Does R&D Influence Revisions in Earnings' Forecasts as it does with Forecast Errors?: Evidence from the UK

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Abstract

Existing research has identified R&D investment as a contributing factor to greater errors in analyst earnings' forecasts. These greater errors have been attributed to the inherently uncertain nature of the future benefits of this investment. The study builds on existing literature on R&D and analyst forecasts by examining whether R&D investments have the strength to influence changes in expectations for future earnings, or forecast revisions, as they do with forecast errors. The prediction is favour of a positive association between R&D and the magnitude of forecast revisions, due exactly to the risky nature of the future outcomes of R&D.

This topic is examined for UK listed firms for the period 1990-2003 and there is not testified any linear positive trend for signed revisions (and forecast errors) to increase with R&D intensity. There is observed tough such a trend for unsigned revisions. R&D intensity is found to be positively associated with forecast revisions, and this relationship is found to be statistically significant when there exists a reasonable amount of time between the initial and the revised forecast. Finally, there are testified larger signed and unsigned forecast revisions (and forecast errors) for firms with high dispersion in analyst forecasts.

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1. Introduction

The inherently risky and uncertain nature of R&D investments and their future economic benefits (Lev, 2001) would justify in theory greater forecast biases when financial analysts forecast earnings in the presence of significant R&D investments. This risky outcome is expected to make earnings' forecasts particularly difficult, since financial analysts would have to predict an uncertain economic outcome in order to forecast earnings. In this context, R&D investments have been empirically associated with greater analyst following and effort (Barth et al, 2001), higher disagreement among analysts (Barron et al, 2002; Chambers et al, 2002), and greater analyst incremental contribution for explaining stock returns (Amir et al, 2003). More importantly, R&D has been empirically linked with greater analyst forecast errors (Amir et al 2003; Gu and Wang, 2005) for the US market, from the direction which more optimism is implied from the side of the analysts in the presence of high R&D investments.

The study builds on prior literature on R&D and analyst forecasts by examining whether R&D investments have the power to influence revisions in earnings' forecasts as they do with forecast errors. The assessment of the relationship between R&D and revisions may offer additional insights into the discussion on the implications of R&D-related analyst forecast biases, compared to assessing the impact of R&D on errors as previously done in the literature. Forecast revisions indicate changes in expectations by financial analysts on the future operating results of firms. In case R&D investment is able to influence revisions in analyst earnings' forecasts, this would constitute evidence that a risky by definition investment has the power to affect expectations and also *changes* in expectations. R&D investments have been considered from a theoretical point of view and have also been empirically found to be risky (e.g. Kothari et al, 2002 and Amir et al, 2007 regarding earnings variability; Ho et al, 2004 for systematic risk; also see Shi 2003 for bond default risk). The UK accounting standards (prior to IFRS application - SSAP 13), exactly as IAS, mandate the expensing of research costs and allow the conditional capitalisation of development costs; the dominant practice though in the UK is to expense all research and development costs (see also endnote 2). R&D investments are therefore in practice treated as risky investments in the UK financial statements and this way immediately expensed.

If a risky investment reported on the income statement is found to have a strong impact on the expectations and changes in the expectations of the users of financial statements, this would provide some evidence that financial statement users inherently capitalise on the information contained in this investment when they produce earnings forecasts. This is because expenses reported on the income statement should in theory have no reflection on expectance of future economic benefits and changes in such expectations, given that these attributes belong to economic resources able which qualify as assets.

