UK Equity Mutual Fund Alphas Make a Comeback

This version: October 2015

In this study we re-visit the performance of 887 active UK equity mutual funds using a new approach proposed by Angelidis, Giamouridis and Tessaromatis (2013). The authors argue that mutual funds stock selection is driven by the benchmark index, so if the benchmark generates alpha, there will be a bias in interpretation of manager's stock picking ability. In their model, alpha of a fund is adjusted by benchmark's alpha. By applying this method, we eliminate bias inflicted by the persistently negative alphas of FTSE 100 index in the period 1992-2013. We find that adjusted Fama-French and Carhat alphas of UK equity mutual funds are higher than those implied by the standard three and four factor models and overall positive, contrary to most of the existing literature on UK fund performance. This result is consistent across funds' investment styles and robust to use of FTSE Small Cap as benchmark for a subsample of small cap funds.

Keywords: Fama-French, Carhart, adjusted alphas, UK equity funds performance
JEL classification: G11, G12, G23

1. Introduction and Literature Review

In this paper we re-visit the question of performance of active UK equity mutual funds by modifying the Fama and French (1993) three-factor (FF3 hereafter) and the Carhart (1997) four-factor models using Angelidis, Giamouridis and Tessaromatis (2013) approach. The FF3 and Carhart models are widely accepted, standard methods of estimation of abnormal returns and portfolio manager's security selection ability (alpha) by many researchers, investors and investment practitioners internationally. Angelidis et al. (2013) argue that security selection in a fund is largely driven by the composition of a selected benchmark; so if the benchmark itself generates significant out/underperformance in the standard performance evaluation models, then investors' interpretation of manager's stock picking ability is biased. To correct for this bias, authors alter the left-hand side of the Carhart (1997) model by replacing excess return of a fund (relative to the risk free rate) with benchmark-adjusted return. Their modification produces a new fund alpha adjusted for the alpha embedded in the benchmark. Such a new alpha therefore represents managers' 'true' stock-picking ability. Angelidis et al. (2013) test the model on a sample of US equity mutual funds and report that benchmark-adjusted alphas are less negative and less statistically significant than the Carhart ones. We believe that this method provides a useful novel insight into performance measurement that is of interest to academics and, in particular, investment professionals. We contribute to the literature by being the first study to re-visit UK equity mutual fund performance utilising this new methodology.

A significant strand of recent academic literature criticises FF3 and Carhart models with specific emphasis on the fact that factor misspecification leads to presence of non-zero alpha in passive indices used as benchmarks in performance measurement. For instance, Chan, Dimmock, and Lakonishok (2009) report a negative and statistically significant alpha for the Russell 2000 Growth index. Cremers, Petajisto and Zitzewitz (2012) reveal an annual Carhart alpha in the S&P 500 index of 0.82% (t=2.78) and in the Russel 2000 that of –2.41% (t = –3.21) for the sample period from 1980 to 2005. Such positive (negative) index alphas would create an upward (downward) bias in a performance of funds benchmarking against those indices.

One of the explanations of significant index alphas offered in literature is the error in the construction of the risk factors FF3 and Carhart models specify; namely: the market risk premium, the size factor (SMB, defined as the return of the small capitalisation minus the return of the large capitalisation portfolio), the style factor (HML, defined as the difference in returns of high vs. low book-to-market ratio stocks. i.e. value vs growth stocks) and the momentum factor (return difference between past winners and past losers portfolio). Cremers et al. (2012) suggest several causes of these errors: first, the FF3 model overweights stocks in the small value portfolio, which outperformed during the specified time period, exaggerating the return on the SMB factor; second, value-weighted excess return obtained from CRSP includes non-U.S. shares, which underperformed U.S. common stocks during the sample period; third, annual changes to the indexes contribute to negative index alphas especially for small-capitalization indices. The authors propose reconstruction of factors to obtain modified Fama-French-Carhart models that reduce passive index alphas significantly and produce less out-of-sample tracking error volatility when used to explain actively managed mutual fund returns. Similarly, Huij and Verbeek (2009) argue that factor proxies systematically bias the performance estimates of mutual funds caused from miscalculating the factor premiums which are either over- or underestimated. Costa and Jakob (2006) document significant non-zero alphas and significant factor loadings on the momentum factor in the Carhart model for a large set of stock market indexes. Recent Fama and French (2012) study confirms that there is a concern with factor portfolios formed on size and momentum in the FF3 model. They examine the size, value, and momentum in individual stocks returns across four regions (North America, Japan, Europe and Asia-Pacific) to test whether the value and momentum patterns in international returns are captured by FF3 and Carhart models. The results show consistent risk premia across markets.

Given the evidence from these studies, some adjustments to the existing FF3 and Carhart models are of essence for the improved performance measurement. One such adjustment is related to incorporating the fund's benchmark returns in the models, as highlighted by Cremers, Petajisto and Zitzewitz (2012). Hsu, Kalesnik and Myers (2010) propose a dynamic allocation attribution methodology based on the traditional Brinson attribution. It includes the adjustment for static and dynamic factor allocation and authors state that "normal portfolio" which represents a manager's preferred allocation can be used as a benchmark when no explicit benchmark exists. Further, Angelidis, Giamouridis and Tessaromatis (2013) adjust the mutual fund returns for the returns of the fund's self- reported benchmark. They argue that a mutual fund performance should be measured relative to its self-designated benchmark and the use of market implicit benchmark rather than self-designated benchmarks biases the current academic performance evaluation practices. Nevertheless, Angelidis et.al (2013) state that their approach can utilise any benchmark a fund wishes to measure their performance against. Note that the choice of self-reported benchmark by funds is not always clear. For example, Sensoy (2009) finds evidence that self-designated benchmarks are persistently mismatched by mutual funds, which may be explained by the funds' strategic incentives to improve inflows. The paper stresses the need for the development and dissemination of measures of mutual fund performance that are both well-grounded in economic theory and not subject to gaming.

Let us review now what is known so far about UK fund performance. Relative to the large number of U.S. studies[1], there has been comparatively fewer studies examining the ex-post performance of mutual funds in the UK. The vast majority of existing UK studies utilise standard unconditional CAPM, FF3 and Carhart models to estimate fund alphas. UK studies corroborate findings from the US, providing stronger evidence in support of fund underperformance than fund outperformance. For instance, Cuthbertson, Nitzsche and O'Sullivan (2008) apply cross-section bootstrap methodology and report stock picking ability among a relatively small number of top performing UK equity mutual funds suggesting that UK equity investors will be better off holding index/tracker funds. Further work by Cuthbertson, Nitzsche and O'Sullivan (2012) based on false discovery rate approach show that only around 3.7% of all funds truly outperform their benchmarks versus 22% of funds which truly underperform their benchmarks. Earlier studies such as Blake and Timmermann (1998) assess UK open-end mutual funds and find evidence of underperformance on a risk-adjusted basis by the average fund manager. On a positive note, they point at the weekly fund outperformance within the first year of inception.

Since the FF3 and Carhart model alphas are commonly used as measures of performance in the range of studies discussed here, and the recent literature points at biases in these measures, we believe that re-evaluation of UK mutual fund performance based on *adjusted* factor model is needed. In this study, we contribute to the UK mutual fund performance literature by applying Angelidis et al. (2013) methodology to re-examine the performance of active UK equity mutual funds. We do not claim that Angelidis et al. (2013) is the best model for adjusting FF3 and Carhart alphas and it is not the purpose of the present paper to

[1] See for instance: Pastor and Stambaugh (2002), Wermers (2000), Daniel et al. (1997), Carhart (1997), Grinblatt et al. (1995) among others.

determine which one is. However, it is a model that not only has academic rationale, but it may also resonate well with practitioners as a) it is less computationally intense than some of the models that require reconstruction of risk factors (e.g. Cremers et al., 2012) and b) it transforms the left hand side of the FF3/Carhart model into excess return of the fund relative to the benchmark; which is core to determining a fund's tracking error – a primary risk matric for investment professionals. To the best of our knowledge, this paper is the first study of active UK equity mutual fund performance using Angelidis et al. (2013) proposed adjustment to the standard FF3 and Carhart models. Such a new take on performance will help investors shed a better light on the choice between active and index tracker funds and revise the previous work on UK fund performance. Therefore, the key question in this paper is whether UK equity fund performance is underestimated by traditional models and whether investors on average actually generate better alphas than existing evidence might suggest. The reader should note that while alpha of a fund may be biased, a fund's ranking may not be; nevertheless, the research into individual fund rankings before and after alpha adjustment is not the focus of this paper.

Our data set includes 887 active UK equity mutual funds for the period January 1992 to October 2013 and FTSE 100 index as the benchmark for the UK focused funds. We identify a significant *negative* FF3 alpha of -1.12% and Carhart alpha of -1.13% of the FTSE 100 index, implying a downward bias in fund performance. Further, we document that this bias is stronger in bear markets. During our period of analysis, the standard FF3 alpha for our sample of funds is only 14bps per year and not strongly significant. By applying the Angelidis et al. (2013) method, the adjusted FF3 alpha of 887 funds increases tenfold to 144bps, significant at 1% level. Similar strong improvement in alphas is confirmed across the bull and particularly the bear sub-sample periods. We also examine if good (or bad) performance is particularly related to an investment style of a fund. Splitting the funds into Morningstar style box categories, we document that performance was biased downward across all style categories when standard FF3 and Carhart models are used. After model alteration, we report that Small/Value and Small/Growth categories are generating positive adjusted alphas in four out of five sub-sample periods, making them the most successful segments of the market in the period analysed. We test the robustness of these results by replicating the analysis for a sub-sample of small capitalisation funds using FTSE Small Cap as a benchmark. We confirm all the previous findings and report even stronger significance of both adjusted alphas and the differences between adjusted and standard alphas. Overall, our study shows that standard FF3 and Carhart models amplify the underperformance of mutual funds reported in previous literature. Our computation of adjusted alphas proves that UK equity fund performance is better than initially documented and significantly positive.

The remainder of the paper is organised as follows: Section 2 describes our data, Section 3 presents the methodology, Section 4 lays out the main results, Section 5 presents robustness check and Section 6 concludes the paper.

2. Data and Methodology

2.1 Data description

The data set comprises of 887 actively managed equity mutual funds with UK investment focus. The net monthly returns of mutual funds are from Morningstar, inclusive of dividends. There is no survivorship bias in the sample. We use FTSE 100 index as a benchmark for measuring performance of our funds. This index represents 80% of UK market capitalisation and is commonly regarded as a proxy of the UK market performance. While our funds follow various investment styles (from Morningstar style box, as discussed in Section 4.3), indices covering combinations of styles such as medium/value, small/growth etc. are not available in the UK and mainstream UK funds still resort to a general market index as benchmark[2]. Therefore, we choose an index commonly used to represent UK market trends – the FTSE 100. The returns of the FTSE 100 index (inclusive of dividends) are from Datastream. We provide a robustness check with FTSE Small Cap index as a benchmark for funds in the small capitalisation category and provide a short discussion on use of other style benchmarks in Section 5. The monthly FF3 and Carhart factors for the UK, as well as the UK risk free rate are defined as in Gregory, Tharyan and Christides (2013) and obtained from University of Exeter, Xfi Centre for Finance and Investment website[3]. The period of analysis spans from January 1992 to October 2013. We split the sample into five bull and bear sub-periods, as follows: January 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013 (bull markets); January 2000 to December 2002 and January 2008 to December 2009 (bear markets)[4].

