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PREDICTABILITY REVISITED:
UK EQUITY RETURNS 1965 TO 2007

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Predictability Revisited: UK Equity Returns 1965 to 2007

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Abstract

If equity returns contain predictable components, then there could be opportunities for investors to capitalize using a number of strategies based on past price history. This study tests UK equity returns from 1965-2007 for signs of serial correlation and predictability. Returns are tested for signs of predictability using the Lo and MacKinlay (1988) variance ratio test and the Chow and Denning (1993) multiple variance ratio tests. Overall, the results show strong serial correlation in the returns, as well as signs of predictability based on statistically significant variance ratio test statistics. There is a size effect, in which small equities appear more predictable in the first half of the sample (1965-1985), and mid to large size equities appear more predictable in the second half of the sample (1986-2007).

J.E.L. Classification: G15, G14
Keywords: Predictability; Serial Correlation; Equity Returns

1. Introduction

Predictability based trading strategies have become increasingly popular over the last decade. Equity market neutral, a strategy generally formulated from statistical analysis of past price movements (Patton, 2009) has assets under management globally increasing from $14bn to $70bn from 2001 to 2007.[2] However, the recent credit crisis has cast a shadow over these strategies with many funds delivering poor returns (Khandani and Lo, 2007), and it is now timely to question whether these strategies are based upon a false premise i.e. are equity returns truly predictable? Our paper addresses this question by employing a range of tests for a large database of UK equities.

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Researchers attempting to evaluate the predictability of equity returns are faced with several challenges. Firstly, it is necessary to specify a long sample period in order to provide a robust test. Specifying a shorter time period means you are less likely to capture a wide range of market conditions. Second it is necessary to specify a large sample of equities. It is likely that there is significant cross-sectional variation in return predictability and some evidence suggests that return predictability is a small stock phenomenon. Third, we need to allow for time variation in predictability. This is particularly relevant for trading strategies based upon predictability as profitability depends upon it being independent of time. Finally, there are several implementation issues associated with statistical tests of predictability.

In this paper we address each of these difficulties. We specify a forty two year sample period of UK equities. Within the sample we specify over 6,700 UK equities. This is the largest and longest sample period that we are aware of in a study of this nature using UK data. To allow for time variation we repeat all statistical tests in several sub-sample periods. We further divide our sample into deciles (both equal and value weighted) based upon market capitalisation, controlling for cross sectional variation in results. The statistical tests we carry out are (1) simple Autocorrelation Functions (ACF) with Ljung-Box tests for serial correlation, (2) Lo and MacKinlay (1988) (hereafter LM) homoscedastic and heteroscedastic Variance Ratio tests, and (3) Chow and Denning (1993) (hereafter CD) Multiple Variance Ratio Tests.

The LM variance ratio test is a simple specification model based on variance estimators that can be used to test whether a series follows a random walk. The variance ratio test exploits the fact that intervals of a random walk are linear. For example, a five day period variance of a time series should be five times as large as a daily variance of the same time series. CD make a modification to the standard variance ratio test to allow for the joint testing of multiple variance ratios. CD argue that instead of examining several variance ratios at different aggregate intervals against the standard statistical critical value, it is appropriate to consider an overall critical value that takes into account the number of variance ratios being tested.

When we specify these different tests our empirical results generally find evidence of predictability. While we do provide evidence that stock price movement contains predictable components, there is considerable cross sectional and time variation in our results. Consistent with prior research (see for example LM, Poterba and Summers (1988), and Lovatt *et al.* (2007)) we find strong signs of serial dependence throughout the sample. When measured by Variance Ratios signs of predictability are also present across all time periods and throughout the full sample. The mid to large sized deciles of the full sample, notably the 6th to 9th deciles, report the highest number of significant variance ratios. The smaller deciles, 2nd to 4th, have a number of insignificant variance ratios. When the sample is divided into four sub-samples, it is quite clear that the first two time periods, encompassing 1965 to 1985, show the highest signs of predictability. In the first half of the sample, 1965-1985, the smaller equities, 2nd to 4th deciles, have the highest signs of predictability, whereas in the second half of the sample, from 1986 to 2007, the larger equities, 6th to 9th deciles, have the highest number of significant variance ratios. The third time period, 1986 to 1996, has the fewest significant variance ratios, in both the equally and value weighted portfolios. When we specify CD, joint variance test results suggest evidence of predictability in the mid to large sized deciles. However, in the smaller deciles, a number of variance ratios that were reported significant in the conventional variance ratio test are found to be insignificant. When the sample is divided into the four sub-samples, these incorrectly reported significant variance ratios are only present in the third time period, 1986 to 1996.

Taken in aggregate these results challenge the classical finance view that financial markets follow a random walk and suggest that there are opportunities to follow statistical arbitrage strategies, based on past price movements, in the UK equity market. In doing so we build on several related themes. There exists a considerable body of research which focus on the predictability of UK equity data with mixed findings. (See for example Malliaropulos (1996), Patro and Wu (2004), Belaire-Franch and Opong (2005), and Lovatt *et al.* (2007)) These studies have generally focused on UK equity indices (Malliaropulos (1996), Patro and Wu (2004), Belaire-Franch and Opong

(2005)) or relatively short sample periods (Lovatt *et al.* (2007)). We build on each of these studies providing more evidence on return predictability for a larger sample over a longer sample period, using a range of statistical tests.

A growing body of research is focused on the profitability of statistical trading strategies. Several authors including Conrad and Kaul (1998) and Jegadeesh and Titman (1993, 1995, 2001) provide US evidence on momentum and contrarian investment strategy profitability. Likewise, in the UK Antoniou *et al.* (2006) and Galariotis *et al.* (2007) report similar findings. With a very extensive test of predictability in UK equities, we present evidence supporting these studies, demonstrating that stock prices do not follow a random walk.

The rest of the paper is structured as follows. Section 2 describes the data, while Section 3 presents the predictability testing methodology. Section 4 reports the empirical results, including variance ratio and multiple variance ratio predictability tests. Finally Section 5 concludes.

2. Data

We test for predictability in UK equities using a database of over 20 million daily equity returns over a sample period from 1965 to 2007 – a time period that covers several market upturns and downturns, as well as relatively calm and volatile periods.

In our universe we have a total of 6,729 equity securities, ranging from large to small capitalization stocks, sourced from DataStream. On average, in any one year, there are 1,872 securities in the sample. The year with the smallest (largest) samples are 1965 (2007) with a total number of 786 (2,225) securities.

To ensure our results are independent of firm size, at the beginning of each year we sort stocks into portfolio deciles based upon end of prior year market capitalization. The 1st portfolio represents the smallest stocks by market capitalization and the 10th, the largest. Within each portfolio stocks are equal weighted. As an additional robustness test, we also form value weighted portfolios.

To investigate whether predictability is consistent across time periods we also divide our sample into four sub-samples: from 1st January 1965 to 31st December 1974; from 1st January 1975 to 31st December 1985; from 1st January 1986 to 31st December 1996; and, from 1st January 1997 to 31st December 2007.

[Insert Table 1 here please]

Table 1 Panel A displays the summary statistics for both the equally weighted and value weighted decile portfolios for the entire sample period. The mean returns for the equal and value weighted sample are 6.30% and 3.94%, respectively. The equally weighted portfolio has slightly higher returns in the 1st, 9th and 10th deciles. The standard deviation levels appear to be impacted by size. As size increases across the deciles, the standard deviation levels correspondingly increase. Each decile displays low levels of negative skewness; however, it is higher in the smaller deciles. The kurtosis levels also appear to be size dependent - as size increases across each decile, the kurtosis levels decrease. The minimum values for equally weighted (-12.24%) and value weighted (-15.25%) full samples occur on 20/10/1987. The maximum values of 6.57% for the equally weighted portfolio and 8.87% for the value weighted portfolio occur on 27/10/1975 and 28/2/2006, respectively.

The summary statistics for the full sample over the four separate sample sub-periods are reported in Table 1 Panel B. For both the equally and value weighted portfolios, the period of 1975 to 1985 has the highest mean returns, 21.71% and 12.03%. The fourth time period, 1997 to 2007, is the worst performing time period, with annual mean returns of -6.06% for the equally weighted sample and -3.06% for the value weighted sample. The standard deviations are greater for the value weighted portfolios in each of the four time periods, whereas the kurtosis levels are considerably higher for the equally weighted portfolios. The lowest daily returns occur in the third time period. Based on the summary statistics, it is evident that the returns vary quite considerably across the time periods investigated in this study.

3. Methodology

In this paper to test for predictability we specify two variations of the variance ratio test, the standard LM variance ratio test and the CD multiple variance ratio test. Below we review the details of these tests.