At this point, prior literature has examined whether the users of financial statements adjust for R&D expensing by applying a market approach: prior studies assess the market value-relevance of R&D pro forma capitalisation, and have indeed found such evidence (indicatively Lev and Sougiannis, 1996). This study does not use a market approach and addresses the issue of whether the users of financial statements unconsciously capitalise on R&D by examining the strength of the investment to affect changes in expectations, well and above having an impact on earnings forecasts. This way, it provides an assessment of the full extent to which R&D is reflected in earnings forecast characteristics, and examines whether financial statement users actually capitalise on this information contained in the income statement. The assumption behind this expectation is that evidence on a strong influence of R&D on the changes in the expectations of the users of financial statements, well and above the positive influence of R&D on forecast errors, would indicate that analyst give such importance to R&D when they are producing forecasts that they act as if they were capitalising inherently on the investment. A change in the expectations of the financial statement users is assumed to be an economically stronger influence compared to an effect on analyst forecast biases, such as lack of accuracy or even low consensus, resulting from the risky nature of the investment. The study is therefore expected to contribute to the discussion on whether R&D investments are actually treated in practice by financial statement users as assets or expenses, by addressing the full strength of their influence on the users of financial statements, by applying for the first time a non-market based approach unlike prior studies in the field.

The study predicts that the probable nature, by construction, of the R&D future benefits will influence the magnitude of analyst forecast revisions, in the presence of high R&D, as has been found to be the case with forecast errors. Analyst forecast bias are expected to be influenced by the degree of uncertainly under which they are made, with greeter uncertainty leading to higher bias. At this point, Gu and Wang (2005) find indeed that forecast errors are significantly greater for firms that invest in more innovative technologies and with an increasing rate of innovation. When financial analysts are therefore called to revise their earnings forecasts, prior to the end of the financial year for which they are forecasting, for R&D intensive firms, they are called to improve their accuracy in the presence of a great degree of uncertainty. In such case, the amount by which they adjust their predictions will also be uncertain and therefore earnings revisions are expected to be greater in the presence of high R&D intensity. This expectation lies on the assumption that analysts improve their learning as the end of the financial year approaches. The outcome of this learning process is expected to be influenced by the uncertain nature of R&D, leading to higher revisions in the presence of high R&D investments. The expectation that R&D intensity should influence the magnitude of earnings revisions does not mean that the study ignores the influence earnings revisions may receive from news, corporate announcements or changes in company fundamentals. The focus of this study is simply limited to the examination the association between R&D and forecast revisions.

In a context of empirical evidence on biases increasing with uncertainty, the expectation is in favour of more pronounced forecast revisions as R&D intensity increases. Regarding the sign of these revisions, consistent with previous evidence on optimistic biases for high R&D firms, the expectation is again in favour of positive revisions as R&D intensity increases. Das et al (1998) also argue that if one assumes that optimism facilitates the analyst access to non-public information, analysts will tend to be using more optimistic forecasts for firms with less predictable earnings. This should be the case for R&D intensive firms due to the uncertain nature of the investment by definition. Lim (2001) and Jackson (2005) also argue in favour of optimistic analyst forecasts when earnings are uncertain.

The study uses all UK listed non-financial firms during the period 1990-2003 with data on the IBES database and there is not observed any linear positive trend for signed revisions (and forecast errors) to increase as R&D intensity increases. This finding holds regardless of the way R&D intensity is defined, without controlling for other factors. There is observed though a positive trend for *unsigned* revisions (and errors) to increase with R&D intensity. The study additionally testifies a contradiction in the behaviour of errors and revisions: the direction of forecast errors indicates a decrease in analyst optimism as year end approaches, but at the same time forecast revisions are found to be positive. This latter observation implies that forecasts get *more* optimistic as year end approaches, when we get indications from errors that earnings' forecasts become *less* optimistic. The justification for this contradiction lies on the observation that optimism may decrease for forecast errors in terms of mean and median errors, but the values in absolute terms of the positive errors are much larger than the ones of the negative errors. This behaviour provides an explanation on why revisions are positive in terms of mean and median values, when the magnitude of the errors indicates a decrease in optimism as year end approaches.

More importantly, the study finds that R&D intensity is positively associated with forecast revisions, and this relationship is generally statistically significant when there exists a reasonable amount of time between the initial and the revised analyst forecast, after controlling for other factors. Finally, there is testified a greater magnitude of forecast revisions (and errors), both signed and unsigned for high analyst forecast dispersion firms.

The paper is organised as follows: In Section 2, there is presented a draft of the methodology used. Section 3 contains the empirical results, and Section 4 concludes by also summarising some study limitations.

