell Investment Group in the United States.

[6] The most commonly used dataset of stock holdings is the Thomson Reuters Mutual Fund Holdings (s12) database of quarterly holdings for US funds sourced from the forms each fund periodically files with the SEC. Furthermore, in Australia stock holdings data have also been used e.g. the Russell Investments research database (Bennett et al., 2012) and the Portfolio Analytics Database (e.g. Brands, Brown and Gallagher, 2005; Gallagher and Looi, 2006; Chan et al., 2009; Gallagher, Gardner and Swan, 2013).

[7] Formerly, Frank Russell Company— the firm changed its name in 2003.

holdings. As such, the data may suffer from an inherent self-selection bias, in the sense that managers can (to a degree) choose the holdings data that they provide BNY Mellon. However, it is not possible to quantify the impact of such a self-selection bias.

Christopherson et al. (1998) state that their dataset suffers from survivorship biases, as managers are removed from the dataset when they go out of business, if they are dropped by RDS, or if they stop sending data to RDS. The fund sample used in this study does not suffer from such survivorship biases, as the BNY Mellon database retains funds which go out of business or which discontinue involvement— they are identified as inactive, as opposed to active, when this occurs. Furthermore, if a fund stops sending data to BNY Mellon, it will be followed up by BNY Mellon to obtain the required data, in order to maintain the consistency of the dataset. However, in the event that a manager no longer supplies their holdings data e.g. due to poor performance, then this would cause an upward bias in the results.

Static stock level data such as exchange and Industry Classification Benchmark (ICB) industry classification are obtained from Datastream. Time-series price, return, market value and accounting data is also sourced from Datastream and supplemented, where required, by Bloomberg. Only stocks classified as Common Equity based on the Security Type variable from Bloomberg are included.

3.2 Descriptive Statistics for Fund Sample

Fund location is inferred from the base currency the portfolio is managed in. The sample of funds is dominated by US funds with these representing 98 of the 157 funds. In addition, 26 funds are based in the United Kingdom, 23 in Europe, five in Australia, four in Canada and one in New Zealand. Table 1 presents summary statistics for the fund sample over the period 2002 to 2012. Panel A provides broad sample characteristics. The number of funds included increases monotonically over the sample period, ending with 113 funds included in 2012. The value of assets managed by the funds increased over the sample period, reaching $118bn by 2012. It is important to highlight that the 'Assets' value presented is the sum of the stock holdings values obtained for a representative portfolio of stocks for each fund. Therefore, this figure understates the actual value of assets under management for the funds. Nonetheless, the sample of funds constitutes a small percentage of global equity assets invested worldwide. However, the stocks held by the funds account for 79% (90%) of the market capitalisation of the MSCI ACWI in 2002 (2012). Therefore, the sample of stock holdings is considered to be representative of the broader universe. In addition, the number of stocks held by the funds is relatively consistent over the sample period, with funds holding 138 (112) stocks on average in 2002 (2012).

INSERT TABLE 1

The funds hold stocks in 61 countries around the world, according to MSCI (2013): 25 are developed, 19 are emerging, 13 are frontier and 4 are Standalone or Unclassified markets. These countries are then classified into one of seven regions following MSCI (2013)[8]. Panel B presents the proportion of stock holdings, relative to total stock holdings in US dollars, which are in each region for the fund sample. The average proportion is calculated as at December of each year for each market type over the period 2002-2012. The Frontier, Standalone and Unclassified markets are omitted from Panel B as they represent a minute portion of the sample. The funds' portfolios are dominated by stocks from Developed Markets (DM), particularly those from North America, Europe and the Middle East, with these representing 48.3% and 35.9% of holdings at the end of 2012, respectively. Furthermore, these values are quite stable over the sample period. Japan and the Asia-Pacific DM represent 6.9% and 5.7% of holdings as at 2012, respectively. Japanese holdings decreased by almost 50% from 2002, whereas the Asia-Pacific DM holdings have increased by 103%. Collectively, the Emerging Markets (EM) account for only 3.2% of the funds' holdings at the end of 2012. Asian-Pacific and Latin American holdings have increased substantially over the sample period, whilst European, Middle Eastern and African holdings have dropped by almost a third.

Figure 1 provides a breakdown of the ICB Supersectors represented by the stock holdings. Evidently, the sample is dominated by Technology stocks, Banks, Healthcare and Industrial Goods and Services firms.

INSERT FIGURE 1

[8] Asia-Pacific Developed Markets (DM) includes Australia, Hong Kong, Korea, New Zealand and Singapore. Europe and the Middle East (DM) includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Japan is analysed as a separate region. North America includes Canada and the United States. Asia-Pacific (EM) comprises China, India, Indonesia, Malaysia, Philippines, Taiwan and Thailand. Europe, the Middle East and Africa (EM) represents the Czech Republic, Egypt, Hungary, Morocco, Poland, Russia, South Africa and Turkey. Latin America (EM) includes Brazil, Chile, Colombia, Peru and Mexico.

4. Global Performance Attribution

In order to investigate fund performance, holdings-based fund returns are calculated. Specifically, the stocks held in each quarter are weighted by the holding value of the stock as at the end of the quarter prior, to obtain the quarterly fund return. Furthermore, the difference between the holdings-based returns and the reported quarterly fund returns is computed. To avoid the impact of any holdings-based return observations which are identified as outliers (e.g. due to missing stock level return data), holdings data for quarters in which the difference between the two returns is greater (less) than the 95th (fifth) percentile are deleted.

4. 1 Performance Attribution Methodology

An attribution analysis is presented in order to determine the source of market-adjusted returns[9] for the global equity funds. Specifically, the market-adjusted fund returns are decomposed into two major components: Stock Selection and Country Selection. These components are then further decomposed into returns earned in local currencies and the effect of currency translation (i.e., conversion of local currency returns into the fund's base currency[10]).

INSERT TABLE 2

4.1.1 Stock Selection

Total Stock Selection, i.e., Stock Selection measured in the fund's base currency comprises a Local Currency Stock Selection component and a Currency component, based on the conversion of the local currency returns into the fund's base currency. Total Stock Selection for fund *j* in quarter *t* is measured as follows:

$$\text{Total Stock Selection}_{j,t} = \sum_{i=1}^{N}(r_{i,BC} - r_{BM,BC,ci})w_i$$

where

- $r_{i,BC}$ is the quarterly return to stock *i* in the base currency of the fund
- $r_{BM,BC,ci}$ is the quarterly return on the relevant country index *c* for stock *i* in the base currency of the fund

[9] The market portfolio is the benchmark index assigned to each fund as detailed in Appendix A i.e., MSCI World, MSCI World Growth, MSCI World Value, MSCI ACWI, MSCI EAFE or MSCI Europe.

[10] Local currency is the currency of the country in which a stock held is listed, whereas base currency is the currency which the fund is managed in i.e., US, Canadian, Australian or New Zealand dollars, the Euro, Danish Krone or Norwegian Krone.

- w_i is the portfolio weight of stock i.

Furthermore, as mentioned previously, Total Stock Selection comprises:

i) Stock Selection (Local Currency) = $\sum_{i=1}^{N}(r_{i,LC} - r_{BM,LC,ci})w_i$

where

- $r_{i,LC}$ is the quarterly return to stock i in the local currency of the fund
- $r_{BM,LC,ci}$ is the quarterly return on the relevant country index c for stock i in local currency
- w_i is the portfolio weight of stock i.

The second component of Stock Selection is a Currency component:

ii) Stock Selection (Currency) = Total Stock Selection – Stock Selection (Local Currency).

Stock Selection (Local Currency) indicates whether managers are contributing positively or negatively to excess fund returns based on the stocks they are picking around the world. These local currency contributions are then converted into the fund's base currency, resulting in the Stock Selection (Currency) component. Thus, Total Stock Selection provides an overall indication of the fund's stock-picking ability, by taking into account the inherent currency effects.

4.1.2 Country Selection

Country Selection is also decomposed into a Local Currency and a Currency component. Total Country Selection for fund j in quarter t is measured as follows:

Total Country Selection$_{j,t}$ = $\sum_{k=1}^{N}(r_{BM,BC,k} * w_k) - r_{BM,BC}$

where

- $r_{BM,BC,k}$ is the quarterly index return for country k in the base currency of the fund
- w_k is the weight of country k in the fund
- $r_{BM,BC}$ is the quarterly return to the fund's benchmark index in the base currency of the fund.

Furthermore, as previously mentioned, Country Selection comprises:

i) Country Selection (Local Currency)$_{j,t}$ = $\sum_{k=1}^{N}(r_{BM,LC,k} * w_k) - r_{BM,LC}$

where

- $r_{BM,LC,k}$ is the quarterly index return for country k in local currency
- w_k is the weight of country k in the fund
- $r_{BM,LC}$ is the quarterly return to the fund's benchmark index in local currency.

It follows that:

ii) Country Selection (Currency) = Total Country Selection – Country Selection (Local Currency).

The Local Currency component indicates whether the countries that managers select are contributing positively or negatively to excess fund returns. These local currency contributions are then converted into the fund's base currency, resulting in a Currency Component. Thus, Total Country Selection provides an overall indication of the fund's country-picking ability incorporating underlying currency movements.

4.2 Benchmark Attribution Results

Table 2 provides the average quarterly benchmark attribution variables for the fund sample over the period 2002 to 2012. All returns are in the base currency of the funds unless stated otherwise. No. of Quarters indicates the average number of observations included in each quarter within the year. Firstly, the average Benchmark Returns based on the funds' assigned benchmarks are reported. Holdings-Based Portfolio Return is the fund return computed as the weighted-average of the unadjusted returns to the stocks held by the fund. The weight applied to each stock is its holding value as at the end of the quarter prior. Excess Holdings-Based Return is the difference between the Holdings-Based Portfolio Return and the Benchmark Return. The Excess Holdings-Based Return can be decomposed into two major components: i) Total Stock Selection and ii) Total Country Selection, both of which are measured as described previously.

Table 2 shows that the managers exhibit positive stock-picking skill on average, with Total Stock Selection of 0.27%, which is statistically significant at the 5% level. Furthermore, this result is solidified by the fact that it is driven by a strong Stock Selection (Local Currency) component of 0.35% on average, which is highly significant. Total Stock Selection is relatively stable over time and is positive in all years except for 2011. However, this negative value is predominantly due to the Stock Selection (Currency) component, and not the managers' stock picking at the local currency level. Total Stock Selection is highest in 2009, with an average of 0.76%. Furthermore, 0.71% is due to Stock Selection (Local Currency) in 2009, which is the highest value over the sample period.

In contrast to Stock Selection, Country Selection does not contribute significantly to excess returns on average, with a statistically insignificant value of 0.13%. This value essentially represents the average currency component, as the local currency component is -0.01% on average. Country Selection contributes positively to excess fund returns in the majority of years, except for 2008 and 2011, in which the average is -0.53% and -0.26%, respectively, both of which are significant at the 1% level. The Local Currency and Currency components both contribute negatively to the overall Country Selection in 2008 and 2011.

Evidently, managers are able to pick stocks that outperform the index within each country on average; however this is on the basis of simple market-adjusted returns. Stock selection skill which incorporates factor adjustments is explored using the global DGTW analysis in section six.

Finally, the corresponding average Reported Portfolio Return, which is the quarterly gross fund return as reported, is also presented. Reported Excess Return is the Reported Portfolio Return minus the Benchmark Return. Unobserved Effects equals the Reported Return less the Holdings-Based Portfolio Return. The average Reported Portfolio Return and Reported Excess Returns of 2.26% and 0.44% are comparable to the mean Holdings-Based Portfolio Return and Excess Holdings-Based Returns of 2.23% and 0.40%, respectively. Thus, in contrast to the extant international equity literature, the sample of funds generate positive market-adjusted performance on average. Furthermore, the average Unobserved Effects is 0.03% and not statistically significant, therefore the holdings-based portfolio returns used throughout the paper provide a strong representation of the actual reported quarterly fund returns[11]. In contrast, US literature shows that holdings-based returns are greater than reported

[11] Holdings data for quarters in which the difference between the holdings-based and reported returns is greater (less) than the 95th (fifth) percentile are deleted. As a robustness test average portfolio returns are computed

returns as the former ignores transaction costs (Wermers, 2000). Perhaps global funds are successfully trading intra-quarter, which is captured in reported returns but not holdings-based returns. Investigation of this is left to further research.