The random walk hypothesis in financial literature states that future stock returns cannot be predicted by previous stock prices. One of the first studies to provide convincing evidence of predictability in equity returns is LM. Using a sample of 1,216 weekly observations of US equity data, LM conduct simple volatility based specification tests based on variance estimators to determine if the prices truly follow a random walk. For the null hypothesis, that equities follow a random walk hypothesis, the variance should be uncorrelated and should follow a linear pattern over time. Therefore, variance ratio at time *k* should be *k* times the variance of its first difference. The LM variance ratios is defined as

$$VR(q) = \frac{\sigma_b^2(q)}{\sigma_a^2(q)} \tag{1}$$

where $\sigma_b^2(q)$ and $\sigma_a^2(q)$ are the maximum likelihood estimators of 1/q of the variance of the qth difference and the first difference of X_t, the return time series. Below, the formulas for $\sigma_b^2(q)$ and $\sigma_a^2(q)$ are defined in (2) and (4).

$$\sigma_b^2(q) = \frac{1}{m}\sum_{t=q}^{nq}(X_t - X_{t-q} - q\hat{\mu})^2 \tag{2}$$

where:

$$m = q(nq - q + 1)(1 - \frac{q}{nq}) \tag{3}$$

$$\sigma_a^2(q) = \frac{1}{nq-1}\sum_{t=1}^{nq}(X_t - X_{t-1} - \hat{\mu})^2 \tag{4}$$

where:

$$\hat{\mu} = \frac{1}{nq-1}(X_{nq} - X_0) \tag{5}$$

The asymptotic variance of the variance-ratio under homoscedasticity is shown below in (6).

$$\phi(q) = \frac{2(2q-1)(q-1)}{3q(nq)} \tag{6}$$

Z(q), the standard normal test statistic under homoscedasticity, is shown below.

$$Z(q) = \frac{VR(q)-1}{\left[\phi(q)\right]^{\frac{1}{2}}} \overset{a}{\sim} N(0,1) \tag{7}$$

$\phi^*(q)$ represents the heteroscedasticity consistent asymptotic variance of the variance ratio and is defined as:

$$\phi^*(q) = \sum_{j=1}^{q-1}\left[\frac{2(q-j)}{q}\right]^2 \hat{\delta}(j) \tag{8}$$

where

$$\hat{\delta}(j) = \frac{\sum_{t=j+1}^{nq}(X_t - X_{t-1} - \hat{\mu})^2 (X_{t-j} - X_{t-j-1} - \hat{\mu})^2}{\left[\sum_{k=1}^{nq}(X_t - X_{t-1} - \hat{\mu})^2\right]^2} \tag{9}$$

As stock returns are often non-normally distributed and heteroscedastic, LM define $Z^*(q)$ as

$$Z^*(q) = \frac{VR(q)-1}{\left[\phi^*(q)\right]^{\frac{1}{2}}} \overset{a}{\sim} N(0,1) \tag{10}$$

In this study we estimate variance ratios at 2, 3, 4, 5, 10 and 20 day frequencies.

CD argue that the random walk hypothesis requires that all variance ratios across all aggregate observations should be equal to one. Therefore, they develop a joint variance ratio test of the null hypothesis of the random walk theory with multiple comparisons of all selected variance ratio estimates that are equal to one. The CD multiple variance ratio test is a modification of the standard variance ratio test designed by LM. CD demonstrate that it is only necessary to consider the largest absolute value of the test statistic. The maximum heteroscedasticity consistent test statistic is defined as.

$$Z_2^*(q) = \max_{1 \le i \le m} \left| Z^*(q_i) \right| \tag{11}$$

where the confidence interval of at least 100(1-α) percent for the extreme statistic is

$$Z_2^*(q) \pm SMM(\alpha; m; \infty) \tag{12}$$

SMM(*α,m,*∞) is the asymptotic critical value of the α-point of Studentized Maximum Modulus distribution with *m* (number of variance ratios) and ∞ (sample size) degrees of freedom. The SMM can also be calculated from the conventional standard normal distribution as displayed in equation 15. CD also note that the SMM table can be found in Hahn and Hendrickson (1971) and Stolin and Ury (1979).

$$SMM(\alpha; m; \infty) = Z_{\alpha+/2} \tag{13}$$

where

$$\alpha^+ = 1 - (1-\alpha)^{1/m} \tag{14}$$

The multiple variance ratio test statistic at the five percent significance level for six variance ratio and ∞ degrees of freedom is calculated to ± 2.632[3]. Therefore, the CD maximum test statistic can be compared to results from the LM conventional variance ratio tests. If the value for Z*(q) is greater than the SMM critical value of 2.632, then the random walk hypothesis is rejected.

4. Results

As discussed in the previous section in order to test for predictability we specify three separate tests: ACFs, the LM variance ratio test, and the CD multiple variance ratio test. In this section of the paper we report results for each of these tests for both equal and value weighted size decile portfolios across four eleven year time periods.

4.1 ACF Tests

[Insert Table 2 here please]

Panels A and B of Table 2 display the ACFs as well as the corresponding Q statistics for the equally and value weighted deciles for the entire sample period. The autocorrelation coefficients and Q-statistics are reported at various lags ranging from one to twenty. Studies such as LM, Poterba and Summers (1988), and Lovatt *et al.* (2007) have shown that equity data may display significant positive autocorrelation in the short term. Both the equally and value weighted deciles show strong signs of autocorrelation, as evidenced by their Q-statistics, which are significant at the one percent level across all deciles and over all lags. Comparing the two sets of results, the equally weighted portfolio coefficients are consistently higher than the value weighted portfolios across all deciles. The 5th to the 8^{th} deciles report the highest autocorrelation coefficients and Q-statistics for both equally and value weighted portfolios. For example, in the 7^{th} equally weighted decile, 33.8% of returns are explained by the previous day's returns. For the value weighted deciles, the 7^{th} decile also reports the highest first order autocorrelation coefficient, 31.3%. In the largest capitalisation decile (10) value weighted portfolio we observe negative autocorrelation coefficients at lags 2, 3 and 4. This is also observed in the Total portfolio at lags 3 and 4. The highly significant Q-statistics support rejection of the null hypothesis that UK stocks follow a random walk over the sample period.

Separating the sample into four sub-samples helps determine if autocorrelation coefficients are consistent across all time periods. The equal weighted decile ACF and Q-statistics from 1965 to 1974 are reported in Table 4 Panel A.[4] Panel B contain the 1975 to 1985 period results, while Panels C and D display the results for 1986 to 1996 and 1997 to 2007 respectively.

[Insert Table 3 here please]

In Panel A all Q-statistics reported across all deciles and lags are significant at the one percent level. The deciles that report the highest Q-statistics for the first four lags are the 5th to 8th deciles. This suggests that mid to large sized equities have the highest level of autocorrelation. Comparing deciles, the 6th decile reports the highest level of autocorrelation at 34.1%. However, examining the 10th and 20th lags, it appears that smaller securities have higher autocorrelations and Q-statistics. For the second time period, 1975 to 1985 the autocorrelation coefficients are all shown to be positive and significant. The 4th decile reports the highest first order autocorrelation coefficient of 44.8%. Comparing to Panel A in the second period, it appears that the autocorrelation coefficients are higher in the lower lags. In Panel C the 10th decile has negative autocorrelations of -3.6% and -2.1% in the first two lags. These are both significant at the ten percent level. For the fourth and final time period, 1997 to 2007, the equally weighted portfolio's autocorrelations are positive and significant at the one percent level across all lags and all deciles, with the exception of the 10th decile. The 10th decile reports insignificant autocorrelations in the first two lags and significant negative autocorrelation coefficients for lags 3 and 5, 10 and 20.

4.2 Variance Ratio tests

The homoscedasticity and heteroscedasticity consistent variance ratios for the equally weighted portfolios within the entire sample period under are reported in Table 4 of Panels A and B respectively. Examining the homoscedastic consistent variance ratios, the results suggest that predictability is evident across all deciles at every number of *q* base observations. The deciles with the highest homoscedasticity-consistent test statistic are generally the 6th to the 8th deciles. The 10th decile reports significant variance ratios; however, unlike the rest of the deciles they are negative, indicating mean reversion. The highly significant Z (q) values for all deciles and for the full sample supports a rejection of the null hypothesis that UK equity returns follow a random walk.

[Insert Table 4 here please]

Panel B in Table 4 reports the results using the heteroscedasticity-consistent test statistics for the equally weighted portfolios. The results are weaker than the results from Panel A but still support a rejection of the random walk hypothesis. Deciles 1, 4-9 and full sample are statistically significant across all aggregate observations. Deciles 6 to 9 report the highest associated test statistic across all aggregate observations. Decile 10 variance ratio is negative and statistically insignificant for all values of q, suggesting that the largest of the UK equities do not show signs of predictability over the sample period when equally weighted. Deciles 2 to 4 do not show signs of significance until the lagged observations are at least 4 days.

[Insert Table 5 here please]

To determine if the weighting scheme affects predictability, the results of an evaluation of the variance ratios for the value weighted portfolios are reported in Table 5. The homoscedasticity-consistent results in Panel A for the value weighted results are comparable to the equally weighted results. The variance ratios are significant across all deciles and all values of q. The deciles with the highest level of significance are generally the deciles 6 to 8. The heteroscedasticity-consistent results for the value weighted portfolios are reported in Panel B. Similar to the equally weighted results there is an overall decrease in the number and level of significant variance ratios reported. The 2nd and 3rd deciles are insignificant at q values of 2 and 3, suggesting less predictability in the smaller equities. Decile 10 is insignificant from values of q

4-20 and in the full sample for *q* values of 5-20. The Decile 6-9 consistently have the highest Z*(q) values across all observations of *q*, implying that mid to large equities may provide the highest level of predictability in UK equity returns. With the highly significant Z*(q) scores, the random walk null hypothesis is rejected for the majority of deciles and frequencies.

[Insert Table 6 here please]

Dividing the sample into the four time periods facilitates determination of consistent predictability for UK equity returns across each sub-sample time period. In the results reported in Panel A, the variance ratios across all deciles and values of *q* are significant at the one percent level. When the observation period is set for values of 2 and 3, the 1st, 3rd and 6th deciles report the highest significance values. For observation periods of 5 to 20 days, the 1st to 3rd deciles report the highest significance values. All of the variance ratios are highly significant, thereby adding more evidence to support rejection of the null hypothesis that UK equity returns follow a random walk for the first sample period, 1965 to 1974.

In Panel B the variance ratios are again significant at the one percent level for the equally weighted deciles. The 1st and 10th deciles have the lowest significance levels, suggesting that predictability is higher in the non-extreme weighted deciles. The 3rd to 5th deciles have the highest level of significance, suggesting average to smaller equity returns have the highest level of predictability. The significance of the variance ratios displayed in Panel B is slightly below the equally weighted portfolios in the first time period, particularly in the larger observation periods.