[2] http://www.morningstar.co.uk/uk/news/58752/understanding-benchmarks.aspx
[3] http://business-school.exeter.ac.uk/research/areas/centres/xfi/research/famafrench/files/
[4] The FTSE 100 annualized return for the five periods analysed are the 11.04%, 9.22% and 9.25% (bull market periods) and -19.07% and -6.70% (bear market periods). We consider the dot.com bubble burst and recent financial crisis as bear periods.

2. 2. Preliminary Analysis: Alpha of the FTSE 100 Index

The Fama and French (1993) three-factor model and the Carhart (1997) four-factor model have been accepted in the industry as standard models for assessing portfolio alpha-generating ability. As discussed earlier, recent literature such as Cremers et al. (2012), points at the presence of significant positive or negative alphas in US passive benchmark indices. We therefore start by assessing the level of FF3 alpha (equation (1)) and Carhart alpha (equation (2)) over the time period *t* in the passive index commonly used as the UK market benchmark – the FTSE 100:

$$R_{FTSE100,t} - R_{F,t} = \alpha_{FTSE100} + \beta_M\left(R_{M,t} - R_{F,t}\right)_t + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t \qquad (1)$$

$$R_{FTSE100,t} - R_{F,t} = \alpha_{FTSE100} + \beta_M\left(R_{M,t} - R_{F,t}\right) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t \qquad (2)$$

where, $\alpha_{FTSE100}$is the excess return of the FTSE100 for period t, $R_{FTSE100,t}$ is the total index monthly return (inclusive of dividends), R_{Ft}, is risk free rate, R_{Mt} is the total monthly return (inclusive of dividends) of the UK equity market proxied by FTSE All Share Index as defined in Gergory et al. (2013), *SMB* and *HML* are Fama and French (1993) size (small minus big returns) and value (high minus low book-to-market returns) factors respectively, *WML* is Carhart (1997) the momentum (winner minus loser returns) factor.

If the performance estimation models in equations (1) and (2) are correctly specified, the FTSE 100, being a broad passive index, should not generate any (positive of negative) abnormal return. However, if it does, the performance of a mutual fund benchmarking against that index will be biased upward (if the index alpha is positive) or downward (if the index alpha is negative).

Figure 1 illustrates 3-year moving average of FTSE 100 (FF3 and Carhart) alphas over our sample period. The alpha values are annualised and given in basis points. The figure reveals persistent negative alpha of the index throughout the period. More extreme negative alpha coincides with the global financial crisis period of 2008-2010, while less extreme alpha values (and even a small positive FF3 alpha of 20bps) are recorded in the late 1990s, a period of dot.com boom and a strong bull market. These inconsistencies in non-zero alphas of FTSE 100 in different market states (bull vs. bear) lead to conjecture that mutual fund performance is more undervalued in bear markets and less undervalued (or overvalued in case of positive index alpha) in the bull markets.

Figure 1: FTSE100 alpha

The following regressions are estimated $R_{FTSE100,t} - R_{F,t} = \alpha_{FTSE100,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ and $R_{FTSE100,t} - R_{F,t} = \alpha_{FTSE100,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$ for the period for January 1992 to October 2013. Monthly alpha is calculated for a three years (36 months) moving average (presented below in annual basis point). $R_{FTSE100,t} - R_{F,t}$ is the excess return on the FTSE 100 index including dividends in period *t*, $R_{F,t}$ is the risk-free rate in period *t*, α (alpha/constant) is the Fama-French and Carhart performance estimate, $(R_{M,t} - R_{F,t})$ is the market risk premium in period *t*, SMB and HML are Fama and French (1993) size and value factors respectively, WML is Carhart (1997) momentum factor and $\varepsilon_{i,t}$.is the error term. The monthly risk factors and risk free rate are collected from University of Exeter, Xfi Centre for Finance and Investment website

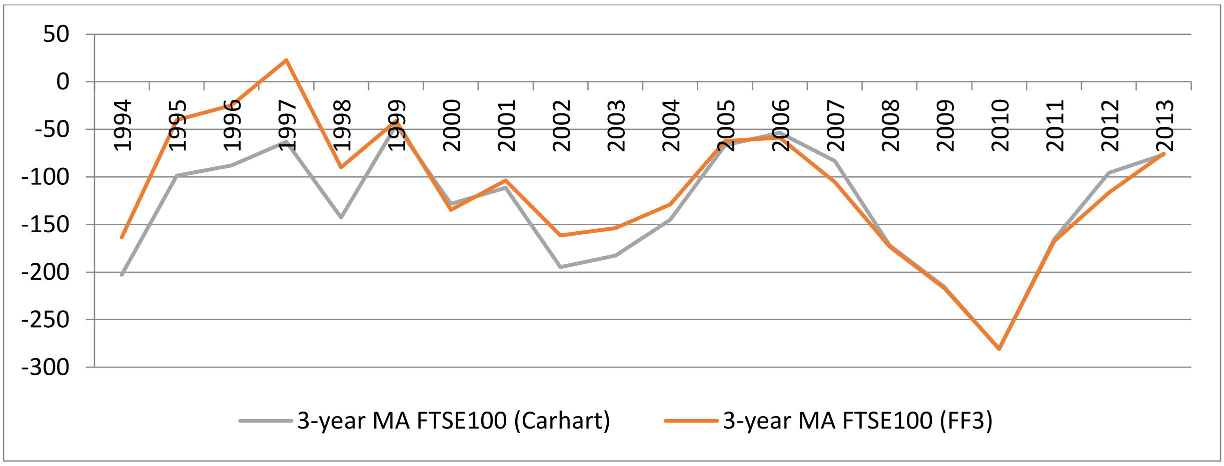


Table 1 takes a closer look at FTSE 100 performance in the overall sample period and in the bull and bear markets. Specifically, Table 1 lays out the FF3 and Carhart alphas of FTSE 100 index in the overall sample period and in five sub-periods. The FTSE 100 index generates a statistically significant *negative* FF3 alpha of -1.12% and Carhart alpha of -1.13% (both significant at 1% level) per annum for the entire sample period January 1992 – October 2013.

Table 1: FTSE 100 Index Alpha regressions

The table reports alpha (intercept) per month and per year (in bps) from the following three- and four-factor model regressions: $R_{FTSE100,t} - R_{F,t} = \alpha_{FTSE100,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ and $R_{FTSE100,t} - R_{F,t} = \alpha_{FTSE100,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$ for the period for January 1992 to October 2013. $FTSE_{TR_t} - RF_t$ is FTSE100 monthly total return in excess to the risk free rate. RF is the monthly risk free rate. α (alpha) is the constant term and $\varepsilon_{i,t}$.the error term. P-values in parenthesis. Superscript *indicate statistical significance at 1% (***), 5% (**) and 10% (*) levels. Alphas are reported for the total sample period (January 1992-October 2013) and for five sub-periods. The number of months and adjusted R-squared from the three-factor and four-factor model are also reported.

Period and Model used	Alpha per month	Alpha p.a. in bps	Market Beta	SMB	HML	WML	Number of Months	Adj. R-squared
Total Sample	-0.0009383***	-112.017***	1.01***	-0.132***	-0.017***	---	262	0.9944
FF3	(0.000)		(0.000)	(0.000)	(0.002)			
Total Sample	-0.0009476***	-113.121***	1.01***	-0.132***	-0.017**	0.001	262	0.9944
Carhart	(0.000)		(0.000)	(0.000)	(0.013)	(0.871)		
1992:01 to 1999:12	-0.0003979	-47.6436	0.99***	-0.191***	-0.037***	---	96	0.9910
FF3	(0.301)		(0.000)	(0.000)	(0.000)			
1992:01 to 1999:12	-0.0005798	-69.3546	0.99***	-0.189***	-0.024	0.019	96	0.9911
Carhart	(0.157)		(0.000)	(0.000)	(0.129)	(0.204)		
2000:01 to 2002:12	-0.0013565**	-161.571**	1.02***	-0.107***	0.001	---	36	0.9965
FF3	(0.023)		(0.000)	(0.000)	(0.927)			
2000:01 to 2002:12	-0.0016378***	-194.775***	1.03***	-0.108***	0.015	0.019**	36	0.9969
Carhart	(0.005)		(0.000)	(0.000)	(0.203)	(0.029)		
2003:01 to 2007:12	-0.0008271***	-98.8017***	0.99***	-0.139***	-0.010	---	60	0.9967
FF3	(0.000)		(0.000)	(0.000)	(0.390)			
2003:01 to 2007:12	-0.0008051***	-96.1853***	0.99***	-0.139***	-0.011	-0.003	60	0.9966
Carhart	(0.001)		(0.000)	(0.000)	(0.360)	(0.712)		
2008:01 to 2009:12	-0.0024236***	-286.986***	1.03***	-0.087***	-0.050***	---	24	0.9989
FF3	(0.000)		(0.000)	(0.000)	(0.008)			
2008:01 to 2009:12	-0.0023247***	-275.425***	1.03***	-0.079***	-0.046**	0.009	24	0.9989
Carhart	(0.000)		(0.000)	(0.000)	(0.017)	(0.293)		
2010:01 to 2013:10	-0.0009215***	-110.021***	0.99***	-0.087***	0.006	---	46	0.9983
FF3	(0.001)		(0.000)	(0.000)	(0.646)			
2010:01 to 2013:10	-0.0007313***	-87.4039***	0.99***	-0.093***	-0.002	-0.014	46	0.9984
Carhart	(0.000)		(0.000)	(0.000)	(0.868)	(0.145)		

Moreover, non-zero annual alphas for the index have larger negative values in bear markets (ranging from -1.61% to -2.86%) then in bull markets (-0.47% and -1.10%). This difference is substantial, therefore being of economic significance to investors. Negative FTSE100 index alphas from Table 1 infer that the performance of UK funds benchmarking against FTSE 100 will be undervalued by the standard FF3 and Carhart models[5]. Such underperformance will particularly be amplified in bear markets. Once the models are modified to correct for the presence of negative benchmark index alpha, we expect the adjusted mutual fund alphas in bear markets to shift *upwards*.

[5] Note that the performance of funds benchmarking against indices whose alphas have positive values, the performance will be overstated.