INSERT TABLE 3

Table 3 provides the average Stock Selection and Country Selection variables by region. A pooled average is presented, as there are not enough quarterly observations for the emerging market regions in the earlier years to compute a reliable time-series average.[12]

Total Stock Selection is strongest in Europe, the Middle East and Africa (EM), with an average of 1.06%, which is significant at the 1% level. The funds also exhibit strong stock-picking skills in Japan, with an average of 0.80%, which is also significant at the 1% level. Moderate stock picking is detected in North America and Europe and the Middle East (DM). Interestingly, the local Stock Selection value for Latin America (EM) is 1.15% and highly significant, however a strong negative currency effect occurs which diminishes the Total Stock Selection value. A similar effect occurs in the Asia-Pacific (EM) region. On the other hand, Total Stock Selection for Japan is enhanced by a positive currency effect.

Total Country Selection is strongest in the emerging markets, with average values of 3.49%, 2.71% and 2.76% for the Asia-Pacific, Europe, the Middle East and Africa and Latin America (EM), respectively, all of which are significant at the 1% level. Furthermore, this is primarily driven by the local currency component. Country Selection (Local Currency) is relatively strong in the Asia-Pacific (DM), however, the currency component diminishes this rendering Total Country Selection insignificant. In contrast, Country Selection (Local Currency) is significantly negative for Japan, but a strong currency component mitigates this substantially. Weakly significant Total Country Selection is also detected for North America, whilst Europe and the Middle East (DM) do not contribute significantly to market-adjusted returns.

Thus far it has been determined that global managers outperform their benchmark indices, which contrasts with the previous literature for international equity funds (e.g. Gallagher and Jarnecic, 2004; Cumby and Glen, 1990). However, this performance is largely sourced from

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using the complete dataset before the aforementioned exclusions. The results are consistent- the average holdings-based portfolio return is 2.46% and the average reported return is 2.43%.

[12] The time-series averages for Total Stock Selection and Total Country Selection are qualitatively consistent with the pooled averages presented.

emerging markets, which are considered to be less efficient and which account for a small portion of managers' stock holdings. Furthermore, the results do not account for transaction costs or management fees, which could diminish the observed outperformance.

5. Global DGTW Methodology

DGTW (1997) develop characteristic-matched benchmark portfolios in the US based on size, book-to-market and momentum. Specifically, stocks are sorted into five portfolios based on size, then five portfolios based on book-to-market, and finally into five portfolios based on momentum. This results in 125 benchmark portfolios. The DGTW (1997) approach is extended to global equities, in order to undertake an adjusted performance attribution which accounts for style exposures. Furthermore, the DGTW approach allows style drift amongst the funds in the global equity sample to be measured. The benchmark portfolios are formed using constituents of the MSCI ACWI index. Stocks in the 'Financials' sector are excluded, which is consistent with the extant literature (Fama and French, 1992).

Size is the market capitalisation as at June of portfolio formation year *t*. Book-to-market ratio is the book value of common equity for the fiscal year ending in year *t-1* divided by market capitalisation as at December of year *t-1*. Following Wermers (2012), book-to-market is scaled by the industry average[13] for all stocks in the MSCI ACWI Index for the fiscal year ending in year *t-1*. This excess value is then normalised by the standard deviation of that industry-year's book-to-market ratio. Momentum is the prior 11-month USD return, skip one month, i.e., from July year *t-1* to May year *t* (to avoid bid-ask bounce and monthly return reversals (Jegadeesh, 1990, cited in DGTW, 1997)). As a robustness test results based on momentum using local currency returns are also computed.

Global DGTW benchmarks are created using MSCI ACWI constituents as at the end of June of each portfolio formation year *t*. Although there are global benchmark indices which comprise a greater number of stocks e.g. the Russell Global Index which contains approximately 10,000 stocks and the MSCI ACWI Investable Market Index which comprises about 9,000 securities, these indices only have a limited history as both were launched in 2007. Thus, the MSCI ACWI is used for the DGTW analysis as it comprises a sufficient

[13] The industry classification is based on Datastream's Level 3 Industry Classification which equates to the ICB Supersector. There are 19 possible supersectors in total, of which 15 are represented by the MSCI ACWI stocks in the sample. The scaling portfolios are required to comprise at least 10 stocks.

number of securities (approximately 2,400) and has a history of constituents for the complete sample period used in this study.

Fama and French (2012) use regional breakpoints to assign stocks into global factor portfolios in order to account for differences in accounting systems. This approach is adopted when forming the DGTW benchmark portfolios. Specifically, at the end of June, all stocks in the index within each region are sorted into four portfolios based on size, then into four portfolios based on book-to-market, and finally, into four portfolios based on momentum, resulting in 64[14] benchmark portfolios for each region. The Global DGTW benchmark portfolio is then formed by aggregating all stocks within the same benchmark portfolio in each region e.g. the Global DGTW benchmark portfolio 4,4,4 contains stocks in the 4,4,4 portfolio in all regions. These include Developed Market regions— Asia-Pacific, Europe and the Middle East, Japan and North America; and Emerging Market regions— Asia-Pacific, Europe, the Middle East and Africa and Latin America; and Frontier, Standalone and Unclassified markets. The stocks are weighted by their market capitalisation as at December of year *t-1*, within each benchmark portfolio. On average each of these benchmark portfolios contain 26 stocks with similar characteristics.

The stocks held by the sample of funds are assigned a Global DGTW benchmark portfolio using the regional breakpoints for the index constituents. The book-to-market ratio for the stocks held is scaled following Wermers (2012), using the associated industry-year portfolio of MSCI ACWI stocks. Specifically, each stock-year's book-to-market ratio is adjusted by subtracting the industry average book-to-market ratio for that year (for the industry corresponding to that stock) using the MSCI ACWI stocks. This excess book-to-market ratio is then normalised by the contemporaneous standard deviation of that industry-year's book-to-market ratio.

The Characteristic-Selectivity (CS) Attribute[15] indicates abnormal performance for a fund, based on the performance of each stock relative to its passive global DGTW benchmark portfolio (also referred to as DGTW-adjusted performance). This provides an indication of the

[14] A four x four x three sort resulting in 48 benchmark portfolios, and a five x four x four sort resulting in 80 benchmark portfolios, yield similar results.
[15] DGTW (1997) also develop a Characteristic-Timing (CT) Attribute and an Average Style (AS) Attribute, which indicate style timing skill and style bias, respectively. However, The CT Attribute requires portfolio weights for quarter *t-5*, which reduces the sample size relative to the CS measure, which only requires data lagged by one quarter. Therefore, this study focuses on examination of risk-adjusted performance using the CS Attribute.

stock selection skill of each manager in excess of the returns earned by each stock due to its size, book-to-market and momentum characteristics:

$$\mathrm{CS_t} = \sum_{j=1}^{N} w_{j,t-1} \left(R_{j,t} - R_t^{\,bj,t-1}\right)$$

where

- $w_{j,t-1}$ is the portfolio weight on stock *j* as at the end of quarter *t-1*
- $R_{j,t}$ is the quarter *t* return of stock *j*
- $R_t^{bj,t-1}$ is the quarter *t* return for the benchmark portfolio that is matched to stock *j* during quarter *t-1*.

6. Global DGTW Results

6.1 Average Fund Performance

Table 4 presents average equally-weighted[16] fund returns over the period 2002-2012[17]. Panel A shows returns in USD to facilitate comparison across currencies. As a robustness test, local currency results are also provided in Panel B, as the conversion to USD may introduce a USD currency effect. The adjusted returns are calculated following DGTW's (1997) CS Attribute, using the 64 benchmark portfolios constructed. As a robustness test, two additional approaches to constructing the DGTW benchmark portfolios are provided. The first involves the generation of 48 benchmark portfolios, by sorting the index constituents into four portfolios based on size, then into four portfolios based on book-to-market, and finally into three momentum portfolios. On average, each benchmark portfolio contains 34 stocks. The second robustness test produces 80 benchmark portfolios, using a five by five by four sorting methodology, based on size, book-to-market, and momentum, respectively. There are 21 stocks in each benchmark portfolio, on average. Finally, Panel C reports the average quarterly Size, Book-to-Market (B/M), and Momentum (MOM) quartiles, based on the primary DGTW approach, which uses 64 benchmark portfolios.

INSERT TABLE 4

[16] Asset-weighted portfolio returns are also generated and they are quantitatively similar to those presented in Table 4.
[17] The results are consistent when the DGTW portfolios are formed by ranking stocks using a momentum factor created using local currency returns instead of USD returns.

Panel A demonstrates that global equity funds do not generate outperformance on a DGTW-adjusted basis, with the average annual return to the sample an insignificant -0.04%. Furthermore, this result is robust to the portfolio formation approach used in the construction of the global benchmarks, with similar returns of -0.16% and 0.20% determined using 48 and 80, characteristic-benchmarks, respectively[18]. The sample of funds exhibits the greatest underperformance in the aftermath of the GFC in 2009[19]. The local currency results in Panel B are generally consistent with the USD results. However, the local currency results for the CS Attribute using 48 portfolios differ, with an average return of -1.20%, on average. Overall, the results do not exhibit a strong currency effect, but rather a timing effect, which is discussed in the next paragraph. In addition, Panel C shows that the average style characteristics of the funds are stable over time, which is consistent with DGTW (1997). The funds prefer stocks which are slightly smaller than those in the median quartile of MSCI ACWI stocks, and which are characterised by lower book-to-market ratios and momentum, than the median.

In order to explore the effect that the country bets managers are making may have on the results, average active country weights for the funds, relative to MSCI ACWI are computed from 2007 to 2012[20], these are provided in Appendix B. The largest average active country weight is for the United States at -5.98%, and this is significant at the 1% level. Thus, the sample funds are consistently underweight the United States. Essentially, it is a timing effect which occurs as the funds are underweight the US, whilst the DGTW benchmark portfolios, which comprise MSCI ACWI stocks, are dominated by US stocks. Specifically, the fund's portfolios are affected by US currency movements in a disproportionate manner to the DGTW benchmark portfolios. A decrease (increase) in the USD, will decrease (increase) the USD return to the DGTW benchmark portfolios, by less (more) than the funds' portfolios, which comprise a greater proportion of foreign stocks. Therefore, there will be an under- (over)

[18] On a CAPM-adjusted basis the sample of funds generate an average return of 5.27%, however consistent with the DGTW results presented it is not statistically significant. Following Ferson and Schadt (1996) a conditional version of the CAPM which incorporates lagged control variables is also employed using the US risk-free rate, dividend yield for the MSCI ACWI, the US Treasury Yield Spread, the US Corporate Bond Yield Spread and a dummy variable for the month of January. The use of the US data is appropriate given that all returns have been transformed into US dollar returns. The conditional CAPM-adjusted results are also consistent with an insignificant average return of 5.14% determined. Therefore, further robustness tests focus on the conventional Unconditional CAPM approach.

[19] This contrasts with the results in Table 2 in which the greatest market-adjusted performance is detected in 2009. This is likely to be due to the fact that the performance attribution includes financial stocks, whereas the DGTW analysis does not.

[20] The country weight data is only available from 2007 to 2012, hence the limited sample period.

correction, when the returns to the stocks held by the funds, are adjusted by the returns to the appropriate DGTW benchmark portfolios.

It is important to consider the DGTW results in light of this, given the nature of the construction of the benchmark portfolios. In particular, the results using 48 benchmark portfolios are based on a lower number of benchmark portfolios, and thus, each benchmark portfolio contains a greater number of stocks, relative to those using 64 and 80 portfolios. Therefore, there is greater disparity between the USD and local currency results for the CS Attribute based on 48 benchmark portfolios, due to the aforementioned timing effect. Irrespectively, the key message emanating from the DGTW analysis, i.e., that the funds do not generate statistically significant outperformance on average, is considered to be robust.

6.2 Average Fund Performance by Region

Table 5 provides the average quarterly DGTW-adjusted fund returns, for each region from 2002 to 2012.