A new trend emerges in Panel C. There is a sharp decrease in the number of significant variance ratios in the third time period, 1986 to 1996. The deciles with the highest level of significance are the 6th through 9th deciles, indicating that mid to large sized securities have the highest level of predictability in the third time period. This is contrary to results from the second time period as reported in Panel B. A number of variance ratios are insignificant during the third time period.

When the observation period is two days, the 1st to 5th deciles are insignificant, and when (q) is set to three and four days, the 2nd to 4th deciles are insignificant. The 10th decile is negative and significant for the first four values of *q*, and negative and insignificant when *q* is set to 10 and 20. This suggests that for the largest securities during the third time period there is evidence of mean reversion, only significant in the short term.

There is a return to higher numbers of significant variance ratios for the equally weighted deciles in the fourth time period, as demonstrated in Panel D. The 1st to 9th deciles are all significant at the one percent level. The 6th to 8th deciles have the highest test statistics in the shorter observation periods (two to three days); however, starting with the four day observation period, the 1st decile has the highest level of predictability. The 10th decile is insignificant across all observation periods in the fourth time period.

4.3 Multiple Variance Ratio test

In this section we provide results from the CD multiple variance ratio test which is a sterner test of predictability. Below we outline instances where according to the CD test the results in section 4.2 are due to inference errors.

The equally and value weighted results under heteroscedastic conditions are reported in Panel A and B of Table 7.[5] In Panel A it appears that only the mid to large sized equities have signs of predictability in their returns. The 6th to 9th deciles and the full sample are significant across all aggregated observations. The smaller portfolios, 1st to 5th deciles, all report insignificant variance ratios, as well as variance ratios that are incorrectly reported as significant under the LM variance ratio tests.

Comparing Table 7 Panel B with Table 5 Panel B a number of the value weighted portfolios had inference errors, with several incorrectly reported significant variances ratios, when considering the joint nature of the variance ratio test. Only the 5th to 9th deciles are significant across all aggregated observations. Once again, the smallest deciles, 1st to 4th, have a number of variance ratios that are insignificant according to the SMM critical value, although they were previously reported as significant. With both portfolios, the evidence of predictability is less convincing when the returns are evaluated at the joint level.

[Insert Table 7 here please]

Separation of the sample into four sub-samples is performed in order to determine if the results from the joint variance ratio test is consistent across all sample time periods. The equal weighted results for each time period are reported in Table 8 Panels A to D. Applying the joint variance ratio test to the first two time periods, 1965 to 1974 (Panel A), and 1975 to 1986 (Panel B), there is almost no deviation from the results reported using the LM variance ratio test. In each time period, all portfolios, at levels of aggregated observations are significant according to the SMM critical value. Predictability is evident across all portfolios during the first two time periods.

[Insert Table 8 here please]

Only the third time period fails to provide convincing evidence of predictability in UK equities. This period, 1986 to 1997, reports dramatically different results to those of the first two time periods. The results show that every portfolio, with the exception of the 8th decile, has incorrectly reported significant variance ratios when utilizing the SMM critical value. The 7th and 9th deciles report significant observations for a number of variance ratios; however, only the 8th decile has significant variance ratios across all aggregated observations. Evidence of predictability significantly decreases in this third time period.

Finally, in the most recent time period, 1997 to 2007, reported in Panel D all portfolios, with the exception of decile 10 exhibit statistically significant signs of predictability. As with the LM variance ratio tests decile 10 variance ratios are statistically insignificant from zero using the CD multiple variance ratio test.

In aggregate the evidence we present in this section of the paper suggests that equity returns do appear to be predictable. The evidence is strongest when predictability is measured using simple autocorrelation tests and LM Variance Ratios. When we estimate, the more stringent, CD Multiple Variance Ratios the evidence is weaker but further analysis shows that this is driven by the 1986 to 1996 period, where for all tests there is considerable less evidence of predictability.

We also find considerable cross sectional and longitudinal variance in the results of our predictability measures. Evidence of predictability is strongest in the 1965 to 1985 and 1997 to 2007 periods. In the 1986 to 1996 period the results are less clear. Cross sectional evidence reported, also shows that in some time periods the Variance Ratios are larger for small capitalisation stocks, whereas in others, it is the largest capitalisation stocks which appear most predictable.

5. Conclusion

This paper has clear practical implications for investors in equity market neutral hedge funds and managers pursuing statistical arbitrage strategies in equity markets. Despite the large losses reported for this group in 2007 and 2008, the strategies are based upon a sound premise - equity returns are, to a degree, predictable. Irrespective of measure our results show strong evidence of return predictability.

The evidence reported in this paper, using the CD Multiple Variance Ratio, our most stringent test, shows that in the early time periods, 1965 to 1974 and 1975 to 1985, all firm size deciles exhibit return predictability. It is reasonable to postulate that statistical arbitrage profitability in such an environment would be relatively high. However, in the 1986 to 1996 time period the results are quite different. Only in the large stock deciles (specifically 7 to 9) is return predictability evident. Again, we can deduce that this environment would be difficult for fund managers. Finally, in the 1997 to 2007 period, the environment becomes more favourable, and returns are predictable for the majority of stocks.

Because return predictability is both cross-sectionally and time varying, practitioners must be very flexible. These results demonstrate the challenges for a manager who bases a strategy on return predictability.

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[2] Barclay Group estimates. http://www.barclaygrp.com/indices/ghs/mum/Equity_Market_Neutral.html.

[3]SMM critical values can be taken from the standard normal z table; the 5% SMM critical value is the z value leaving an upper tail area of $0.5[1 - (1 - 0.05)^{1/k}]$ where k is the number of sampling intervals.
Upper Tail: 05*(1-(1-0.05)^(1/6))= 0.004256
Lower Tail: 1-0.004256= 0.99574

$\alpha^{+} = \pm 2.632$

[4] For the sake of brevity we report only results for equal weighted portfolios in the sub-samples. The results for value weighted deciles are very similar and available from the authors on request.

[5] The results under homoscedastic conditions are very similar and available from the authors on request.

References

Antoniou, A., Galarioutis, E. C. & Spyrou, S. I. (2006) Short-term contrarian strategies in the london stock exchange: Are they profitable? Which factors affect them? *Journal of Business Finance & Accounting,* 33**,** 839-867.

Belaire-Franch, J. & Opong, K. (2005) A variance ratio test of the behaviour of some ftse equity indices using rank and signs. *Review of Quantitative Finance and Accounting,* 24**,** 93-107.

Chow, K. V. & Denning, K. C. (1993) A simple multiple variance ration test. *Journal of Econometrics,* 58**,** 385-401.

Conrad, J. & Kaul, G. (1998) An anatomy of trading strategies. *Review of Financial Studies* 11**,** 489-519.

Galariotis, E. C., Holmes, P. & Ma, X. S. (2007) Contrarian and momentum profitability revisited: Evidence from the london stock exchange 1964-2005. *Journal of Multinational Financial Management,* 17**,** 432-447.

Hahn, G. R. & Hendrickson, R. W. (1971) A table of percentage points on the distribution of large absolute value of k student t variates and its applications. *Biometrika,* 58**,** 323-332.

Jegadeesh, N. & Titman, S. (1993) Returns to buying winners and selling losers: Implications for stock market efficiency. *Journal of Finance,* 48**,** 65-91.

Jegadeesh, N. & Titman, S. (1995) Overreaction, delayed reaction, and contrarian profits. *Review of Financial Studies,* 8**,** 973-993.

Jegadeesh, N. & Titman, S. (2001) Profitability of momentum strategies: An evaluation of alternative explanations. *Journal of Finance,* 56**,** 699-720.

Khandani, A. E. & Lo, A. W. (2007) What happened to the quants in august 2007? *SSRN eLibrary*.

Lo, A. W. & Mackinlay, A. C. (1988) Stock market prices do not follow random walks: Evidence from a simple specification test. *Review of Financial Studies,* 1**,** 41-66.

Lovatt, D., Boswell, A. & Noor, R. (2007) A note on the predictability of uk stock returns. *European Journal of Finance,* 13**,** 159-164.

Malliaropulos, D. (1996) Are long-horizon stock returns predictable? A bootstrap analysis. *Journal of Business Finance & Accounting,* 23**,** 93-106.

Patro, D. K. & Wu, Y. (2004) Predictability of short-horizon returns in international equity markets. *Journal of Empirical Finance,* 11**,** 553-584.

Patton, A. J. (2009) Are "Market neutral" Hedge funds really market neutral? *Review of Financial Studies,* 22**,** 2495-2530.

Poterba, J. & Summers, L. (1988) Mean reversion in stock prices : Evidence and implications. *Journal of Financial Economics,* 22**,** 27-59.

Stolin, M. R. & Ury, H. K. (1979) Tables of the studentized maximum modulus distribution and an application to multiple comparisons among means. *Technometrics,* 21**,** 87-93.

Table 1: Summary statistics Panel A contains 10 equally weighted and value weighted portfolios of daily returns for all equities listed in the United Kingdom from 31/12/65-31/12/07, decile 1 being the smallest, and decile 10 being the largest. Panel B looks at all equities over four time period 1965-1974, 1975-1985, 1986-1997 and 1998 to 2007.

