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Does Volatility Improve UK Earnings Forecasts?

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Abstract: We investigate the relation between UK accounting earnings volatility and the level of future earnings using a unique sample comprising some 10,480 firm-year observations for 1,481 non-financial firms over the 1985-2003 period. The findings confirm the in-sample result of an inverse volatility-earnings relation only for the 1998-2003 sub-period and for the most profitable firms. The out-of-sample forecast accuracy for the top earnings quintile when volatility is added as a regressor is superior to the model including only lagged earnings. The findings are consistent with the overinvestment hypothesis and the view that the earnings of the most volatile firms tend to mean revert more rapidly.

Keywords: Earnings volatility, under-investment, over-investment, earnings persistence.

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We are grateful for the insightful comments and suggestions of the Editor Martin Walker, an anonymous referee, Ana Gisbert, and participants at the EFMA 2006 Conference at Complutense University, Madrid. Nikola gratefully acknowledges the financial support provided by the UK Overseas Research Studentship Award Scheme and the School of Accounting, Finance and Management at the University of Essex for a PhD scholarship.

1. INTRODUCTION

The importance of earnings volatility for a firm's value has long been recognized in the accounting and finance literature. Such volatility can have an impact either through its relation to the discount rate or to expected cash flows (earnings) in valuation models. Most existing research has focused on the link to the discount rate or cost of capital. One established result in this context is a positive relationship between earnings volatility and different measures of the cost of capital.[1] Collins and Kothari (1989) and Barth et al. (1999) document that the market reaction to unexpected earnings decreases as the earnings volatility increases. A few recent studies directly test the link between firm value and earnings volatility for the US market. Barnes (2001) find that earnings volatility is negatively related to firm value measured by the market-to-book ratio while Allayannis et al. (2005) show that the same relation becomes insignificant after controlling for cash flow volatility.

However, there is virtually no research on the relation between current earnings volatility and future performance. Corporate finance and accounting theories provide a motivation as to why volatility matters in this regard. A shortage of internal funds may make companies forego some profitable investment opportunities due to the higher costs of external financing (Myers and Majluf, 1984; Stiglitz and Weiss, 1981). An abundance of funds provides incentives for managers to invest beyond optimal levels either because they pursue their own interests rather than those of the shareholders (Jensen, 1986; Stulz, 1990; Morellec, 2004), or they are overconfident about the returns new investment may yield (Roll, 1986; Heaton, 2002; Malmendier and Tate, 2004 and 2006), or because they exploit favourable market sentiment (Stein, 1996; Jensen, 2005; Gilchrist et al, 2005; Polk and Sapienza, 2006; Dong et al., 2007). Volatile earnings increase the likelihood of a lack or excess of internal funds, and consequently increase both the likelihood of underinvestment (Froot, Scharfstein, and Stein, 1993) and that of overinvestment (Morellec and Smith, 2002). As investment distortions decrease profitability, earnings volatility should be negatively related to future earnings.

[1] See for example Beaver et al. (1970), Minton and Schrand (1999), Gebhardt et al. (2001), and Francis et al. (2004).

Accounting studies provide evidence that more volatile earnings are less persistent (Dechow and Dichev, 2002; Dichev and Tang, 2007). This implies faster mean reversion for more volatile firms whose earnings are far below or above expected earnings. The noise component of volatility as a result of uncertainty about business operations and of accounting choices such as estimation error in accruals and poor matching between costs and related revenues may cause this volatility/persistence relation. Minton, Schrand and Walther (2002) were the first to document an impact of volatility on future earnings for the US market. In a similar vein, Dichev and Tang (2007) document that for the current most profitable firms those with low volatility have higher earnings by approximately 3 percentage points than those with high volatility in each of the five years ahead.

In this paper, we examine whether earnings volatility is negatively related to future earnings as the corporate finance and the accounting literatures predict. For our sample of 10,480 UK non-financial firm-year observations over the 1985-2003 period, we find a statistically significant but economically weak inverse volatility-future earnings relation for the full sample. We show that the strength of the relation is particularly marked when current earnings levels are high. Within the highest earnings quintile, low volatility firms have 4.1 percentage points higher one-year ahead net earnings than high volatility firms. This spread remains persistent up to four years ahead. The negative relationship is strongest in the market bubble 1998-2003 sub-period. The results are broadly consistent with the overinvestment and earnings persistence hypotheses. In addition, out-of-sample forecast accuracy analysis validates the in-sample results. The inclusion of volatility in the regression reduces forecast error for those particular sub-samples where the impact of volatility is greatest: for high earnings firms and for the most recent sub-sample period. Our results are robust to alternative measures of earnings and volatility.

This paper makes several contributions to the literature. First, given the paucity of studies on the relation between current earnings volatility and future earnings, this paper seeks to fill the gap in the literature. It is the first large scale non-US study to investigate the relevance of earnings volatility for forecasting future earnings. We integrate the intuition from the two

separate strands of corporate finance and accounting research as a way of explaining the negative volatility-future earnings relation. Our findings are more consistent with the overinvestment hypothesis, which has not been previously proposed in the literature as an explanation for the negative volatility/future earnings relation. By the same token, they are contrary to Minton, Schrand and Walthers (2002) who find the biggest improvement in forecast accuracy for low profitability firms in the US market and interpret these findings as supporting the underinvestment hypothesis. Our results are consistent with the comparative Dichev and Tang (2007) study for the US market who find that the volatility-future earnings relation is the strongest when earnings are high.

Second, our paper supplements the vast body of fundamental analysis research that identifies a set of variables that improves valuation.[2] Our findings show that the simple inclusion of volatility in the cross-sectional regression of future on current earnings improves forecast accuracy for the firms with high current profits. Although relevant only for a particular sub-set of firms, the strength of this relation is an important insight that may contribute to more precise earnings estimates.

Finally, our approach is distinctive from similar studies looking at the relation between investments and future earnings or uncertainty and future earnings. Fairfield et al. (2003) find that current investment measured by the growth in long-term net operating assets is negatively associated with future earnings after controlling for current earnings and attribute this to diminishing returns on investment. Thus, managers undertake positive NPV projects but their marginal profitability is decreasing. By contrast, our predictions are based on investment distortions which are value destroying. Penman and Zhang (2002) demonstrate that firms

[2] Using different methodologies the literature so far has identified several factors that could be used to improve earnings' forecasts for various cross-section of firms. Some of these are stock prices (Collins et al., 1987, Shroff, 1999), accruals (Sloan, 1996), disaggregated earnings (Fairfield and Sweeney, 1996), ratio of tax-to-book income (Lev and Nissim, 2004), cost stickiness (Banker and Chan, 2006) and various combined accounting data (Ou and Penman, 1989; Lev and Thiagarajan, 1993; Abarbanell and Bushee, 1997; Setiono and Strong, 1998). Whittington (1971) established that the addition of size, historical growth in assets, and changes in external finance (equity and long-term debt) does not increase explanatory power over and above past profitability in the UK for 1948-1960 period. Similarly, Chan et al. (2003) find that long-term analysts' forecasts, dividend yield, earnings yield, past sales growth, past returns, and membership of the pharmaceutical and technology sectors do not have predictive ability of earnings growth in the US market.

which release their hidden reserves by decreasing investment in inventories, research and development and advertising and thereby increasing current earnings have lower subsequent earnings. Whereas the Penman and Zhang (2002) effect is attributable to a combination of investment policy and inherent accounting conservatism, we rely on the real economic effect of investment distortions and noise in earnings. Han and Manry (2000) find that the dispersion in the analyst forecasts is negatively associated with the future accounting rate of return on equity and stock return. They argue that analysts' disagreement decreases as the available information increases. The latter applies when firm prospects are good since both analysts and managers are keen to disclose favourable information.[3] To the extent that smoother earnings signal better prospects, our study may capture a similar phenomenon. Contrary to Han and Manry (2000), we argue that the lower persistence caused by uncertainty results in lower future earnings when current earnings are high.

The paper proceeds as follows. The literature review and our predictions are outlined in Section 2. Section 3 describes the sample, defines the variables and provides some summary statistics. Section 4 describes the empirical methods used and analyses the main findings. Section 5 presents results of out-of-sample tests. In Section 6 some conclusions and ideas for future research are provided.

2. BACKGROUND, MOTIVATION AND PREDICTIONS

Corporate finance theories based on information asymmetry, agency costs of equity and behavioural explanations (managerial overconfidence and overvalued equity) all suggest that earnings volatility may cause investment distortions. The accounting literature documents the inverse relation between earnings volatility and earnings persistence. Combining the insights

[3] Their results may also be interpreted as coming from the other channel consistent with the overvalued equity explanation of investment. The dispersion of analysts' forecasts may be positively correlated with overvaluation because optimistic investors buy the stock but pessimistic ones fail to short (Gilchrist et al., 2005).

from these two strands of literature, we predict that earnings volatility is negatively related to the future earnings, particularly when current earnings are high.[4]

i) Earnings volatility and under/overinvestment

Starting with Fazzari, Hubbard and Petersen (1988), a number of studies have established the positive sensitivity of investment to internally generated cash flow controlling for the investment opportunities set (see Stein, 2003 for review). The underlying cause is still debated, but it revolves around the market imperfections explanations (agency costs and information asymmetry) and behavioural explanations (managerial or market bias).

Due to information asymmetry between managers and capital markets external financing of new investments is more costly than internal financing (Myers and Majluf, 1984; Stiglitz and Weiss, 1981). Therefore, firms often forego profitable investment opportunities, that is, underinvest, when faced with a lack of internal funds. Conversely, overinvestment occurs if the interests of shareholders and managers are misaligned. Managers of firms may be tempted to spend free cash in excess of profitable investments in 'empire-building' projects (Jensen, 1986; Stulz, 1990; Morellec, 2004). Pawlina and Renneboog (2005) find evidence that the observed investment-cash flow sensitivity is primarily attributable to the overinvestment problem for a sample of 985 UK firms in the 1992-1998 period.