Prior UK studies show strong evidence of underperformance of UK mutual funds, as seen in Blake and Timmermann (1998), Quigley and Sinquefield (2000), Cuthbertson, Nitzsche and O'Sullivan (2008) among others. The negative FTSE 100 alphas from the standard FF3 and Carhart models in our study are at least in part covering the period of analysis in a number of these UK studies. Therefore, the use of misspecified performance evaluation models in these studies, which lead to negative benchmark alphas, may be the reason behind the evidence of persistent underperformance of UK mutual funds. It is then imperative that the UK mutual fund performance is re-assessed using the adjusted FF3 and Carhart models suggested in recent literature on performance measurement, such as Angelidis et. al. (2013).

2.3. Evaluating Mutual Fund Performance: Standard vs. Adjusted FF3 and Carhart Alphas

For each equity mutual fund *i* in our sample, we first estimate the standard FF3 factor and Carhart four-factor model alphas as per equations (3) and (4).

$$R_{i,t} - R_{F,t} = \alpha_i + \beta_{i,M}\left(R_{M,t} - R_{F,t}\right)_t + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t \qquad (3)$$

$$R_{i,t} - R_{F,t} = \alpha_i + \beta_M\left(R_{M,t} - R_{F,t}\right) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t \qquad (4)$$

where $R_{i,t}$ is the return of a mutual fund *i* in period *t*, α_i is the excess return of the fund *i* over period *t* and the rest of the variables are described as per equations (1) and (2).

Next, we apply Angelidis, Giamouridis and Tessaromatis (2013) adjustment to FF3 and Carhart model (AGT-adjustment hereafter) that accounts for benchmark index performance and consequently improves the accuracy of measuring the funds' excess returns:

$$R_{i,t} - R_{FTSE100,t} = \alpha_i^* + \beta_{i1}^*\left(R_{M,t} - R_{F,t}\right) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + e_i^* \qquad (5)$$

$$R_{i,t} - R_{FTSE100,t} = \alpha_i^* + \beta_{i1}^*\left(R_{M,t} - R_{F,t}\right) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + \beta_{i4}^*WML_t + e_i^* \qquad (6)$$

where $R_{i,t} - R_{FTSE100,t}$ is the excess return of a mutual fund *i* over the FTSE 100 index in period *t*, α_i^* is the difference of the fund's and benchmark's FF3 (Carhart) alpha estimated in equations (3) and (1) (equations (4) and (2)); i.e. AGT-adjusted alpha hereafter. Additionally if the excess Beta ($\beta_{i1}^*, \beta_{i2,}^*\beta_{i3,}^*\beta_{i4}^*$) is different from zero (again obtained as the difference in betas between equation (3) and (1) or (4) and (2) in FF3 and Carhart model respectively) the manager has a portfolio in which beta differs from that of the FTSE 100. As an example, if the estimated SMB beta is 0.1 means that the fund's is 10 percent more exposed to small stocks than the benchmark.

4. Results

4.1. Standard FF3 and Carhart alpha of UK mutual funds

Using equations (3) and (4) and a fixed effects panel model estimation procedure we obtain standard FF3 and Carhart alphas for 887 funds in our sample[6]. The results of for five sub periods and the overall sample period are reported in Table 2.

Without the adjustment for the negative FTSE 100 alpha in the whole sample period, we find a positive annual FF3 alpha for our 887 equity mutual funds of 0.14% (13.81bps p.a., significant at 10% level) and a negative Carhart alpha of -0.29 % (28.76bps p.a., significant at 1%). In the sub-periods, funds exhibit higher standard alphas in the bull periods than in bear markets. The strongest positive alphas are recorded in the last bull period in our sample (2010-2013). However, while being statistically significant, they do not add great economic value to investors: FF3 alpha is 1.04% p.a. and Carhart only 0.69% p.a. in 2010-2013. With all WML coefficients throughout sub-periods being positive and significant at 1% level, there is evidence of strong managers' ability to successfully pick winner stocks and sell losers in their portfolios. In spite of this, funds' performance still results in a negative standard Carhart alpha in the overall period and most of the sub-periods. This further adds to the fact that if the benchmark index alphas are negative over the estimation period, the performance of funds benchmarking against that index is underestimated according to standard alpha models.

Hence, the performance estimates reported in Table 2 are not showing accurate reflection of UK equity mutual fund performance. Coefficient for SMB risk factor is positive in all sub-periods indicating presence of small cap risk in the funds, while the evidence on the presence of value/growth style risk is mixed (coefficients varying from positive to negative) across sub-periods. Section 4.3. will provide further insight into performance of funds in our sample by their investment style.

[6] Hausman test statistic was used to choose between the fixed and random effects estimation.

Table 2: Fixed Effects Panel FF3 and Carhart regressions for UK Equity Mutual Funds returns:

The sample consists in 887 unique UK Equity Mutual Funds and 123,768 monthly observations over the period January 1992 to October 2013. The following regressions are estimated $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ and $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$. Monthly alpha is calculated for a five different time periods: January, 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013 (bull market) and January 2000 to December 2002 and January 2008 to December 2009 (bear market). Alphas from benchmark index are collected from table 3. $R_{i,t} - R_{F,t}$ is the excess return on equity mutual fund *i* for month *t*. $R_{F,t}$ is the risk-free rate in period *t*, α (alpha/constant) is the Fama-French and Carhart performance estimate, $(R_{M,t} - R_{F,t})$ is the market risk premium in period *t*, SMB and HML are Fama and French (1993) size and value factors respectively, WML is Carhart (1997) momentum factor and $\varepsilon_{i,t}$.is the error term. The monthly risk factors and risk free rate are collected from University of Exeter, Xfi Centre for Finance and Investment website. P-values in parenthesis. Superscript *indicate statistical significance at 1%(***), 5% (**) and 10% (*) levels.

Period	Alpha Measure	Equity Mutual Fund Alpha p.a. (in %)	Market Beta	SMB	HML	WML	Number Funds	Observations	Adj. R-squared
Total Sample	***FF3***	13.81*	0.9357***	0.2355***	0.00066	---	887	123,768	0.7902
		(0.057)	(0.000)	(0.000)	(0.716)				
Total Sample	***Carhart***	-28.76***	0.94064***	0.24689***	0.02501***	0.03351***	887	123,768	0.7910
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
1992:01to 1999:12	***FF3***	32.45**	0.9553***	0.27159***	-0.00955**	---	385	26,107	0.7472
		(0.049)	(0.000)	(0.000)	(0.014)				
1992:01to 1999:12	***Carhart***	-17.99	0.95432***	0.28004***	0.02393***	0.04654***	385	26,107	0.7480
		(0.294)	(0.000)	(0.000)	(0.000)	(0.000)			
2000:01 to 2002:12	***FF3***	-83.68***	0.89914***	0.25135***	0.02466***	---	504	15,690	0.7322
		(0.0006)	(0.000)	(0.000)	(0.000)				
2000:01 to 2002:12	***Carhart***	10.81***	0.86898***	0.25316***	-0.01040*	-0.04727***	504	15,690	0.7344
		(0.000)	(0.000)	(0.000)	(0.060)	(0.000)			
2003:01 to 2007:12	***FF3***	9.24	0.91950***	0.25153***	-0.03234***	---	760	37,060	0.7499
		(0.3750)	(0.000)	(0.000)	(0.000)				
2003:01 to 2007:12	***Carhart***	-51.48***	0.92068***	0.25957***	-0.00910***	0.06297***	760	37,060	0.7528
		(0.000)	(0.000)	(0.0540)	(0.000)	(0.000)			
2008:01 to 2009:12	***FF3***	-207.99***	0.97349***	0.22975***	-0.09078***	---	765	16,771	0.8374
		(0.000)	(0.000)	(0.000)	(0.000)				
2008:01 to 2009:12	***Carhart***	-92.01***	0.99426***	0.31484***	-0.04656***	0.09126***	765	16,771	0.8417
		(0.001)	(0.000)	(0.000)	(0.000)	(0.000)			
2010:01 to 2013:10	***FF3***	103.69***	0.93341***	0.23719***	0.07670***	---	735	28,140	0.8029
		(0.000)	(0.000)	(0.000)	(0.000)				
2010:01 to 2013:10	***Carhart***	68.62***	0.92961***	0.24637***	0.08997***	0.02150***	735	28,140	0.8031
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			

4.2. Adjusted FF3 and Carhart Alpha of UK mutual funds

This section reports AGT-adjusted FF3 and Carhart alphas for active UK equity mutual funds. The values of AGT-adjusted annualised alphas, the coefficients on the Market, SMB, HML and WML factor reported in Table 3 are obtained by estimating equations (5) and (6) with fixed effects panel model estimation, as in Section 4.1. For ease of comparison, in this table we also include the values of standard FF3 and Carhart annualised alphas previously reported in Table 2. Table 3 uniformly documents strong positive improvement in all FF3 (Panel A) and Carhart alphas (Panel B) after the AGT-adjustment in the whole sample period and each sub-period. The difference in standard and AGT-adjusted alphas is statistically significant at 1% level for the whole sample period and each of the sub-periods in both Panels; the exception is the first bull period 1992-1999, where the difference between standard and adjusted FF3 (Cahrart) alphas Panel A (Panel B) is significant at 10% (5%) level, as indicated by Z-test[7].

Specifically, in the total sample period, the value of annualised FF3 alpha increases more than tenfold from 14 to 144 bps (significant at 1% level[8]) when fund returns are benchmark-adjusted, using AGT model specification. Across sub-periods, the AGT-adjusted FF3 alphas are overall statistically significant and positive, which stands even in bear markets. The improvement in alphas post-adjustment ranges from 30bps in the first bull sub-period 1992-1999 to 289bp in the last bear period 2007-2009. What is more, FF3 alphas in bear markets change sign from negative (-84 bps in 2000-2002 and -208bps in 2008-2009) to positive (76bps and 81bps in the two bear periods respectively). Panel B shows qualitatively the same results for Carhart alpha adjustment. This is in line with our expectations that greater underestimation of fund performance in standard FF3 and Carhart models occurs in bear markets, due to presence of larger negative alphas of the benchmark index.

[7] Z-test is calculated as: $Z - stat = \frac{alpha_{before} - alpha_{adjusted}}{\sqrt{\left(SE_{alpha_{before}}\right)^2 + \left(SE_{alpha_{adjusted}}\right)^2}}$

[8] We have re-estimated standard errors of AGT-adjusted alphas in this paper using Petersen (2009) method and clustering by fund and months, fund and years and fund and bull/bear periods. Our alphas for the total sample of funds and funds per investment style by and large remain of the same level of significance.