Panel A	Ann Mean	Ann Med	Ann Std Dev	Skewness	Kurtosis	Minimum	Maximum
Decile 1							
Equally weighted	10.32	6.19	8.27	-2.04	48.13	-10.47	5.18
Value Weighted	8.38	5.70	7.65	-1.73	43.24	-9.22	5.08
Decile 2							
Equally weighted	4.97	5.63	8.65	-3.10	74.63	-11.82	6.64
Value Weighted	5.25	5.64	7.98	-2.88	72.93	-10.82	6.24
Decile 3							
Equally weighted	3.42	5.69	8.96	-2.62	62.77	-12.80	7.54
Value Weighted	3.94	5.65	8.32	-2.13	50.20	-10.79	6.27
Decile 4							
Equally weighted	4.14	6.20	9.26	-2.45	50.88	-11.88	6.68
Value Weighted	4.60	6.06	8.51	-2.01	43.69	-10.02	6.76
Decile 5							
Equally weighted	3.42	6.01	9.46	-2.14	41.50	-10.95	7.26
Value Weighted	3.83	5.93	8.82	-1.70	35.70	-9.37	7.37
Decile 6							
Equally weighted	4.90	6.15	9.74	-1.90	39.47	-11.12	8.64
Value Weighted	5.02	6.07	9.16	-1.52	36.74	-9.59	8.68
Decile 7							
Equally weighted	5.81	6.63	10.48	-1.61	32.41	-10.61	8.22
Value Weighted	6.03	6.54	10.00	-1.30	29.60	-9.22	8.24
Decile 8							
Equally weighted	6.20	5.99	11.40	-1.31	28.55	-11.19	7.89
Value Weighted	6.51	5.91	10.91	-1.09	27.31	-9.89	7.85
Decile 9							
Equally weighted	8.69	5.37	13.38	-0.60	20.10	-13.27	8.62
Value Weighted	8.35	5.30	12.91	-0.49	20.34	-12.83	8.80
Decile 10							
Equally weighted	7.95	5.10	14.46	-0.64	19.62	-15.14	8.94
Value Weighted	3.81	4.65	16.12	-0.37	15.04	-15.85	8.98
Full Sample							
Equally weighted	6.30	7.17	8.91	-2.46	52.26	-12.24	6.57
Value Weighted	3.94	4.77	15.53	-0.37	15.30	-15.25	8.87

Panel B	Ann Mean	Ann Med	Ann Std Dev	Skewness	Kurtosis	Minimum	Maximum
1965-1974							
Equally weighted	3.73	5.45	9.06	-1.60	24.25	-6.95	3.77
Value Weighted	3.33	5.02	13.00	-0.16	8.05	-4.69	5.13
1975-1985							
Equally weighted	21.71	24.07	8.82	0.83	22.38	-4.74	6.57
Value Weighted	12.03	5.67	12.55	-0.28	8.83	-7.30	4.86
1986-1996							
Equally weighted	5.60	10.24	9.58	-6.01	110.95	-12.24	4.90
Value Weighted	3.40	2.93	13.50	-2.38	47.67	-15.25	6.04
1997-2007							
Equally weighted	-6.06	10.41	8.03	-1.98	14.44	-4.65	2.40
Value Weighted	-3.06	0.36	21.20	0.17	7.28	-7.16	8.87

Table 2: Autocorrelations of continuously compounded daily returns from 1/1/1965 to 31/12/2007. (Q statistics).

Panel A:	Auto-correlations of continuously compounded equally weighted daily returns						
Lags	1	2	3	4	5	10	20
Decile 1	0.212	0.145	0.133	0.151	0.126	0.144	0.100
	(503.5)***	(738.4)***	(937.7)***	(1192)***	(1369.4)***	(2155)***	(2910.8)***
Decile 2	0.249	0.196	0.150	0.168	0.145	0.158	0.117
	(694.9)***	(1126.1)***	(1377.9)***	(1694.4)***	(1929.9)***	(2866.1)***	(3816.3)***
Decile 3	0.258	0.180	0.137	0.154	0.132	0.137	0.102
	(748.2)***	(1112.3)***	(1323.4)***	(1587.8)***	(1782.2)***	(2509.5)***	(3288.8)***
Decile 4	0.294	0.190	0.143	0.151	0.132	0.134	0.096
	(968.5)***	(1372.6)***	(1601.3)***	(1856.1)***	(2051)***	(2813.7)***	(3461.1)***
Decile 5	0.331	0.202	0.160	0.155	0.141	0.124	0.075
	(1227.6)***	(1685.2)***	(1973.9)***	(2244.2)***	(2466.6)***	(3193.5)***	(3814.5)***
Decile 6	0.332	0.203	0.157	0.149	0.139	0.133	0.064
	(1234.7)***	(1697.7)***	(1975.2)***	(2224.2)***	(2439.9)***	(3119.6)***	(3629)***
Decile 7	0.338	0.191	0.143	0.132	0.122	0.122	0.064
	(1281.5)***	(1692.4)***	(1922.1)***	(2119.1)***	(2285.6)***	(2832.9)***	(3243.7)***
Decile 8	0.320	0.164	0.139	0.126	0.112	0.114	0.050
	(1146.7)***	(1448.2)***	(1664)***	(1842.2)***	(1982.2)***	(2384.1)***	(2660)***
Decile 9	0.242	0.091	0.079	0.081	0.063	0.085	0.045
	(659.3)***	(753.2)***	(822.9)***	(897.1)***	(942.1)***	(1115.1)***	(1226.6)***
Decile 10	0.085	0.018	0.023	0.039	0.002	0.047	0.049
	(80.3)***	(84)***	(89.8)***	(107)***	(107)***	(148.3)***	(204.1)***
Total	0.321	0.178	0.145	0.153	0.126	0.138	0.079
	(1154.8)***	(1512.3)***	(1749.3)***	(2011.6)***	(2189.8)***	(2870.6)***	(3414.7)***
Panel B:	Auto-correlations of value weighted continuously compounded daily returns						
Decile 1	0.228	0.160	0.149	0.155	0.143	0.150	0.110
	(585.5)***	(874.5)***	(1123.5)***	(1394.4)***	(1622.5)***	(2442.6)***	(3272.5)***
Decile 2	0.246	0.192	0.145	0.160	0.144	0.159	0.123
	(680.8)***	(1095.6)***	(1331.8)***	(1620.2)***	(1854.6)***	(2746.7)***	(3681.6)***
Decile 3	0.265	0.182	0.141	0.146	0.138	0.145	0.106
	(790.2)***	(1160.8)***	(1385.3)***	(1625.8)***	(1839.9)***	(2548.3)***	(3322.7)***
Decile 4	0.308	0.197	0.147	0.149	0.139	0.141	0.099
	(1064.2)***	(1501.7)***	(1744.7)***	(1995.5)***	(2212.2)***	(2982.2)***	(3646.9)***
Decile 5	0.341	0.205	0.163	0.148	0.144	0.127	0.079
	(1305.6)***	(1779.2)***	(2077.4)***	(2324.7)***	(2558)***	(3264.2)***	(3886.7)***
Decile 6	0.337	0.205	0.159	0.142	0.142	0.135	0.066
	(1270.9)***	(1740.8)***	(2025.1)***	(2251.6)***	(2477.3)***	(3114.3)***	(3630.6)***
Decile 7	0.339	0.188	0.139	0.122	0.122	0.123	0.068
	(1286.7)***	(1682.3)***	(1900.5)***	(2068.8)***	(2234.7)***	(2747.2)***	(3151)***
Decile 8	0.317	0.156	0.132	0.117	0.108	0.115	0.052
	(1126)***	(1400)***	(1594.6)***	(1749.4)***	(1881)***	(2253)***	(2523.4)***
Decile 9	0.237	0.084	0.075	0.074	0.060	0.087	0.048
	(628.1)***	(707.9)***	(770.5)***	(832)***	(872.6)***	(1037.8)***	(1151.4)***
Decile 10	0.108	-0.004	-0.022	-0.019	0.020	0.008	0.005
	(131.8)***	(132)***	(137.3)***	(141.2)***	(145.6)***	(148.8)***	(161.9)***
Total	0.118	0.000	-0.017	-0.015	0.026	0.012	0.006
	(155.4)***	(155.4)***	(158.8)***	(161.2)***	(168.5)***	(173.1)***	(189.7)***

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

Table 3: Autocorrelations of continuously compounded daily returns for sub-sample periods. (Q statistics).