Behavioural explanations combine overconfident managers with rational markets, or rational managers with market sentiment. Overconfident managers overestimate returns to their investments but do not go to external markets because they perceive that their equity is undervalued (Roll, 1986; Heaton, 2002; Malmendier and Tate, 2004 and 2006). The alternative behavioural explanation is based on management's investment response to overvalued equity (Stein, 1996; Jensen, 2005; Gilchrist et al, 2005; Polk and Sapienza, 2006;

[4] Although we could have used the same corporate valuation framework if we had tested for the relation between current and future cash flows, we focus only on earnings. There is a large accounting literature showing that earnings are a better measure of true firm performance than operating cash flows. See for example Dechow (1994), Dechow, Kothari and Watts (1998), and Ball and Shivakumar (2006). Only a few studies such as Lev et al. (2005) dispute this. Moreover, forecasting earnings is a starting point in any valuation exercise regardless of the model used. Financial analysts prefer to forecast earnings rather than cash flows and rely more on earnings based than on cash flow based valuation models (Demirakos, Strong and Walker, 2004).

Dong et al., 2007). If the market prices a company according to its level of investment, then managers of overpriced companies with ample cash may undertake negative NPV to boost stock prices. By contrast, managers of under-priced companied will forego positive NPV projects so long as the undervaluation persists.

Earnings volatility increases the likelihood of very low and very high future cash realizations. Since both lack of funds and excess liquidity are costly, theory shows that an increase in volatility exacerbates underinvestment (Froot, Scharfstein, and Stein, 1993) and overinvestment (Morellec and Smith, 2002, Morellec, 2004). In support of the underinvestment story, Minton and Schrand (1999) find that average investment over six years is indeed negatively associated with contemporaneous volatility but only for firms with medium and high cash flow levels.

Holding all other factors constant, firms which forego investment will have lower future profitability than firms that invest optimally. Similarly, firms which overinvest will have lower future profitability and cash flows relative to current profitability. Since earnings volatility increases the investment distortions as explained above, we predict a negative relation between volatility and future earnings.[5]

The earnings volatility/future earnings relation may vary with the level of earnings as the impact of volatility on the under/overinvestment is a second-order effect relative to the availability of internal funds. As the *expected* level of cash flow from the assets in place as a result of previous investment increases, an increase in volatility becomes less severe for the

[5] Some other related explanations not related to the investment distortions can be also put forward to motivate the hypothesized negative relation. More volatile cash flows increase the probability of default and associated expected direct and indirect costs (see e.g. Bartram, 2000; Smith and Stulz, 1985). Volatility exacerbates underinvestment due to agency costs of debt (Myers, 1977) by increasing the likelihood of default and thus increases an incentive to underinvest and increases the cost of external financing (Mayers and Smith, 1977; Bessembinder, 1991). Undiversified and risk averse managers require higher compensation for non-diversifiable risk since expected utility is concave in compensation (see e.g. Bartram, 2000; Stulz, 2003). Finally, the present value of expected income tax increases with the increase in the volatility of pre-tax earnings (see e.g. Smith and Stulz, 1985; Bartram, 2000; Graham and Smith, 1999; Graham and Rogers, 2002). We focus on the link between volatility and corporate investment since it is more pervasive and not concentrated in a relatively small number of specific companies.

underinvestment problem, but more so for the overinvestment problem.[6] This implies a non-linear U shaped sensitivity of future earnings to current volatility. The sensitivity is highest for low earnings when underinvestment is most pronounced and a risk of overinvestment small, and for high earnings when overinvestment is most pronounced and the risk of underinvestment is small. For the medium earnings levels increase these two risks may offset each other and the sensitivity may be small.

In addition, the low and high earnings realizations of more volatile stocks may already represent outliers from the firm-specific expected level of earnings. For such firms, the investment distortion should appear in the current year rather than be delayed to one of the following years. High volatility/low earnings firms should forego investment in the current year, and companies with high volatility/high earnings should have excessive investment in the current year. Indeed, Blanchard et al. (1994) provide evidence that large cash windfalls from legal settlements increase firms' acquisition activity (overinvestment). This makes earnings volatility more important as a predictor of short-term rather than long-term earnings.

Motivated by the underinvestment story, Minton, Schrand and Walther (2002) (hereinafter MSW) were first to test the impact of volatility on future earnings. They show for a US sample of 3,501 non-financial firm-year observations in the 1987-1999 period, that current cash flow (earnings) volatility is negatively related to future cash flow (earnings) in terms of lower forecast error and less biased predictions. Consistent with the underinvestment story, MSW find the biggest improvement in forecast accuracy is when volatility is used for earnings forecasting for the firms with the lowest cash return on assets.

ii) Earnings volatility and earnings persistence

The volatility of reported earnings is a result of the uncertainty of operations and of accounting choices and conventions. For example, small, growing companies with frequent changes in demand can be expected to have more volatile earnings than big, stable companies

[6] This is in line with Mello and Parsons (2000) who show that the volatility of cash flows does not alter future cash flows as long as a firm is not financially constrained. They assume the existence of costs of financial distress and underinvestment but that financial slack is not costly. Firms with higher expected cash flows from the assets in place are less likely to be financially constrained.

with steady and predictable demand. On the accounting level, Dechow and Dichev (2002) show a very high positive correlation between earnings volatility and the quality of accruals, where the quality of accruals measures the precision to which past, current and future cash flows are mapped into current accruals. In addition, the expenses which are poorly matched to related sales increase volatility as well (Dichev and Tang, 2007; hereinafter DT).

DT find that earnings volatility is inversely related to earnings predictability (measured by R^2) and earnings persistence (see also Nissim, 2002 for the latter). Earnings persistence measures how fast earnings revert to the mean or, alternatively stated, how much current earnings shocks become part of the permanent earnings series (Schipper and Vincent, 2003).[7] They attribute this to a noise component of the earnings volatility described above. This is consistent with Dechow and Dichev (2002) who found the same inverse relation between their measure of accrual quality and earnings persistence.

Consequently, at low levels of current earnings, earnings revert faster to the mean and the increase in magnitude of earnings is higher as volatility increases. Conversely, at high levels of earnings more volatile earnings are less persistent and decrease faster in the subsequent period. This implies that the volatility/future earnings relation is positive when earnings are low or negative, and negative when earnings are high.

iii) Other factors and asymmetry of the volatility/earnings relation

Accounting conservatism provides a basis for a positive earnings volatility-persistence association for loss making firms. It is well documented that conservatism induces managers to recognize future anticipated losses in a more timely fashion than future surpluses (see Basu, 1997 for the US market, Pope and Walker, 1999 and Giner and Rees, 2001 for the UK market; Balls et al., 2001 for an international sample). Such losses are transitory from a reporting point of view since all current and anticipated losses are recognized. Future earnings revert to their pre-loss level and transitory items induce additional volatility.[8] Consequently,

[7] DT argue that the relation between earning volatility and persistence is not a statistical artifact. For example, if profits are doubled, then the variance of current earnings and earnings one-year ahead is quadrupled as well as their covariance. However, earnings persistence and R^2 clearly do not change.
[8] Some papers (e.g. Givoly and Hayn, 2000) use earnings volatility as the measure of conservatism.

this additional volatility is positively related to future earnings. Conceptually, conservatism should be reflected in negative earnings news and not necessarily in earnings levels (Callen et al., 2006). However, most research approaches earnings conservatism in terms of accounting losses and negative cash flows. Therefore, it is reasonable to expect that this effect weakens as current earning levels increase. The abandonment option and sample bias are additional reasons for the positive relation.[9]

Controlling for the level of earnings is also important due to the established fact that earnings at the tails of distribution are less persistent than earnings closer to the average (Brooks and Buckmaster, 1976; Freeman and Ohlson, 1982; Fama and French, 2000). Competitive forces drive eye-catching profits down as competitors replicate successful models and drive loss-making companies out of business or force them to change. Any negative relation between volatility and future earnings could be thus erroneously attributed to our hypothesis in the full sample by not allowing the persistence coefficient to vary across the earnings levels (Nissim, 2002).

iv) Summary of predictions

Based on the under/overinvestment hypothesis we predict a negative relation between volatility and future earnings. This relation should be particularly pronounced for extreme levels of earnings. However, the inverse association between earnings and persistence implies a positive volatility/ future earnings relation when earnings are low and a negative one when earnings are high. Furthermore, accounting conservatism, the abandonment option and sample bias also induce a positive relation when earnings are low. Consequently, the magnitude and sign of the volatility-future earnings relation cannot be predicted unambiguously *ex ante* when

[9] If managers have the option of abandoning loss making projects, then losses are more transitory than positive earnings (Hayn, 1995; Berger, Ofek and Swary, 1996). The abandonment option exists when the liquidation value is higher than the present value of expected cash flows from the continued use of the project. Once the losses are incurred and the option exercised, the reversal in earnings is expected to be more pronounced for the more volatile firms. As for sample bias, firms making losses for an extended period are more likely to be delisted, taken over or bankrupted. Therefore, they are less likely to survive in the sample to the following year. The hypothesized effect may be particularly pronounced for these firms as they are more likely to be financially constrained and distressed, with no internal funds available for investment projects. Non-inclusion of these firms leads to a less negative volatility coefficient in our regression.

earnings are low. On the other hand, the persistence and overinvestment arguments reinforce each other and the negative relation should be strongest for the high earnings realizations.

3. SAMPLE DESCRIPTION AND VARIABLE MEASUREMENT

(i) Data

The sample consists of non-financial firms listed on the London Stock Exchange from 1980 to 2003 with sufficient data to calculate our measure of earnings and their respective volatility and other firm-specific characteristics used in the analysis. The final sample includes 10,480 firm-year observations (1,481 distinct non-financial firms). The number of observations per period is in the range from 199 in 1987 to 837 in 1995 (Figure 1). We divide the final sample into 19 five-year overlapping periods (1981-1985 is the first and 1999-2003 is the last). The sample construction is shown in Table 1.

[Figure 1 around here]

[Table 1 around here]

The need to have firm operating and net earnings available for five consecutive years imposes a significant restriction on the sample size. The dataset before eliminating data with incomplete earnings series is almost twice as big as the final sample and includes 20,483 firm-year observations. Non-included companies tend to be smaller, less profitable, more levered, and with higher growth prospects as measured by the market-to-book ratio.[10] As these characteristics indicate that these firms are more financially constrained (Kaplan and Zingales, 1997), then investment distortions can be expected to be higher and the negative earnings/volatility relation more pronounced. Therefore the final sample may be biased against our predictions. All the variables were extracted from the Worldscope database accessed through Datastream.