Table 3: Fixed Effects Panel Data regressions for UK Equity Mutual Funds returns: FF3 and Carhart model alphas before and after AGT-adjustment with FTSE 100 benchmark

The sample consists in 887 unique UK Equity Mutual Funds and 123,768 monthly observations over the period January 1992 to October 2013. The following regressions are estimated: $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ (before adjustment) and $R_{i,t} - R_{FTSE100,t} = \alpha_i^* + \beta_{i1}^*(R_{M,t} - R_{F,t}) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + e_i^*$ (after adjustment) in Panel A; and $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$ (before adjustment) and $R_{i,t} - R_{FTSE100,t} = \alpha_i^* + \beta_{i1}^*(R_{M,t} - R_{F,t}) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + \beta_{i4}^*WML_t + e_i^*$ (after adjustment) in Panel B. $R_{i,t} - R_{F,t}$ is the excess return on equity mutual fund *i* for month *t*. $R_{F,t}$ is the risk-free rate in period *t*, α (alpha/constant) is the Fama-French and Carhart performance estimate, $(R_{M,t} - R_{F,t})$ is the market risk premium in period *t*, SMB and HML are Fama and French (1993) size and value factors respectively, WML is Carhart (1997) momentum factor and $\varepsilon_{i,t}$.is the error term. α_i^* is the AGT-adjusted alpha and β_{i1}^*-β_{i4}^* are excess factor betas. This is done for the full time period (1992-2013), January, 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013 (bull market) and January 2000 to December 2002 and January 2008 to December 2009 (bear market). The monthly risk factors and risk free rate are collected from University of Exeter, Xfi Centre for Finance and Investment website. *P-values* are in parenthesis. Significance of the difference in alphas is determined by $Z-stat = \frac{alpha_{before} - alpha_{adjusted}}{\sqrt{(SE_{alpha_{before}})^2 + (SE_{alpha_{adjusted}})^2}}$. Superscript *indicate statistical significance at 1% (***), 5% (**) and 10% (*) levels.

Panel A: FF3 model and AGT-adjusted three factor model

	FF3 Alpha (annual basis points)				Excess Market Beta	Excess SMB	Excess HML	Number of Funds	Obs.	R-Squared (within)
	Before	*After AGT-adj.*	*Difference*	Z-test						
Total Sample	13.81* (0.057)	143.64*** (0.000)	**129.83**	12.46***	-0.0741259*** (0.000)	0.3561225*** (0.000)	0.0129689*** (0.000)	887	123,768	0.7902/0.2368
1992:01-1999:12	32.45** (0.049)	62.54 (0.107)	**30.09**	1.68*	-0.0424562*** (0.000)	0.4623843*** (0.000)	0.0254355*** (0.000)	385	26,107	0.7472/0.2544
2000:01-2002:12	-83.68*** (0.0006)	76.54** (0.015)	**160.22**	3.65***	-0.1228128*** (0.000)	0.3571102*** (0.000)	0.0230574*** (0.000)	504	15,690	0.7322/ 0.2511
2003:01-2007:12	9.24 (0.3750)	112.06*** (0.000)	**102.82**	6.98***	-0.0734209*** (0.000)	0.3898085*** (0.000)	-0.0240685*** (0.000)	760	37,060	0.7499/ 0.3132
2008:01-2009:12	-207.99*** (0.000)	81.46*** (0.003)	**289.45**	7.62***	-0.0578245*** (0.000)	0.317387*** (0.000)	-0.0404989*** (0.000)	765	16,771	0.8374/0.2044
2010:01-2013:10	103.69*** (0.000)	217.40*** (0.000)	**113.71**	5.47***	-0.0555168 (0.000)	0.3241709*** (0.000)	0.0704108*** (0.000)	735	28,140	0.8029/0.1783

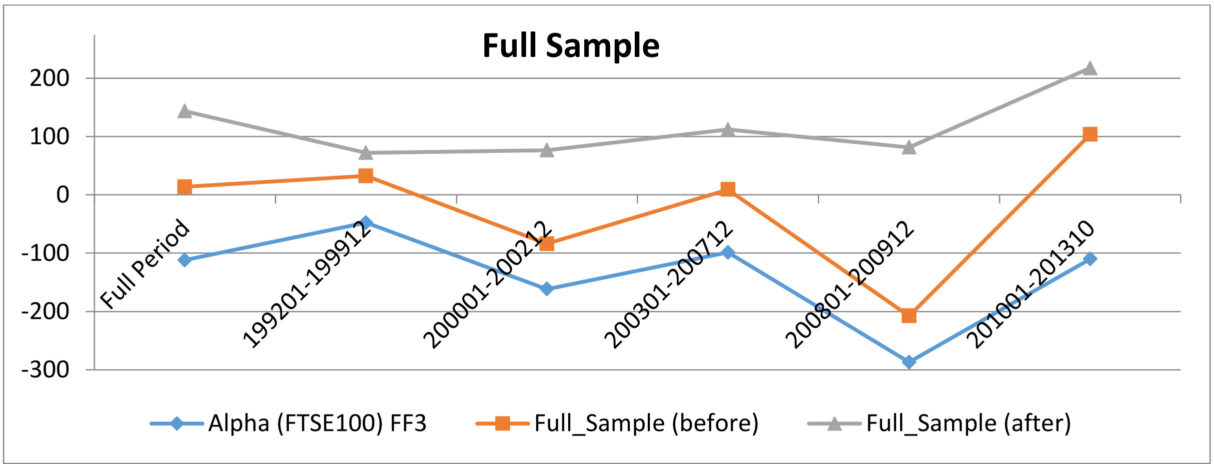
Panel B: Carhart model and AGT-adjusted four factor model											
	Carhart Alpha (annual basis points)				Excess Market Beta	Excess SMB	Excess HML	Excess WML	Number of Funds	Obs.	R-Squared (within)
	Before	*After AGT-adj.*	*Difference*	Z-test							
Total Sample	-28.76***	98.57***	**127.33**	11.91***	-0.069***	0.368***	0.038***	0.035***	887	123,768	0.7910/ 0.2399
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)			
1992:01-1999:12	-17.99	35.58**	**53.57**	2.16**	-0.043***	0.469***	0.048***	0.034***	385	26,107	0.7480/0.2596
	(0.294)	(0.047)			(0.000)	(0.000)	(0.000)	(0.000)			
2000:01-2002:12	10.81***	210.10***	**199.29**	4.36***	-0.165***	0.356***	-0.025***	-0.065***	504	15,690	0.7344/0.2727
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)			
2003:01-2007:12	-51.48***	46.79***	**98.27**	6.47***	-0.072***	0.398***	0.001	0.068***	760	37,060	0.7528/0.3287
	(0.000)	(0.000)			(0.000)	(0.000)	(0.852)	(0.000)			
2008:01-2009:12	-92.01***	188.79***	**280.80**	7.26***	-0.039***	0.394***	-0.001	0.082***	765	16,771	0.8417/ 0.2300
	(0.001)	(0.000)			(0.000)	(0.000)	(0.936)	(0.000)			
2010:01-2013:10	68.62***	158.71***	**90.09**	3.87***	-0.062***	0.340***	0.093***	0.036***	735	28,140	0.8031/0.1847
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)			

Finally, similarly to Table 2, we observe positive and statistically significant coefficients for SMB in Table 3, indicating a small cap orientation of funds in the sample and the mixed results for HML risk factor coefficients. The performance of funds by styles will be addressed in the next section.

Figure 2 presents a summary of these results for the sample of 887 equity mutual funds, split in five sub-sample periods before and after the AGT-adjustment. The Figure specifically shows annualized FF3 alphas[9] in bps for the FTSE 100 and for the total sample funds and annualized AGT-adjusted alphas in bps for the total sample of funds.

Figure 2: Equity mutual fund (before and after AGT- adjustment) and FTSE 100 index alphas

Figure shows for different time periods the FTSE 100 index alpha (FF3 model), the equity mutual fund alpha before and after adjustment the non-zero benchmark index alpha. This is done for the full time period (1992-2013), January, 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013 (bull market) and January 2000 to December 2002 and January 2008 to December 2009 (bear market).



This illustration distinctly shows that after AGT model adjustment, fund alphas considerably improve. On the average, active UK equity mutual funds are able to generate positive outperformance without major declines even during the last financial crisis. Our findings corroborate our initial notion that UK equity mutual funds generate better performance than previously estimated in the literature deploying standard factor models for evaluating performance. Our results are also in line with Angelidis et al (2013) who report less negative

[9] As the results for Carhart alphas are qualitatively the same, we do not report them in a separate figure

and less statistically significant adjusted-alphas across their categories of funds, i.e. a better US mutual fund performance than the literature suggests.

4.3. Performance by Investment Styles

To test performance by funds style, we place each of the 887 mutual funds into one of the Morningstar style box categories: small-value, small-growth, small blend, large-value, large-growth, large-blend, mid cap-value, mid cap-growth and mid-cap blend. To identify the style category each fund should be placed to, we run individual regressions for each fund as specified by Equation (4). We then split the total sample of the funds according to their style characteristics given by SMB and HML coefficients from equation (3)[10]. There is 618 Small/Value, Small/Growth and Small/Blend style funds, representing 70 percent of the whole sample of 887 funds. Medium/Value and Medium/Growth comprise 6.7% of funds (59 out of 887), while there are 159 Medium/Blend funds, accounting for almost 18% of the total number. For each category of funds, we estimate FF3 and Carhart alphas before and after the AGT-adjustment using fixed effects panel estimation.

Table 4 lays out these results for the whole sample period. Panel A presents FF3 alphas and AGT-adjusted three factor model alphas, while Panel B shows Carhart alphas and AGT-adjusted four factor model alphas. Both panels report the differences in alphas, the significance of those differences (Z-test) and the Market, SMB, HML (and WML, in Panel B only) coefficients from the AGT- adjusted models.

[10] Small/value group: β SMB positive and statistically significant, β HML positive and statistically significant. Small/Growth group: β SMB positive and statistically significant, β HML negative and statistically significant. Small/blend group: β SMB positive and statistically significant, β HML not statistically significant. Large/value group: β SMB negative and statistically significant, β HML positive and statistically significant. Large/growth group: β SMB negative and statistically significant, β HML negative and statistically significant. Large/blend: β SMB negative and statistically significant, β HML not statistically significant. Medium/value group: β SMB not statistically significant, β HML positive and statistically significant. Medium /growth group: β SMB not statistically significant, β HML negative and statistically significant. Medium/blend group: β SMB not statistically significant, β HML not statistically significant.