2. Data and Methodology

The study uses all UK listed (in the London Stock Exchange and the Alternative Investment Market) non-financial firms between 1990-2003 with data on IBES[1], identifying the sample firms through the London Share Price Database 2003 version. Data on analyst earnings forecasts, financial year ends, actual reported earnings and stock prices have been retrieved from IBES. Worldscope has been used for accounting figures, and Datastream for market data (stock returns and market values). The sample inclusion criteria require data on the book-to-market ratio, market value of equity, sales and total assets at year end, and at least one observation of one year ahead forecasted earning during the twelve months before financial year end, as well as a figure for actual reported earnings from IBES for the particular year. There are used one year ahead EPS forecast data.

In the UK accounting years end at different times during the calendar year, so consistent with prior literature (e.g. Al-Horani et al, 2003) accounting year ends are used for accounting data, and calendar year ends for market data. There have been eliminated the firms with a change in the month of the financial year end more than once during the sample period (IBES data). The study uses the R&D expense from the income statement[2]. Finally, the study uses the FTSE Actuaries industry classification which is followed by LSPD.

Under the above sample selection procedure, the study employs 10,653 firm-year observations (1,647 firms) for the period 1990-2003 35.69% of these firm-year observations are R&D reporting firms in their income statements (3,802 firm-year observations and 610 firms). The most R&D-intensive industry sectors are IT Hardware and Pharmaceuticals, with R&D reporting for more than 80%. As intuitively expected, there is testified significant R&D reporting in the case of Electronics and Engineering, with percentages around 70% and above 60% of firm-year observations respectively. Chemicals also exhibits a percentage of R&D reporting above 70%. Interestingly, only 56.5% of Software & Computer Services companies report R&D, when the relative percentage for Hardware firms was much higher. Limited R&D activity is observed for Retailers, Leisure, Media and Support Services, with R&D reporting below 20%. These are sectors highly represented in the overall sample formation in terms of firm-year observations, but with a nature of activities that may not require significant R&D investments in order for a firm to become or remain competitive in its industry sector.

An interesting observation is that when limiting the sample selection criteria to requiring data only for the book-to-market ratio, market value of equity, sales and total assets at year end, the sample is increased to 15,488 firm-year observations (2,182 firms), out of which a lower percentage of 31.4% report R&D (4,851 firm-year observations and 770 firms). It is therefore evident that imposing the sample selection requirement of having data on IBES automatically results in a sample of firms with higher R&D reporting. This should be an indication that financial analysts tend to cover R&D reporting firms, or larger firms if the R&D reporting firms are larger firms.

Last but not least, R&D intensity is defined as R&D expense from the income statement divided by annual sales and second, as R&D expense divided by firm Total Assets. There is not casually used a market-based measure of R&D intensity since the study does not mainly involve market valuation. In most of the analyses tough, following the R&D intensity proxies employed in prior literature (e.g. Lev and Sougiannis, 1999; Chan et al, 2001), for robustness purposes there is also used R&D/MVE as a proxy for R&D intensity. During the sample period, the R&D/Sales and R&D/TA ratios have increased steadily from median values of around 1% in 1990 to around 4 for R&D/Sales and 3.5% for R&D/TA in 2003. When dividing the values of the R&D intensity ratios into quintiles (untabulated data), there is observed very high increase in the value of the top R&D intensity quintile breakpoints towards the end of the sample period. The value of the breakpoint for the top quintile went from around 3% in the early 1990's to above 17% for R&D/Sales (and about 12% for R&D/TA) towards 2003. The very high values of the top R&D intensity quintile breakpoints coincide with the New Economy years in the late 1990's - early 2000.