[10] Descriptive statistics for the complete dataset available on request.

(ii) Earnings and earnings volatility

Annual earnings (E) are defined as net profit (Worldscope item 01751). We also use operating profit (OP) after excluding items of an exceptional nature, which do not form part of a company's normal trading activities, but before depreciation (item 01250 plus item 01151). Net profit (NP) is the more volatile as it includes transitory, extraordinary and exceptional items as well as net interest expenses and taxes. It may capture some elements of economic uncertainty not present in operating income. OP may serve as a proxy for operating cash flows not affected by transitory variations in working capital. Consistent with other similar studies, the earnings measures are scaled by the average of the opening and closing total assets in a given year (item 02999).

Current earnings volatility (EV) is measured as the coefficient of variation (CV) over the first four years in the five-year period. Unlike most existing studies, we do not use interim data but annual data for the volatility calculation since the latter smoothes out volatility induced by seasonal effects if quarterly or half-yearly date were used (Nissim, 2002). The coefficient of variation is widely used in the related literature (e.g. MSW; Michelson et al., 1995) and is calculated as the standard deviation of the unscaled earnings series divided by the mean of the absolute values. We use the mean of the absolute values in the denominator rather than the mean of the actual values to control for size by focusing on the magnitude of earnings irrespective of their sign. The earnings and earnings volatility variables are winsorized at the 1st and 99th percentiles to reduce the effect of extreme observations.[11]

(iii) Summary statistics

Table 2 present summary statistics of the variables used in subsequent tests.

[Table 2 around here]

Panels A and B present summary statistics for earnings levels and volatility for alternative measure of earnings. The future, one-year ahead mean (median) NP of 0.035 (0.056) is

[11] The robustness of the results is tested by using standard deviation of NP and OP scaled by total average assets over the first four years in the five-year period winsorized at 1% and 99% level as an alternative definition of earnings volatility. This measure is used in some other studies (e.g. Gebhardt et al, 2000; Nissim, 2002; Dichev and Tang, 2007). The direction of the results remains qualitatively similar.

significantly lower that its current mean (median) level of 0.042 (0.059) at the 1% level. Similarly, one-year ahead mean (median) OP level of 0.128 (0.130) is slightly lower than its current mean (median) level of 0.132 (0.133). The sample is moderately left skewed in the earnings variables.

The data show large variations in firm-specific volatility. NP volatility is higher than that of OP. The mean EV for NP is 0.592 and for OP it is 0.355. Median firm-specific EV measures are both around one-half of median NP and OP. EV for both earnings measures is right-skewed which is expected since it is bounded below at zero.

Both the mean NP and OP have a declining trend throughout the sample period as illustrated in Figure 2.

[Figure 2 around here]

However, this trend in earnings is not monotonic over the sample period. Mean NP and OP decline from 1985 to 1991, then increase until 1997, and then decrease again. The skewness observed in the summary statistics is attributable to the post-1991 period for NP and the post-1997 period for OP. The difference between higher median and lower mean levels of NP and OP is increasing towards the end of sample period, being around 5 percentage points in 2002 for NP and 1.7 percentage points for OP. The overall declining trend explains why the average earnings one-year ahead are slightly lower than current earnings in Table 2.

The annual averages for both volatility measures are presented in Figure 3.

[Figure 3 around here]

Interestingly, volatility for both definitions of earnings displays an increasing trend throughout the sample period. This trend is particularly pronounced for the volatility of NP in the post-1992 period. Change in reporting conventions may explain the observed pattern. For instance, FRS3 (effective from 1993) has decreased management's opportunities for smoothing earnings through reporting transitory items as extraordinary (Pope and Walker, 1999), which should particularly affect the volatility of NP. The single biggest increase of 0.13 is in 1992 (a 40% change relative to the 1991 volatility). This coincides with the decreasing average size of the firms from 1992 and a sharp increase of the firm-year

observations in the sample (statistics not reported). As smaller firms tend to be more volatile, we observe an increase in volatility.

The unconditional correlation between the earnings variables and firm-characteristics is presented in Table 3.

[Table 3 around here]

Panel A (Panel B) presents unconditional pairwise correlations between earnings levels and volatilities for NP (OP). The correlation signs are generally supportive of our hypotheses. EV is significantly negatively correlated with future earnings and similar in magnitude for both measures of earnings with a coefficient of -0.32 for NP and -0.34 for OP. The correlation coefficient between volatilities for NP and OP is around 0.54 indicating the possibility of different results when different measures of earnings are used (Panel C).

However, we predict a non-linear volatility-future earnings relation which cannot be uncovered by unconditional correlation tests. In Table 4, we present mean current earnings, earnings one-year ahead and volatility across current earnings quintiles from lowest to highest formed for every sample-year.

[Table 4 around here]

The results confirm a negative correlation between future earnings and volatility. Volatility monotonically decreases from the lowest to the highest earnings quintile for both NP and OP. However, volatility is disproportionately high for the low quintile (1.001 for NP and 0.618 for OP), consistent with conditional conservatism. Similarly, whereas quintiles 2 to 5 earnings one year ahead are on average lower than current earnings, the opposite holds for low earnings – they revert to the higher mean.

4. EMPIRICAL IN-SAMPLE RESULTS

Our empirical tests focus on reported volatility. Reported earnings are assumed to be 'smoothed' after a mix of optimal actions (such as usage of derivatives, complex debt

arrangements and diversification) is undertaken to minimize the total costs of volatility.[12] Total costs are given as the sum of the costs of risk reducing actions and the costs of bearing the remaining risk, and are minimized to the point where the marginal costs of further volatility reduction are equal to the marginal costs of bearing the remaining volatility (Shin and Stulz, 2000).[13] Since there is always some residual volatility with its associated costs, the proposed inverse relation holds both for reported and non-observable pre-smoothed earnings.

The starting point in forecasting future one-year ahead earnings is current earnings. Therefore, it is valuable to explore whether the univariate negative correlation between earnings volatility and future earnings is still valid after controlling for current earnings. Our benchmark model (Model 1) regresses future earnings on current earnings while Model 2 includes earnings volatility as an extra regressor:

$$\text{Model 1:} \quad E_{t+1} = \alpha + \beta_1 E_t + \varepsilon_t$$
$$\text{Model 2:} \quad E_{t+1} = \alpha + \beta_1 E_t + \beta_2 EV + \varepsilon_t$$

Annual cross-section, rolling regressions are estimated for 19 five-year sample periods (Fama and MacBeth, 1972). In this way, the number of holdout sample periods to examine forecast accuracy of different specifications is maximized. In addition, Fama and French (2000) argue that this procedure is superior to pooled OLS estimators because the variation of the annual slopes allows for cross-sectional correlation of residuals across the firms. The mean coefficients and adjusted R^2 from these regressions using CV as the measure of volatility are presented in Table 5 where the figures in parentheses represent *t*-statistics (mean divided by the standard error of the time series distribution of the coefficients. The summary results for the significance of the EV coefficient sign by year are also reported. This gives us additional insight into the strength of the relation since *t*-statistics based on the time-series

[12] Derivatives (either at their cost or fair value) were not required to be reported in the balance sheet and profit and loss account until the recent adoption of IAS 39. Also, most of the assets in the sample period are reported at historical cost. Therefore, the impact of derivatives on the reduction in the variability of reported earnings is negligible.

[13] While residual volatility is costly, the alternatives actions may be even more expensive. For example, small firms can find the use of derivatives more expensive due to direct transaction costs and the fixed costs of information services, expertise and know-how when contrasted with the opportunity costs of the volatility.

means of the coefficient estimates does not take into account whether they are statistically significant in a given year.

(i) Full sample results

Table 5 presents the results for both definitions of earnings, net profit in Panel A and operating profit before depreciation in Panel B.

[Table 5 around here]

There were significant changes in the economic environment over the course of our sample period that could drive our results. Consequently, the results of the same regressions over three sub-periods: 1985-1991, 1992-1997, and 1998-2003 are reported. The period until 1992 is one of high interest rates which may have affected the level of corporate investment, one of the main underlying causes of the hypothesized negative relation. There is a significant increase in the number of firm-years from 1992 relative to the earlier period (see Figure 1). The average annual total assets and market to book ratios across the sample period (table not reported) reveal a decrease in firm size and growth prospects after this year. We use 1997 as an additional break point to signify the beginning of the bull market period. There is also a significant increase in earnings volatility from 1998 onwards (see Figure 3). These three sub-periods are also reflected in the earnings levels trends (Figure 2).

Benchmark Model 1 shows that the average net profit persistence coefficient is 0.70 while it falls marginally to 0.68 in Model 2. The persistence coefficient remains similar when volatility is added in Model 2 for the full sample as well as across the sub-periods. The biggest change in the persistence coefficient between the models is a decrease from 0.64 (Model 1) to 0.59 (Model 2) in the 1992-1997 period. This shows that the inclusion of volatility in a linear way as an additional regressor for the entire sample does not substantially decrease earnings persistence and that volatility might be related to future earnings in a non-linear way as hypothesized. The Model 2 results suggest that earnings volatility has an inverse relation with future earnings after controlling for current earnings. The coefficient is negative and statistically significant at the 5% level. Its economic magnitude of -0.0105 is small. An increase by one unit of scaled standard deviation (0.447) would result in a small decrease of

0.47 percentage points in future earnings (0.447 multiplied by 0.0105). The coefficient is negative and significant in only 6 out of 19 annual cross-section regressions. The results are similar for the OP earnings definition in Panel B except that the persistence coefficient now increases to around 0.84. The EV coefficient is significantly negative and almost identical to that in the NP regression.