INSERT TABLE 5

Panel A provides USD returns. Specifically, the Asia-Pacific is the only Developed Market which generates statistically significant DGTW-adjusted outperformance, over the sample period. In particular, the average quarterly DGTW alpha for this region is 8.51%, and significant at the 1% level. However, the strongest DGTW-adjusted performance is generated by the three emerging market regions, with average returns of 18.64%, 17.15% and 8.80%, for Latin America, Europe the Middle East and Africa, and the Asia-Pacific, respectively. The effect of the GFC is detected in 2008 in the Asia-Pacific with the developed and emerging markets underperforming by 2.74% and 9.61%, respectively. Underperformance for the other developed markets is detected in 2009, whilst the emerging market regions— Europe, the Middle East and Africa, and Latin America do not incur negative performance due to the GFC. Panel B presents local currency results which are consistent with the aforementioned USD results[21]. Thus, the emerging markets are the strongest contributors to returns, on both a market-adjusted and style-adjusted return basis, as demonstrated by the performance attribution presented earlier, and the DGTW analysis by region. However, the emerging market stock holdings only account for a small proportion of total holdings. Thus, global

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[21] Unconditional CAPM-adjusted USD returns are also computed which highlight the same four regions as the strongest performers, on average.

managers' portfolios are dominated by stocks in regions which do not contribute as strongly to returns. However, given that investment in emerging market regions is associated with a greater level of risk (in terms of tracking error), it is likely that managers are constrained in terms of the amount they can invest in these regions.

6.3 Performance Persistence

At the end of 2002, all funds for which there is at least a one year track record are sorted into quintile portfolios, based on their average quarterly return, during 2002. Quintile 1 (5) contains the worst (best) performing funds. Equally-weighted average quarterly portfolio returns, for each quintile, are then calculated over 2003, all funds existing in each quarter are included. This process is repeated at the end of each year from 2002 to 2011, thus, post-ranking period returns are from 2003 to 2012. The pooled average of the post-ranking period returns are presented in Table 6, for each quintile over 2003 to 2012[22]. Panel A provides USD returns for portfolios formed based on the average raw return to each fund in USD, and Panel B shows the USD returns, when funds are sorted based on their average quarterly CS Attribute performance, in USD. As a robustness test, Panels C and D provide the corresponding Local Currency returns.

INSERT TABLE 6

Evidence of performance persistence, over the subsequent 12 months to the ranking period, is identified. Specifically, Panel A shows that on a DGTW-adjusted basis, funds classified into quintile 1 (5), based on their average quarterly raw USD return over the ranking period, continue to underperform (outperform) by -0.40% (0.77%), this being significant at the 5% (1%) level. In addition, the top performing funds outperform the worst performing funds by a statistically significant 1.15%[23], on a DGTW-adjusted basis. Furthermore, this result is robust to the return used to rank the funds, with similar results identified when funds are sorted into quintiles, using their average quarterly USD CS Attribute[24]. Moreover, the Local Currency

[22] The pooled average is presented given that the number of funds in each quintile, in the earlier years of the sample, is limited due to the sample size. Therefore, calculating the average performance each year, and then presenting the time-series mean, is not as reliable. However, time-series means are also generated, and these results are quantitatively consistent with those presented.

[23] Please note that the difference of 1.15% is based on a paired sample *t*-test of the difference in means, between the Quintile 5 and Quintile 1, pooled average returns. This value does not exactly equate to the difference in the average return to Quintile 5 and Quintile 1, i.e., 1.17% (4.76% annually). This applies to all quintile differences computed in Table 6.

[24] On an Unconditional CAPM-adjusted USD return basis, Quintile 5 funds outperform Quintile 1 funds when ranking on the Raw Return in USD (CS Attribute) by 1.20% (1.31%), and this difference is significant at the 5% level.

results presented in Panels C and D are consistent. DGTW (1997) find evidence of persistence in unadjusted returns for US funds. However, in contrast to this study, once momentum is controlled for, using their characteristic benchmark approach, the performance difference between the best and worst performing funds is no longer statistically significant. Similarly, Carhart (1997), and Busse et al. (2010) find that the momentum anomaly explains persistence.

The persistence results have direct implications for the mutual fund industry in terms of the provision of investment consulting advice, and the construction of multi-manager portfolios. Essentially, if past performers continue to outperform over the following year, then this provides a time-frame, which can be used to guide decisions regarding manager addition, retention and removal.

7. Style Drift

7.1 Total Style Drift

The TSD for a fund represents the change in its style characteristics over time. Specifically, TSD for a fund's portfolio during the year prior to June 30th of year *t* in style dimension *l*, where *l* = size, book-to-market or momentum, is calculated as follows:

$$\mathrm{TSD}^{l}_{t,m} = \sum_{j=1}^{N}\left(w_{j,t}C^{l}_{j,t} - w_{j,t-1}C^{l}_{j,t-1}\right)$$

where

- $w_{j,t}$ is the portfolio weight on stock *j* as at June 30th of year *t*
- $C^{l}_{j,t}$ is the style characteristic of stock *j* in style dimension *l* as at June 30th of year *t*
- $w_{j,t-1}$ is the portfolio weight on stock *j* as at June 30th of year *t-1*
- $C^{l}_{j,t-1}$ is the style characteristic of stock *j* in style dimension *l* as at June 30th of year *t-1*.

The TSD indicates the extent to which a fund drifts across the three style characteristics. The cross-sectional average of TSD in each style dimension *l* in June of each year *t* for the fund sample is calculated as follows:

$$\mathrm{TSD}^{l}_{t} = \frac{1}{M}\sum_{m=1}^{M}\left|TSD^{l}_{m,t}\right|$$

7.2 Active and Passive Style Drift

TSD can be broken down into drift that occurs due to the passage of time and drift which is attributed to the trading activities of the manager. Therefore, TSD equates to the aggregate of PSD and ASD:

$$\mathrm{TSD}^{l}_{t} = \mathrm{PSD}^{l}_{t} + \mathrm{ASD}^{l}_{t}$$

where PSD is the change in a style *l* if the manager passively holds the portfolio during year *t*:

$$\mathrm{PSD}^{l}_{t} = \sum_{j=1}^{N}\left(w'_{j,t}C^{l}_{j,t} - w_{j,t-1}C^{l}_{j,t-1}\right)$$

where

- $w'_{j,t}$ is the portfolio weight on stock *j* as at June 30th of year *t*, assuming that the manager employed a buy-and-hold strategy for the entire portfolio over the period *t-1* to *t*.
- $C^{l}_{j,t}$ is the style characteristic of stock *j* in style dimension *l* as at June 30th of year *t*
- $w_{j,t-1}$ is the portfolio weight on stock *j* as at June 30th of year *t-1*
- $C^{l}_{j,t-1}$ is the style characteristic of stock *j* in style dimension *l* as at June 30th of year *t-1*.

PSD can occur due to changes in the style characteristics of a stock over time and/or due to changes in the weights of a buy-and-hold portfolio. The fund manager can partially offset PSD via the ASD component by trading stocks to adjust the inherent style tilt of the portfolio. Style drift which is due to active trading by the fund manager is calculated as follows:

$$\mathrm{ASD}^{l}_{t} = \sum_{j=1}^{N}\left(w_{j,t}C^{l}_{j,t} - w'_{j,t}C^{l}_{j,t}\right)$$

where

- $w_{j,t}$ is the portfolio weight on stock *j* as at June 30th of year *t*
- $C^{l}_{j,t}$ is the style characteristic of stock *j* in style dimension *l* as at June 30th of year *t*
- $w'_{j,t}$ is the portfolio weight on stock *j* as at June 30th of year *t*, assuming that the manager employed a buy-and-hold strategy for the entire portfolio over the period *t-1* to *t*.

Wermers (2012) states that "a perfectly style-controlled fund would have offsetting PSD and ASD measures, giving a TSD measure of zero in each dimension" (p.9).

7.3 Style Drift Results

Table 7 presents the average cross-sectional measures of TSD, PSD and ASD for the funds from 2003 to 2012. Panels A, B and C relate to Size, Book-to-Market, and Momentum, respectively.

INSERT TABLE 7

Panel A shows that TSD for Size is greater than PSD, which indicates that active trades are not being made to decrease the passive drift. However, the PSD measure is low, with a time-series average value of 0.04, thus passive drift is not a major concern for Size. A manager that trades to mitigate drift will have a very small value of TSD, relative to the associated sum of PSD and ASD (Wermers, 2012). On average, TSD is close in magnitude to the aggregate of PSD and ASD, differing only by 0.04 quartiles. Therefore, managers are trading with little regard for the consequences of the resulting drift in the Size dimension. This trend is greatest for Size; however, it is also evident in Panels B and C for Book-to-Market, and to a lesser extent Momentum, respectively. Specifically, the average sum of PSD and ASD is 0.10 and 0.14 quartiles higher than TSD for Book-to-Market and Momentum, respectively. Evidently, the trading that does occur in relation to Momentum has greater consideration for the drift consequences, relative to the other two styles. Furthermore, the only case of TSD being less than PSD (and thus active trades being made to offset PSD) is for Book-to-Market in 2003.

Panel B demonstrates that the gap between TSD and PSD for Book-to-Market peaks at 0.22 in 2008, which indicates that managers are the least concerned about being style consistent during this period. This is not surprising given that this coincides with the GFC.

Panel C shows that the gap between TSD and PSD remains relatively constant over time, this may be due to the fact that controlling momentum drift requires high turnover. Interestingly, comparison of the time-series average PSD portions reveals that consistent with the US results, the greatest risk is associated with holding momentum stocks as PSD is 0.22 quartiles on average, compared to 0.04 and 0.13 quartiles for Size and Book-to-Market stocks, respectively. The interpretation of this result is that in order to control for this PSD, a manager would need to trade 22% of the stocks held, for stocks with a Momentum quartile that is one quartile different.

Table 8 provides equally-weighted average returns to quintiles formed using ASD and TSD. Panels A and B present USD returns and as a robustness test local currency returns are provided in Panels C and D. In particular, funds are sorted into quintiles based on their TSD and ASD in year *t-1*. Quintile 1 (5) contains the funds exhibiting the least (greatest) drift. The average quarterly performance over year *t* is then computed for the quintiles. Essentially, if managers that drift are doing so in order to take advantage of style cycles, then it is expected that managers exhibiting greater levels of style drift (particularly ASD) will outperform. In relation to the TSD USD results, the funds which exhibit the highest style drift (quintile 5 funds) underperform on a DGTW-adjusted basis, with an average quarterly return of -0.27%, over year *t*. In contrast, the funds in quintile 1 generate an average DGTW-adjusted return of 0.30%, although neither average is statistically significant. However, a paired sample *t*-test of the difference in means between the two quintiles reveals that the style consistent funds outperform the style cavalier funds by 0.58%[25] (2.34% annually), this being significant at the 5% level. The direction and magnitude is consistent when using raw returns, however, the difference between the quintiles is not statistically significant. Panel B shows that when ranking on ASD, the difference in the DGTW-adjusted performance of the funds exhibiting high and low style drift is muted, and not statistically significant. However, the difference between quintiles 5 and 1 is -1.14% (-4.48%), and significant at the 5% level when using raw returns[26]. Panels C and D demonstrate that the results for TSD and ASD using local currency returns are consistent.

INSERT TABLE 8

Overall, the results provide some evidence that managers that remain style consistent outperform those exhibiting greater levels of style drift, which is consistent with Brown et al. (2009). In contrast, Wermers (2012) finds that managers that drift outperform their style stable counterparts. The outperformance of style drifters is contingent on their ability to identify opportunities outside of their usual style realm. Brown et al. (2009) suggest that managers that remain style consistent are less likely to make asset allocation and stock selection errors. Therefore, a possible reason for the differing result between this study and Wermers (2012) is that global equity managers may find it harder to correctly identify opportunities, relative to US managers, given the broader nature of their potential investment

[25] Please note that the difference of 0.58%% is based on a paired sample *t*-test of the difference in means, between the Quintile 5 and Quintile 1, pooled average returns. This value does not exactly equate to the difference in the average return to Quintile 5 and Quintile 1, i.e. 0.57%. This applies to all quintile differences computed in Table 8.

[26] Unreported analyses using Unconditional CAPM-adjusted USD returns show that Quintile 5 funds underperform Quintile 1 funds when ranking on TSD (ASD) by -0.85% (-0.89%) and this difference is significant at the 10% (5%) level.

universe. Furthermore, Brown et al. (2009) purport that it is likely that managers that drift have higher portfolio turnover, which results in higher transaction costs that diminish fund returns.