3. R&D and the Revisions in Analyst Earnings Forecasts

3.1 Forecast Errors and Revisions: Descriptive Statistics

Before proceeding with the detailed examination of forecast revisions, for reasons of completeness of the analysis, there are first reported some descriptive statistics on R&D and analyst forecast errors. Consistent with previous literature, there are used two definitions of analyst forecast errors: Forecasted minus actual EPS divided 1) by the absolute value of actual EPS and 2) by the firm stock price twelve months prior to year end. There are used the mean one year ahead EPS forecasts, employing all of the minus twelve, six and one month previous to year end forecasts. In Table 1 Panel A, there are presented the average signed errors throughout the sample period 1990-2003, according to the two definitions of forecast errors for the whole sample, the R&D firms and the zero R&D firms. As expected, the closer we get to the end of the financial year, the lower the errors, which is more striking when errors are scaled by the absolute value of actual EPS, with values to reduce from 0.802 to 0.129 at the sample level. When scaling errors by the absolute value of actual EPS, errors are higher for the R&D compared to the zero R&D firms, no matter whether minus twelve, six and one month previous to year end forecast data are used. The previous result does not hold when scaling errors by price, since errors for R&D firms are very much stable and are not reduced as we move towards the end of the financial year. As one would intuitively observe, errors are generally lower when scaling by price as opposed to absolute value of actual EPS, given that stock prices tend to be greater than EPS ratios.

Insert Table 1 here.

Table 1 Panel B proceeds with showing the sample period average signed forecast errors according to R&D intensity quartiles. This analysis is performed only for R&D firms, using all of R&D/Sales, R&D/TA and R&D/MVE as proxies for R&D intensity. As can be observed from

Table 1 Panel B, when assessing signed errors according to R&D intensity for R&D firms, the way R&D intensity is defined plays a role for the behaviour of errors as R&D intensity changes. Signed errors are found to be positive and steadily get larger as R&D/MVE increases, with optimism to be decreasing as the end of the accounting year gets closer. When R&D intensity defined as R&D/Sales or TA though, optimism continues to decrease as year end approaches, but there is not observed any clear trend for error behaviour as R&D intensity increases. Finally, the values of the errors as financial year end approaches change in a much smoother pattern when scaling by absolute actual EPS instead of price. The latter finding implies that scaling by price may result in denominator-driven biases.

In Table 2, there are reported the average sample period absolute errors for the whole sample, the R&D firms, the zero R&D firms (Panel A), and then for the R&D firms according to R&D/Sales, R&D/TA and R&D/MVE quartiles (Panel B). In Panel A, unsigned errors, no matter how scaled, steadily decrease in values as the end of the financial year approaches. From the results in Panel B, there is a clear trend, though not always completely linear, for absolute errors to increase as R&D intensity increases. Particularly when R&D/MVE is used as a proxy for R&D intensity, errors are close to three times larger for the top R&D intensity quartile compared to the lowest intensity one. The results on Tables 1 and 2 though have to be interpreted with caution since they lack controls for other factors with a possible influence on errors. But casually taking the findings from Tables 1 and 2 as a whole, there are indications for larger errors as R&D intensity increases when absolute errors are examined, but no such trend when using non-absolute raw errors. This observation might imply possible biases resulting from the relative magnitude of positive and negative errors

Insert Table 2 here.

After having briefly observed the behaviour of signed and unsigned average errors as R&D intensity increases, without controlling for any other factors, the study proceeds with the descriptive analysis of the main topic of examination, forecast revisions, according to different degrees of R&D intensity.

There are used two definitions for forecast revisions (using one year ahead EPS forecast data): In the first one, the mean analyst forecast twelve months prior to financial year end is subtracted from the mean analyst forecast six months prior to year end, and the result is divided by the stock price twelve months prior to year end (stock price given by IBES). In the second one, the mean analyst forecast twelve month prior to financial year end is subtracted from the mean analyst forecast one months prior to year end, and the result is divided by the stock price twelve months prior to year end. The standardisation by stock price is consistent with prior literature (see Capstaff et al, 1995; Helbok and Walker, 2004 for the rationale for scaling by price). Also following Helbok and Walker (2004), if revision exceeds +/-100%, it is considered an outlier and is removed. The analysis is repeated by standardising the change in forecasts by the absolute value of the median one year ahead EPS forecast twelve months prior to year end instead of price.