The earnings persistence coefficient in Model 1, Panel A is highest in the early 1985-1991 sub-period and falls sharply in the later two sub-periods. This is consistent with DT (2007) – volatility increases as we move towards 2003, and this is reflected in lower earnings' persistence for the NP definition of earnings. The coefficient on EV is statistically negative only in the later 1992-1997 and 1998-2003 sub-periods. Its magnitude is similar in these two periods, around -0.0181, which suggests a decrease in one year-ahead net profit of 0.81 percentage points if the coefficient of variation increases by one scaled unit of standard deviation (0.447). Finally, there are no significantly negative EV coefficients in any year in the first sub-period while half are negative in the other two sub-periods. Turning to Panel B with the OP definition of earnings, we find that the earnings persistence coefficient always exceeds 0.80 across both Model 1 and 2 and sub-periods. However, the persistence coefficient remains similar across sub-periods, probably due to the smaller presence of transitory items. The coefficient on EV is significantly negative only in the most recent period. It is significant in 3 out of the 6 years in the latest sub-period.

Overall, the test results indicate a weak inverse relation between volatility and future earnings which seems to be more pronounced for NP and for the bubble 1997-2003 sub-period. This may capture investor sentiment, managerial overconfidence and the overinvestment effect as a decrease in earnings associated with volatility may be a result of optimistic short-term managers investing in non-profitable projects, especially in the most recent sub-period.

(ii) Sub-sample results across earnings levels

In this section, we provide the results for the hypothesis that the negative relation is expected to be stronger for high rather than for low levels of earnings. We first present some

descriptive evidence to examine whether the volatility-future earnings relation varies with the level of earnings. We sort earnings each year into five portfolios according to the level of their current earnings in ascending order. Loss-making firms make up 71% of the total number of observations in the lowest earnings quintile 1 and 11% of the total number of observations in quintile 2. The proportion of loss-making firms to the total number of annual observations is particularly large in the three final years – 24% in 2001, 30% in 2002, and 36% in 2003, but was also large in 1994 when it was 21%. Each of these portfolios is then sorted into five further quintiles based on their volatility levels.[14] This yields 25 quintiles. The overall mean of earnings changes (earnings one year ahead less current earnings) for each portfolio is presented in Table 6. As before, Panel A presents results for NP and Panel B for OP before depreciation.

[Table 6 around here]

In Panel A, for the lowest earnings portfolio the profits increase is 3.55 percentage points. Conversely, there is a 2.76 percentage points decrease in earnings for the highest earnings portfolio. This is consistent with the finding that extreme levels of earnings mean revert faster than do intermediate (quintiles 2-4) levels (Brooks and Buckmaster, 1976; Freeman and Ohlson, 1982; Fama and French, 2000). However, there is a huge dispersion in earnings changes within earnings level quintiles, particularly for low and high earnings firms. We find that, for the most profitable firms (earnings quintile 5), high volatility firms (volatility quintile 5) command a 4.11 percentage points earnings change premium relative to low volatility firms (volatility quintile 1). On the other hand, high volatility firms have a 6.4 percentage points higher increase in earnings than do low volatility firms within the low earnings quintile. For medium earnings ranks, high volatility firms' future earnings decline around 1.17-1.66 percentage points more than low volatility firms. The direction of the results is similar to those in Panel B, though the spread between low and high volatile firms is somewhat smaller. These findings indicate that earnings volatility strongly predicts decreases

[14] This procedure controls for the correlation between earnings levels and volatility. Also, note that due to the correlation, independent sorting would not result in the same number of observations across the portfolios.

in earnings incremental to the average decrease attributable to expected mean-reversion for highly profitable firms, consistent with DT (2007). Conversely, the spread in volatility predicts a positive change in earnings within low earnings firms.

Figure 4 provides more insight into the longer time-series evolution of earnings four years before and after ranking into the opposite volatility quintiles for the high and low earning firms and which survive through the examined sampled period in order to mitigate sample bias.

[Figure 4 around here]

Low NP firms (Panel A) exhibit similar behaviour four to one years before and two to four years after quintile formation irrespective of their volatility. They exhibit first a declining, and then an increasing trend. However, in the formation year and post-formation year, high volatility firms sharply decrease and then increase resulting in almost a 7 percentage points gap in the earnings level in the quintile formation year. This reversal behaviour is most consistent with conservatism explanation - anticipated losses are recognised in the years in which they occur and, since they are transitory, earnings subsequently increase. High earnings/low volatility firms exhibit a declining earnings trend before and after portfolio formation. High earnings/high volatility firms have a sharp increase in the pre-formation period, exceeding the earnings levels of high earnings/low volatility by 1.4 percentage points in *t*. However, the earnings in year *t+1* of volatile firms sharply decrease falling below low volatile firms. This results in a high/low volatility earnings spread of around 2.4 percentage points. In *t+2* through *t+4* they exhibit a similar decreasing trend so the spread remains similar or slightly increases. This magnitude is comparable with the DT (2007) finding for the US market. In a similar test they find that the average earnings spread in each of the five years following the portfolio formation period is persistently around 3 percentage points.

In Panel B, the picture for OP looks very similar except for the low earnings/high volatility firms – in the pre-formation period they decrease faster than low volatility firms but then increase faster in the post-formation period. However, the trend is smoother absent the conservatism affecting transitory items in net earnings.

Overall, Figure 4 indicates that, *ceteris paribus*, the ability of earnings volatility to successfully predict changes in earnings for highly profitable firms is not restricted to the short term. The difference in future earnings between low and high volatility firms in the highest earnings quintile persists for at least four years into the future. The strong pre-formation growth of high earnings/high volatility firms is consistent with overinvestment and related managerial overconfidence and investment catering hypothesis – optimistic managers of successful or overvalued firms have more incentives to extend investments beyond profitable investment opportunities.

Finally, we run Model 2 for portfolios sorted by earnings level to provide more formal tests of this non-linear relation and to test whether the effect of volatility is reduced for the most profitable firms. The results are presented in Table 7.

[Table 7 around here]

As expected, the results in Panels A show that the earning persistence coefficient is hill-shaped across quintiles, being lowest for the low and high earnings quintiles. The coefficient on EV is positive for the low earnings quintile but significantly negative for quintiles 2 and 4 and especially so for the high earnings quintile 5. The magnitude for the latter quintile is 4 times higher than for the full sample (-0.0428 for NP). If firm-specific volatility increases one scaled unit of standard deviation (0.447), earnings decrease by 1.91 percentage points in the high earnings portfolio. As for individual years, the coefficient is negative and significant in 12 out of 19 years for high earnings portfolio. The coefficient for quintile 5 is consistently negative across the three sub-periods, varying from -0.0394 in the 1985-1991 period, -0.0195 in the 1992-1997 to -0.0701 in 1998-2003 (all years' coefficients in this sub-period are statistically significant). Furthermore, the earnings persistence coefficient in this quintile is only 0.51 in the 1998-2003 period, much lower than in the other two periods. The coefficient for the low earnings quintile is highly positive and significant (0.0786) only in the most recent period. The earnings persistence coefficients are very low in the 1992-1997 (0.38) and 1998-2003 periods (0.44). In most cases, the individual EV coefficients for quintiles 2-4 are insignificant.

The direction of the results is similar in Panel B, when earnings are defined as OP. The EV coefficient is consistently negative across quintile 5, being highest in magnitude for the latest period. However, the difference in magnitude is not so pronounced as for NP – it varies between -0.0436 in the 1992-1997 period to -0.0710 in the 1998-2003 period. It is statistically negative in 12 out of 19 annual regressions. On the other hand, the EV coefficient is insignificant for low earnings (unlike in Panel A) and for most medium level earnings across sub-periods (similarly to Panel A).

The above findings are consistent with a non-linear effect of volatility. There is either no or a significantly positive effect of volatility on future earnings for the lowest earnings quintile. Even when it is statistically significant, it is economically small for medium earnings much like the impact for the full sample. Volatility, however, is a strong negative predictor of earnings for the most highly profitable firms as in DT (2007). This effect is strongest in the 1998-2003 period when volatility is also a strong positive predictor of future earnings when earnings are low. This is consistent with the behavioural explanation of overinvestment (investor sentiment and managerial overconfidence) and earnings persistence predictions.

(iii) Earnings volatility, overinvestment and financial constraints

We interpret the results from the empirical tests as being consistent with the overinvestment explanation. This explanation implies that for most profitable firms, more volatile ones invest more than is optimal. The consequent negative marginal returns decrease profitability relative to current levels. Moreover, investment of financially constrained firms' is more sensitive to the level of internally generated cash flows because these firms are expected to have higher costs of external capital. Malmendier and Tate (2004) show that investment by overconfident managers is more sensitive to cash flow when a company is financially constrained. Dong et al. (2007) provide evidence that financially constrained overvalued firms invest more than non-constrained ones. In addition, Pawlina and Renneboog (2005) find that in firms which do not increase dividend payout and which do not repurchase shares (constrained firms) their investment is more sensitive to cash flows. Therefore, the increase in volatility will more likely result in higher investment if the firm is more financially constrained.

To provide some evidence whether highly volatile firms indeed invest more, we report the average of current abnormal investment for volatility quintiles within the highest earnings quintiles for both definitions of earnings.[15] Following Titman et al. (2004) we calculate the abnormal investment as follows:

$$ABNCAPEXP_t = \frac{CAPEXP_t}{\sum_{i=1}^{3} CAPEXP_{t-i} / 3} - 1$$

where $ABNCAPEXP_t$ is abnormal capital expenditures in current period and $CAPEXP$ is capital expenditures, i.e. cash paid for tangible fixed assets during the year including payments deferred from previous years. (Worldscope item 04601). $ABNCAPEXP_t$ are winsorized at the 99% level.

To examine whether the volatility for most profitable firms is associated with financial constraints, we report the mean cash flows, level of cash, leverage, market-to-book ratio and size for volatility quintiles within the highest earnings quintiles in period *t-1*. Financially constrained firms are expected to have lower cash flows, lower levels of cash, higher leverage, higher market-to-book ratio.[16] In addition, smaller firms could also be expected to have higher costs of external capital.