8. Conclusion

This paper investigates a number of aspects of global equity fund performance from 2002 to 2012. Firstly, a standard market-adjusted performance attribution is undertaken which shows that global equity funds outperformed their benchmark indices, on average. Furthermore, a decomposition of the funds' market-adjusted excess returns shows that the funds generate statistically significant outperformance based on their stock picking, on average. However, country-picking does not contribute strongly to market-adjusted fund returns. A further dissection of performance across regions highlights that Total Stock Selection is strongest in European, Middle Eastern and African emerging markets, and Japan. Furthermore, it is predominantly the emerging market regions which contribute positively to Total Country Selection. However, these regions constitute a small portion of funds' holdings; thus, the overall contribution to total market-adjusted performance may be modest, due to the low exposure of the funds. A further contribution of this paper is the development of global DGTW (1997)-inspired characteristic-matched benchmark portfolios. The risk-adjusted performance evidence indicates that once accounting for systematic size, book-to-market and momentum exposures, global equity funds do not exhibit stock selection on average.

However, performance does appear to be persistent over the 12 month period following portfolio ranking, with the top performing funds continuing to outperform the worst performers. Following Wermers (2012) style drift is also investigated with managers not exhibiting a strong tendency to trade with regard for the consequences of drift in mind. In addition, weak evidence that managers that remain style consistent outperform managers exhibiting higher drift is determined.

Thus, global equity managers are able to achieve returns in excess of a passive market benchmark; however outperformance is not determined on a risk-adjusted basis. Furthermore, performance is persistent, which has direct implications for the mutual fund industry in terms of the provision of multi-manager portfolio construction advice. Similarly, the style drift results suggest that investors will benefit from focusing on global equity managers that focus on a consistent style, rather than those that are characterised as style drifters.

There is a paucity of literature pertaining to global equity funds, thus, the scope for further research is broad. This paper provides a foundation of analysis which pertains to key areas of performance evaluation. Thus, future research on topics such as what drives the persistence in performance, and how manager trades relate to performance, is warranted. Furthermore, it would be fruitful to investigate how timing/currency effects could be completely eliminated from a global DGTW benchmark portfolio application.

9. Appendices

Appendix A: Benchmark Index Assignment

The benchmark to use for each fund is determined as follows. Firstly, a variable which indicates a number of benchmarks that are assigned to each fund, in sequential order, is obtained from Russell Investments. This variable identifies either:

1. One primary benchmark for a fund (n=90), i.e., the benchmark sequence variable equals one, for one index.
2. Several primary benchmarks for a fund (n=66), i.e., the benchmark sequence variable equals one, for more than one index.
3. No primary benchmark (n=1), i.e., the first benchmark sequence variable value is two.

Regression analysis is used to select a benchmark for the funds in categories two and three. Specifically, using all time periods available for each fund, the reported fund returns are regressed on the returns for the benchmark options. The benchmark for which the R^2 is the highest is initially selected, as the benchmark to use, for each fund. The degrees of freedom varies across funds and it is not required to surpass a minimum level, as this process is simply undertaken to allow comparison between index options, thus, all options are subject to the same conditions. One fund is excluded from the attribution analysis as it is not possible to assign an appropriate benchmark.

Two funds are assigned the Financial Times Stock Exchange (FTSE) World Index as their benchmark; however, holdings data is not available for this index from any of the sources used in this paper. Therefore, the fund returns are regressed against MSCI World to see if it can be used as an alternative. The R^2 is within 1% of that for FTSE World for one fund, and it actually represents a better fit for the other fund. Therefore, MSCI World is used for these two funds. In addition, ten (of the 90 primary benchmark funds) funds identified MSCI All Country World Growth Index as their primary benchmark. However, holdings data is not available from any of the sources used in this study for this index either. Therefore, the returns for these funds are regressed against the MSCI World Growth Index— all R^2 are similar, so this index is used instead.

There are several benchmarks which are common amongst the funds. Therefore, across all three fund categories, funds which were assigned an uncommon benchmark are then re-assigned one of the common benchmarks, if possible. Essentially, if the R^2 for one of the common benchmarks is within 1% of that for the originally assigned benchmark, and if the common benchmark is an option for the fund, then re-assignment occurs. This is possible for the majority of funds assigned an uncommon benchmark initially. If one of the common benchmarks doesn't satisfy the 1% criterion, yet it still explains a significant proportion of the fund's returns, i.e., if R^2 is greater than 75%, then re-assignment occurs. The average (median) R^2 is 87% (91%), this is based on 154 funds for which the regression analysis is possible, i.e., two funds had reported returns for only two quarters. The average (median) degrees of freedom is 36 (31). The table below details the final frequency for each of the benchmark options:

Index	N
MSCI World	103
MSCI World Growth	30
MSCI All Country World	12
MSCI World Value	7
MSCI EAFE	2
MSCI Europe	2
Excluded	1
Total	**157**

Appendix B: Average Active Country Weights

This table provides average active country weights over 2007 to 2012, which are computed as the average difference between the portfolio weight of each fund, in each country, and the weight of that country, in the fund's assigned benchmark index.

Country	Active Weight (%)	*t*-statistic
USA	-5.98	-10.06
Canada	-1.02	-5.02
Australia	-0.52	-2.56
New Zealand	0.35	5.01
Spain	0.38	3.38
Japan	0.47	1.93
Hungary	0.62	2.91
Ireland	0.73	9.47
Israel	0.74	6.23
Poland	0.76	10.97
Portugal	0.81	9.08
Denmark	0.88	19.81
Italy	0.90	6.61
Mexico	1.02	23.68
Sweden	1.03	4.62
Czech Republic	1.07	4.31
Finland	1.08	42.40
Austria	1.09	16.83
China	1.11	2.40
Malaysia	1.15	8.35
United Kingdom	1.17	6.22
Singapore	1.20	18.12
Thailand	1.25	27.12
Greece	1.27	4.46
Egypt	1.28	5.65
Germany	1.40	8.31
Netherlands	1.46	21.96
Philippines	1.46	13.59
South Africa	1.54	29.67
Russia	1.54	6.34
France	1.60	14.59
Belgium	1.62	6.21
Norway	1.68	14.65
Switzerland	1.87	12.90
Brazil	1.91	7.06
Taiwan	2.08	32.54
Turkey	2.16	7.77
Indonesia	2.21	7.21
India	2.71	8.34
Korea	2.86	10.74
Hong Kong	3.26	15.43

Table 1: Descriptive Statistics for Global Equity Funds

This table presents summary statistics for the sample of long-only active global equity funds from 2002 to 2012. Panel A provides broad sample characteristics; No. Funds is the average number of funds in the sample, over the four quarters of the year indicated. Assets refers to the total holding value of the stocks held in each fund's representative portfolio. Importantly, this is not the official assets under management for each fund. Index Holdings is the market capitalisation proportion of stocks, in the MSCI ACWI, represented by the stocks held by the mutual fund sample, as at December of each year. No. Stocks Held is the average number of stocks held in each quarter. Panel B details the proportion of the funds' holdings which are in each region. DM indicates a Developed Market region and EM an Emerging Market region. Asia-Pacific (DM) includes Australia, Hong Kong, Korea, New Zealand and Singapore. Europe and the Middle East (DM) includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Japan is analysed as a separate region. North America includes Canada and the United States. Asia-Pacific (EM) comprises China, India, Indonesia, Malaysia, Philippines, Taiwan and Thailand. Europe, the Middle East and Africa (EM) represents the Czech Republic, Egypt, Hungary, Morocco, Poland, Russia, South Africa and Turkey. Latin America (EM) includes Brazil, Chile, Colombia, Peru and Mexico.

N.B. the sum of the holdings proportions may not equate to 100 due to Frontier, Standalone and Unclassified holdings being omitted, given their minute representation.

Panel A: Broad Sample Characteristics					Panel B: Proportion of Holdings by Region (%)						
Year	**No. Funds**	**Assets ($US bn)**	**Index Holdings (%)**	**No. Stocks Held**	**Asia-Pacific (DM)**	**Europe & Middle East (DM)**	**Japan**	**North America**	**Asia-Pacific (EM)**	**Europe, Middle East & Africa (EM)**	**Latin America (EM)**
2002	20	10.99	78.84	138	2.83	36.99	12.62	45.15	1.05	1.01	0.36
2003	25	22.32	80.83	177	4.70	37.95	13.51	41.56	0.96	1.02	0.30
2004	37	43.15	81.52	168	6.15	39.26	13.93	38.67	1.07	0.78	0.15
2005	50	43.61	82.76	124	6.56	31.00	13.52	46.36	0.70	1.36	0.21
2006	66	66.72	82.42	109	6.57	35.18	10.37	45.89	0.95	0.70	0.33
2007	77	86.44	85.30	115	8.54	39.25	9.04	40.18	1.55	0.99	0.41
2008	88	53.89	89.76	128	5.99	38.24	12.19	40.26	1.89	0.84	0.38
2009	100	95.27	88.69	125	6.23	34.24	7.20	48.40	2.19	0.82	0.73
2010	107	96.80	88.96	116	7.92	33.64	9.47	43.48	2.56	1.20	1.38
2011	110	96.06	90.06	114	6.25	34.02	7.87	47.82	1.89	0.75	1.32
2012	113	118.12	89.82	112	5.74	35.89	6.86	48.28	1.72	0.71	0.75

Table 2: Benchmark Attribution Analysis

This table provides a decomposition of average quarterly returns, for a sample of 156 active global equity funds over the period 2002 to 2012. Only 156 funds are used as an appropriate benchmark index was not able to be assigned for one fund. All returns are in the base currency of the fund unless stated otherwise. No. of Quarters indicates the average number of observations included in each quarter, within the year. Benchmark Return is the quarterly return to the index assigned to each fund. Holdings-Based Portfolio Return is the fund return computed as the weighted-average of the unadjusted returns to the stocks held by the fund. The weight applied to each stock is its holding value, as at the end of the quarter prior. Excess Holdings-Based Return is the difference between the Holdings-Based Portfolio Return and the Benchmark Return. The Excess Holdings-Based Return can be decomposed into two major components: i) Total Stock Selection and ii) Total Country Selection. Total Stock Selection is computed as the weighted sum of the difference between the quarterly return to each stock *i*, and the quarterly country return for the same country as stock *i*. Total Stock Selection comprises a Local Currency, and a Currency, component. Stock Selection (Local Currency) is computed as the weighted sum of the difference between the quarterly return to each stock *i*, and the quarterly country return for the same country as stock *i*, in local currency. Stock Selection (Currency) is measured as Total Stock Selection minus Stock Selection (Local Currency). Total Country Selection is calculated as the weighted sum of the quarterly return to country *i*, minus the quarterly return to the fund's benchmark. The weight applied is the sum of the portfolio weights by country *i*. Total Country Selection can also be decomposed into a Local Currency, and a Currency, component. Country Selection (Local Currency) is computed as the weighted sum of the quarterly return to country *i*, in local currency, minus the quarterly return to the fund's benchmark, also in local currency. Again, the weight applied is the sum of the portfolio weights by country *i*. Country Selection (Currency) is measured as Total Country Selection, minus Country Selection (Local Currency). Reported Portfolio Return is the quarterly gross fund return as reported. Reported Excess Return is the Reported Portfolio Return, minus the Benchmark Return. Unobserved Effects equals the Reported Return, less the Holdings-Based Portfolio Return. The time-series averages are also presented, and *t*-statistics are provided in parentheses, below the mean returns.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