Signed and unsigned forecast revisions are first assessed according to R&D intensity. As previously done in Table 1 for forecast errors, Table 3 reports the average signed forecast revisions during the sample period for the whole sample, the R&D firms, the zero R&D firms (Panel A) and according to quartiles formed by R&D intensity (using R&D/Sales, R&D/TA and R&D/MVE as proxies of R&D intensity - Panel B). Revisions are scaled both by price and by the absolute value of the median one year ahead EPS forecast twelve months prior to year end. As can be observed from Panel A of the Table, as one would intuitively expect, revisions between twelve and six months prior to year end are much smaller compared to revisions between twelve and one month, comparing the values of 0.94% as opposed to 1.577% at the sample level respectively, when scaling revisions by price. Similar differences are observed at the sample level (2.269% between twelve and six months compared to 3.545% between twelve and one month before year end), and again for R&D and zero R&D firms separately, when scaling revisions by the absolute value of the median EPS forecast. Revisions are also higher when scaled by median forecasted EPS compared to prices, as prices tend to be higher than EPS ratios. In addition, revisions appear to be slightly higher for non R&D reporting firms compared to R&D firms, which could be due to the fact that the non R&D sample population is almost double the R&D one.

Given the way they are defined, positive revisions imply upgrades as the end of the financial year approaches. From Table 3 Panel A, there are generally observed positive average revisions, for the whole sample and for the R&D and non R&D samples separately. This observation is contradictory to existing empirical evidence for the US and for the UK as well (Hussain, 1996) that testifies a decrease in optimism in analyst forecasts as the end of the financial year gets closer. This result is also contradictory to the previous finding of this study on

Table 1 in the case of errors, the behaviour of which implied less optimism as year end approached, and will be therefore examined in more detail in the parts of this study that follow.

When assessing signed forecast revisions among R&D firms in Table 3 Panel B, revisions appear to be particularly high for the top R&D intensity portfolio, no matter if there are used R&D/Sales or R&D/TA as proxies of R&D intensity (or using price instead of the absolute value of the median one year ahead EPS forecast twelve months prior to year end to scale revisions). Revisions are also found to be positive when R&D/Sales or R&D/TA are used as proxies for R&D intensity. Despite the fact that very high R&D/Sales or R&D/TA firms consistently show very high revisions, with values around 5% or higher than 7% between twelve and one month depending on the scaling (compared to values around 1% for the bottom intensity quartile), there does not appear to exist any clear steady trend for revisions as we move from lower to higher R&D intensity quartiles. The positive sign of the revisions, given the ways they are defined, implies an increase in optimism for these firms as year end approaches. The surprising observation is that when R&D intensity is defined as R&D/MVE, as we move from lower to higher R&D/MVE quartiles, revisions decrease. This result may have been influenced by the denominator of MVE in the R&D/MVE ratio. Interestingly, the firms in the top R&D/MVE quartile exhibit negative revisions (between -2% and 3% depending on the definition), implying decrease in optimism as R&D intensity increases.

Insert Table 3 here.

In Table 4, there are further reported the average sample period absolute revisions for the whole sample, R&D firms and zero R&D firms (Panel A), and then according to R&D/Sales, R&D/TA and R&D/MVE quartiles (for R&D firms only - Panel B). In Panel A, there is observed that absolute revisions get much higher absolute values compared to non absolute ones, with percentages of around 15% or 20% depending on the definition of the revision. From Panel B, there is observed a clear trend for absolute revisions to increase as R&D intensity increases, particularly when R&D/MVE is used as a proxy for R&D intensity. Firms in the top R&D intensity quartile exhibit absolute revisions above 20% or even close to 30% between twelve and one month before year end, again depending on the definition of the revisions. This comes in contrast with the behaviour of non absolute revisions, which increased as R&D/Sales or R&D/TA increased, but decreased as R&D/MVE increased. This finding constitutes evidence on larger absolute revisions when R&D intensity increases no matter which proxy is used for R&D

intensity, when there had been observed no such trend with non-absolute raw revisions. As in the case with absolute and non absolute errors, the previous observation may imply differences in the relative magnitude of positive and negative revisions for different degrees of R&D intensity.