Cash flows are calculated indirectly using Balance Sheet data.[17] Cash levels are cash and cash equivalents (item 02001), leverage is total debt-to-capital employed ratio (item 08221), market-to-book ratio is market value of equity (item 08001) over book value of equity (item 03501), size is total assets (item 02999). Cash flows are winsorized at the 1% and 99% level, whereas cash levels, market-to-book ratio and size are winsorized at the 99% level. Negative

[15] Quintiles are constructed in the same way as in the previous section.
[16] This association is based on Kaplan and Zingales (1997) index model. They use ordered logit for their US sample and regress level of financial constraints determined outside the model on cash flows, cash levels, market-to-book, leverage and dividends in the US market. The development of this model for the UK market is beyond scope of this paper so we rely on a sign of these coefficient estimates to link the magnitude of these explanatory accounting variables to the level of financial constraints.
[17] Cash flows are calculated as net profit (Worldscope item 01751 less changes in non-cash working capital plus depreciation (item 01151). Non-cash working capital is change in working capital (item 01351) less change in cash and cash equivalents (item 02001) plus change in short term debt. Change in short term debt is change in total debt (item 03255) minus change in long-term debt (item 03251).

leverage ratios and those higher than 100 are replaced with the value of 100 (leverage is expressed in percentage points).

We first report summary statistics for the abnormal capital expenditures and the accounting variables associated with financial constraints for the full sample in Table 8 to give us an indication of the magnitude of differences in mean characteristics across volatility quintiles within highly profitable firms. Quintile means for NP (Panel A) and OP (Panel B) are reported in Table 9.

[Table 8 around here]

[Table 9 around here]

The average $ABNCAPEXP_t$ for the full sample is close to zero (0.005). The most volatile firms (quintile 5) within highly profitable firms, however, have $ABNCAPEXP_t$ of 0.228, which on average places them within the highest quartile of the overall distribution of abnormal investments. By contrast, the mean abnormal investment in quintile 1 of 0.032 is statistically not different from zero (*t*-statistics not reported). The most volatile firms have lower cash flows, lower cash levels, higher leverage and smaller total assets than the lowest volatility firms and therefore the former seem to be more financially constrained. A caveat is that cash flows, cash levels and total assets are above the median for the full sample and leverage is only slightly above the median for the full sample, which may indicate that the overall constraints for the most volatile firms are not so severe. The market-to-book ratio is, contrary to predictions, slightly higher for low volatility firms.

In Panel B, abnormal investment is much higher for high relative to low volatility firms (0.156 relative to 0.017). Cash flows and size are lower, whereas leverage is higher for high relative to low volatility firms, consistent with financial constraints prediction and Panel A. Unlike in Panel A, cash levels are slightly higher for the most volatile firms as well as the market-to-book ratio. However, the overall magnitude of the average characteristics in the context of the full sample distribution does not indicate any significant financial constraint on the most volatile firms.

To summarize, most volatile firms overinvest more than low volatility firms when current profits are high. They also seem to be more financially constrained but these constraints seem not to be very significant. These results indicate that overinvestment can serve as an explanation for the negative volatility/future earnings relation.

5. OUT-OF-SAMPLE FORECAST ACCURACY

We examine the economic significance of regression estimates for equity valuation by testing the out-of-sample forecast accuracy of our two models. The coefficients estimated for year *t+1* are used to forecast earnings in year *t+2*. Forecasting is performed on the total sample available for year *t+2* irrespective of whether the firms included are used for coefficient estimation purposes in year *t*.

Absolute error and absolute percentage error as the measures of forecast accuracy are calculated. Absolute error (AE) is calculated as the absolute value of the difference between actual and predicted earnings. For consistency with comparable studies such as MSW (2002) we calculate relative measures of accuracy as well. The absolute percentage error (APE) is the absolute value of the difference between actual and forecasted earnings divided by absolute actual earnings. APE as a relative measure is useful if the forecast variables have very different magnitude and their variance is heteroskedastic. Since we have already use scaled earnings (return on assets), AE can reliably serve as a relative measure as well. AE and APE are calculated for each observation in year *t+2* and their mean and median values are reported.

The results are reported only for the high earnings quintile regression since in-sample results have provided evidence that volatility matters most for these firms for prediction purposes. Panel A presents results for the NP definition of earnings, and Panel B for the OP definition for the full sample and across sub-periods as defined earlier.

[Table 10 around here]

Model 2 with volatility invariably performs rather better than Model 1 in terms of mean and median AE and APE at the 5% significance level (10% for the mean APE) for the NP definition of earnings. The mean (median) AE in Model 2 of 0.0374 (0.0230) is 0.0009 lower than the mean (median) AE of Model 1 which represents around 2.3% (3.8%) of the total error magnitude of Model 1. As for mean (median) APE, the gain from including volatility of 0.2938 (0.0101) represents a significant 26% (5%) of the total error magnitude of Model 1. However, this difference seems to come entirely from the 1998-2003 period. In other periods, no statistically significant difference in the errors could be found between Models 1 and 2. The results are similar in Panel B when the OP is used for definition of earnings

To summarize, cross-sectional models with volatility included beat those models based only on lagged earnings for the top quintile. This seems to come from better predictability in the final sample sub-period. The relative improvements are highest for the mean APE. Nonetheless, although the gains in accuracy are statistically significant, they are relatively small in economic terms.

6. CONCLUSIONS

Motivated by the under/overinvestment hypotheses and documented positive association between earnings persistence and volatility, this paper is the first large scale non-US study to investigate the contribution of earnings volatility towards forecasting future earnings. Our sample comprises some 10,480 UK firm-year observations for 1,481 non-financial firms over the period from 1980 to 2003. We find that earnings volatility has an inverse relationship with future expected earnings. This link is most pronounced for the bubble 1998-2003 sub-period and is driven by the highest earnings firms. These findings are most consistent with the overinvestment and persistence explanations.

The forecasting models that include volatility show a considerable improvement over the benchmark model that includes just earnings both in terms of mean and median AE and APE but only for the highest earnings quintile. This is inconsistent with the MSW (2002) US

finding that the inclusion of an earnings volatility variable in a forecasting model improves forecast accuracy and reduces bias mostly for low profitability firms. It is not apparent why there should be differences between the results for the US and the UK markets and further research is needed to resolve this issue. These findings are of relevance both for investors and managers for valuation and capital budgeting purposes.

Some of the findings suggest interesting avenues for future research. DT (2007) show that financial analysts do not fully discount the decreases in future earnings of the more volatile firms whereas MSW show that trading strategies that exploit more precise forecasts from models with volatility can yield positive abnormal returns. It would be interesting to investigate these relationships in the UK context. Another interesting question is the extent to which the earnings volatility effect is related to the dispersion of analysts' forecasts which are a negative predictor of future returns (Diether et al., 2002). If such disagreement is reflected in equity overvaluation, it may be the case that investors' disagreement increases with historical earnings volatility as a proxy for operations uncertainty.

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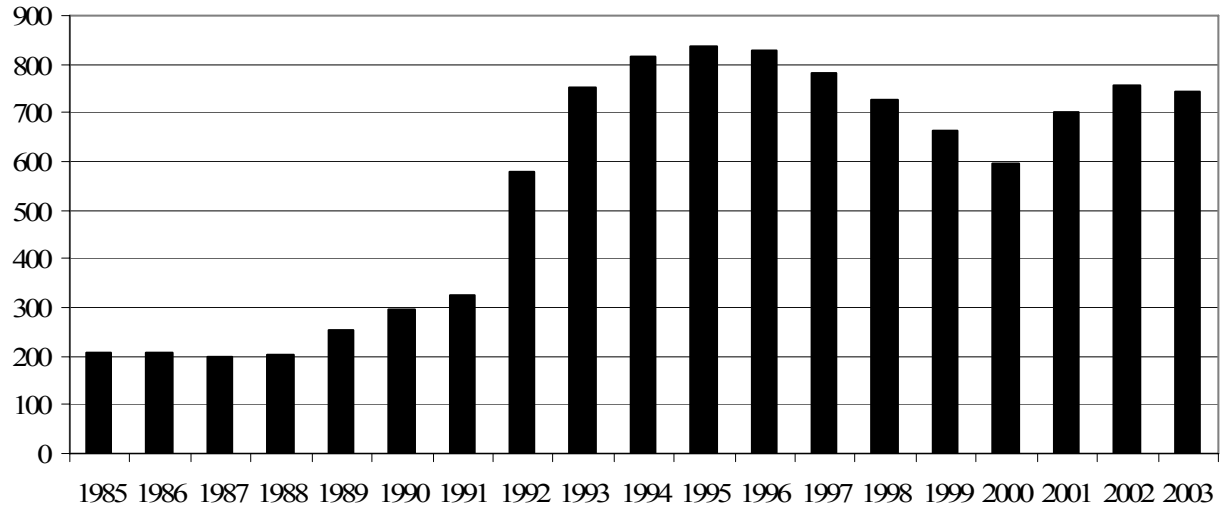
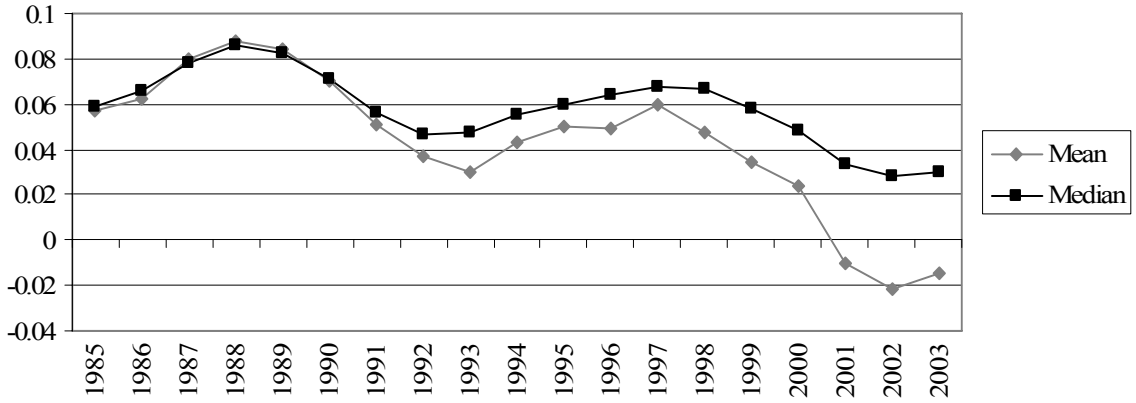
Figure 1
Number of Observations per Year