Table 4: UK Equity Mutual Funds alphas by fund style, before and after AGT-adjustment: total sample period Jan 1992 – Oct 2013

887 equity mutual funds are divided styles as per Morningstar style box (Small/Value, Small/Growth, Small/Blend, Medium/Value, Medium/Growth, Medium/Blend, Large/Value, Large/Growth, Large/Blend). The following regressions are estimated: $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ (before adjustment) and $R_{i,t} - R_{FTSE100,t} = \alpha_i^* + \beta_{i1}^*(R_{M,t} - R_{F,t}) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + e_i^*$ (after adjustment) in Panel A; and $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$ (before adjustment) and $R_{i,t} - R_{FTSE100,t} = \alpha_i^* + \beta_{i1}^*(R_{M,t} - R_{F,t}) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + \beta_{i4}^*WML_t + e_i^*$ (after adjustment) in Panel B. $R_{i,t} - R_{F,t}$ is the excess return on equity mutual fund *i* for month *t*. $R_{F,t}$ is the risk-free rate in period *t*, α (alpha/constant) is the Fama-French and Carhart performance estimate, $(R_{M,t} - R_{F,t})$ is the market risk premium in period *t*, SMB and HML are Fama and French (1993) size and value factors respectively, WML is Carhart (1997) momentum factor and $\varepsilon_{i,t}$.is the error term. α_i^* is the AGT-adjusted alpha and β_{i1}^*-β_{i4}^* are excess factor betas. The monthly risk factors and risk free rate are collected from University of Exeter, Xfi Centre for Finance and Investment website. *P-values* are in parenthesis. Significance of the difference in alphas is determined by $Z-stat = \frac{alpha_{before} - alpha_{adjusted}}{\sqrt{(SE_{alpha_{before}})^2 + (SE_{alpha_{adjusted}})^2}}$. Superscript *indicate statistical significance at 1% (***), 5% (**) and 10% (*) levels.

Panel A: FF3 model and AGT-adjusted three factor model

Investment Style	**FF3 Alpha (annual basis points)**				**Excess Market Beta**	**Excess SMB**	**Excess HML**	**Number of Funds**	**Obs.**	**R-Squared (within)**
	Before	***After AGT-adj.***	***Difference***	**Z-test**						
Small_Value	40.42***	162.51***	**122.09**	5.86***	-0.093*** (0.000)	0.396*** (0.000)	0.153*** (0.000)	135	26,764	0.8186/0.3212
Small_Growth	81.56***	203.6***	**122.04**	4.20***	-0.077*** (0.000)	0.581*** (0.000)	-0.171*** (0.000)	118	22,004	0.7577/0.4161
Small_Blend	14.27	153.96***	**139.69**	8.26***	-0.067*** (0.000)	0.391*** (0.000)	0.016*** (0.000)	365	44,031	0.8110/0.2841
Large_Value	-148.5***	-15.12	**133.38**	2.74***	-0.017*** (0.007)	0.038*** (0.000)	0.056*** (0.000)	6	925	0.9597/ 0.0679
Large_Growth	-26.15	98.31	**124.46**	0.83	-0.061*** (0.005)	0.011 (0.671)	-0.113*** (0.000)	5	659	0.7515/ 0.0461
Large_Blend	-94.72***	29.14	**123.86**	3.28***	-0.048*** (0.000)	0.029*** (0.000)	-0.006 (0.314)	40	5,779	0.8515/0.0166
Medium_Value	24.80	144.24***	**119.44**	3.64***	-0.095 (0.000)	0.144*** (0.000)	0.127*** (0.000)	35	6,324	0.8727/0.1607
Medium_Growth	2.62	123.17***	**120.55**	2.50***	-0.054*** (0.000)	0.141*** (0.000)	-0.084*** (0.000)	24	2,879	0.8733/ 0.1390
Medium_Blend	-83.34***	-48.59***	**34.75**	5.81***	-0.068*** (0.000)	0.133*** (0.000)	0.003 (0.462)	159	14,403	0.8608/0.0856

Panel B: Carhart model and AGT-adjusted four factor model											
Investment Style	**Carhart Alpha (annual basis points)**				**Excess Market Beta**	**Excess SMB**	**Excess HML**	**Excess WML**	**Number of Funds**	**Obs.**	**R-Squared (within)**
	Before	***After AGT-adj.***	***Difference***	**Z-test**							
Small_Value	43.19***	165.34***	**122.15**	5.65***	-0.093*** (0.000)	0.395*** (0.000)	0.152*** (0.000)	-0.002 (0.495)	135	26,764	0.8186/0.3212
Small_Growth	-22.50	98.71***	**121.21**	4.10***	-0.063*** (0.000)	0.603*** (0.000)	-0.115*** (0.000)	0.077*** (0.000)	118	22,004	0.7616/0.4249
Small_Blend	-39.04***	96.65***	**135.69**	7.85***	-0.061*** (0.000)	0.410*** (0.000)	0.049*** (0.000)	0.047*** (0.000)	365	44,031	0.8123/0.2898
Large_Value	-120.85***	14.09	**134.94**	2.69***	-0.029*** (0.001)	0.032*** (0.000)	0.041*** (0.000)	-0.021 (0.002)	6	925	0.9601/0.0780
Large_Growth	-71.97	52.43	**124.40**	0.81	-0.056*** (0.010)	0.021 (0.455)	-0.089*** (0.005)	0.034 (0.143)	5	659	0.7524/0.0492
Large_Blend	-101.64***	23.12	**124.76**	3.19***	-0.047*** (0.000)	0.031*** (0.000)	-0.003 (0.692)	0.004 (0.407)	40	5,779	0.8515/0.0167
Medium_Value	22.76	143.20***	**120.44**	3.53***	-0.095*** (0.000)	0.145*** (0.000)	0.127*** (0.000)	0.001 (0.878)	35	6,324	0.8727/0.1607
Medium_Growth	-51.78	67.31*	**119.09**	2.41***	-0.0476581 (0.000)	0.154*** (0.000)	-0.053 (0.000)	0.042 (0.000)	24	2,879	0.8748/0.1492
Medium_Blend	-109.58***	19.05	**128.63**	5.49***	-0.065*** (0.000)	0.142*** (0.000)	0.020*** (0.000)	0.0237 (0.000)	159	14,403	0.8611/0.0885

Table 4 demonstrates that results per fund category are consistent with the overall sample of funds from Table 3. In both Panel A and Panel B, the AGT-adjustment leads to improvement in alphas in each style category over the sample period. The differences in standard and AGT-adjusted alphas are significant at 1% level for all fund categories except Large/Growth. The AGT-adjusted alphas are positive and statistically significant for all Small Cap sub-categories as well as Medium/Value and Medium/Growth groups. According to standard FF3 (Panel A) and Carhart (Panel B) models, large cap funds generate negative alphas and underperform other fund styles. After the AGT-adjustment, large cap funds performance is in line with the market. In Panel A, the best performing group are small cap growth funds with 82bps in the standard FF3 model and 204bps AGT-adjusted three factor alpha per year. According to Carhart alphas in Panel B, small cap value funds are best performing with 43bps standard and 165bp AGT-adjusted alpha. In general, in both panels, small cap funds outperform the medium or large cap funds in each of the corresponding sub-categories ('value', 'growth' and 'blend'). They generate positive ATG-adjusted alphas across all subcategories, significant at 1% level. It is interesting to note that 'blend' funds generate overall negative performance according to standard performance measures, which is consistent with Jennifer, Sialm, and Zhang (2011) who provide evidence that funds that tend to shift risks perform worse than others. Once AGT-adjustment is applied, small/blend and medium/blend categories in Panel B exhibit greatest increase in alphas within their size categories, which turn from negative to positive values. In spite of this strong improvement in adjusted alphas, 'blend' funds do not perform as well as the value and growth group within the same size category.

We now turn our analysis to the bull and bear market sub-periods, which will help us identify if the performance of some style groups is driven by any particular sub-period. Table 5 reports FF3 and Carhart alphas before and after the AGT-adjustment in the five sub-periods. The table is separated into four panels to differentiate between three and four factor models on the one hand, and bull and bear periods[11] on the other. Results for the FF3 model are presented in Panel A for the bull and Panel B for the bear periods; while results for the Carhart four factor model are in Panel C for the bull and Panel D for the bear periods.

[11] Bull and bear periods are defined in section 2 of this paper

Table 5: Annualized (in bps) bull vs. bear market FF3 and Carhart alphas before and after AGT-adjustment, per investment style category

Panel A reports standard FF3 and AGT-adjusted FF3 alphas and their difference in bull periods January, 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013; Panel B reports the same for the bear market periods January 2000 to December 2002 and January 2008 to December 2009. Panel C reports standard Carhart, AGT-adjusted Carhart alphas and their difference in the bull market periods and Panel D reports the same for the bear market. All alphas and their difference are annualized values in basis points. Results in each panel are presented by "investment style" category (Small/Value, Small/Growth, Small/Blend, Medium/Value, Medium/Growth, Medium/Blend, Large/Value, Large/Growth, Large/Blend) following Morningstar Equity Style box allocation. Significance of the difference in alphas is determined by $Z-stat=\frac{alpha_{before}-alpha_{adjusted}}{\sqrt{\left(SE_{alpha_{before}}\right)^2+\left(SE_{alpha_{adjusted}}\right)^2}}$. ***indicates statistical significance at 1%, ** at 5% and * at 10% level.

Panel A: FF3 and AGT-adjusted three factor model alpha in bull market periods

Investment Style	***1992:01-1999:12***				**Funds /Obs.**	***2003:01-2007:12***				**Funds /Obs.**	***2010:01-2013:10***				**Funds /Obs.**
	Before	**After AGT-adj.**	**Difference**	**Z-test**		**Before**	**After AGT-adj.**	**Difference**	**Z-test**		**Before**	**After AGT adj.**	**Difference**	**Z-test**	
Small_Value	-18.90	25.00	**43.9**	1.18	104/7,758	25.42	126.40***	**100.98**	3.08***	126/7,121	131.11***	245.90***	**114.79**	2.35***	122/5,044
Small_Growth	174.03***	212.65***	**38.62**	0.62	85/5,893	36.87	136.26***	**99.39**	2.51***	115/6,460	216.00***	332.06***	**116.06**	1.82*	97/3,860
Small_Blend	43.66	84.38*	**40.72**	0.90	93/5,930	38.03**	143.80***	**105.77**	4.27***	321/14,274	119.64***	233.41***	**113.77**	3.48***	311/12,213
Large_Value	-88.50	-68.75	**19.75**	0.13	5/147	-216.69***	-120.36***	**96.33**	1.74*	6/301	-221.10*	-104.79	**116.31**	0.68	5/177
Large_Growth	105.26	147.63	**42.37**	0.17	2/175	-130.67	-26.21	**104.46**	0.87	4/203	-75.95***	34.34	**110.29**	3.34***	3/121
Large_Blend	-100.78*	-80.10	**20.68**	0.27	24/1,138	-149.35***	-48.26*	**101.09**	2.86***	37/1,759	6.91	106.94***	**100.03**	1.87*	31/1,176
Medium_Value	-76.70**	-6.19	**70.51**	0.80	26/1,975	-23.53	77.60**	**101.13**	2.06**	33/1,693	7.53	123.40**	**115.87**	1.34	28/1,038
Medium_Growth	-43.60	0.00	**43.6**	0.48	10/770	-6.55	92.24*	**98.79**	1.25	15/765	111.21	223.32***	**112.11**	1.00	20/656
Medium_Blend	-76.70**	-42.29	**34.41**	0.61	36/2,321	-64.54***	38.66*	**103.2**	3.40***	103/4,484	9.56	119.34***	**109.78**	2.35***	118/3,855