			Holdings-Based Returns		*Stock Selection Variables*			*Country Selection Variables*			*Reported Returns*		
Year	**No. of Quarters**	**Benchmark Return (%)**	**Holdings-Based Portfolio Return (%)**	**Excess Holdings-Based Return (%)**	**Total Stock Selection (%)**	**Stock Selection (Local Currency) (%)**	**Stock Selection (Currency) (%)**	**Total Country Selection (%)**	**Country Selection (Local Currency) (%)**	**Country Selection (Currency) (%)**	**Reported Portfolio Return (%)**	**Reported Excess Return (%)**	**Unobserved Effects (%)**
2002	76	-3.51***	-2.79**	0.72	0.49	0.64*	-0.15	0.23	0.11	0.12	-2.60**	0.91**	0.19
		(-2.97)	(-2.26)	(1.65)	(1.23)	(1.72)	(-1.66)	(1.13)	(0.65)	(0.73)	(-2.14)	(2.32)	(0.95)
2003	101	7.36***	7.69***	0.33	0.10	0.07	0.03	0.23	0.11	0.12	7.73***	0.37	0.04
		(8.86)	(8.10)	(0.99)	(0.43)	(0.30)	(0.82)	(1.08)	(0.74)	(0.80)	(8.32)	(1.23)	(0.25)
2004	147	4.07***	4.47***	0.40**	0.28*	0.31*	-0.03	0.12	-0.11*	0.23**	4.46***	0.40**	-0.01
		(8.95)	(9.15)	(2.00)	(1.82)	(1.86)	(-0.40)	(1.10)	(-1.72)	(2.17)	(9.27)	(2.19)	(-0.04)
2005	200	3.55***	4.37***	0.82***	0.38**	0.46**	-0.08	0.44***	0.60***	-0.16***	4.63***	1.09***	0.26**
		(15.85)	(14.89)	(4.49)	(2.28)	(2.50)	(-0.90)	(5.17)	(5.51)	(-2.65)	(16.37)	(7.02)	(2.25)
2006	251	4.27***	4.99***	0.72***	0.64***	0.61***	0.03	0.08	0.02	0.07	5.05***	0.78***	0.06
		(15.17)	(14.23)	(4.40)	(4.56)	(3.31)	(0.23)	(1.07)	(0.32)	(1.19)	(15.20)	(5.20)	(0.53)
2007	295	1.49***	1.85***	0.37*	0.01	0.09	-0.09	0.36***	0.35***	0.01	2.17***	0.68***	0.31***
		(7.31)	(6.43)	(1.93)	(0.04)	(0.53)	(-1.08)	(5.30)	(5.79)	(0.21)	(8.31)	(4.23)	(2.93)
2008	259	-10.87***	-11.37***	-0.50**	0.03	0.24	-0.21**	-0.53***	-0.31***	-0.22***	-11.36***	-0.49**	0.01
		(-21.92)	(-23.19)	(-1.99)	(0.15)	(1.03)	(-2.30)	(-5.71)	(-3.72)	(-2.68)	(-22.06)	(-2.03)	(0.05)
2009	328	6.39***	7.58***	1.20***	0.76***	0.71***	0.05	0.44***	0.55***	-0.11**	7.60***	1.22***	0.02
		(10.44)	(11.94)	(6.11)	(4.26)	(4.27)	(0.59)	(5.34)	(7.41)	(-2.34)	(12.20)	(6.08)	(0.19)
2010	386	3.90***	4.47***	0.57***	0.44***	0.46***	-0.02	0.13**	0.23***	-0.11**	4.24***	0.34***	-0.23***
		(8.57)	(9.74)	(4.62)	(3.77)	(3.90)	(-0.31)	(2.13)	(4.07)	(-2.50)	(9.56)	(2.92)	(-2.72)
2011	407	-0.29	-0.87*	-0.57***	-0.31**	-0.12	-0.19***	-0.26***	-0.15***	-0.11***	-0.94**	-0.64***	-0.07
		(-0.70)	(-1.90)	(-3.82)	(-2.39)	(-0.91)	(-4.11)	(-4.52)	(-3.01)	(-3.48)	(-2.09)	(-4.32)	(-0.91)
2012	430	3.78***	4.14***	0.37***	0.16	0.35***	-0.18***	0.20***	0.20***	0.00	3.92***	0.14	-0.23***
		(14.05)	(12.63)	(2.71)	(1.31)	(2.81)	(-3.17)	(5.26)	(4.23)	(0.15)	(12.48)	(1.08)	(-3.20)
Average	262	1.83	2.23	0.40**	0.27**	0.35***	-0.08**	0.13	-0.01	0.15	2.26	0.44**	0.03
		(1.17)	(1.34)	(2.52)	(2.89)	(4.42)	(-2.60)	(1.49)	(-0.35)	(1.71)	(1.36)	(2.42)	(0.62)

Table 3: Stock and Country Selection by Region

This table presents the average quarterly excess return attributable to Stock Selection and Country Selection, in each region, for the sample of funds. Total Stock Selection is computed as the weighted sum of the difference between the quarterly return to each stock *i*, and the quarterly country return for the same country as stock *i*. Total Stock Selection comprises a Local Currency, and a Currency, component. Stock Selection (Local Currency) is computed as the weighted sum of the difference between the quarterly return to each stock *i*, and the quarterly country return for the same country as stock *i*, in local currency. Stock Selection (Currency) is measured as Total Stock Selection, minus Stock Selection (Local Currency). Total Country Selection is calculated as the weighted sum of the quarterly return to country *i*, minus the quarterly return to the fund's benchmark. The weight applied is the sum of the portfolio weights by country *i*. Country Selection can be decomposed into a Local Currency, and a Currency, component. Country Selection (Local Currency) is computed as the weighted sum of the quarterly return to country *i*, in local currency, minus the quarterly return to the fund's benchmark, also in local currency. Again, the weight applied is the sum of the portfolio weights by country *i*. Country Selection (Currency) is measured as Total Country Selection, minus the Country Selection (Local Currency).

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. the Country Selection variables are only computed from 2007 to 2012, due to the availability of country weight data required.

Panel A: Stock Selection by Region				
Region	**No. of Quarters**	**Total Stock Selection (%)**	**Stock Selection (Local Currency) (%)**	**Stock Selection (Currency) (%)**
Asia-Pacific (DM)	2543	0.19	0.37**	-0.17*
		(1.17)	(2.38)	(-1.86)
Europe & Middle East (DM)	2804	0.22**	0.38***	-0.16***
		(2.55)	(4.54)	(-3.47)
Asia-Pacific (EM)	1270	0.48	0.83***	-0.35*
		(1.47)	(2.82)	(-1.77)
Europe, Middle East & Africa (EM)	992	1.06***	1.08***	-0.02
		(2.98)	(3.18)	(-0.10)
Latin America (EM)	846	0.63	1.15***	-0.52*
		(1.32)	(2.62)	(-1.78)
Japan	2512	0.80***	0.67***	0.13*
		(5.75)	(5.15)	(1.70)
North America	2839	0.35***	0.36***	0.00
		(4.17)	(4.58)	(-0.08)

Panel B: Country Selection by Region				
Region	**No. of Quarters**	**Total Country Selection (%)**	**Country Selection (Local Currency) (%)**	**Country Selection (Currency) (%)**
Asia-Pacific (DM)	1898	0.56	1.18***	-0.62***
		(1.61)	(4.16)	(-4.49)
Europe & Middle East (DM)	2085	0.33	0.31	0.02
		(1.01)	(1.19)	(0.17)
Asia-Pacific (EM)	1029	3.49***	2.92***	0.57***
		(8.27)	(7.68)	(4.59)
Europe, Middle East & Africa (EM)	790	2.71***	2.73***	-0.02
		(5.12)	(7.53)	(-0.07)
Latin America (EM)	721	2.76***	2.48***	0.27
		(4.65)	(5.94)	(1.15)
Japan	1850	-0.21	-0.78**	0.56**
		(-0.70)	(-2.09)	(2.41)
North America	2099	0.42*	0.49*	-0.07
		(1.66)	(1.85)	(-0.66)

Table 4: DGTW-adjusted Fund Returns

This table presents annual equally-weighted average fund and market performance measures. Panel A provides returns in USD, and Panel B demonstrates the corresponding local currency returns, as a robustness test. Individual fund returns are calculated as the weighted average of the stocks held. The holding value of a stock, as at the end of the prior quarter, is the weight applied to that stock's return, over the next quarter. The annual fund returns presented are calculated by first determining the mean return for each quarter, using all funds that existed during that quarter. These four quarterly means are then annualised using simple compounding. Raw Return is the unadjusted holdings-based fund return. MSCI ACWI is the return to the MSCI All-Country World Index, which is calculated using simple compounding of the relevant monthly returns. CS Attribute n=64 provides fund returns adjusted using the DGTW approach for global stocks developed in this paper. Specifically, the raw quarterly return to each stock held is adjusted by the quarterly return to one of 64 global benchmark portfolios, assigned in June of each year *t*, using a four by four by four sort, based on the stock's size, book-to-market, and momentum characteristics. The global benchmarks comprise MSCI ACWI constituent stocks. Adjusted returns are computed for each stock held, based on the quarterly return to its characteristic-matched benchmark portfolio. As a robustness test, two alternative DGTW approaches are presented: CS Attribute n=48 which uses a four by four by three sort and CS Attribute n=80 which uses a five by four by four sort. Panel C presents the average quarterly Size, Book-to-Market (B/M) and Momentum (MOM) quartiles, for the funds, based on CS Attribute n=64. *t*-statistics are in parentheses below the time-series means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. the *t*-statistics for the Size, B/M and MOM quartile averages are relative to an expected value of 2.5.

	Panel A: USD Results					Panel B: Local Currency Results					Panel C: Average Quartiles		
Year	**Raw Return (%)**	**MSCI ACWI (%)**	**CS Attribute n=64 (%)**	**CS Attribute n=48 (%)**	**CS Attribute n=80 (%)**	**Raw Return (%)**	**MSCI ACWI (%)**	**CS Attribute n=64 (%)**	**CS Attribute n=48 (%)**	**CS Attribute n=80 (%)**	**Size Quartile**	**B/M Quartile**	**MOM Quartile**
2002	-17.68	-18.98	-3.31	-3.65	-2.84	-22.92	-23.10	-4.31	-1.63	-3.66	2.35	1.21	1.54
2003	32.92	34.63	-3.40	-4.22	-2.79	23.96	26.36	-4.00	-11.46	-3.40	2.47	1.19	1.48
2004	16.48	15.75	0.35	0.15	0.53	12.42	12.05	0.22	-2.74	0.40	2.34	1.36	1.40
2005	14.09	11.37	2.36	2.73	2.72	21.39	17.45	3.36	4.33	3.74	2.33	1.37	1.50
2006	22.30	21.53	1.92	2.10	2.27	17.77	17.04	1.38	-0.26	1.63	2.30	1.42	1.49
2007	17.53	12.18	1.09	1.00	1.37	12.85	7.68	1.39	8.04	1.68	2.29	1.45	1.47
2008	-38.51	-41.85	6.79	5.36	6.34	-36.19	-39.17	5.83	1.62	5.32	2.26	1.42	1.62
2009	37.48	35.41	-9.34	-8.42	-8.75	33.58	29.97	-7.93	-12.67	-7.30	2.24	1.35	1.66
2010	16.27	13.21	-2.02	-1.62	-1.79	15.09	11.07	-1.03	-2.17	-0.73	2.21	1.36	1.54
2011	-3.98	-6.86	3.10	2.81	3.24	-3.52	-5.96	2.61	4.36	2.71	2.19	1.39	1.52
2012	16.44	16.80	2.03	2.00	1.89	16.28	16.54	1.90	-0.66	1.80	2.22	1.39	1.71
Average	10.31	8.47	-0.04	-0.16	0.20	8.25	6.36	-0.05	-1.20	0.20	2.29***	1.36***	1.54***
	(1.54)	(1.22)	(-0.03)	(-0.13)	(0.16)	(1.31)	(1.00)	(-0.04)	(-0.63)	(0.18)	(-8.63)	(-45.40)	(-35.57)

Table 5: DGTW-adjusted Returns by Region

This table provides average annual DGTW-adjusted fund returns by region for 157 long-only active global equity mutual funds from 2002 to 2012. Panel A provides USD returns adjusted using the DGTW approach for global stocks developed in this paper. Specifically, the raw quarterly return to each stock is adjusted by the quarterly return to one of 64 benchmark portfolios, assigned based on the stock's size, book-to-market and momentum characteristics. Panel B presents local currency returns as a robustness test. *t*-statistics are provided in parentheses below the time-series means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. The average annual fund returns for the region Latin America Emerging Markets are omitted for 2002, 2003 and 2004 due to an inadequate number of sample observations for these years, given the low proportion of stocks held in this region by the funds.