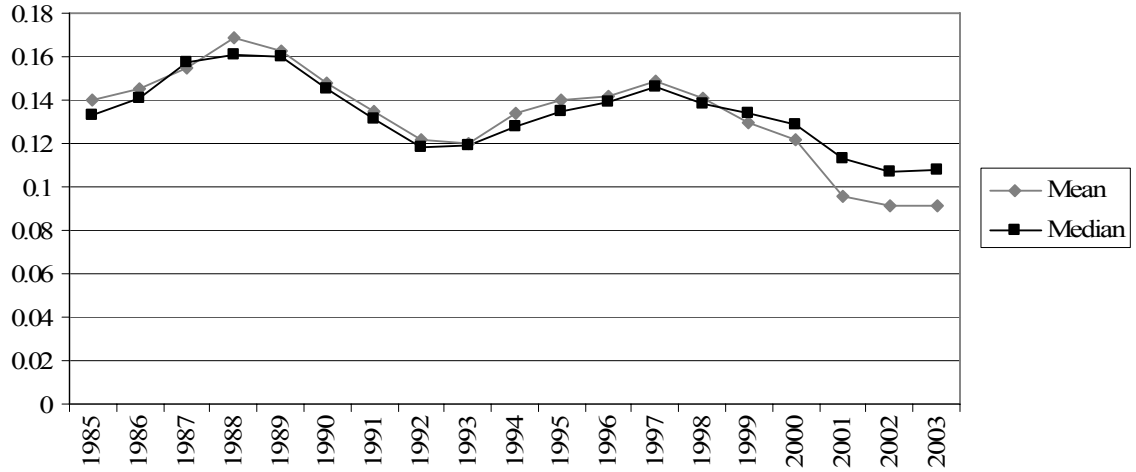
Notes:
Number of firm observations in each year of the sample period.

Figure 2
Annual Mean and Median Earnings

Panel A: Net profit

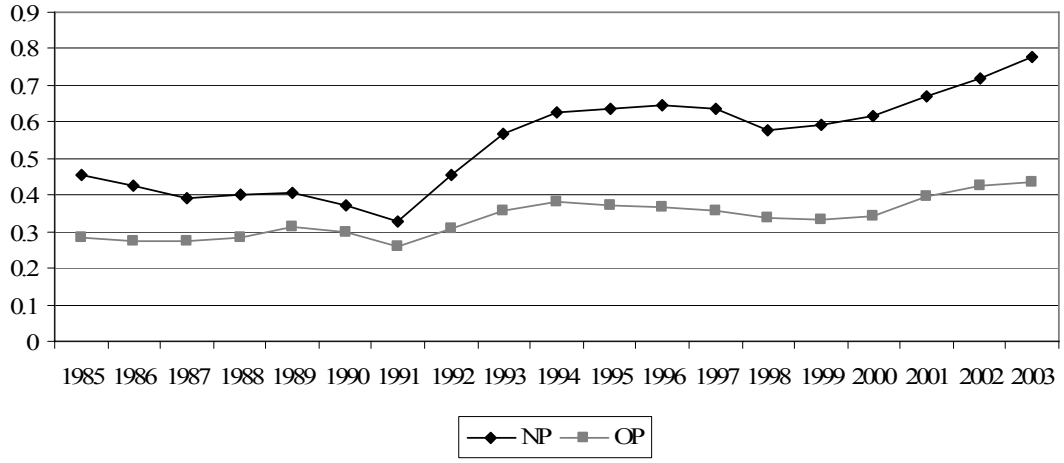


Panel B: Operating profit before depreciation



Notes:
Mean and median earnings levels one-year ahead in every year of the sample period are plotted for the net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. Both earnings measures are defined in Table 2.

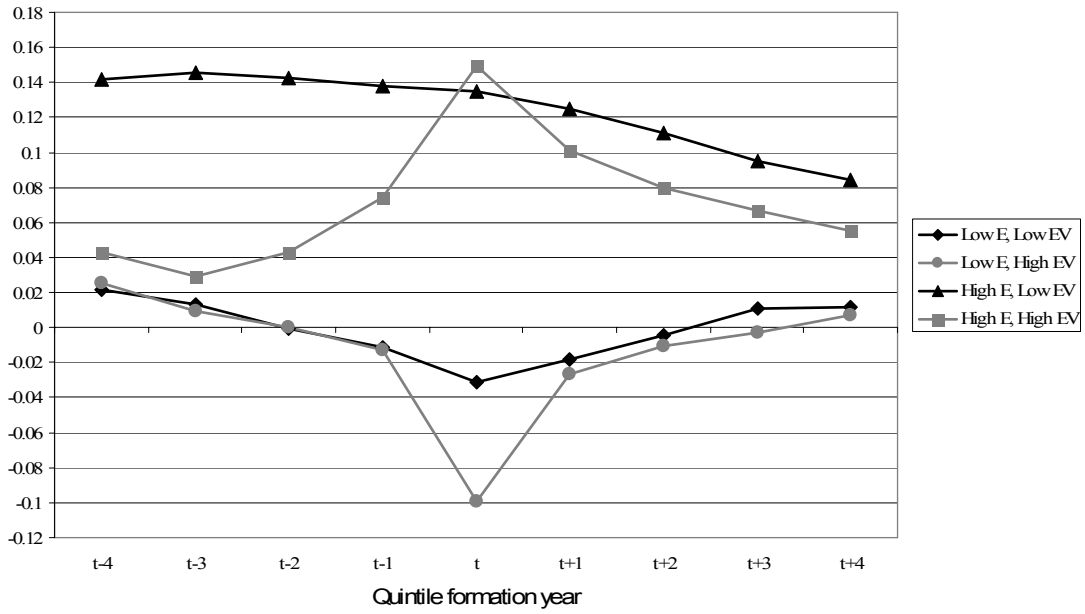
Figure 3
Annual Mean Earnings Volatility



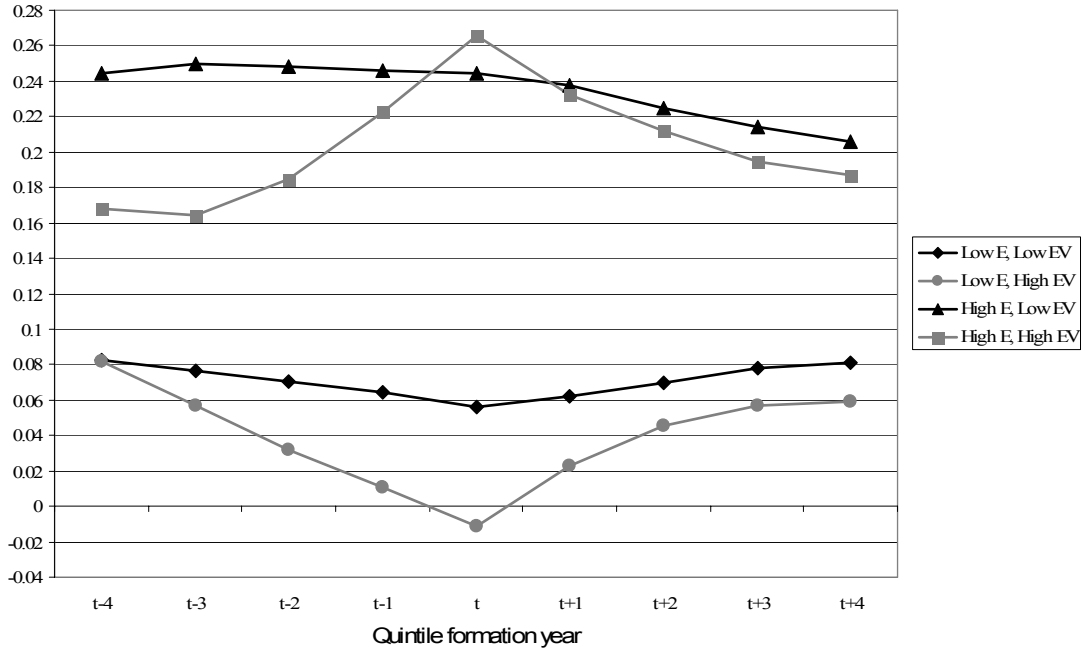
Notes:
Mean earnings volatility in every year of the sample period is plotted for the net profit (NP) and operating profit before depreciation (OP) definitions of earnings. Earnings volatility and both earnings measures are defined in Table 2.

Figure 4
Earnings Evolution Four Years Before and After Earnings Quintile Formation Period (Constant Sample)

Panel A: Net profit



Panel B: Operating profit before depreciation



Notes:
Each year firms are sorted into five portfolios by the level of current earnings. Each of these portfolios is then sorted into five further quintiles based on their volatility levels. The results are presented for the sample of firms surviving through the examined period. The graphs plot mean earnings for high and low earnings volatility (EV) quintiles within high and low earnings (E) quintiles for the net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings for four years before and after quintiles formation. Both earnings measures are defined in Table 2.

Table 1
Sample Formation

Total Worldscope firm observations	87,576
Financial firm-year observations eliminated	(23,544)
Non-LSE firm-year observations eliminated	(672)
Firm-years observations with missing industry classification eliminated	(3,600)
Firm-years where current year length is less than 350 or more than 380 days eliminated	(2,958)
Firm-year observation with insufficient data to calculate current net profits and operating profits before depreciation	(36,319)
	20,483
Firm-year observations with insufficient data to calculate current and one-year ahead net profits and operating profits before depreciation	(2,727)
	17,756
Firm-year observations with insufficient data to calculate current net profits and operating profits before depreciation volatility measure, as well as other firm characteristics (defined later) used in the analysis	(7,276)
Total final firm-year observations	**10,480**

Table 2
Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Median	Max
Panel A: Net profit					
E_{t+1}	0.035	0.115	-0.544	0.056	0.228
E_t	0.042	0.104	-0.489	0.059	0.232
EV	0.592	0.447	0.052	0.414	1.723
Panel B: Operating profit before depreciation					
E_{t+1}	0.128	0.096	-0.263	0.130	0.377
E_t	0.132	0.095	-0.260	0.133	0.386
EV	0.355	0.306	0.035	0.254	1.442

Notes:
In Panel A, earnings (E) are defined as net profit before extraordinary items (Worldscope item 01751). In Panel B, earnings are defined after excluding items of an exceptional nature which do not form part of a company's normal trading activities, but before depreciation (item 01250 plus 01151). Earnings volatility (EV) is measured as the coefficient of variation over the first four years in the five-year period. The coefficient of variation is calculated as the standard deviation of the unscaled earnings series divided by the mean of their absolute values.