Panel B: FF3 and AGT-adjusted three factor model alpha in bear market periods

Investment Style	*2000:01-2002:12*				**Funds /Obs.**	*2008:01-2009:12*				**Funds /Obs.**
	Before	**After AGT-adj.**	**Difference**	**Z-test**		**Before**	**After AGT-adj.**	**Difference**	**Z-test**	
Small_Value	-44.31	118.33**	**162.64**	2.14***	112/3,862	-58.44	235.17***	**293.61**	3.35***	132/2,979
Small_Growth	83.39	247.00***	**163.61**	1.48	99/3,323	-243.48***	44.24	**287.72**	2.74***	107/2,468
Small_Blend	-147.09***	10.96	**158.05**	2.08**	164/4,388	-231.53***	57.19	**288.72**	5.17***	326/7,226
Large_Value	-82.53	80.23	**162.76**	1.68*	5/180	34.29	329.96***	**295.67**	2.13**	5/120
Large_Growth	-237.19	-77.35	**159.84**	0.67	3/86	-256.79	34.54	**291.33**	0.24	4/74
Large_Blend	-327.53***	-173.69***	**153.84**	1.79*	27/934	-109.96	181.72	**291.68**	1.30	35/772
Medium_Value	43.59	208.98**	**165.39**	1.32	28/969	-237.30***	-11.93	**225.37**	2.18**	29/649
Medium_Growth	-104.98	57.44	**162.42**	0.96	10/360	-365.44***	-78.23	**287.21**	1.52	16/328
Medium_Blend	-249.31***	-91.44	**157.87**	1.85*	56/1,588	-337.818***	-52.09	**285.728**	3.32***	111/2,155

Panel C: Carhart and AGT-adjusted four factor model alpha in bull market periods

Investment Style	*1992:01-1999:12*				Funds /Obs.	*2003:01-2007:12*				Funds /Obs.	*2010:01-2013:10*				Funds /Obs.
	Before	**After AGT-adj.**	**Difference**	**Z-test**		**Before**	**After AGT-adj.**	**Difference**	**Z-test**		**Before**	**After AGT-adj.**	**Difference**	**Z-test**	
Small_Value	-14.70	45.82	**60.52**	1.53	104/7,758	5.46	103.13***	**97.67**	2.88***	126/7,121	135.61***	226.54***	**90.93**	1.68*	122/5,044
Small_Growth	-8.19	43.41	**51.6**	0.81	85/5,893	-60.72**	34.55	**95.27**	2.47***	115/6,460	98.80**	188.98***	**90.18**	1.29	97/3,860
Small_Blend	-3.05	49.75	**52.8**	1.11	93/5,930	-37.41**	61.64***	**99.05**	3.89***	321/14,274	70.67***	160.29***	**89.62**	2.48***	311/12,213
Large_Value	-107.42	-81.02	**26.40**	0.17	5/147	-191.41***	-97.46**	**93.95**	1.65*	6/301	-230.36*	-137.69	**92.67**	0.49	5/177
Large_Growth	137.09	194.88	**57.79**	0.22	2/175	-187.90**	-87.77	**100.13**	0.81	4/203	-72.82***	19.84	**92.66**	2.56***	3/121
Large_Blend	-93.00*	-66.06	**26.94**	0.34	24/1,138	-175.36***	-77.75***	**97.61**	2.68***	37/1,759	37.03	126.65***	**89.62**	1.32	31/1,176
Medium_Value	-4.12	56.04	**60.16**	1.06	26/1,975	-38.54	59.32*	**97.86**	1.92**	33/1,693	6.99	99.38	**92.39**	0.96	28/1,038
Medium_Growth	-72.63	-9.48	**63.15**	0.65	10/770	-89.92	4.12	**94.04**	1.18	15/765	129.01	218.60***	**89.50**	0.71	20/656
Medium_Blend	-68.90*	-22.97	**45.93**	0.78	36/2,321	-124.47***	-27.21	**97.26**	3.13***	103/4,484	7.68	93.45***	**85.77**	1.66*	118/3,855

Panel D: Carhart and AGT-adjusted four factor model alpha in bear market periods

Investment Style	*2000:01-2002:12*				**Funds**	*2008:01-2009:12*				**Funds**
	Before	**After AGT-adj.**	**Difference**	**Z-test**	**/Obs.**	**Before**	**After AGT-adj.**	**Difference**	**Z-test**	**/Obs.**
Small_Value	42.53	241.53***	**199.00**	2.55***	112/3,862	-18.19	264.32***	**282.51**	3.14***	132/2,979
Small_Growth	205.39***	407.34***	**201.95**	1.76*	99/3,323	-42.18	238.76***	**280.94**	2.67***	107/2,468
Small_Blend	-28.03	171.72***	**143.69**	2.51***	164/4,388	-92.38**	188.18***	**280.56**	4.95***	326/7,226
Large_Value	-45.34	152.16**	**106.82**	2.04**	5/180	-11.44	270.82***	**282.26**	2.06***	5/120
Large_Growth	-189.79	11.59	**201.38**	0.80	3/86	-202.93	79.45	**282.38**	0.23	4/74
Large_Blend	-268.64***	-78.57	**190.07**	2.17**	27/934	-71.33	208.99	**280.32**	1.22	35/772
Medium_Value	106.77	307.70***	**200.93**	1.56	28/969	-276.40***	-2.43	**273.97**	2.05**	29/649
Medium_Growth	-84.25	112.54	**196.79**	1.13	10/360	-198.75	80.94	**279.69**	1.50	16/328
Medium_Blend	-177.83***	19.86	**197.69**	2.22**	56/1,588	-230.39***	46.60	**276.99**	3.18***	111/2,155

The differences in the standard and the AGT-adjusted alphas in Panels A-D show that the standard three factor model undervalues fund performance in bear periods more than in bull periods, corroborating our findings from Table 3. This is particularly pronounced during the last bear period in the sample corresponding to the most recent financial crisis, January 2008 – December 2009, where the standard FF3 and Carhart models underestimate performance compared to the AGT-adjusted model by well over 2% per year in all fund categories. There is greater difference in standard and the AGT-adjusted alphas in the later rather than earlier sub-periods in the sample. Also, there is greater significance in the difference in alphas documented by Z-test in the later periods in our sample. The difference in alphas is most persistently significant for all small cap fund groups, large/value and medium/blend categories across all four panels in Table 5. In the first bull period 1992-1999, the differences in alphas are the smallest and not statistically significant, which is reflecting our findings for the whole sample of funds from Table 3.

Looking at the small size category performance over sub-periods, it can be said that most consistent outperformance across sub-periods according to adjusted alphas is in the small cap/value group, in line with numerous empirical evidence documenting outperformance of small cap and value stocks[12]. The highest AGT-adjusted FF3 alpha over the whole sample period (Panel A, Table 4), generated by the Small/growth category is largely driven by a dot.com boom in the 1990s and the most recent post-crisis period (Panels A and B, Table 5). Small/blend funds have competitive advantage in bull markets according to Table 5. Within the large size category that in the overall period does not generate significant alphas, we note that Large cap/Value group generates particularly large annual AGT-adjusted FF3 alpha of 3.29% (Carhart equivalent of 2.71%) during the latest financial crisis. This implies that investors' tendency for 'flight to safety' in turbulent periods, i.e. investment in larger companies that pay dividends, is justified. Medium/Value category generates the highest positive alphas in the aftermath of the dot.com boom (January 2000-December 2003), while Medium/Growth and Medium/Blend categories do best in the aftermath of the recent financial crisis (January 2010 – October 2013).

In conclusion to this section, our most significant finding arises from the fact that assessing UK equity mutual fund performance using adjusted FF3 and Carhart model that corrects for

[12] For the UK evidence, see for instance Dimpson and Marsh (2000), Levis (1985), Levis and Liodakis (1999).

the ‘errors’ in alphas in the original versions of those models leads us to conclude that UK equity funds have actually performed better than suggested by the existing literature.

5. Robustness check: FTSE Small Cap Index as a benchmark

In this paper we have used FTSE 100 Index as a benchmark for all the funds in our sample. One may argue that using fund-style-specific benchmarks will be more appropriate, but unfortunately, benchmarks accounting for combinations of styles such as small/growth, medium/value index etc. are not available. Therefore, in this section we replicate the methodology and present findings for the subset of UK equity mutual funds that were categorised as Small Cap (including all three sub-categories: Value, Growth and Blend) in the analysis in section 4.3. A total of 618 funds was identified, representing 69.7% of our total sample. We benchmark the performance of those funds against a more appropriate index given their style category – the FTSE Small Cap Index. Total returns of FTSE Small Cap index (inclusive of dividends) are from Datastream. We note that FTSE 100 and FTSE Small Cap Index are highly related, having a correlation coefficient of 0.76 over our sample period. This section reports results equivalent to Figure 1, Figure 2 and Table 3 from section 4.1 and 4.2[13].

Figure 3 illustrates three-year moving average of FF3 and Carhart alphas for FTSE Small Cap index. Both alphas indicate even more pronounced underperformance of FTSE Small Cap Index relative to that of FTSE 100, reported in Figure 1. The sharpest decrease in alpha corresponds to dot-com bubble burst period in our sample, 2000-2003 (lowest recoded value is -878bps); while the only period of small positive alphas (56bps) was the dot-com boom period. This implies that in the same manner as with FTSE 100 as a benchmark, adjusting fund performance for index underperformance is expected to produce an upward shift in ATG-adjusted alphas for the small cap funds.