Insert Table 4 here.

An observation that appears relatively upsetting has to do with the fact that errors are generally positive with decreasing values as year end gets near. So, given the way they are defined[3], analyst optimism should decreasing as the end of the financial year for which they are forecasting approaches. At the same time though, forecast revisions appear to be also positive. This latter fact implies that earnings forecasts get *more* optimistic as year end approaches, when we get indications from errors that earnings forecasts become *less* optimistic. In Table 5, there have been calculated the average and median unsigned errors and revisions for the whole sample and then for positive and negative errors and revisions separately. In the case of errors, as can be observed from Table 5, in absolute terms positive errors are much larger than negative ones. This fact could lead to very large average errors, since the values of the positive and thus 'optimistic' errors are much higher than the ones of the negative errors. In the case of revisions now, in absolute terms a casual comparison shows not so great differences between positive and negative revisions. Negative revisions in absolute terms are actually slightly larger than positive ones.

This way, in the case of errors, there is observed a decrease in optimism in terms of mean and median errors, but the values of the positive errors are much larger than the ones of the negative errors. This observation provides an explanation on why revisions are positive in terms of mean and median values, when the magnitude of the errors indicates a decrease in optimism as year end approaches.

The findings on Table 5 are completely in accordance with the confliction in the findings when assessing absolute versus non absolute errors and revisions for different degrees of R&D intensity in Tables 1 to 4. They confirm the fact that the relative magnitude and number of positive versus negative errors and revisions causes distortion when average or even median values are computed.

Insert Table 5 here.

Taking the findings from Tables 1 and 3, and combining them with the ones from Tables 2 and 4 for absolute errors and revisions, there is not observed any linear positive trend for signed errors and revisions to increase as R&D intensity increases, without controlling for other factors, regardless of the way we define R&D intensity. When making use of unsigned errors and revision compared to signed ones, there exists evidence on a trend for both errors and revisions to increase as R&D intensity increases, again without including controls for other factors that could have an impact of analyst forecasts.

3.2 The Impact of R&D Intensity on Forecast Errors and Revisions: Regression Analysis

The previous analyses lack controls for factors other than RD that could influence revisions in earnings forecasts. They also provide no evidence on the statistical significance of the influence of R&D on revisions. In order to assess the impact of R&D intensity on forecast revisions, there regression analysis is used. The following regression is run with OLS using panel data for the period 1990-2003:

$$Revisions_{it} = \beta_0 + \beta_1 RD + \beta_2 BM + \beta_3 MV + \beta_4 PASTR + \beta_5 STDEV + \varepsilon_{it}$$

(1) where:

Revisions - the dependent variable is defined in four ways, using one year ahead mean EPS analyst forecasts scaled either by stock price or by median EPS forecast:

1) Forecast Revision: 12 6 (Mean Forecast six months prior to year end-Mean Forecast Twelve months prior to year end)/Share price twelve months prior to year end
2) Forecast Revision: 12 1(Mean Forecast one month prior to year end-Mean Forecast twelve months prior to year end)/Share price twelve months prior to year end
3) Forecast Revision: 12 6 (Mean Forecast six months prior to year end-Mean Forecast twelve months prior to year end)/Absolute value of median forecast twelve months prior to year end
4) Forecast Revision: 12 1 (Mean forecast one month prior to year end-Mean forecast Twelve months prior to year end)/Absolute value of median forecast twelve months prior to year end

RD - R&D/Sales or R&D/Total Assets or R&D/Market value of equity at year end

BM - the book-to-market ratio at year end

MVE - the natural log of market value of equity at year end

PASTR - the six month prior to previous year end geometric average of monthly stock returns

STDEV -the standard deviation of reported EPS for a three year period prior to base year (eg 1988-1990 for the base year 1990)

The regressions are run using OLS and Whites Heteroscedasticity robust standard errors[4]. Observations above the 98 and below the 2 percentile were eliminated. All variables have been transformed using natural logs since this improved heteroskedasticity in the models and provided a better functional form for the model. There are used both absolute and non absolute revisions as dependent variables. Non absolute revisions and errors have been adjusted as follows in order to be able to use logs: (100+revision)/100 e.g. if a revision was 3%, it will appear as 103 or 97 for -3%.