Panel A: CS Attribute for Funds in USD							
	Developed Markets				*Emerging Markets*		
Year	**Asia-Pacific**	**Europe & Middle East**	**Japan**	**North America**	**Asia-Pacific**	**Europe, Middle East & Africa**	**Latin-America**
2002	13.29	-3.05	5.86	-8.96	4.02	65.00	.
2003	5.74	3.93	-8.72	-7.54	11.87	-4.40	.
2004	11.51	5.85	0.08	-3.89	-2.78	42.33	.
2005	13.36	1.96	11.75	-2.01	11.47	33.91	51.54
2006	12.29	14.99	-5.74	-2.91	9.43	4.60	31.98
2007	23.93	5.33	-18.31	0.10	18.27	5.42	15.15
2008	-2.74	2.81	23.89	8.20	-9.61	10.94	2.46
2009	8.17	-7.29	-23.80	-11.24	32.96	18.13	20.28
2010	6.01	-6.22	0.59	-0.89	15.15	10.70	25.79
2011	-6.67	0.87	-1.49	7.91	-5.42	-9.13	-9.52
2012	8.69	6.97	-6.31	-0.70	11.44	11.09	11.47
Mean	8.51***	2.38	-2.02	-1.99	8.80**	17.15**	18.64**
	(3.42)	(1.24)	(-0.51)	(-1.08)	(2.44)	(2.60)	(2.83)

Panel B: CS Attribute for Funds in Local Currency							
	Developed Markets				*Emerging Markets*		
Year	**Asia-Pacific**	**Europe & Middle East**	**Japan**	**North America**	**Asia-Pacific**	**Europe, Middle East & Africa**	**Latin-America**
2002	11.06	-10.15	1.74	-3.92	5.85	23.24	.
2003	2.83	-5.15	-11.90	-1.29	12.24	-21.72	.
2004	8.77	1.21	-1.43	-0.56	-3.05	28.42	.
2005	9.14	11.18	22.21	-7.28	9.48	46.37	33.42
2006	9.59	5.85	-1.33	0.39	6.13	12.91	42.01
2007	24.22	1.65	-19.08	3.53	17.75	4.60	1.99
2008	2.80	7.80	1.64	5.52	-9.37	30.88	9.80
2009	1.67	-9.87	-18.42	-7.09	29.72	1.93	29.37
2010	3.66	-2.55	-10.28	1.34	7.06	5.20	4.41
2011	-7.92	0.81	-5.95	7.45	-0.43	5.99	0.32
2012	5.92	3.45	6.70	-0.70	8.07	12.65	10.25
Mean	6.52**	0.39	-3.28	-0.24	7.59**	13.68**	16.45**
	(2.74)	(0.19)	(-0.91)	(-0.17)	(2.41)	(2.51)	(2.90)

Table 6: Performance Persistence

This table presents average quarterly returns from 2003 to 2012 to equally-weighted quintile portfolios of funds, which have been formed at the end of the year prior, based on the average quarterly return to each fund, for that year. Only funds with return data for all four quarters are included in the portfolio sort. Fund returns over the following year are then determined. All funds existing during a given quarter, over the following year, are included irrespective of whether or not they were subsequently active. Panel A provides USD returns for portfolios formed based on the average raw return to each fund in USD, and Panel B shows the USD returns when funds are sorted based on their average quarterly CS Attribute performance in USD. Local Currency (LC) results are also provided as a robustness test. Panel C provides the LC returns for portfolios formed based on the average raw return to each fund in LC, and Panel D presents the LC results when funds are sorted based on their average quarterly CS Attribute performance in LC. The average returns presented are the pooled average of the post-ranking period quarterly returns, to each quintile. Raw Return is the average unadjusted quarterly fund return. CS Attribute is the average quarterly fund return adjusted using the DGTW approach for global stocks developed in this paper. Specifically, the raw quarterly return to each stock held is adjusted by the quarterly return to one of 64 global benchmark portfolios, assigned in June of each year *t*, using a four by four by four sort, based on the stock's size, book-to-market, and momentum characteristics. The global benchmarks comprise MSCI ACWI constituent stocks. Adjusted returns are computed for each stock held, based on the quarterly return to its characteristic-matched benchmark portfolio. *t*-statistics are provided in parentheses below the means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Q1 (Worst)	Q2	Q3	Q4	Q5 (Best)	Q5 - Q1	Q1 (Worst)	Q2	Q3	Q4	Q5 (Best)	Q5 - Q1
	Panel A: Raw Return (USD) Rank USD Returns						Panel C: Raw Return (LC) Rank LC Returns					
	1.76***	2.27***	2.39***	2.07***	3.01***	1.25	1.69***	2.07***	1.82***	2.03***	2.68***	1.03
Raw Return	(2.95)	(4.13)	(4.48)	(3.78)	(4.80)	(1.39)	(3.14)	(4.31)	(3.69)	(4.29)	(4.80)	(1.34)
	-0.40**	-0.28*	-0.18	0.34**	0.77***	1.15***	-0.26	-0.25*	-0.30*	0.59***	0.62***	0.84***
CS Attribute	(-2.24)	(-1.72)	(-1.07)	(2.10)	(3.26)	(3.93)	(-1.48)	(-1.69)	(-1.95)	(3.74)	(2.73)	(2.88)
	Panel B: CS Attribute (USD) Rank USD Returns						Panel D: CS Attribute (LC) Rank LC Returns					
	1.85***	2.28***	2.18***	2.18***	3.01***	1.20	1.64***	1.86***	2.10***	1.78***	2.93***	1.35*
Raw Return	(3.05)	(4.34)	(3.95)	(4.04)	(4.75)	(1.35)	(3.09)	(3.77)	(4.49)	(3.65)	(5.27)	(1.65)
	-0.57***	-0.16	0.07	0.15	0.77***	1.31***	-0.32*	-0.37**	0.06	0.29*	0.78***	1.08***
CS Attribute	(-3.19)	(-0.96)	(0.15)	(0.89)	(3.31)	(4.41)	(-1.77)	(-2.34)	(0.44)	(1.77)	(3.47)	(3.79)

Table 7: Average Style Drift Measures

This table presents average style drift measures for size, book-to-market and momentum from 2003 to 2012. Total Style Drift (TSD) for a fund's portfolio, during the year prior to June 30th of year *t*, in style dimension *l*, where *l* = size, book-to-market or momentum is calculated as follows: $TSD^{l}_{t,m} = \sum_{j=1}^{N}\left(w_{j,t}C^{l}_{j,t} - w_{j,t-1}C^{l}_{j,t-1}\right)$, where $w_{j,t}$ is the portfolio weight on stock *j* as at June 30th of year *t*, $C^{l}_{j,t}$ is the style characteristic of stock *j* in style dimension *l*, as at June 30th of year *t*, $w_{j,t-1}$ is the portfolio weight on stock *j* as at June 30th of year *t-1* and $C^{l}_{j,t-1}$ is the style characteristic of stock *j*, in style dimension *l*, as at June 30th of year *t-1*. The cross-sectional average of TSD in each style dimension *l*, in June of each year *t*, for the fund sample is calculated as follows: $TSD^{l}_{t} = \frac{1}{M}\sum_{m=1}^{M}|TSD^{l}_{m,t}|$. TSD can be broken down into drift that occurs due to the passage of time and drift which is attributed to the trading activities of the manager. Therefore, TSD equates to the aggregate of PSD and ASD. $TSD^{l}_{t} = PSD^{l}_{t} + ASD^{l}_{t}$, where PSD is the change in a style *l* if the manager passively holds the portfolio during year *t*: $PSD^{l}_{t} = \sum_{j=1}^{N}\left(w'_{j,t}C^{l}_{j,t} - w_{j,t-1}C^{l}_{j,t-1}\right)$, where $w'_{j,t}$ is the portfolio weight on stock *j*, as at June 30th of year *t* assuming that the manager employed a buy-and-hold strategy for the entire portfolio over the period *t-1* to *t*, $C^{l}_{j,t}$ is the style characteristic of stock *j*, in style dimension *l*, as at June 30th of year *t*, $w_{j,t-1}$ is the portfolio weight on stock *j*, as at June 30th of year *t-1* and $C^{l}_{j,t-1}$ is the style characteristic of stock *j*, in style dimension *l*, as at June 30th of year *t-1*. Style drift which is due to active trading by the fund manager is calculated as follows: $ASD^{l}_{t} = \sum_{j=1}^{N}\left(w_{j,t}C^{l}_{j,t} - w'_{j,t}C^{l}_{j,t}\right)$, where $w_{j,t}$ is the portfolio weight on stock *j*, as at June 30th of year *t*, $C^{l}_{j,t}$ is the style characteristic of stock *j*, in style dimension *l*, as at June 30th of year *t* and $w'_{j,t}$ is the portfolio weight on stock *j*, as at June 30th of year *t*, assuming that the manager employed a buy-and-hold strategy for the entire portfolio over the period *t-1* to *t*. The cross-sectional average PSD and ASD measures are computed as per the average for TSD. Furthermore, time-series averages over the sample period are also provided for all three measures.

Panel A: Size				
Year	**PSD**	**ASD**	**TSD**	**PSD + ASD**
2003	0.04	0.24	0.23	0.28
2004	0.03	0.17	0.15	0.20
2005	0.06	0.28	0.29	0.34
2006	0.06	0.35	0.34	0.41
2007	0.05	0.30	0.31	0.35
2008	0.02	0.39	0.39	0.41
2009	0.07	0.35	0.39	0.42
2010	0.04	0.25	0.26	0.29
2011	0.04	0.24	0.24	0.27
2012	0.04	0.21	0.23	0.25
Average	0.04	0.28	0.28	0.32

Panel B: Book-to-Market				
Year	**PSD**	**ASD**	**TSD**	**PSD + ASD**
2003	0.18	0.16	0.17	0.33
2004	0.20	0.12	0.22	0.32
2005	0.13	0.22	0.24	0.35
2006	0.12	0.27	0.29	0.39
2007	0.09	0.22	0.22	0.31
2008	0.07	0.27	0.29	0.35
2009	0.09	0.26	0.28	0.35
2010	0.15	0.18	0.20	0.33
2011	0.14	0.17	0.21	0.31
2012	0.10	0.17	0.18	0.26
Average	0.13	0.20	0.23	0.33

Panel C: Momentum				
Year	**PSD**	**ASD**	**TSD**	**PSD + ASD**
2003	0.15	0.18	0.25	0.33
2004	0.13	0.11	0.19	0.24
2005	0.32	0.24	0.38	0.56
2006	0.17	0.29	0.32	0.46
2007	0.19	0.22	0.31	0.41
2008	0.24	0.28	0.33	0.51
2009	0.28	0.27	0.31	0.55
2010	0.24	0.20	0.35	0.44
2011	0.32	0.19	0.37	0.51
2012	0.19	0.16	0.23	0.36
Average	0.22	0.21	0.30	0.44

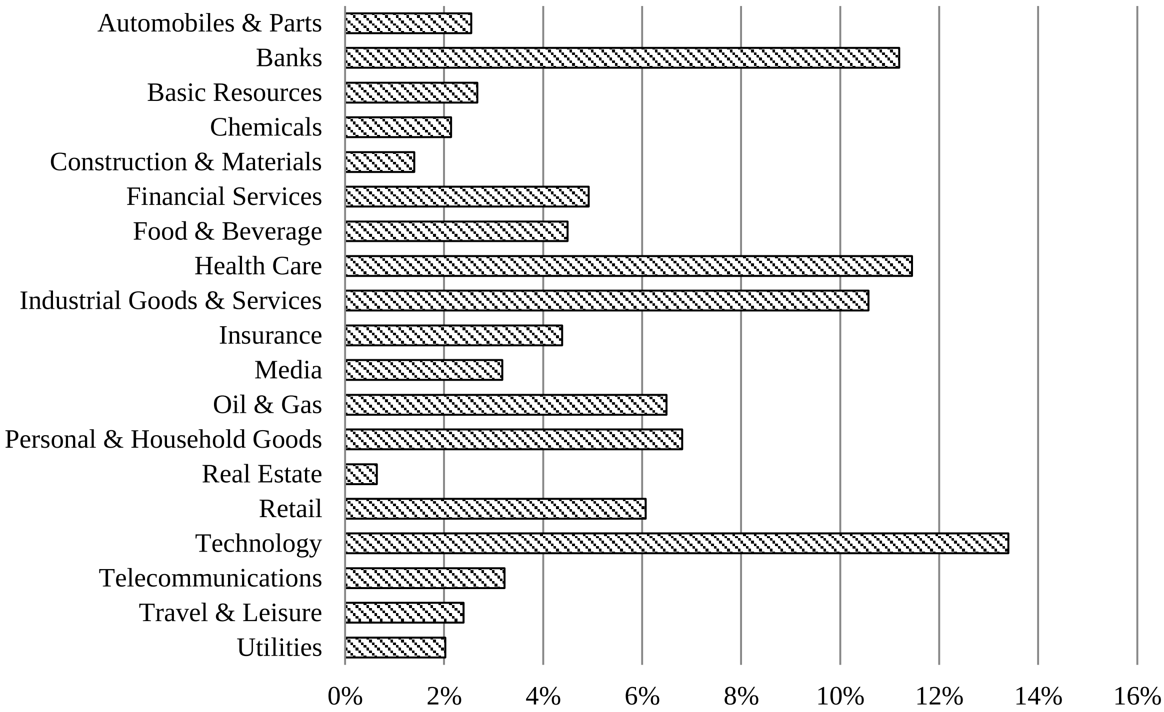
Table 8: Style Drift and Fund Performance

This table presents average quarterly returns from 2004 to 2012 to equally-weighted quintile portfolios of funds, which have been formed at the end of the year prior, based on each fund's average style drift in the size, book-to-market and momentum characteristics. Panel A (B) shows the USD results when ranking based on a fund's Total (Active) Style Drift. Panel C (D) shows the Local Currency (LC) results when ranking based on a fund's Total (Active) Style Drift. All funds existing during a given quarter, in the post-ranking year, are included irrespective of whether or not they were subsequently active. The average returns presented are the pooled average of the post-ranking period quarterly returns to each quintile. Raw Return is the unadjusted quarterly fund return. CS Attribute is the average quarterly fund return, adjusted using the DGTW approach for global stocks, developed in this paper. Specifically, the raw quarterly return to each stock held is adjusted by the quarterly return to one of 64 global benchmark portfolios, assigned in June of each year *t*, using a four by four by four sort, based on the stock's size, book-to-market and momentum characteristics. The global benchmarks comprise MSCI ACWI constituent stocks. Adjusted returns are computed for each stock held, based on the quarterly return to its characteristic-matched benchmark portfolio. *t*-statistics are provided in parentheses below the means.