Panel A:	Auto-correlations of equally weighted continuously compounded daily returns 1965-1974						
Lags	1	2	3	4	5	10	20
Decile 1	0.167	0.118	0.103	0.089	0.205	0.246	0.179
	(72.9)***	(109.2)***	(137.1)***	(157.8)***	(267.4)***	(510.2)***	(763.5)***
Decile 2	0.238	0.168	0.132	0.121	0.261	0.212	0.231
	(147.4)***	(221.3)***	(266.8)***	(305)***	(482.9)***	(701.9)***	(1005.6)***
Decile 3	0.272	0.179	0.140	0.118	0.245	0.240	0.179
	(193.1)***	(276.6)***	(327.9)***	(364.3)***	(521.4)***	(766.8)***	(1105.2)***
Decile 4	0.303	0.188	0.123	0.130	0.242	0.198	0.140
	(240.3)***	(332.4)***	(371.7)***	(415.6)***	(568.7)***	(791.5)***	(1025.8)***
Decile 5	0.328	0.185	0.120	0.102	0.230	0.168	0.089
	(281.5)***	(371.1)***	(408.6)***	(436)***	(574)***	(740.2)***	(913.4)***
Decile 6	0.341	0.192	0.106	0.098	0.218	0.165	0.075
	(303)***	(399.6)***	(428.7)***	(453.8)***	(577.7)***	(730.7)***	(909.7)***
Decile 7	0.339	0.176	0.094	0.093	0.180	0.156	0.080
	(300.7)***	(381.2)***	(404.5)***	(426.9)***	(511.8)***	(637.7)***	(791.2)***
Decile 8	0.318	0.152	0.095	0.087	0.172	0.127	0.048
	(264.3)***	(324.8)***	(348.3)***	(367.9)***	(445.7)***	(544)***	(664.5)***
Decile 9	0.277	0.115	0.068	0.056	0.141	0.104	0.051
	(200.9)***	(235.7)***	(247.9)***	(255.9)***	(307.7)***	(366.2)***	(429.1)***
Decile 10	0.200	0.055	0.006	0.029	0.045	0.075	0.054
	(104.9)***	(112.8)***	(112.9)***	(115.1)***	(120.3)***	(146.4)***	(182.5)***
Total	0.313	0.169	0.107	0.106	0.226	0.195	0.110
	(255)***	(329.9)***	(359.6)***	(388.7)***	(522.3)***	(701.4)***	(908.6)***
Panel B	Auto-correlations of equally weighted continuously compounded daily returns 1975-1985						
Decile 1	0.331	0.234	0.184	0.127	0.123	0.098	0.085
	(314)***	(471)***	(568.9)***	(615.2)***	(658.7)***	(753.1)***	(843.6)***
Decile 2	0.376	0.241	0.163	0.074	0.089	0.132	0.089
	(406.7)***	(573.1)***	(649.7)***	(665.3)***	(687.9)***	(788.3)***	(905.4)***
Decile 3	0.429	0.254	0.180	0.098	0.079	0.104	0.086
	(528.3)***	(714.4)***	(807.9)***	(835.3)***	(853.5)***	(905.9)***	(991.9)***
Decile 4	0.448	0.228	0.165	0.086	0.060	0.099	0.071
	(577.7)***	(727.7)***	(806.2)***	(827.4)***	(837.8)***	(887)***	(940.6)***
Decile 5	0.433	0.233	0.184	0.091	0.067	0.075	0.063
	(537.4)***	(693.6)***	(791)***	(814.6)***	(827.5)***	(868.7)***	(924.2)***
Decile 6	0.401	0.203	0.184	0.084	0.070	0.097	0.053
	(463)***	(581.2)***	(678.4)***	(698.6)***	(712.8)***	(752)***	(799.9)***
Decile 7	0.389	0.157	0.141	0.055	0.058	0.103	0.083
	(434.7)***	(505.5)***	(562.5)***	(571.3)***	(580.9)***	(627.5)***	(680)***
Decile 8	0.352	0.121	0.134	0.073	0.044	0.117	0.074
	(355.5)***	(397.9)***	(449.4)***	(464.5)***	(470.1)***	(520.5)***	(574.3)***
Decile 9	0.289	0.061	0.097	0.052	0.030	0.115	0.081
	(240.5)***	(251.3)***	(278.3)***	(286)***	(288.7)***	(338.2)***	(389.6)***
Decile 10	0.189	0.034	0.078	0.038	0.000	0.094	0.050
	(102.4)***	(105.8)***	(123.1)***	(127.3)***	(127.3)***	(162.9)***	(182.2)***
Full Sample	0.419	0.185	0.173	0.091	0.059	0.122	0.082
	(503.5)***	(602.2)***	(688.3)***	(712.2)***	(722.2)***	(789.9)***	(862.3)***

Table 3 Continued

Panel C:	Auto-correlations of equally weighted continuously compounded daily returns 1986-1996						
Lags	1	2	3	4	5	10	20
Decile 1	0.201	0.126	0.121	0.185	0.079	0.133	0.084
	(115.6)***	(161.3)***	(203.3)***	(301.9)***	(319.8)***	(565.4)***	(804)***
Decile 2	0.171	0.161	0.109	0.200	0.078	0.142	0.080
	(83.7)***	(158.3)***	(192.3)***	(307.3)***	(324.7)***	(593)***	(840.7)***
Decile 3	0.167	0.136	0.090	0.199	0.061	0.102	0.066
	(80.1)***	(133)***	(156.5)***	(270.3)***	(281)***	(536.8)***	(745.5)***
Decile 4	0.209	0.163	0.109	0.205	0.080	0.133	0.082
	(125.1)***	(201.9)***	(236.1)***	(357.5)***	(376)***	(677.4)***	(882.8)***
Decile 5	0.245	0.187	0.146	0.217	0.107	0.126	0.063
	(172)***	(272.4)***	(333.9)***	(469.3)***	(502.4)***	(825.6)***	(1058)***
Decile 6	0.250	0.209	0.158	0.229	0.107	0.147	0.062
	(179.5)***	(305.1)***	(377.2)***	(528.6)***	(561.5)***	(905.7)***	(1130.4)***
Decile 7	0.275	0.227	0.163	0.232	0.122	0.134	0.045
	(217.3)***	(365.2)***	(441.4)***	(596.4)***	(639)***	(956.3)***	(1158.1)***
Decile 8	0.299	0.192	0.154	0.217	0.110	0.125	0.030
	(256.5)***	(362.6)***	(430.8)***	(566.5)***	(601.4)***	(810.3)***	(925)***
Decile 9	0.217	0.098	0.084	0.138	0.063	0.088	0.013
	(134.9)***	(162.6)***	(182.7)***	(237.1)***	(248.5)***	(316.7)***	(354.2)***
Decile 10	-0.036	-0.021	0.053	0.055	0.002	0.043	0.086
	(3.7)*	(5)*	(13)***	(21.6)***	(21.6)***	(31.9)***	(81.2)***
Full Sample	0.242	0.152	0.124	0.210	0.084	0.126	0.057
	(167.9)***	(234)***	(277.8)***	(404.2)***	(424.4)***	(675.7)***	(855.2)***

Panel D	Auto-correlations of equally weighted continuously compounded daily returns 1997-2007						
Decile 1	0.164	0.111	0.112	0.122	0.120	0.099	0.058
	(77.5)***	(112.7)***	(148.8)***	(191.7)***	(233.3)***	(361)***	(468.2)***
Decile 2	0.271	0.212	0.186	0.179	0.163	0.123	0.071
	(210.3)***	(339.4)***	(438.4)***	(530.5)***	(606.9)***	(836.8)***	(1057.4)***
Decile 3	0.216	0.157	0.136	0.133	0.141	0.091	0.063
	(134)***	(204.5)***	(258)***	(308.5)***	(366)***	(508.1)***	(653.9)***
Decile 4	0.239	0.171	0.163	0.132	0.135	0.082	0.069
	(164.6)***	(248.6)***	(325)***	(375.2)***	(427.9)***	(609.1)***	(756)***
Decile 5	0.310	0.185	0.175	0.186	0.149	0.108	0.063
	(276.7)***	(375.3)***	(463)***	(562)***	(625.6)***	(864.4)***	(1052.1)***
Decile 6	0.315	0.194	0.165	0.173	0.156	0.105	0.052
	(285.6)***	(393.8)***	(472.4)***	(558)***	(628)***	(879.4)***	(1013.9)***
Decile 7	0.320	0.210	0.171	0.169	0.127	0.083	0.012
	(293.4)***	(420.1)***	(504.4)***	(586.3)***	(632.7)***	(821.1)***	(914.6)***
Decile 8	0.283	0.201	0.172	0.152	0.124	0.066	0.011
	(230)***	(346)***	(430.8)***	(497.4)***	(541.9)***	(670.7)***	(722.6)***
Decile 9	0.165	0.096	0.055	0.087	0.028	0.022	0.009
	(78.3)***	(104.8)***	(113.5)***	(135.1)***	(137.4)***	(172)***	(194)***
Decile 10	0.020	0.010	-0.047	0.029	-0.037	-0.019	-0.004
	(1.1)	(1.4)	(7.7)*	(10.2)**	(14.1)**	(23.4)***	(42.7)***
Total	0.309	0.200	0.168	0.181	0.130	0.089	0.044
	(273.9)***	(388.3)***	(469.3)***	(563.2)***	(611.7)***	(835.1)***	(975.7)***

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

Table 4: Variance ratios for continuously compounded daily returns for UK equities returns at various aggregations 1/1/1965 to 31/12/2007 for 10 equally weighed portfolios.

Panel A:	Variance Ratio Test Under Homoscedastic Time Series Equally Weighted					
	Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20
Decile 1	1.18	1.32	1.44	1.59	2.14	3.14
	(19.03)***	(22.54)***	(25.16)***	(28.56)***	(35.83)***	(45.57)***
Decile 2	1.15	1.29	1.40	1.55	2.05	2.99
	(16.00)***	(20.92)***	(22.77)***	(26.4)***	(33.03)***	(42.47)***
Decile 3	1.14	1.26	1.36	1.50	1.99	2.84
	(15.01)***	(18.75)***	(20.4)***	(24.00)***	(30.98)***	(39.28)***
Decile 4	1.19	1.35	1.47	1.62	2.18	3.11
	(20.32)***	(24.55)***	(26.49)***	(29.74)***	(36.94)***	(44.95)***
Decile 5	1.23	1.42	1.57	1.74	2.41	3.42
	(24.69)***	(29.73)***	(32.24)***	(35.96)***	(44.22)***	(51.60)***
Decile 6	1.24	1.44	1.61	1.79	2.50	3.55
	(25.58)***	(31.37)***	(34.51)***	(38.29)***	(47.08)***	(54.25)***
Decile 7	1.28	1.51	1.71	1.90	2.63	3.67
	(29.66)***	(36.48)***	(39.95)***	(43.49)***	(51.26)***	(56.98)***
Decile 8	1.28	1.50	1.69	1.87	2.54	3.39
	(29.90)***	(35.56)***	(38.90)***	(41.98)***	(48.32)***	(51.01)***
Decile 9	1.14	1.24	1.31	1.38	1.62	1.93
	(14.58)***	(16.77)***	(17.47)***	(18.4)***	(19.30)***	(19.80)***
Decile 10	0.95	0.93	0.91	0.90	0.87	0.90
	(-5.27)***	(-5.29)***	(-5.29)***	(-4.62)***	(-3.98)***	(-2.14)**
Total	1.25	1.44	1.59	1.76	2.40	3.38
	(26.67)***	(31.01)***	(33.44)***	(36.75)***	(43.97)***	(50.68)***
Panel B:	Variance Ratio Test Under Heteroscedastic Time Series Equally Weighted					
Decile 1	1.18	1.32	1.44	1.59	2.14	3.14
	(2.38)**	(3.03)***	(3.60)***	(4.23)***	(5.86)***	(8.51)***
Decile 2	1.15	1.29	1.40	1.55	2.05	2.99
	(1.06)	(1.49)	(1.72)*	(2.06)**	(2.82)***	(4.21)***
Decile 3	1.14	1.26	1.36	1.50	1.99	2.84
	(0.97)	(1.30)	(1.50)	(1.84)*	(2.7)***	(4.01)***
Decile 4	1.19	1.35	1.47	1.62	2.18	3.11
	(1.73)*	(2.24)**	(2.56)**	(2.96)***	(4.01)***	(5.65)***
Decile 5	1.23	1.42	1.57	1.74	2.41	3.42
	(2.23)**	(2.87)***	(3.30)***	(3.78)***	(5.00)***	(6.63)***
Decile 6	1.24	1.44	1.61	1.79	2.50	3.55
	(3.12)***	(4.04)***	(4.69)***	(5.31)***	(6.9)***	(9.06)***
Decile 7	1.28	1.51	1.71	1.90	2.63	3.67
	(4.57)***	(5.85)***	(6.67)***	(7.41)***	(9.27)***	(11.69)***
Decile 8	1.28	1.50	1.69	1.87	2.54	3.39
	(5.75)***	(7.27)***	(8.43)***	(9.36)***	(11.48)***	(13.68)***
Decile 9	1.14	1.24	1.31	1.38	1.62	1.93
	(4.77)***	(5.66)***	(6.06)***	(6.5)***	(7.18)***	(7.87)***
Decile 10	0.95	0.93	0.91	0.90	0.87	0.90
	(-1.37)	(-1.48)	(-1.57)	(-1.44)	(-1.44)	(-0.86)
Total	1.25	1.44	1.59	1.76	2.40	3.38
	(2.73)***	(3.42)***	(3.95)***	(4.51)***	(5.98)***	(8.03)***