The relevant results for absolute revisions are presented on Table 6 Panels A (using scaling by price) and B (using scaling by the absolute value of the median forecast twelve months prior to year end), and for signed revisions on Table 6 Panels C (using scaling by price) and D (using scaling by the absolute value of the median forecast twelve months prior to year end).

Insert Table 6 here.

In the case of the absolute revisions regressions, no matter how revisions are scaled, as can be readily observed from Table 6 Panels A and B, MVE gets a negative coefficient which is always statistically significant. The same applies for the BM coefficient in the case of revisions scaled by the absolute value of the median forecast twelve months prior to year end. In the case of revisions scaled by stock price, the BM coefficient is positive but not statistically significant at any reasonable level of significance. The coefficient of the past return variable is generally of limited significance in the revisions between twelve and six months prior to year end, but positive and significant at 1% in the regressions with revisions between twelve and one month prior to year end. This variable is also the one with the highest economical significance. The standard deviation of past EPS variable is also very strongly statistically significant and always positive, conforming to the intuition. The p-values of the F statistics are always zero and the explanatory power of the model is better when we assess revisions between twelve and one month prior to year end, compared to twelve and six months: in the first case, adjusted R squares are around 20% and in the latter around 15%.

The R&D intensity variable is always positive and statistically significant at 5% significance level in the case of absolute revisions between twelve and one month prior to year end, no matter how defined, when revisions are scaled by the absolute value of the median forecast twelve months before year end. The highest t statistics and coefficients for the R&D intensity variable are observed when it is defined as R&D/MVE. The R&D intensity variable, although positive, is not significant even at 15% significance level in the regressions when revisions are scaled by price. In the case though of absolute revisions between twelve and six months before year end, the R&D intensity variable is not statistically significant, and its coefficient even gets a negative sign when revisions are scaled by price. This provides evidence that R&D is able to influence the magnitude of forecast revisions, when there exists a reasonable amount of time between the initial and the revised analyst forecast. Still, the definition of revisions plays a role in the strength of the results.

Given that the research hypothesis was in favour of a positive sing in forecast revisions as R&D intensity increases, there have also been regressed raw as opposed to absolute revisions on the same regressors. The relevant results appear on Table 6 Panels C and D. When taking the sing of revisions into account, BM relates negatively to revisions and is always statistically significant, as was the case with absolute revisions, when BM was also negative. Contrary to the intuition, MVE is generally positive in these regressions and its significance varies with the regression. Strong past returns also relate positively to forecast revisions, and this particular variable is statistically significant at 5% significance level. This variable is also the one with the highest economical significance, as was the case in the absolute revision regressions. The standard deviation of past EPS variable is also statistically significant, but it relates negatively to forecast revisions, contrary to the intuition. This latter finding implies that lower volatility in past earnings would relate to higher revisions. The finding is also in contrast with the positive sing of the same variable in the absolute revisions and errors regressions. The p-values of the F statistics are always zero and the explanatory power of the model is better when we assess revisions between twelve and one month prior to year end, compared to twelve and six months. In the first case, adjusted R squares are around 15%, and in the latter case around 10%, getting values generally lower than the ones of the adjusted R squares in the absolute revision regressions.

The R&D intensity variable is always positive but it is statistically significant at 5% significance level only in the regressions for revisions between twelve and one month before year end, as opposed to twelve and six months, no matter how defined. This provides some evidence that R&D intensity is able to influence the magnitude as well as the sign of forecast revisions. The significance of the R&D intensity variable, as in the case of the absolute revisions, is stronger when there exists a reasonable amount of time between the initial and the revised analyst forecast, and not for shorter term revisions[5].