Table 3
Correlation Table

Panel A: Net profit

	E_{t+1}	E_t	EV
E_{t+1}	1.0000		
E_t	0.6021*	1.0000	
EV	-0.3154*	-0.4342*	1.0000

Panel B: Operating profit before depreciation

	E_{t+1}	E_t	EV
E_{t+1}	1.0000		
E_t	0.8332*	1.0000	
EV	-0.3396*	-0.3776*	1.0000

Panel C: Net profit and operating profit before depreciation volatility correlation

	Operating profit before depreciation EV
Net profit EV	0.5385*

Notes:
Pearson correlation coefficients between earnings levels (E) and earnings volatility (EV) are reported below the main diagonal for the net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. Panel C presents correlation between earnings volatilities calculated for net profit and operating profit before depreciation. Earnings volatility and both earnings measures are defined in Table 2.
* denotes statistical significance at the 1% level.

Table 4
Mean Earnings and Earnings Volatility by Earnings Quintiles

Panel A: Net profit

	E_{t+1}	E_t	EV
1 (Lowest)	-0.061	-0.096	1.001
2	0.012	0.028	0.673
3	0.044	0.057	0.460
4	0.068	0.083	0.405
5 (Highest)	0.112	0.139	0.421

Panel B: Operating profit before depreciation

	E_{t+1}	E_t	EV
1 (Lowest)	0.023	0.008	0.618
2	0.095	0.095	0.326
3	0.128	0.133	0.274
4	0.162	0.171	0.263
5 (Highest)	0.231	0.254	0.293

Notes:
Each year earnings are sorted into five portfolios by the level of current earnings. Mean earnings one-year ahead, current earnings and earnings volatility for each quintile are reported for net profit (Panel A) and operating profit before depreciation (Panel B). The definitions of earnings,. earnings volatility and both earnings measures are defined in Table 2.

Table 5
Regression Results (Full Sample)

	Model 1			Model 2				
	Intercept	E_t	Mean adjusted R^2	Intercept	E_t	EV	Mean adjusted R^2	No. of EV<0
Panel A: Net profit								
Full sample	0.0065	0.7049	0.4130	0.0139	0.6844	-0.0105		6/19
(N=10,480)	(1.43)	(18.09)**		(3.14)**	(16.70)**	(-3.05)**	0.4157	
1985-1991	0.0085	0.8231		0.0070	0.8320	0.0025		
(N=1689)	(0.88)	(10.65)**	0.5543	(0.74)	(10.90)**	(0.80)	0.5541	0/7
1992-1997	0.0153	0.6424		0.0279	0.5915	-0.0180		
(N=4597)	(2.88)**	(11.71)**	0.3293	(5.87)**	(12.43)**	(-3.16)**	0.3347	3/6
1998-2003	-0.0047	0.6296		0.0079	0.6050	-0.0181		
(N=4194)	(-0.83)	(22.76)**	0.3318	(1.87)	(23.36)**	(-3.56)**	0.3351	3/6
Panel B: Operating profit before depreciation								
Full sample	0.0181	0.8352		0.0221	0.8312	-0.0104		
(N=10,480)	(5.24)**	(51.36)**	0.6905	(6.53)**	(47.99)**	(-2.47)**	0.6931	6/19
1985-1991	0.0229	0.8206		0.0258	0.8270	-0.0131		
(N=1689)	(2.92)**	(21.76)**	0.6849	(3.38)**	(20.91)**	(-1.31)	0.6894	2/7
1992-1997	0.0210	0.8513		0.0209	0.8503	0.0005		
(N=4597)	(4.55)**	(61.28)**	0.7036	(4.24)**	(55.02)**	(0.12)	0.7039	1/6
1998-2003	0.0097	0.8363		0.0188	0.8171	-0.0181		
(N=4194)	(3.41)**	(30.98)**	0.6841	(4.34)**	(27.65)**	(-5.37)**	0.6866	3/6

Notes:
Annual regressions are run for each year in the period from 1985 to 2003 for the following models:

Model 1: $E_{t+1} = \alpha + \beta_1 E_t + \varepsilon_t$

Model 2: $E_{t+1} = \alpha + \beta_1 E_t + \beta_2 EV + \varepsilon_t$

where E is earnings and EV is earnings volatility. The time-series mean coefficient estimates, corresponding *t*-statistics for the means (in parentheses), and the time-series mean adjusted R^2 are reported for net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. The number of significantly negative EV coefficients at the 5% level in annual regressions is reported in the final column,. Results of regressions are also reported for three sub-periods: 1985-1991, 1992-1997 and 1998-2003. N is the total number of observations. Earnings volatility and both earnings measures are as defined in Table 2.
** and * denote statistical significance at the 5% and 10% levels, respectively, for a two-tailed *t*-statistic test.

Table 6
Mean Earnings Changes by Earnings Volatility Quintiles Conditional on Earnings Quintiles

Panel A: Net profit

	EV						
E_t	1 (Lowest)	2	3	4	5 (Highest)	Average change	Diff. 5-1
1 (Lowest)	0.0089	0.0294	0.0277	0.0396	0.0728	0.0355	0.0640
2	-0.0104	-0.0144	-0.0167	-0.0118	-0.0255	-0.0157	-0.0151
3	-0.0075	-0.0096	-0.0143	-0.0149	-0.0192	-0.0131	-0.0117
4	-0.0112	-0.0121	-0.0126	-0.0131	-0.0278	-0.0153	-0.0166
5 (Highest)	-0.0142	-0.0153	-0.0235	-0.0303	-0.0553	-0.0276	-0.0411

Panel B: Operating profit before depreciation

	EV						
E_t	1 (Lowest)	2	3	4	5 (Highest)	Average change	Diff. 5-1
1 (Lowest)	0.0069	0.0117	0.0169	0.0158	0.0263	0.0155	0.0195
2	-0.0004	0.0000	0.0026	0.0005	-0.0049	-0.0004	-0.0045
3	-0.0037	0.0000	-0.0032	-0.0043	-0.0113	-0.0045	-0.0076
4	-0.0095	-0.0069	-0.0079	-0.0071	-0.0137	-0.0090	-0.0042
5 (Highest)	-0.0117	-0.0136	-0.0142	-0.0250	-0.0468	-0.0222	-0.0351

Notes:
Each year firms are sorted into five portfolios by the level of current earnings (E_t). Each of these portfolios is then sorted into five further quintiles based on their volatility levels (EV). The overall mean of earnings changes (earnings one year ahead less current earnings) for each portfolio is presented for net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. Average change is the mean change for the earnings quintile. The final column reports difference in earnings changes between the highest and lowest EV quintiles within each E_t quintile. Earnings volatility and both earnings measures are defined in Table 2.

Table 7
Regressions Results by Earnings Quintiles

Panel A: Net profit

Full sample	1 (Lowest)	2	3	4	5 (Highest)
Intercept	-0.0510 (-2.77)**	-0.0033 (-0.46)	-0.0080 (-0.83)	-0.0073 (-0.57)	0.0242 (3.07)**
E	0.5885 (5.02)**	0.8364 (5.15)**	1.0577 (6.72)**	1.0459 (7.29)**	0.7960 (13.00)**
EV	0.0369 (2.86)**	-0.0133 (-2.36)**	-0.0034 (-0.63)	-0.0176 (-4.44)**	-0.0428 (-5.86)**
Mean adjusted R^2	0.1479	0.0322	0.0369	0.0648	0.3679
No. of EV<0 (at the 5% level)	1/19	2/19	3/19	4/19	12/19

1985-1991	1 (Lowest)	2	3	4	5 (Highest)
Intercept	-0.0117 (-0.58)	-0.0060 (-0.62)	0.0126 (0.94)	-0.0325 (-1.56)	0.0082 (0.88)
E	0.8938 (3.08)**	1.0872 (7.23)**	0.7611 (3.74)**	1.3536 (6.66)**	0.9786 (24.17)**
EV	0.0286 (1.70)	-0.0083 (-1.15)	0.0108 (2.17)*	-0.0055 (-0.99)	-0.0394 (-4.13)**
Mean adjusted R^2	0.1763	0.0572	0.0495	0.1018	0.6039
No. of EV<0 (at the 5% level)	0/7	1/7	0/7	0/7	3/7

1992-1997	1 (Lowest)	2	3	4	5 (Highest)
Intercept	-0.0154 (-0.94)	0.0083 (0.65)	-0.0357 (-1.98)	0.0010 (0.08)	0.0124 (0.92)
E	0.3808 (8.20)**	0.6807 (1.75)	1.5499 (4.84)**	0.9576 (5.67)**	0.8687 (11.17)**
EV	0.0050 (0.27)	-0.0118 (-0.84)	-0.0033 (-0.31)	-0.0224 (-3.81)**	-0.0195 (-2.33)*
Mean adjusted R^2	0.0995	0.0297	0.0355	0.0518	0.3105
No. of EV<0 (at the 5% level)	1/6	1/6	1/6	2/6	3/6

1998-2003	1 (Lowest)	2	3	4	5 (Highest)
Intercept	-0.1323 (-4.04)**	-0.0117 (-0.76)	-0.0044 (-0.29)	0.0136 (0.46)	0.0546 (4.76)**
E	0.4401 (11.76)**	0.6994 (2.26)*	0.9114 (4.13)**	0.7751 (2.33)*	0.5101 (5.32)**
EV	0.0786 (3.21)**	-0.0207 (-2.36)*	-0.0203 (-2.17)*	-0.0269 (-4.04)**	-0.0701 (-5.73)**
Mean adjusted R^2	0.1631	0.0056	0.0237	0.0346	0.1500
No. of EV<0 (at the 5% level)	0/6	0/6	2/6	2/6	6/6

Table 7 (Continued)