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

Table 5: Variance ratios for continuously compounded daily returns for UK equities returns at various aggregations 1/1/1965 to 31/12/2007 for value weighted portfolios.

Panel A:	Variance Ratio Test Under Homoscedastic Time Series Value Weighted					
	Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20
Decile 1	1.19	1.33	1.47	1.62	2.21	3.26
	(20.06)***	(23.69)***	(26.49)***	(30.14)***	(38.09)***	(48.15)***
Decile 2	1.15	1.29	1.40	1.54	2.03	2.98
	(15.72)***	(20.73)***	(22.53)***	(26.01)***	(32.39)***	(42.19)***
Decile 3	1.15	1.28	1.38	1.51	2.02	2.90
	(15.83)***	(19.7)***	(21.54)***	(24.9)***	(31.88)***	(40.4)***
Decile 4	1.20	1.37	1.51	1.66	2.26	3.25
	(21.69)***	(26.39)***	(28.69)***	(31.95)***	(39.5)***	(47.9)***
Decile 5	1.25	1.44	1.61	1.79	2.48	3.54
	(26.25)***	(31.61)***	(34.45)***	(38.09)***	(46.47)***	(54.15)***
Decile 6	1.25	1.45	1.63	1.81	2.54	3.63
	(26)***	(32.08)***	(35.5)***	(39.3)***	(48.38)***	(56.07)***
Decile 7	1.28	1.51	1.71	1.90	2.63	3.67
	(29.57)***	(36.54)***	(40.07)***	(43.43)***	(51.12)***	(56.94)***
Decile 8	1.27	1.47	1.65	1.82	2.45	3.25
	(28.26)***	(33.61)***	(36.76)***	(39.62)***	(45.36)***	(48.02)***
Decile 9	1.13	1.22	1.29	1.36	1.57	1.86
	(13.98)***	(15.92)***	(16.39)***	(17.19)***	(17.8)***	(18.33)***
Decile 10	1.08	1.09	1.08	1.07	1.05	1.11
	(8.45)***	(6.45)***	(4.81)***	(3.46)***	(1.71)*	(2.39)**
Total	1.08	1.10	1.09	1.08	1.08	1.15
	(8.98)***	(6.96)***	(5.28)***	(3.97)***	(2.38)**	(3.22)***
Panel B:	Variance Ratio Test Under Heteroscedastic Time Series Value Weighted					
Decile 1	1.19	1.33	1.47	1.62	2.21	3.26
	(2.26)**	(2.87)***	(3.42)***	(4.03)***	(5.63)***	(8.16)***
Decile 2	1.15	1.29	1.40	1.54	2.03	2.98
	(1.09)	(1.54)	(1.78)*	(2.12)**	(2.9)***	(4.38)***
Decile 3	1.15	1.28	1.38	1.51	2.02	2.90
	(1.2)	(1.61)	(1.87)*	(2.25)**	(3.26)***	(4.81)***
Decile 4	1.20	1.37	1.51	1.66	2.26	3.25
	(2.16)**	(2.8)***	(3.22)***	(3.69)***	(4.94)***	(6.88)***
Decile 5	1.25	1.44	1.61	1.79	2.48	3.54
	(2.69)***	(3.47)***	(4)***	(4.54)***	(5.92)***	(7.79)***
Decile 6	1.25	1.45	1.63	1.81	2.54	3.63
	(3.58)***	(4.68)***	(5.45)***	(6.17)***	(8.03)***	(10.58)***
Decile 7	1.28	1.51	1.71	1.90	2.63	3.67
	(5.45)***	(6.98)***	(7.96)***	(8.79)***	(10.93)***	(13.72)***
Decile 8	1.27	1.47	1.65	1.82	2.45	3.25
	(6.47)***	(8.16)***	(9.43)***	(10.43)***	(12.65)***	(14.95)***
Decile 9	1.13	1.22	1.29	1.36	1.57	1.86
	(4.61)***	(5.47)***	(5.84)***	(6.27)***	(6.91)***	(7.71)***
Decile 10	1.08	1.09	1.08	1.07	1.05	1.11
	(2.48)**	(2.02)**	(1.6)	(1.2)	(0.68)	(1.07)
Total	1.08	1.10	1.09	1.08	1.08	1.15
	(2.59)***	(2.15)**	(1.73)*	(1.36)	(0.93)	(1.41)

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

Table 6: Variance ratios for continuously compounded daily returns for UK equities returns at for equally weighted portfolios under heteroscedastic conditions for sub-sample periods

Panel A:	Heteroscedastic Time Series Equally Weighted 1965-1974					
	Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20
Decile 1	1.37	1.70	1.97	2.20	3.35	5.18
	(7.66)***	(9.77)***	(11.22)***	(12.37)***	(17.5)***	(22.79)***
Decile 2	1.46	1.83	2.13	2.40	3.59	5.32
	(6.69)***	(8.62)***	(10.04)***	(11.29)***	(15.52)***	(19.3)***
Decile 3	1.44	1.77	2.04	2.28	3.26	4.86
	(7.96)***	(9.58)***	(10.65)***	(11.56)***	(14.57)***	(18.27)***
Decile 4	1.43	1.74	1.97	2.17	3.11	4.51
	(6.71)***	(8.17)***	(9.05)***	(9.89)***	(13.04)***	(15.95)***
Decile 5	1.42	1.71	1.92	2.10	2.86	3.96
	(7.48)***	(8.78)***	(9.54)***	(10.15)***	(12.44)***	(14.62)***
Decile 6	1.42	1.71	1.91	2.07	2.80	3.91
	(7.63)***	(8.92)***	(9.5)***	(9.99)***	(12.2)***	(14.59)***
Decile 7	1.40	1.67	1.85	1.99	2.64	3.64
	(7.4)***	(8.59)***	(9.12)***	(9.56)***	(11.36)***	(13.45)***
Decile 8	1.39	1.65	1.83	1.98	2.64	3.64
	(7.37)***	(8.43)***	(8.99)***	(9.47)***	(11.42)***	(13.51)***
Decile 9	1.34	1.55	1.68	1.80	2.31	3.05
	(7.23)***	(8.04)***	(8.37)***	(8.7)***	(10.12)***	(11.47)***
Decile 10	1.25	1.37	1.43	1.48	1.70	2.11
	(7.41)***	(7.55)***	(7.15)***	(7.02)***	(6.96)***	(7.8)***
Total	1.43	1.72	1.92	2.11	2.91	4.12
	(7.15)***	(8.39)***	(9.08)***	(9.72)***	(12.17)***	(14.64)***
Panel B:	Heteroscedastic Time Series Equally Weighted 1975-1985					
Decile 1	1.21	1.38	1.51	1.61	1.92	2.59
	(5.2)***	(6.62)***	(7.16)***	(7.42)***	(7.76)***	(9.82)***
Decile 2	1.35	1.60	1.77	1.87	2.15	2.87
	(8.27)***	(9.25)***	(9.4)***	(9.19)***	(8.66)***	(10.78)***
Decile 3	1.36	1.63	1.81	1.92	2.16	2.67
	(9.04)***	(10.1)***	(10.24)***	(10.06)***	(9.15)***	(9.96)***
Decile 4	1.41	1.68	1.86	1.97	2.23	2.64
	(8.98)***	(9.75)***	(9.83)***	(9.65)***	(8.83)***	(9.32)***
Decile 5	1.38	1.64	1.84	1.97	2.34	2.80
	(8.83)***	(9.87)***	(10.17)***	(10.17)***	(10.13)***	(10.77)***
Decile 6	1.37	1.62	1.81	1.95	2.34	2.82
	(8.42)***	(9.17)***	(9.44)***	(9.53)***	(9.86)***	(10.75)***
Decile 7	1.36	1.58	1.75	1.85	2.15	2.54
	(8.87)***	(9.56)***	(9.7)***	(9.57)***	(9.27)***	(9.63)***
Decile 8	1.31	1.50	1.65	1.74	2.00	2.31
	(7.61)***	(8.31)***	(8.57)***	(8.51)***	(8.26)***	(8.31)***
Decile 9	1.24	1.35	1.43	1.48	1.61	1.79
	(7.66)***	(7.73)***	(7.7)***	(7.4)***	(6.37)***	(5.96)***
Decile 10	1.14	1.20	1.25	1.30	1.37	1.45
	(5.51)***	(5.52)***	(5.69)***	(5.68)***	(4.74)***	(3.91)***
Total	1.38	1.63	1.80	1.92	2.25	2.72
	(8.92)***	(9.8)***	(10.09)***	(10.06)***	(9.81)***	(10.51)***