	Q1 (Low)	Q2	Q3	Q4	Q5 (High)	Q5 - Q1	Q1 (Low)	Q2	Q3	Q4	Q5 (High)	Q5 - Q1
	Panel A: Total Style Drift Rank USD Returns						Panel C: Total Style Drift Rank LC Returns					
Raw Return	2.60***	2.18***	2.78***	2.85***	1.45***	-1.15	2.34***	1.91***	2.39***	2.69***	1.23**	-1.12
	(4.20)	(3.39)	(4.35)	(4.87)	(2.18)	(-1.32)	(4.21)	(3.34)	(4.16)	(5.22)	(2.06)	(-1.43)
CS Attribute	0.30	0.19	0.09	0.07	-0.27	-0.58**	0.34*	0.18	0.07	0.22	-0.25	-0.60**
	(1.62)	(0.96)	(0.43)	(0.35)	(-1.28)	(-2.01)	(1.90)	(0.92)	(0.35)	(1.10)	(-1.20)	(-2.12)
	Panel B: Active Style Drift Rank USD Returns						Panel D: Active Style Drift Rank LC Returns					
Raw Return	2.57***	2.14***	2.71***	2.95***	1.44***	-1.14**	2.34***	1.84***	2.47***	2.64***	1.25***	-1.09**
	(4.12)	(3.39)	(4.20)	(5.01)	(2.17)	(-2.09)	(4.22)	(3.24)	(4.32)	(4.98)	(2.09)	(-2.22)
CS Attribute	0.07	-0.01	0.26	0.29	-0.23	-0.27	0.12	-0.04	0.38*	0.31	-0.21	-0.32
	(0.39)	(-0.05)	(1.21)	(1.41)	(-1.06)	(-1.00)	(0.69)	(-0.21)	(1.78)	(1.58)	(-0.98)	(-1.20)

Figure 1: Average Proportion of Stock Holdings ($US) by Industry as at Dec. from 2002 to 2012

This figure demonstrates the proportion of stock holdings in US dollars, by industry, as at December. The industry classification used is the Industry Classification Benchmark Supersectors obtained from Datastream.



Footnote 11: Stock and Country Selection by Region- Time-Series Average

This table presents the average quarterly excess return attributable to Stock Selection and Country Selection, in each region, for the sample of funds. Total Stock Selection is computed as the weighted sum of the difference between the quarterly return to each stock *i* and the quarterly country return for the same country as stock *i*. Total Country Selection is calculated as the weighted sum of the quarterly return to country *i*, minus the quarterly return to the fund's benchmark. The weight applied is the sum of the portfolio weights by country *i*.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. the Total Country Selection variables are only computed from 2007 to 2012, due to the availability of country weight data required.

Region	Total Stock Selection (%)	Total Country Selection (%)
	0.47**	1.14
Asia-Pacific (DM)	(2.24)	(0.72)
	0.23	1.10
Europe & Middle East (DM)	(1.57)	(0.98)
	0.18	4.21
Asia-Pacific (EM)	(0.56)	(1.14)
	1.46**	4.98
Europe, Middle East & Africa (EM)	(2.32)	(1.19)
	0.24	4.80
Latin America (EM)	(0.26)	(1.13)
	0.57*	-0.01
Japan	(2.08)	(-0.01)
	0.48**	0.92
North America	(2.93)	(0.78)

Footnote 14: DGTW-adjusted Fund Returns using Asset-Weighting

This table presents annual asset-weighted average fund and market performance measures. Panel A provides returns in USD and Panel B demonstrates the corresponding local currency returns, as a robustness test. Individual fund returns are calculated as the weighted average of the stocks held. The holding value of a stock, as at the end of the prior quarter, is the weight applied to that stock's return, over the next quarter. The annual fund returns presented are calculated by first determining the mean return for each quarter, using all funds that existed during that quarter. These four quarterly means are then annualised using simple compounding. Raw Return is the unadjusted holdings-based fund return. MSCI ACWI is the return to the MSCI All-Country World Index, which is calculated using simple compounding of the relevant monthly returns. CS Attribute n=64 provides fund returns adjusted using the DGTW approach for global stocks developed in this paper. Specifically, the raw quarterly return to each stock held is adjusted by the quarterly return to one of 64 global benchmark portfolios, assigned in June of each year *t*, using a four by four by four sort based on the stock's size, book-to-market and momentum characteristics. The global benchmarks comprise MSCI ACWI constituent stocks. Adjusted returns are computed for each stock held based on the quarterly return to its characteristic-matched benchmark portfolio. As a robustness test, two alternative DGTW approaches are presented: CS Attribute n=48 uses a four by four by three sort and CS Attribute n=80 uses a five by four by four sort. Panel C presents the average quarterly Size, Book-to-Market (B/M) and Momentum (MOM) quartiles based on CS Attribute n=64 for the funds. *t*-statistics are in parentheses below the time-series means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. the *t*-statistics for the Size, B/M and MOM quartile averages are relative to an expected value of 2.5.

	Panel A: USD Results					Panel B: Local Currency Results					Panel C: Average Quartiles		
Year	**Raw Return (%)**	**MSCI ACWI (%)**	**CS Attribute n=64 (%)**	**CS Attribute n=48 (%)**	**CS Attribute n=80 (%)**	**Raw Return (%)**	**MSCI ACWI (%)**	**CS Attribute n=64 (%)**	**CS Attribute n=48 (%)**	**CS Attribute n=80 (%)**	**Size Quartile**	**B/M Quartile**	**MOM Quartile**
2002	-18.32	-18.98	-3.57	-4.10	-3.42	-23.29	-23.10	-4.30	-1.12	-4.01	2.35	1.21	1.54
2003	32.37	34.63	-4.28	-4.83	-3.51	23.98	26.36	-4.40	-11.25	-3.66	2.47	1.19	1.48
2004	14.49	15.75	-1.30	-1.51	-1.18	10.23	12.05	-1.71	-4.67	-1.60	2.34	1.36	1.40
2005	13.16	11.37	1.59	2.01	1.88	20.20	17.45	2.39	3.29	2.69	2.33	1.37	1.50
2006	19.05	21.53	-0.95	-0.83	-0.80	15.09	17.04	-1.02	-2.68	-0.95	2.30	1.42	1.49
2007	16.40	12.18	0.48	0.40	0.78	11.79	7.68	0.84	7.39	1.13	2.29	1.45	1.47
2008	-39.14	-41.85	4.85	3.64	4.67	-36.42	-39.17	4.48	1.25	4.21	2.26	1.42	1.62
2009	37.65	35.41	-7.54	-6.70	-7.00	34.50	29.97	-5.67	-11.28	-5.10	2.24	1.35	1.66
2010	15.31	13.21	-2.49	-2.11	-2.11	14.43	11.07	-1.31	-2.68	-0.88	2.21	1.36	1.54
2011	-4.54	-6.86	2.38	2.12	2.55	-3.99	-5.96	2.04	3.53	2.13	2.19	1.39	1.52
2012	16.02	16.80	1.67	1.69	1.42	15.76	16.54	1.43	-1.13	1.22	2.22	1.39	1.71
Average	9.31	8.47	-0.83	-0.93	-0.61	7.48	6.36	-0.66	-1.76	-0.44	2.29***	1.36***	1.54***
	(1.39)	(1.22)	(-0.79)	(-0.94)	(-0.61)	(1.19)	(1.00)	(-0.68)	(-1.00)	(-048)	(-8.63)	(-45.40)	(-35.57)

Footnote 15: DGTW-adjusted Fund Returns- Local Currency Momentum Factor

This table presents annual equally-weighted average fund and market performance measures. Panel A provides returns in USD and Panel B demonstrates the corresponding local currency returns, as a robustness test. Individual fund returns are calculated as the weighted average of the stocks held. The holding value of a stock, as at the end of the prior quarter, is the weight applied to that stock's return, over the next quarter. The annual fund returns presented are calculated by first determining the mean return for each quarter, using all funds that existed during that quarter. These four quarterly means are then annualised using simple compounding. Raw Return is the unadjusted holdings-based fund return. MSCI ACWI is the return to the MSCI All-Country World Index, which is calculated using simple compounding of the relevant monthly returns. CS Attribute n=64 provides fund returns adjusted using the DGTW approach for global stocks, developed in this paper. Specifically, the raw quarterly return to each stock held is adjusted by the quarterly return to one of 64 global benchmark portfolios, assigned in June of each year *t*, using a four by four by four sort based on the stock's size, book-to-market and local currency momentum characteristics. The global benchmarks comprise MSCI ACWI constituent stocks. Adjusted returns are computed for each stock held based on the quarterly return to its characteristic-matched benchmark portfolio. As a robustness test two alternative DGTW approaches are presented: CS Attribute n=48 uses a four by four by three sort and CS Attribute n=80 uses a five by four by four sort. Panel C presents the average quarterly Size, Book-to-Market (B/M) and local currency Momentum (MOM) quartiles based on CS Attribute n=64 for the funds. *t*-statistics are in parentheses below the time-series means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. the *t*-statistics for the Size, B/M and MOM quartile averages are relative to an expected value of 2.5.

	Panel A: USD Returns					Panel B: Local Currency Returns					Panel C: Average Quartiles		
Year	**Raw Return (%)**	**MSCI ACWI (%)**	**CS Attribute n=64 (%)**	**CS Attribute n=48 (%)**	**CS Attribute n=80 (%)**	**Raw Return (%)**	**MSCI ACWI (%)**	**CS Attribute n=64 (%)**	**CS Attribute n=48 (%)**	**CS Attribute n=80 (%)**	**Size Quartile**	**B/M Quartile**	**MOM Quartile**
2002	-17.68	-18.98	-2.91	-1.94	-2.20	-22.92	-23.10	-3.84	-2.97	-3.04	2.34	1.22	1.52
2003	32.92	34.63	-3.42	-3.93	-3.93	24.18	26.36	-4.06	-4.67	-4.41	2.45	1.21	1.50
2004	16.48	15.75	0.15	-0.11	0.05	12.35	12.05	-0.07	-0.37	-0.11	2.32	1.36	1.41
2005	14.05	11.37	2.54	2.68	2.66	21.54	17.45	3.78	3.94	3.84	2.32	1.38	1.50
2006	22.28	21.53	1.96	1.85	2.26	17.70	17.04	1.25	1.18	1.54	2.29	1.42	1.50
2007	17.53	12.18	0.86	0.68	0.62	12.84	7.68	1.17	1.01	0.94	2.28	1.46	1.49
2008	-38.51	-41.85	7.29	5.75	7.31	-36.20	-39.17	6.27	4.77	6.14	2.24	1.43	1.65
2009	37.45	35.41	-9.36	-8.68	-9.56	33.59	29.97	-7.86	-7.26	-7.90	2.23	1.36	1.66
2010	16.27	13.21	-1.98	-1.32	-1.61	15.10	11.07	-0.88	-0.28	-0.61	2.21	1.37	1.53
2011	-3.98	-6.86	2.99	2.52	3.20	-3.52	-5.96	2.50	2.03	2.67	2.18	1.39	1.55
2012	16.44	16.80	2.11	1.85	1.96	16.28	16.54	2.03	1.81	1.93	2.22	1.39	1.72
Average	10.30	8.47	0.02	-0.06	0.07	8.27	6.36	0.03	-0.07	0.09	2.28***	1.36***	1.55***
	(1.54)	(1.22)	(0.02)	(-0.05)	(0.05)	(1.31)	(1.00)	(0.02)	(-0.07)	(0.08)	(-9.69)	(-47.83)	(-34.59)

Footnote 19: CAPM-adjusted Returns by Region

This table provides average annual CAPM-adjusted fund returns in USD by region for 157 long-only active global equity mutual funds from 2002 to 2012. Specifically, the risk-free rate is the US Treasury Bill rate and the market portfolio is the MSCI ACWI, and a 60-month estimation period is used. *t*-statistics are provided in parentheses below the time-series means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

N.B. The average annual fund returns for the region Latin America Emerging Markets are omitted for 2002, 2003 and 2004, due to an inadequate number of sample observations for these years, given the low proportion of stocks held in this region by the funds.