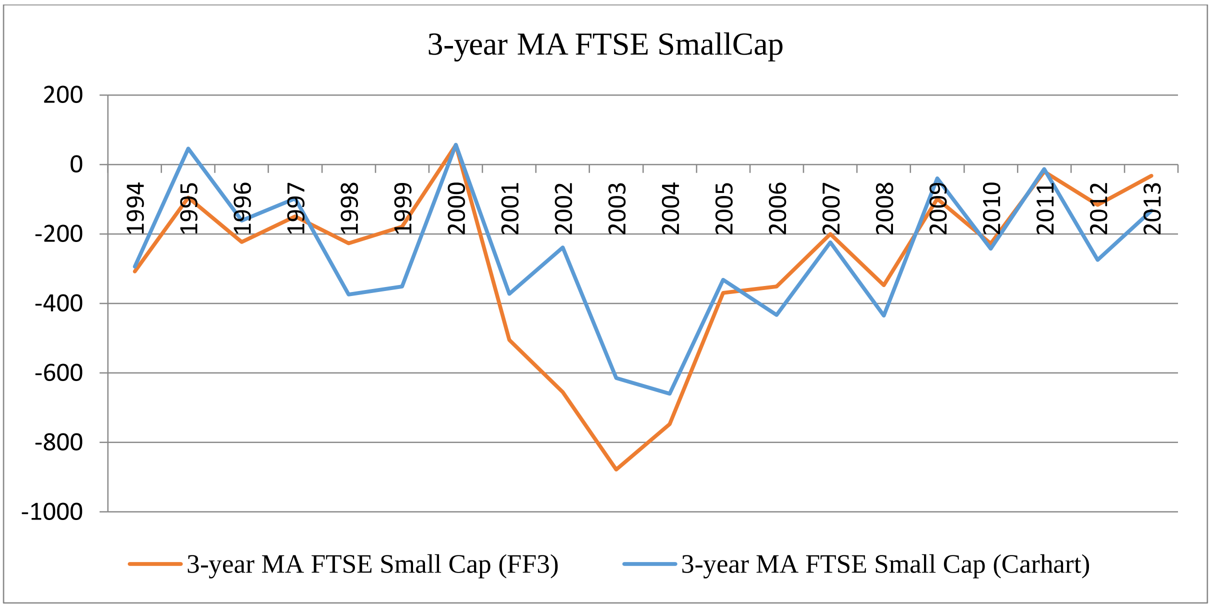
Table 6, in which FTSE Small Cap Index is used for AGT adjustment, corroborates those expectations. Panel A of Table 6 shows the results of the fixed effects panel model used to obtain standard FF3 and AGT-adjusted alphas given in basis points per annum, their difference, significance of the difference; the market, SMB and HML AGT-coefficients, number of funds, number of observations and model’s R-squared. Panel B reports the Carhart model equivalents. The table is corresponding to Table 3, where FTSE 100 was used as a

[13] Note that equivalents of the remaining tables, i.e. Tables 2, 4 and 5 are available on request from authors but are not reported here due to space constraints.

benchmark. The results in Table 6 are consistent and even more convincing than those reported in Table 3.

Figure 3: FTSE Small Cap alpha

The following regressions are estimated $R_{FTSE\ Small,t} - R_{F,t} = \alpha_{FTSE\ Small,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ and $R_{FTSE\ Small,t} - R_{F,t} = \alpha_{FTSE\ Small,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$ for the period for January 1992 to October 2013. Monthly alpha is calculated for a three years (36 months) moving average (presented below in annual basis point). $R_{FTSE\ Small,t} - R_{F,t}$ is the excess return on the FTSE Small Cap index including dividends in period *t*, $R_{F,t}$ is the risk-free rate in period *t*, α (alpha/constant) is the Fama-French and Carhart performance estimate, $(R_{M,t} - R_{F,t})$ is the market risk premium in period *t*, SMB and HML are Fama and French (1993) size and value factors respectively, WML is Carhart (1997) momentum factor and $\varepsilon_{i,t}$.is the error term. The monthly risk factors and risk free rate are collected from University of Exeter, Xfi Centre for Finance and Investment website



AGT-adjustment generates alphas significantly above standard FF3 and Carhart model estimates. This is consistent both in the overall sample period and all sub-periods. FF3 alpha increase post adjustment ranges from 53bps (period 2010-2013) to 759 bps (period 2000-2002). AGT-adjusted Carhart alpha shows improvement in performance between 81bps (period 2008-2009) and 441bps (1992-1999). In the total sample period, the FF3 alpha increases tenfold by 339 bps, while Carhart alpha exhibits rise of 291bps post AGT-adjustment. Z-tests shows that the differences in alphas are statistically significant across both Panels of Table 6, mostly at 1% level. This re-iterates that our results from section 4 are robust to the choice of the benchmark index.

Table 6: Fixed Effects Panel Data regressions for UK Equity Mutual Funds returns: FF3 and Carhart model alphas before and after AGT-adjustment with FTSE Small Cap benchmark

The sample consists in 618 unique UK Equity Mutual Funds and 92,799 monthly observations over the period January 1992 to October 2013. The following regressions are estimated: $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + e_t$ (before adjustment) and $R_{i,t} - R_{FTSE\ Small,t} = \alpha_i^* + \beta_{i1}^*(R_{M,t} - R_{F,t}) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + e_i^*$ (after adjustment) in Panel A; and $R_{i,t} - R_{F,t} = \alpha_{i,t} + \beta_{M,t}(R_{M,t} - R_{F,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + e_t$ (before adjustment) and $R_{i,t} - R_{FTSE\ Small,t} = \alpha_i^* + \beta_{i1}^*(R_{M,t} - R_{F,t}) + \beta_{i2}^*SMB_t + \beta_{i3}^*HML_t + \beta_{i4}^*WML_t + e_i^*$ (after adjustment) in Panel B. $R_{i,t} - R_{F,t}$ is the excess return on equity mutual fund *i* for month *t*. $R_{FTSE\ Small,t}$ is the total return of FTSE Small Cap index in period t. $R_{F,t}$ is the risk-free rate in period *t*, α (alpha/constant) is the Fama-French and Carhart performance estimate, $(R_{M,t} - R_{F,t})$ is the market risk premium in period *t*, SMB and HML are Fama and French (1993) size and value factors respectively, WML is Carhart (1997) momentum factor and $\varepsilon_{i,t}$.is the error term. . α_i^* is the AGT-adjusted alpha and β_{i1}^*-β_{i4}^* are excess factor betas. This is done for the full time period (1992-2013), January, 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013 (bull market) and January 2000 to December 2002 and January 2008 to December 2009 (bear market). The monthly risk factors and risk free rate are collected from University of Exeter, Xfi Centre for Finance and Investment website. *P-values* are in parenthesis. Significance of the difference in alphas is determined by $Z - stat = \frac{alpha_{before} - alpha_{adjusted}}{\sqrt{(SE_{alpha_{before}})^2 + (SE_{alpha_{adjusted}})^2}}$. Superscript *indicate statistical significance at 1% (***), 5% (**) and 10% (*) levels.

Panel A: FF3 model and AGT-adjusted three factor model

	FF3 Alpha (annual basis points)				**Excess Market Beta**	**Excess SMB**	**Excess HML**	**Number of Funds**	**Obs.**	**R-Squared (within)**
	Before	***After AGT-adj.***	***Difference***	**Z-test**						
Total Sample	37.14***	376.26***	**339.12**	25.88***	-0.0276403***	-0.4933105***	-0.0963244***	618	92,799	0.7859/ 0.3354
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)			
1992:01-1999:12	60.99***	353.42***	**292.43**	10.03***	0.038813***	-0.5184793***	-0.1438147***	282	19,581	0.7327/ 0.2964
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)			
2000:01-2002:12	-48.16	710.53***	**758.70**	12.89***	-0.1357732***	-0.5265839***	-.01140015***	375	11,573	0.7219/ 0.3205
	(0.204)	(0.000)			(0.000)	(0.000)	(0.000)			
2003:01-2007:12	38.13***	272.47***	**234.34**	12.34***	-0.0169282***	-0.4536958***	-0.1175154***	562	27,855	0.7460/ 0.3475
	(0.002)	(0.000)			(0.000)	(0.000)	(0.000)			
2008:01-2009:12	-192.22***	-1.30	**190.92**	4.40***	-0.0775052***	-0.4550481***	-0.1870532***	565	12,673	0.8478/ 0.5161
	(0.000)	(-0.84)			(0.000)	(0.000)	(0.000)			
2010:01-2013:10	139.90***	193.41	**53.51**	2.05**	0.105324***	-0.4370582***	0.0417551***	530	21,117	0.7914/ 0.2533
	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)			

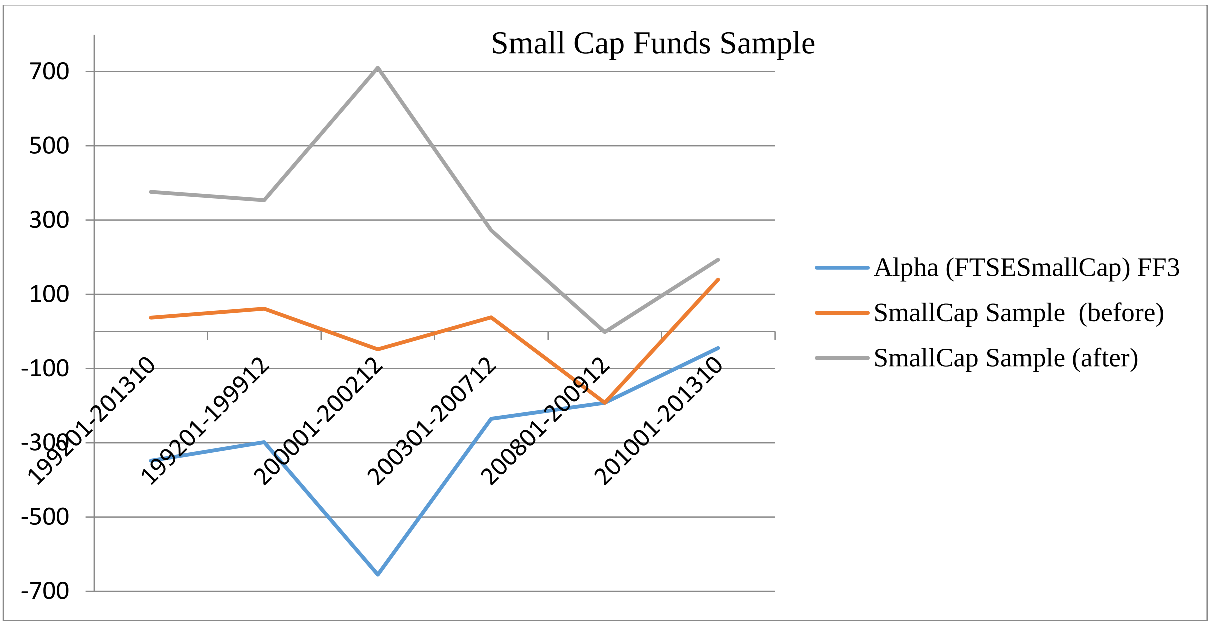
Panel B: Carhart model and AGT-adjusted four factor model

	Carhart Alpha (annual basis points)				Excess Market Beta	Excess SMB	Excess HML	WML differential	Number of Funds	Obs.	R-Squared (within)
	Before	*After AGT-adj.*	*Difference*	Z-test							
Total Sample	-14.62* (0.098)	275.54*** (0.000)	**290.16**	21.69***	-0.0164589*** (0.000)	-0.4669055*** (0.000)	-0.0404432*** (0.000)	0.07702*** (0.000)	618	92,799	0.7871/ 0.3463
1992:01-1999:12	-8.31 (0.692)	432.56*** (0.000)	**440.87**	14.34***	0.0402107*** (0.000)	-0.5308038*** (0.000)	-0.1940534*** (0.000)	-0.0700122*** (0.000)	282	19,581	0.7340/ 0.3008
2000:01-2002:12	59.80 (0.127)	320.32 (0.000)	**260.52**	4.46***	-0.0183653*** (0.000)	-0.5333997*** (0.000)	0.0228298*** (0.002)	0.1842752*** (0.000)	375	11,573	0.7245/ 0.3843
2003:01-2007:12	-28.14** (0.030)	201.47*** (0.000)	**229.61**	11.76***	-0.0155747*** (0.000)	-0.4443821*** (0.000)	-0.0907341 (0.000)	0.0724778*** (0.000)	562	27,855	0.7491/ 0.3546
2008:01-2009:12	-63.19** (0.040)	17.62 (0.581)	**80.81**	1.83*	-0.0741597*** (0.000)	-0.4414543*** (0.000)	-0.1800103*** (0.000)	0.0145683*** (0.004)	565	12,673	0.8528/ 0.5164
2010:01-2013:10	91.65*** (0.000)	275.31*** (0.000)	**183.66**	6.31***	0.1143765*** (0.000)	-0.4587158*** (0.000)	0.0102935 (0.257)	-0.0507207*** (0.000)	530	21,117	0.7917/ 0.2559