Panel C:	Heteroscedastic Time Series Equally Weighted 1986-1996					
	Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20
Decile 1	1.17	1.29	1.40	1.54	2.06	3.04
	(1.53)	(1.9)*	(2.23)**	(2.67)***	(3.72)***	(5.59)***
Decile 2	1.14	1.27	1.37	1.51	2.01	2.95
	(0.87)	(1.23)	(1.42)	(1.74)*	(2.43)**	(3.69)***
Decile 3	1.13	1.24	1.33	1.47	1.96	2.84
	(0.75)	(1.02)	(1.18)	(1.48)	(2.23)**	(3.4)***
Decile 4	1.18	1.33	1.44	1.59	2.17	3.15
	(1.27)	(1.65)*	(1.88)*	(2.22)**	(3.1)***	(4.47)***
Decile 5	1.21	1.38	1.53	1.71	2.40	3.47
	(1.49)	(1.98)**	(2.3)**	(2.7)***	(3.73)***	(5.07)***
Decile 6	1.22	1.42	1.59	1.79	2.54	3.70
	(1.88)*	(2.52)**	(2.98)***	(3.46)***	(4.65)***	(6.32)***
Decile 7	1.26	1.49	1.69	1.90	2.73	3.93
	(2.27)**	(3.04)***	(3.54)***	(4.05)***	(5.34)***	(7.04)***
Decile 8	1.30	1.52	1.71	1.92	2.67	3.67
	(3.03)***	(3.82)***	(4.42)***	(5)***	(6.25)***	(7.74)***
Decile 9	1.14	1.24	1.32	1.41	1.74	2.17
	(2.13)**	(2.64)***	(3.07)***	(3.48)***	(4.52)***	(5.64)***
Decile 10	0.80	0.71	0.69	0.70	0.70	0.75
	(-2.07)**	(-2.21)**	(-2.04)**	(-1.85)*	(-1.51)	(-1.08)
Total	1.22	1.38	1.52	1.69	2.32	3.30
	(1.55)	(1.93)*	(2.24)**	(2.64)***	(3.64)***	(5.05)***

Panel D:	Heteroscedastic Time Series Equally Weighted 1997-2007					
Decile 1	1.20	1.37	1.53	1.68	2.32	3.35
	(5.1)***	(6.52)***	(7.7)***	(8.73)***	(11.68)***	(14.93)***
Decile 2	1.25	1.46	1.64	1.81	2.46	3.54
	(4.41)***	(5.53)***	(6.19)***	(6.82)***	(8.81)***	(11.04)***
Decile 3	1.17	1.32	1.45	1.57	2.11	2.93
	(3.96)***	(5.08)***	(5.89)***	(6.57)***	(9.2)***	(11.31)***
Decile 4	1.20	1.35	1.50	1.63	2.18	3.03
	(4.21)***	(5.15)***	(6.01)***	(6.65)***	(9)***	(11.42)***
Decile 5	1.28	1.47	1.63	1.79	2.44	3.43
	(5.5)***	(6.36)***	(7)***	(7.7)***	(9.91)***	(12.2)***
Decile 6	1.26	1.45	1.62	1.77	2.43	3.32
	(5.61)***	(6.84)***	(7.71)***	(8.56)***	(11.47)***	(13.65)***
Decile 7	1.30	1.53	1.72	1.90	2.56	3.48
	(7.31)***	(8.84)***	(9.76)***	(10.59)***	(12.83)***	(14.59)***
Decile 8	1.26	1.48	1.66	1.83	2.45	3.20
	(6.9)***	(8.64)***	(9.88)***	(10.86)***	(13.59)***	(15.14)***
Decile 9	1.13	1.23	1.30	1.37	1.57	1.85
	(4.15)***	(4.85)***	(5.04)***	(5.29)***	(5.5)***	(5.83)***
Decile 10	1.02	1.02	1.00	1.00	0.95	0.97
	(0.69)	(0.59)	(0.07)	(-0.04)	(-0.6)	(-0.25)
Total	1.30	1.52	1.70	1.88	2.56	3.56
	(6.15)***	(7.45)***	(8.3)***	(9.11)***	(11.59)***	(13.83)***

Table 7: Multiple variance ratios for continuously compounded daily returns for UK equities returns at various aggregations for 10 equally weighted deciles form 1/1/1965 to 31/12/2007 under Heteroscedastic conditions.

Panel A:	Variance Ratio Test Equally Weighted Time Series						Panel B:	Variance Ratio Test Value Weighted Time Series					
	Number (q) of base observations aggregated to form variance ratio							Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20		2	3	4	5	10	20
Decile 1	1.18	1.32	1.44	1.59	2.14	3.14	Decile 1	1.19	1.33	1.47	1.62	2.21	3.26
	(2.38)[b]	(3.03)[a]	(3.60)[a]	(4.23)[a]	(5.86)[a]	(8.51)[a]		(2.26)[b]	(2.87)[a]	(3.42)[a]	(4.03)[a]	(5.63)[a]	(8.16)[a]
Decile 2	1.15	1.29	1.40	1.55	2.05	2.99	Decile 2	1.15	1.29	1.40	1.54	2.03	2.98
	(1.06)	(1.49)	(1.72)	(2.06)[b]	(2.82)[a]	(4.21)[a]		(1.09)	(1.54)	(1.78)	(2.12)[b]	(2.9)[a]	(4.38)[a]
Decile 3	1.14	1.26	1.36	1.50	1.99	2.84	Decile 3	1.15	1.28	1.38	1.51	2.02	2.90
	(0.97)	(1.30)	(1.50)	(1.84)	(2.7)[a]	(4.01)[a]		(1.20)	(1.61)	(1.87)	(2.25)[b]	(3.26)[a]	(4.81)[a]
Decile 4	1.19	1.35	1.47	1.62	2.18	3.11	Decile 4	1.2	1.37	1.51	1.66	2.26	3.25
	(1.73)	(2.24)[b]	(2.56)[b]	(2.96)[a]	(4.01)[a]	(5.65)[a]		(2.16)[b]	(2.8)[a]	(3.22)[a]	(3.69)[a]	(4.94)[a]	(6.88)[a]
Decile 5	1.23	1.42	1.57	1.74	2.41	3.42	Decile 5	1.25	1.44	1.61	1.79	2.48	3.54
	(2.23)[b]	(2.87)[a]	(3.3)[a]	(3.78)[a]	(5)[a]	(6.63)[a]		(2.69)[a]	(3.47)[a]	(4)[a]	(4.54)[a]	(5.92)[a]	(7.79)[a]
Decile 6	1.24	1.44	1.61	1.79	2.5	3.55	Decile 6	1.25	1.45	1.63	1.81	2.54	3.63
	(3.12)[a]	(4.04)[a]	(4.69)[a]	(5.31)[a]	(6.9)[a]	(9.06)[a]		(3.58)[a]	(4.68)[a]	(5.45)[a]	(6.17)[a]	(8.03)[a]	(10.58)[a]
Decile 7	1.28	1.51	1.71	1.9	2.63	3.67	Decile 7	1.28	1.51	1.71	1.9	2.63	3.67
	(4.57)[a]	(5.85)[a]	(6.67)[a]	(7.41)[a]	(9.27)[a]	(11.69)[a]		(5.45)[a]	(6.98)[a]	(7.96)[a]	(8.79)[a]	(10.93)[a]	(13.72)[a]
Decile 8	1.28	1.5	1.69	1.87	2.54	3.39	Decile 8	1.27	1.47	1.65	1.82	2.45	3.25
	(5.75)[a]	(7.27)[a]	(8.43)[a]	(9.36)[a]	(11.48)[a]	(13.68)[a]		(6.47)[a]	(8.16)[a]	(9.43)[a]	(10.43)[a]	(12.65)[a]	(14.95)[a]
Decile 9	1.14	1.24	1.31	1.38	1.62	1.93	Decile 9	1.13	1.22	1.29	1.36	1.57	1.86
	(4.77)[a]	(5.66)[a]	(6.06)[a]	(6.5)[a]	(7.18)[a]	(7.87)[a]		(4.61)[a]	(5.47)[a]	(5.84)[a]	(6.27)[a]	(6.91)[a]	(7.71)[a]
Decile 10	0.95	0.93	0.91	0.9	0.87	0.9	Decile 10	1.08	1.09	1.08	1.07	1.05	1.11
	(-1.37)	(-1.48)	(-1.57)	(-1.44)	(-1.44)	(-0.86)		(2.48)[b]	(2.02)[b]	(1.60)	(1.20)	(0.68)	(1.07)
Total	1.25	1.44	1.59	1.76	2.4	3.38	Total	1.08	1.10	1.09	1.08	1.08	1.15
	(2.73)[a]	(3.42)[a]	(3.95)[a]	(4.51)[a]	(5.98)[a]	(8.03)[a]		(2.59)[b]	(2.15)[b]	(1.73)	(1.36)	(0.93)	(1.41)

[a] The corresponding variance ratio are statistically different from one at the 5 percent level when compared with the SMM critical value of 2.632.

[b] Inference error in which the test statistics are significant according to the standard normal critical value but are jointly insignificant.

Table 8: Multiple variance ratios for continuously compounded daily returns for UK equity returns at various aggregations for 10 equally and value weighted deciles under heteroscedastic conditions.