	Developed Markets				*Emerging Markets*		
Year	**Asia-Pacific**	**Europe & Middle East**	**Japan**	**North America**	**Asia-Pacific**	**Europe, Middle East & Africa**	**Latin-America**
2002	5.69	-16.16	-3.58	-20.35	-7.91	64.25	.
2003	13.00	16.77	4.79	5.79	37.29	3.74	.
2004	20.71	14.65	10.22	3.72	5.57	51.33	.
2005	15.08	4.47	20.42	3.84	5.86	41.77	38.58
2006	16.15	15.29	5.28	1.49	13.98	9.30	26.92
2007	38.02	13.67	-3.59	10.02	31.57	16.22	12.92
2008	-17.03	-14.18	-6.22	-14.91	-20.78	4.64	-1.03
2009	37.46	20.10	4.01	17.69	63.79	42.48	73.59
2010	36.35	20.55	27.68	23.79	46.17	46.12	60.11
2011	-20.12	-10.25	-9.79	-4.08	-18.21	-27.97	-16.58
2012	16.41	16.00	4.65	8.45	19.99	22.35	14.70
Mean	14.70**	7.35	4.90	3.22	16.12*	24.93**	26.15**
	(2.48)	(1.73)	(1.44)	(0.83)	(1.99)	(3.07)	(2.44)

Footnote 20: Performance Persistence- Time-Series Averages

This table presents average quarterly returns from 2003 to 2012 to equally-weighted quintile portfolios of funds, which have been formed at the end of the year prior, based on the average quarterly return to each fund, for that year. Only funds with return data for all four quarters are included in the portfolio sort. Fund returns over the following year are then determined. All funds existing during a given quarter, over the following year, are included, irrespective of whether or not they were subsequently active. Panel A provides USD returns for portfolios formed based on the average raw return to each fund in USD and Panel B shows the USD returns when funds are sorted based on their average quarterly CS Attribute performance in USD. Local currency (LC) results are also provided, as a robustness test. Panel C provides the LC returns for portfolios formed based on the average raw return to each fund in LC and Panel D presents the LC results when funds are sorted based on their average quarterly CS Attribute performance, in LC. The average returns presented are the pooled average of the post-ranking period quarterly returns to each quintile. Raw Return is the average unadjusted quarterly fund return. CS Attribute is the average quarterly fund return adjusted using the DGTW approach for global stocks, developed in this paper. Specifically, the raw quarterly return to each stock held is adjusted by the quarterly return to one of 64 global benchmark portfolios, assigned in June of each year *t*, using a four by four by four sort based on the stock's size, book-to-market and momentum characteristics. The global benchmarks comprise MSCI ACWI constituent stocks. Adjusted returns are computed for each stock held based on the quarterly return to its characteristic-matched benchmark portfolio. *t*-statistics are provided in parentheses below the means.

***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	Q1 (Worst)	Q2	Q3	Q4	Q5 (Best)	Q5 - Q1	Q1 (Worst)	Q2	Q3	Q4	Q5 (Best)	Q5 - Q1
	Panel A: Raw Return (USD) Rank USD Returns						Panel C: Raw Return (LC) Rank LC Returns					
	2.17	2.70	2.53	2.83	3.40	1.23*	2.16	2.19	2.03	2.58	2.86	0.71
Raw Return	(1.26)	(1.51)	(1.43)	(1.66)	(1.80)	(1.90)	(1.33)	(1.30)	(1.26)	(1.73)	(1.65)	(1.13)
	-0.66	-0.29	-0.20	0.17	0.51	1.17*	-0.35	-0.34	-0.25	0.33	0.37	0.72
CS Attribute	(-1.72)	(-0.81)	(-0.53)	(0.43)	(0.75)	(2.06)	(-1.16)	(-1.25)	(-0.72)	(0.77)	(0.64)	(1.21)
	Panel B: CS Attribute (USD) Rank USD Returns						Panel D: CS Attribute (LC) Rank LC Returns					
	2.28	2.68	2.67	2.91	3.31	1.03	2.08	2.27	2.02	2.39	2.99	0.91
Raw Return	(1.29)	(1.59)	(1.48)	(1.69)	(1.73)	(1.72)	(1.33)	(1.38)	(1.30)	(1.51)	(1.72)	(1.70)
	-0.67	-0.21	-0.06	0.11	0.54	1.20*	-0.47	-0.37	-0.14	0.09	0.60	1.07**
CS Attribute	(-1.75)	(-0.48)	(-0.22)	(0.54)	(0.84)	(2.15)	(-1.40)	(-1.13)	(-0.45)	(0.25)	(1.12)	(2.19)

Chapter 6: Conclusions and Future Research Directions

In this thesis, I present four research studies which all investigate investment strategies/styles and the performance of actively managed funds. The first essay investigates the investment style called Quality for a sample of US funds, with the second providing an extension of this approach to the Australian market. The third develops forecasts of style factors using macroeconomic and market data to determine whether a style timing strategy is viable at the stock and/or the FoF level in the US. Finally, the fourth study provides a review of global equity fund performance using a unique dataset of stock holdings. The examination of these three areas of equity investment management was selected in order to contribute academically by extending the mutual fund literature.

In Chapter 2, I presented the study “Portfolio Quality and Mutual Fund Performance”, in which I develop a measure of stock quality called a Q-Score, which is the aggregate of 14 accounting metrics. The stocks with the lowest Q-Scores underperform significantly on average, whilst their higher quality counterparts do not generate significant positive returns. However, during stressful market periods, the highest quality stocks outperform the lowest quality stocks. This measure is then applied to a sample of US mutual funds’ stock holdings, in order to investigate how the quality of a portfolio relates to fund performance. Similar to the stock level results, low quality funds underperform significantly on average, whilst a return premium is not identified for high quality funds. However, the higher quality funds provide downside protection amid crises. Overall, the results from this study are consistent with the flight-to-quality phenomenon.

A weakness of the research undertaken in Chapter 2 is that it only examines the equity portion of the funds’ holdings. The notion of downside protection is often considered at the asset allocation level, i.e., the transition of assets between equities and bonds. Evidently, by only analysing the quality of the equity holdings of the funds, I may have missed the effect that the funds’ holdings of other assets, particularly bonds, has in stressful periods, e.g. if a fund decreases its equity holdings leading up to, or during, a crisis in favour of less risky assets within a different asset class. Future research investigating how a timing strategy could be used to take advantage of the downside protection offered by high quality equities would be interesting. In addition, this could be further enhanced by incorporating other asset classes, to see how timing could be used across asset classes within a fund's portfolio, and across groups of funds.

Chapter 3 comprises the study "Quality Investing in an Australian Context", in which I provide an extension of the US research on quality to the Australian market. An Australian version of the Q-Score is developed which encompasses eight of the 14 metrics used for the US study. In contrast to the US results, a quality return premium is identified, with high quality stocks generating significant positive returns on average. Similar to the US, low quality stocks underperform significantly on average. Interestingly, segmentation based on size first and quality second, reveals that the quality return premium is greatest for small stocks. Evidence of downside protection amidst crises is also determined at the stock level. However, using a sample of Australian funds, weak evidence that the quality return premium exists at the fund level is determined.

As with the paper in Chapter 2, the Australian quality research in Chapter 3 only investigates the equity portion of the funds' holdings. Furthermore, the sample of funds is sourced from a proprietary database, given that funds in Australia are not required to report their holdings periodically to a regulatory body. Therefore, the sample is not as comprehensive as that used for the US analysis. In addition, there is no consideration of the impact of market frictions on the profitability of the strategy. Thus, although the evidence indicates that there is a quality return premium, particularly at the stock level, further research investigating how exploitable this is in practice would be interesting.

Chapter 4, titled "Style Factor Timing: An Application to the Portfolio Holdings of US Funds", develops a style timing strategy based on style factor forecasts created using macroeconomic and market data in the US. A style timing strategy which alternates between value, size, momentum and quality factors generates statistically significant positive returns on average at the stock level, although using the style factor forecasts as signals for a FoF timing strategy does not prove to be viable. Further investigations reveal that this is due to the fact that the style factors are constructed as long-short portfolios, whilst the sample funds are long-only. Therefore, the funds are not able to exploit the short side, which is identified as the driver of the style factor returns.

The research in Chapter 4 highlights that the use of long-short style factors to evaluate the performance of long-only funds may not be appropriate. A future research direction could be to investigate how the nature of factor construction affects the results determined for popular performance evaluation models such as the three-Factor and four-Factor models. In addition, market frictions, such as transaction costs, are not accounted for in the assessment of the profitability of the stock level timing strategy. Thus, future research quantifying how transaction costs affect the performance outcome of the strategy would be useful. Furthermore, given that a style timing strategy at the FoF level did not prove to be viable, there are a number of alternative approaches to style timing which future research could focus on. For example, the use of a base FoF portfolio whose style characteristics are then adjusted over time by adding or removing funds with the desired or unfavourable characteristics. Moreover, the use of derivative products such as Futures or ETFs to change the nature of the FoF's style characteristics is also worthy of further investigation. Additionally, investigation of the profitability of a style timing strategy within mutual fund portfolios, i.e., not at the FoF level, would also be an interesting extension.

Chapter 5 provides the final research essay, namely "Global Equity Fund Performance", which undertakes a review of the performance of global equity funds. A benchmark attribution of market-adjusted returns is undertaken, which reveals that managers exhibit positive stock selection on average, whilst country selection is driven by less efficient emerging markets. This paper also develops a set of DGTW-inspired global characteristic benchmark portfolios in order to examine risk-adjusted performance. After controlling for size, book-to-market and momentum effects, no evidence of stock selection skill is identified. However, evidence of persistence in performance is detected. Furthermore, weak evidence that style consistent managers outperform those that drift is determined.

The research in Chapter 5 is limited by the sample size, with further dissections, e.g. computation of the DGTW Characteristic-Timing (CT) measure to assess timing skill and timing skill by region, not viable[1]. Moreover, the holdings data are for a representative portfolio of stocks for the funds examined and thus do not reflect the actual value of assets under management in each period. Furthermore, the DGTW results appear to be affected by some currency and/or timing effects, thus future research focused on mitigating these issues is desirable.

[1] The CT measure requires portfolio weights for quarter *t-5*, which reduces the sample size relative to the CS measure which only requires data lagged by one quarter.

The aim of this thesis is to investigate the efficacy of equity investment strategies and styles by conducting original empirical research in order to guide decisions-makers when constructing actively managed equity portfolios. It is important to conduct such research, as it provides information for institutional investors, advisors and market participants. Evidently, the research in Chapters 2 and 3 indicates that quality stock holdings provide funds with downside protection during market crises. Furthermore, Chapter 4 demonstrates that a style timing strategy in a multi-manager setting is not viable, and is best approached alternatively. Finally, Chapter 5 provides a foundation of information for global equity funds. Overall, the four chapters in this thesis present rigorous research which adds to the mutual fund literature and also has practical applications within the investment management industry.

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