Figure 4 provides summary of the results for the sub-sample of 618 Small cap equity funds and is equivalent of Figure 2 from Section 4.2. Figure illustrates annualized FF3 alphas[14] (in bps) for the FTSE Small Cap Index and for the small-cap sub-sample of funds as well as annualized AGT-adjusted alphas (in bps) for the small-cap funds. Alphas are presented for the total sample period and each of the five sub-periods. The figure uniformly documents clear improvement in performance of small cap funds once the underperformance of FTSE Small Cap index as their benchmark is taken into account through AGT adjustment. The greatest performance enhancement over standard FF3 alpha is in the bear period 2000-2002, when the index was at its lowest: the small cap funds alpha increases from -0.48% to 7.1%. This supports our earlier findings that greater improvement in alphas is expected during market downturns.

Figure 4: Equity mutual fund (before and after AGT- adjustment) and FTSE Small Cap Index alphas

Figure shows for different time periods the FTSE Small Cap index alpha (FF3 model), the alpha of the Small cap sub-sample of equity mutual funds before and after adjustment the non-zero benchmark index alpha. This is done for the full time period (1992-2013), January, 1992 to December 1999, January 2003 to December 2007 and January 2010 to October 2013 (bull market) and January 2000 to December 2002 and January 2008 to December 2009 (bear market).



In summary, substituting a more general UK market index, FTSE 100, with a style specific benchmark, FTSE Small Cap, in the AGT model for a sample of UK small cap funds does

[14] As the results for Carhart alphas are qualitatively the same, we do not report them due to space considerations

not change our findings; it reinforces them and confirms that UK equity mutual fund performance is better than what the prior literature suggests. We believe these results will remain robust to the choice of other UK style specific indices as benchmarks, as they are highly correlated to FTSE 100. For instance, the correlations between FTSE UK Value Index and FTSE UK Growth Index with FTSE 100 are 0.95 each; while FTSE 250 Index that serves as a proxy for mid-cap companies has correlation of 0.84 with FTSE 100[15].

6. Conclusion

We take a new look at the performance of UK active equity mutual funds in light of recent academic evidence which suggest that indices funds select as benchmarks contain alphas. Therefore, the inferences one makes about the stock picking skills of fund managers stemming from standard performance measurement models such as Fama-French and Carhart, may be wrong as they embed benchmark alphas. In this study, we follow Angelidis et al. (2013) approach that suggests the use of benchmark adjusted alphas to shed a new light on performance measurement. Ours is the first study to document these benchmark-adjusted alphas for a sample of UK equity mutual funds. Our sample comprises of 887 active funds in the period of January 1992 to October 2013.

In our preliminary analysis, similar to some studies conducted on the US market such as Cremers et al. (2012), we report non-zero alphas of a passive benchmark index FTSE 100, used as a benchmark for all the funds in this study. However, in contrast to the US evidence, our findings indicate a significant negative benchmark index alpha of -1.12% for the Fama and French three-factor model and the annual alpha of -1.13% for the Carhart four-factor model, both statistically significant at 1% level. In addition, we show that benchmark index alphas vary in accordance to different market conditions; being significantly larger in bear market (between -1.61 and -2.86%) then bull market (-0.47 and -1.10%).

Most importantly, we reveal that both the Fama and French three-factor and Carhart four-factor models amplify the underperformance of UK equity mutual funds. After the Angelidis et al. (2013) adjustment for the negative alphas in the benchmark index, we show that UK focused equity funds are able to deliver positive excess performance, which is better than previous UK evidence suggests. As an illustration, for the whole sample period and the whole

[15] Source of data for all indices mentioned (inclusive of dividends): Datastream

sample of funds, the Fama-French alpha exhibits ten-fold increase from just 13.81bps to 143.64bps per year when adjusted for the negative alpha in FTSE 100. The adjustment brings greater increase in alphas in bear rather than in bull market periods, as the benchmark index performance was more depressed during market downturns. For instance, the financial crisis period of 2008-2009 bares the adjusted Fama-French annual alpha which is 2.89% higher than standard alpha for the sample of our funds. These results fare well with Angelidis et al. (2013), who show improvement in US mutual fund alphas after adjusting them for the funds' self-reported benchmarks.

Further, to test if the findings are consistent across funds' investment styles, we split the funds into nine style categories given by Morningstar style-box. When adjusted, alphas in all fund categories improve: when their value given by the standard Fama-French-Carhart models was negative, they became less negative (even positive, albeit mostly insignificant); when the standard alphas were positive, the AGT-adjustment brought them to a higher positive and significant level. We also find that over 70% of mutual funds concentrate their portfolios in Small/Value, Small/Growth and Small/Blend stocks. They perform better than other styles (generating positive AGT-adjusted FF3 alpha of 1.62%, 2.04% and 1.54%, respectively; statistically significant at 1% level). In these style groups, positive abnormal performance persists even during market downturns. Small/value style exhibits the most consistent outperformance, small/growth performance is driven largely by the dot.com boom, while large/value funds do better than any other group during the financial crisis 2008-2009. We conduct a robustness test for the choice of benchmark index. We find that replacing FTSE 100 benchmark with style-specific FTSE Small Cap Index for small cap funds in our sample strengthens and corroborates our results.

Overall, our study shows that adjusting fund alphas, obtained from standard Fama-French-Carhart performance measurement models, by the alpha of the benchmark shows improvement in UK equity mutual fund performance. Specifically, conclusions from previous empirical studies based on standard performance measures strongly tilt towards significant underperformance of UK funds. We show opposing evidence from AGT-adjusted alphas, in support of significant outperformance of UK equity funds, even during bear market periods. The study could be extended to the assessment of the conditional vs unconditional adjusted alphas and market timing ability of funds as in Ferson and Warther (1996) or the new look at the persistence in performance, similar to Fletcher and Forbes (2002).

References

Angelidis, T., Giamouridis, D. and Tessaromatis, N., (2013), Revisiting Mutual Fund Performance Evaluation, *Journal of Banking and Finance,* 37 (5):1759-1776

Blake, D., Timmerman, A., 1998. Mutual fund performance: evidence from the UK. European Finance Review 2: 57–77.

Carhart, M. M. (1997), On persistence in mutual fund performance, *Journal of Finance* 52:57-82.

Chan, L.K.C, Dimmock, S.G and Lakonishok J., (2009), Benchmarking money manager performance: issues and management, *Review of Financial Studies*, 22: 4553-4599

Cremers, M., Petajisto, A. and Zitzewitz, E. (2012), Should Benchmark Indices Have Alpha? Revisiting Performance Evaluation, *Critical Finance Review*, 2: 1-48

Cuthbertson, K., Nitzsche, D., O'Sullivan, N., 2008. UK mutual fund performance: skill or luck? *Journal of Empirical Finance*, 15 (4): 613–634.

Cuthbertson, K., Nitzsche, D., & O'Sullivan, N. (2012). False discoveries in UK mutual fund performance, *European Financial Management*, 18(3), 444–463

Copeland M. M. and Thomas E. Copeland T. E. 1999, Style and Size Rotation Using the VIX, Financial Analysts Journal, 55 (2): 73-81

Costa, B. and K. Jakob, 2006, Do Stock indexes Have Abnormal Performance?, The Journal of Performance Measurement 11 (1): 8-18

Daniel, K., Grinblatt M., Titman S. and Wermers R. (1997), Measuring Mutual Fund Performance with Characteristics-Based Benchmarks, *Journal of Finance*, 52: 1035–1058

Dimson E., Marsh P. and M. Staunton, 2004, Low-Cap and Low-Rated Companies: Tiny and troubled in 20^{th} Century Europe, Journal of Portfolio Management 2004 Vol 30(4): 133-143

Fama, E. F., and French, K. R. (1993), Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33: 3-56

Fama, E. F., and French, K. R. (2012), Size, value, and momentum in international stock returns, *Journal of Financial Economics*, 105: 457-472

Ferson W. and Warther V.A., 1996, Evaluating Fund Performance in a Dynamic Market, *Financial Analysts Journal*, 52(6): 20-28

Fletcher, J. and D. Forbes. 2002. An Exploration of the Persistence of UK Unit Trusts Performance, *Journal of Empirical Finance,* 9: 475-493

Gregory A, Tharyan R. and A. Christides (2013), Constructing and Testing Alternative Versions of the Fama–French and Carhart Models in the UK, *Journal of Business Finance & Accounting*, 40: 172–214

Grinblatt M., Titman S. and Wermers R. (1995) Momentum Investment Strategies, Portfolio Performance, and Herding: A Study of Mutual Fund Behavior, *The American Economic Review*, 85(5): 1088-1105

Huij, J.J. & Verbeek, M.J.C.M. (2009), On the use of multifactor models to evaluate mutual fund performance, *Financial Management*, *38* (1): 75-102

Hsu J.C., Kalesnik V., and Myers B. W. (2010) Performance Attribution: Measuring Dynamic Allocation Skill, *Financial Analysts Journal*, 66 (6)

Levis, 1985, Are small firms big performers, Investment Analyst, 76, 21-27.

Levis M. and Liodakis M., 1999, The Profitability of Style Rotation Strategies in the United Kingdom, The Journal of Portfolio Management, Fall 1999, Vol. 26, No. 1: pp. 73-86

Pastor, Lubos, and Robert F. Stambaugh, 2002, Mutual fund performance and seemingly unrelated assets, Journal of Financial Economics 63: 315-349.

Petersen, M. A., 2009, "Estimating standard errors in finance panel data sets: Comparing approaches", *Review of Financial Studies*, 22: 435-480

Quigley, G and Sinquefield, R A, 2000, Performance of UK equity unit trusts, *Journal of Asset Management*, 1: 72-92

Sensoy, B., 2009, Performance evaluation and self-designated benchmarks in the mutual fund industry, *Journal of Financial Economics*, 92: 25-39.

Wermers R., 2000, Mutual Fund Performance: An Empirical Decomposition into Stock-Picking Talent, Style, Transactions Costs, and Expenses, *The Journal of Finance*, 55 (4): 1655–1703.