Panel A:	Variance Ratio Test Under Heteroscedastic from 1/1/1965 to 31/12/1974 Time Series Equally Weighted						Panel B:	Variance Ratio Test Under Heteroscedastic from 1/1/1975 to 31/12/1985 Time Series Equally Weighted					
	Number (q) of base observations aggregated to form variance ratio							Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20		2	3	4	5	10	20
Decile 1	1.37	1.7	1.97	2.2	3.35	5.18	Decile 1	1.21	1.38	1.51	1.61	1.92	2.59
	(7.66)[a]	(9.77)[a]	(11.22)[a]	(12.37)[a]	(17.5)[a]	(22.79)[a]		(5.2)[a]	(6.62)[a]	(7.16)[a]	(7.42)[a]	(7.76)[a]	(9.82)[a]
Decile 2	1.46	1.83	2.13	2.4	3.59	5.32	Decile 2	1.35	1.6	1.77	1.87	2.15	2.87
	(6.69)[a]	(8.62)[a]	(10.04)[a]	(11.29)[a]	(15.52)[a]	(19.3)[a]		(8.27)[a]	(9.25)[a]	(9.4)[a]	(9.19)[a]	(8.66)[a]	(10.78)[a]
Decile 3	1.44	1.77	2.04	2.28	3.26	4.86	Decile 3	1.36	1.63	1.81	1.92	2.16	2.67
	(7.96)[a]	(9.58)[a]	(10.65)[a]	(11.56)[a]	(14.57)[a]	(18.27)[a]		(9.04)[a]	(10.1)[a]	(10.24)[a]	(10.06)[a]	(9.15)[a]	(9.96)[a]
Decile 4	1.43	1.74	1.97	2.17	3.11	4.51	Decile 4	1.41	1.68	1.86	1.97	2.23	2.64
	(6.71)[a]	(8.17)[a]	(9.05)[a]	(9.89)[a]	(13.04)[a]	(15.95)[a]		(8.98)[a]	(9.75)[a]	(9.83)[a]	(9.65)[a]	(8.83)[a]	(9.32)[a]
Decile 5	1.42	1.71	1.92	2.1	2.86	3.96	Decile 5	1.38	1.64	1.84	1.97	2.34	2.8
	(7.48)[a]	(8.78)[a]	(9.54)[a]	(10.15)[a]	(12.44)[a]	(14.62)[a]		(8.83)[a]	(9.87)[a]	(10.17)[a]	(10.17)[a]	(10.13)[a]	(10.77)[a]
Decile 6	1.42	1.71	1.91	2.07	2.8	3.91	Decile 6	1.37	1.62	1.81	1.95	2.34	2.82
	(7.63)[a]	(8.92)[a]	(9.5)[a]	(9.99)[a]	(12.2)[a]	(14.59)[a]		(8.42)[a]	(9.17)[a]	(9.44)[a]	(9.53)[a]	(9.86)[a]	(10.75)[a]
Decile 7	1.4	1.67	1.85	1.99	2.64	3.64	Decile 7	1.36	1.58	1.75	1.85	2.15	2.54
	(7.4)[a]	(8.59)[a]	(9.12)[a]	(9.56)[a]	(11.36)[a]	(13.45)[a]		(8.87)[a]	(9.56)[a]	(9.7)[a]	(9.57)[a]	(9.27)[a]	(9.63)[a]
Decile 8	1.39	1.65	1.83	1.98	2.64	3.64	Decile 8	1.31	1.5	1.65	1.74	2	2.31
	(7.37)[a]	(8.43)[a]	(8.99)[a]	(9.47)[a]	(11.42)[a]	(13.51)[a]		(7.61)[a]	(8.31)[a]	(8.57)[a]	(8.51)[a]	(8.26)[a]	(8.31)[a]
Decile 9	1.34	1.55	1.68	1.8	2.31	3.05	Decile 9	1.24	1.35	1.43	1.48	1.61	1.79
	(7.23)[a]	(8.04)[a]	(8.37)[a]	(8.7)[a]	(10.12)[a]	(11.47)[a]		(7.66)[a]	(7.73)[a]	(7.7)[a]	(7.4)[a]	(6.37)[a]	(5.96)[a]
Decile 10	1.25	1.37	1.43	1.48	1.7	2.11	Decile 10	1.14	1.2	1.25	1.3	1.37	1.45
	(7.41)[a]	(7.55)[a]	(7.15)[a]	(7.02)[a]	(6.96)[a]	(7.8)[a]		(5.51)[a]	(5.52)[a]	(5.69)[a]	(5.68)[a]	(4.74)[a]	(3.91)[a]
Total	1.43	1.72	1.92	2.11	2.91	4.12	Total	1.38	1.63	1.8	1.92	2.25	2.72
	(7.15)[a]	(8.39)[a]	(9.08)[a]	(9.72)[a]	(12.17)[a]	(14.64)[a]		(8.92)[a]	(9.8)[a]	(10.09)[a]	(10.06)[a]	(9.81)[a]	(10.51)[a]

[a] The corresponding variance ratio are statistically different from one at the 5 percent level when compared with the SMM critical value of 2.632.
[b] Inference error in which the test statistics are significant according to the standard normal critical value but are jointly insignificant.

Table 8 Continued

Panel C:	Variance Ratio Test Under Heteroscedastic from 1/1/1986 to 31/12/1996 Time Series Equally Weighted						Panel B:	Variance Ratio Test Under Heteroscedastic from 1/1/1997 to 31/12/2007 Time Series Equally Weighted					
	Number (q) of base observations aggregated to form variance ratio							Number (q) of base observations aggregated to form variance ratio					
	2	3	4	5	10	20		2	3	4	5	10	20
Decile 1	1.17	1.29	1.40	1.54	2.06	3.04	Decile 1	1.2	1.37	1.53	1.68	2.32	3.35
	(1.53)	(1.90)	(2.23)[b]	(2.67)[a]	(3.72)[a]	(5.59)[a]		(5.1)[a]	(6.52)[a]	(7.7)[a]	(8.73)[a]	(11.68)[a]	(14.93)[a]
Decile 2	1.14	1.27	1.37	1.51	2.01	2.95	Decile 2	1.25	1.46	1.64	1.81	2.46	3.54
	(0.87)	(1.23)	(1.42)	(1.74)	(2.43)[b]	(3.69)[a]		(4.41)[a]	(5.53)[a]	(6.19)[a]	(6.82)[a]	(8.81)[a]	(11.04)[a]
Decile 3	1.13	1.24	1.33	1.47	1.96	2.84	Decile 3	1.17	1.32	1.45	1.57	2.11	2.93
	(0.75)	(1.02)	(1.18)	(1.48)	(2.23)[b]	(3.4)[a]		(3.96)[a]	(5.08)[a]	(5.89)[a]	(6.57)[a]	(9.2)[a]	(11.31)[a]
Decile 4	1.18	1.33	1.44	1.59	2.17	3.15	Decile 4	1.2	1.35	1.5	1.63	2.18	3.03
	(1.27)	(1.65)	(1.88)	(2.22)[b]	(3.1)[a]	(4.47)[a]		(4.21)[a]	(5.15)[a]	(6.01)[a]	(6.65)[a]	(9)[a]	(11.42)[a]
Decile 5	1.21	1.38	1.53	1.71	2.4	3.47	Decile 5	1.28	1.47	1.63	1.79	2.44	3.43
	(1.49)	(1.98)[b]	(2.30)[b]	(2.70)[a]	(3.73)[a]	(5.07)[a]		(5.5)[a]	(6.36)[a]	(7)[a]	(7.7)[a]	(9.91)[a]	(12.2)[a]
Decile 6	1.22	1.42	1.59	1.79	2.54	3.7	Decile 6	1.26	1.45	1.62	1.77	2.43	3.32
	(1.88)	(2.52)[b]	(2.98)[a]	(3.46)[a]	(4.65)[a]	(6.32)[a]		(5.61)[a]	(6.84)[a]	(7.71)[a]	(8.56)[a]	(11.47)[a]	(13.65)[a]
Decile 7	1.26	1.49	1.69	1.9	2.73	3.93	Decile 7	1.3	1.53	1.72	1.9	2.56	3.48
	(2.27)[b]	(3.04)[a]	(3.54)[a]	(4.05)[a]	(5.34)[a]	(7.04)[a]		(7.31)[a]	(8.84)[a]	(9.76)[a]	(10.59)[a]	(12.83)[a]	(14.59)[a]
Decile 8	1.3	1.52	1.71	1.92	2.67	3.67	Decile 8	1.26	1.48	1.66	1.83	2.45	3.2
	(3.03)[a]	(3.82)[a]	(4.42)[a]	(5)[a]	(6.25)[a]	(7.74)[a]		(6.9)[a]	(8.64)[a]	(9.88)[a]	(10.86)[a]	(13.59)[a]	(15.14)[a]
Decile 9	1.14	1.24	1.32	1.41	1.74	2.17	Decile 9	1.13	1.23	1.3	1.37	1.57	1.85
	(2.13)[b]	(2.64)[a]	(3.07)[a]	(3.48)[a]	(4.52)[a]	(5.64)[a]		(4.15)[a]	(4.85)[a]	(5.04)[a]	(5.29)[a]	(5.5)[a]	(5.83)[a]
Decile 10	0.8	0.71	0.69	0.7	0.7	0.75	Decile 10	1.02	1.02	1.00	1	0.95	0.97
	(-2.07)[b]	(-2.21)[b]	(-2.04)[b]	(-1.85)	(-1.51)	(-1.08)		(0.69)	(0.59)	(0.07)	(-0.04)	(-0.6)	(-0.25)
Total	1.22	1.38	1.52	1.69	2.32	3.3	Total	1.3	1.52	1.7	1.88	2.56	3.56
	(1.55)	(1.93)	(2.24)[b]	(2.64)[a]	(3.64)[a]	(5.05)[a]		(6.15)[a]	(7.45)[a]	(8.3)[a]	(9.11)[a]	(11.59)[a]	(13.83)[a]

[a] The corresponding variance ratio are statistically different from one at the 5 percent level when compared with the SMM critical value of 2.632.
[b] Inference error in which the test statistics are significant according to the standard normal critical value but are jointly insignificant.