Panel B: Operating profit before depreciation

Full sample	1 (Lowest)	2	3	4	5 (Highest)
Intercept	0.0212 (3.18)**	0.0158 (1.90)*	0.0212 (1.79)*	0.0356 (2.46)**	0.0382 (3.43)**
E	0.7172 (9.72)**	0.8878 (11.79)**	0.8529 (10.15)**	0.7728 (9.53)**	0.8363 (17.06)**
EV	0.0004 (0.07)	-0.0196 (-2.89)**	-0.0198 (-2.30)**	-0.0186 (-2.23)**	-0.0616 (-7.53)**
Mean adjusted R^2	0.3295	0.0979	0.0743	0.0735	0.4628
No. of EV<0 (at the 5% level)	1/19	3/19	4/19	5/19	12/19

1985-1991	1 (Lowest)	2	3	4	5 (Highest)
Intercept	0.0324 (2.07)*	0.0213 (1.39)	0.0148 (0.61)	0.0379 (1.16)	0.0445 (1.79)
E	0.6510 (3.52)**	0.8971 (8.53)**	0.9176 (5.68)**	0.7861 (4.87)**	0.8330 (7.51)**
EV	-0.0085 (-0.56)	-0.0359 (-2.75)**	-0.0083 (-0.41)	-0.0320 (-2.93)**	-0.0690 (-4.36)**
Mean adjusted R^2	0.2037	0.1452	0.1031	0.0663	0.5321
No. of EV<0 (at the 5% level)	1/7	2/7	1/7	1/7	4/7

1992-1997	1 (Lowest)	2	3	4	5 (Highest)
Intercept	0.0262 (4.05)**	0.0056 (0.44)	0.0281 (1.53)	0.0347 (1.93)	0.0187 (2.06)*
E	0.6162 (10.43)**	0.9580 (7.16)**	0.8266 (5.63)**	0.7813 (6.53)**	0.9285 (30.48)**
EV	0.0036 (0.39)	-0.0023 (-0.22)	-0.0338 (-2.46)*	-0.0091 (-0.66)	-0.0436 (-4.92)**
Mean adjusted R^2	0.2528	0.0807	0.0853	0.0810	0.5098
No. of EV<0 (at the 5% level)	0/6	0/6	3/6	2/6	3/6

1998-2003	1 (Lowest)	2	3	4	5 (Highest)
Intercept	0.0029 (0.70)	0.0197 (1.19)	0.0219 (1.08)	0.0338 (1.41)	0.0502 (2.68)**
E	0.8955 (24.08)**	0.8066 (4.74)**	0.8038 (5.56)**	0.7488 (4.83)**	0.7479 (9.69)**
EV	0.0076 (2.31)*	-0.0180 (-2.32)*	-0.0194 (-5.33)**	-0.0126 (-0.65)	-0.0710 (-4.59)**
Mean adjusted R^2	0.5530	0.0598	0.0298	0.0742	0.3348
No. of EV<0 (at the 5% level)	0/6	1/6	0/6	2/6	5/6

Notes:
Each year earnings are sorted into five portfolios by the level of current earnings. For each quintile. annual regressions are

run for each year in the period from 1985 to 2003 for the Model 2 from Table 5:

$$E_{t+1} = \alpha + \beta_1 E_t + \beta_2 EV + \varepsilon_t$$

where E is earnings and EV is earnings volatility. The time-series mean coefficient estimates, corresponding *t*-statistics for the means (in parentheses), and the time-series mean adjusted R^2 are reported for net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. The number of significantly negative EV coefficient at the 5% level in annual regressions is presented. Results of regressions are also reported for three sub-periods: 1985-1991, 1992-1997 and 1998-2003. Earnings volatility and both earnings measures are defined in Table 2.
** and * denote statistical significance at the 5% and 10% levels, respectively, for a two-tailed *t*-statistic test.

Table 8
Descriptive Statistics for Abnormal Investment and Firm Characteristics Associated with Financial Constraints

Variable	Mean	Std. Dev.	25%	Median	75%	Min	Max
$ABNCAPEXP_t$	0.005	0.656	-0.393	-0.108	0.218	-1.000	3.210
CFO_{t-1}	0.085	0.120	0.036	0.092	0.147	-0.388	0.398
$CASH_{t-1}$	0.108	0.123	0.021	0.067	0.151	0.000	0.603
$LEVERAGE_{t-1}$ (in %)	26.707	20.087	10.610	25.190	38.660	0.000	100.000
MTB_{t-1}	2.693	3.240	1.072	1.787	2.972	0.097	23.226
$SIZE_{t-1}$ (in millions)	683.628	1826.512	30.014	94.998	400.868	0.545	13008.000

Notes:
Abnormal current investment ($ABNCAPEXP_t$) defined as follows as follows:

$$ABNCAPEXP_t = \frac{CAPEXP_t}{\sum_{i=1}^{3} CAPEXP_{t-i}/3} - 1$$

where CAPEXP is capital expenditures, i.e. cash paid for tangible fixed assets during the year including payments deferred from previous years. (Worldscope item 04601). Cash flows (CFO) is calculated as net profit (Worldscope item 01751 less changes in non-cash working capital plus depreciation (item 01151). Non-cash working capital is change in working capital (item 01351) less change in cash and cash equivalents (item 02001) plus change in short term debt. Change in short term debt is change in total debt (item 03255) minus change in long-term debt (item 03251). CASH is cash and cash equivalents (item 02001). LEVERAGE is total debt-to-capital employed ratio (item 08221). MTB is market-to-book ratio is market value of equity (item 08001) over book value of equity (item 03501). SIZE is total assets (item 02999). CFO are winsorized at the 1% and 99% level, whereas ABNCAPEXP, CASH, MTB and SIZE are winsorized at the 99% level. Negative LEVERAGE ratios and those higher than 100 are replaced with the value of 100 (leverage is expressed in percentage points).

Table 9
Mean Abnormal investment and Firm Characteristics Associated with Financial Constraints by Volatility Quintiles within Highest Earnings Quintiles

Panel A: Net profit

	1 (Lowest)	2	3	4	5 (Highest)
$ABNCAPEXP_t$	0.032	0.002	0.061	0.079	0.228
CFO_{t-1}	0.169	0.165	0.182	0.170	0.124
$CASH_{t-1}$	0.182	0.161	0.160	0.170	0.134
$LEVERAGE_{t-1}$ (in%)	14.627	16.315	17.711	20.098	25.399
MTB_{t-1}	3.950	4.120	4.766	5.166	3.902
$SIZE_{t-1}$ (in millions)	418.591	481.679	382.887	662.510	168.936

Panel B: Operating profit before depreciation

	1 (Lowest)	2	3	4	5 (Highest)
$ABNCAPEXP_t$	0.017	-0.023	0.018	0.086	0.156
CFO_{t-1}	0.168	0.173	0.177	0.181	0.161
$CASH_{t-1}$	0.122	0.125	0.126	0.142	0.130
$LEVERAGE_{t-1}$ (in%)	22.789	22.956	21.557	21.348	26.139
MTB_{t-1}	3.813	3.901	4.611	5.040	5.219
$SIZE_{t-1}$ (in millions)	977.029	590.750	338.251	379.332	288.559

Notes:
Each year firms are sorted into five portfolios by the level of current earnings. Each of these portfolios is then sorted into five further quintiles based on their volatility levels. Mean abnormal investment and firm characteristics associated with financial constraints are presented by volatility quintile within the highest earnings quintile for net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. Abnormal investment and firm characteristics are defined in Table 8. Earnings volatility and both earnings measures are defined in Table 2.

Table 10
Forecast Accuracy for Highest Earnings Quintiles

	N	Mean AE	Median AE	Mean APE	Median APE
Panel A: Net profit					
Full sample					
Model 1	2048	0.0383	0.0239	1.1166	0.1995
Model 2		0.0374**	0.0230**	0.8228*	0.1894**
1985-1991					
Model 1	410	0.0191	0.0144	0.2436	0.1211
Model 2		0.0193	0.0140	0.2305	0.1123
1992-1997					
Model 1	946	0.0345	0.0219	1.1151	0.1610
Model 2		0.0343	0.0218	0.9792	0.1594
1998-2003					
Model 1	692	0.0549	0.0362	1.6358	0.3460
Model 2		0.0524**	0.0346**	0.9598	0.3180**
Panel B: Operating profit before depreciation					
Full sample					
Model 1	2048	0.0390	0.0267	0.4327	0.1136
Model 2		0.0380**	0.0254**	0.3861	0.1093**
1985-1991					
Model 1	410	0.0315	0.0243	0.1548	0.1098
Model 2		0.0305*	0.0228**	0.1501	0.0997**
1992-1997					
Model 1	946	0.0335	0.0228	0.5349	0.0940
Model 2		0.0333	0.0228*	0.4535	0.0897
1998-2003					
Model 1	692	0.0509	0.0349	0.4578	0.1574
Model 2		0.0488**	0.0333**	0.4338**	0.1479**

Notes:
Each year firms are sorted into five portfolios by the level of current earnings. For the highest quintile. annual regressions are run for each year in the period from 1985 to 2002 for Models 1 and 2 from Table 5:

$$\text{Model 1: } E_{t+1} = \alpha + \beta_1 E_t + \varepsilon_t$$
$$\text{Model 2: } E_{t+1} = \alpha + \beta_1 E_t + \beta_2 EV + \varepsilon_t$$

where E is earnings and EV is earnings volatility. The coefficients estimated for year *t+1* are used to forecast earnings in year *t+2*. Forecasting is performed on the total sample available for year *t+2* irrespective of whether the firms included are used for coefficient estimation purposes in year *t*. Absolute error and absolute percentage error as the measures of forecast accuracy are calculated. Absolute error (AE) is calculated as the absolute value of the difference between actual and predicted earnings. The absolute percentage error (APE) is the absolute value of the difference between actual and forecasted earnings divided by absolute actual earnings. AE and APE are calculated for each observation within the highest earnings quintile in year *t+2* for net profit (Panel A) and operating profit before depreciation (Panel B) definitions of earnings. Mean and median values of AE and APE are reported. Results are also reported for three sub-periods: 1985-1991, 1992-1997 and 1998-2003. N is the number of observations. Earnings volatility and both earnings measures are defined in Table 2.

** and * significantly different from each other at the 5% and 10% level, respectively. The test statistic is *t*-statistic (Wilcoxon *z*-statistic) that the means (medians) in Model 1 and Model 2 are statistically different from each other.