From the findings on Table 6, it is deduced that after controlling for firm size and BM, R&D intensity appears to have a positive influence and is shown to be a statistically significant factor for analyst forecast revisions, even after taking the sign of revisions into account. This result though only holds when there exists a reasonable amount of time between the initial and the revised analyst forecast, and not for shorter term revisions. Finally, the influence of R&D on revisions still appears to be quite sensitive to controls for firm size and the BM factor.

3.3 Errors and Revisions for Different Degrees of Analyst forecast Dispersion

After examining in detail the association between R&D investments and analyst forecast revisions, the study briefly provides some descriptive statistics on the whether forecast revisions (and errors) are accompanied by high market consensus or, in opposite, by large disagreement among market participants. The reason for performing this type of analysis is in order to assess whether the changes in expectations, as indicated by forecast revisions, are roughly accompanied by high analyst disagreement. In other words, whether the changes in expectations go hand in hand with a more general lack of consensus for firm from the side of the analysts. The motivation for performing this analysis is received from the study by Diether et al (2002), who interpret their results as evidence that in the presence of high analyst disagreement, pessimism among analysts is the leading trend in the market which subsequently affects market valuation. The examination of the changes in expectations may offer a good context for the assessment of the existence of optimistic versus pessimistic trends in the expectations of the users of financial statements. In order to make the analysis of the attributes forecast revisions as thorough as possible, there is examined the magnitude of the revisions *and errors* as analyst forecast dispersion changes. There are reported on Tables 7 and 8, for errors and revisions respectively, the average signed and unsigned errors end revisions according to dispersion quintiles, from D1 (low) to D5 (High). Dispersion is defined following Diether et al (2002), as the standard deviation in analyst forecasts scaled by the absolute value of the mean EPS forecast for the month in question, using one year ahead EPS forecasts. There are used minus twelve, six and one month prior to year end forecast data for purposes of dispersion calculation.

Insert Tables 7 and 8 here.

In then the case of signed errors in Table 7 Panel A, it is observed that as dispersion increases, so do signed errors, which get larger positive values. This behaviour of errors implies increase in optimism for high levels of forecast dispersion, despite the observation that the increase in signed errors ad dispersion increases is not linear. The finding is generally robust to different methods of scaling errors, and to the use of minus twelve as opposed to minus six or one month forecast data for error and dispersion calculation. When absolute errors are assessed according to five dispersion portfolios in Table 7 Panel B, all of the previously observed trends regarding the behaviour of signed errors are still found to hold.

In the case of revisions though, the relevant results show a different behaviour of revisions as forecast dispersion changes, as can be testified from Table 8 Panel A (for signed revisions) and B (for absolute revisions). There can be observed from Table 8 Panel B that as dispersion increases, revisions also increase in absolute values. This increase is not always steadily linear, but the top dispersion portfolios clearly exhibit the highest absolute revisions, no matter how revisions are defined, or what kind of dispersion data are used (minus twelve or six or one month prior to year end) for dispersion calculation. When it comes though to their non absolute values (Table 8, Panel A), revisions start from exhibiting slightly positive values for the low dispersion portfolios, and get much larger negative values for the top dispersion portfolios. The result is more striking when minus one month data are used for dispersion calculation.

Overall, errors and revisions in are found to be high in absolute terms when disagreement on future operating results is also high for firms in the market. Errors are also found to be larger and positive for larger dispersion portfolios, and revisions to be high and negative (pessimistic analysts) for higher dispersion portfolios. The latter finding that in the presence of high forecast dispersion, revisions tend to be highly negative would provide some confirmation the research hypothesis of Diether et al (2002) on the implications of high forecast dispersion. Diether et al (2002) testify a negative association between analyst forecast dispersion and subsequent stock returns. They rationalise this empirical finding by arguing that when analyst disagreement is high, the pessimistic investors will be kept out of the market because of high short sale costs. In that case, the remaining optimistic investors will keep the market prices high, and returns will be lower for these high dispersion portfolios. If evidence on highly negative revisions in the presence of high dispersion is interpreted as evidence on pessimism, then the finding of this study on high dispersion being accompanied by highly negative revisions would provide some support for this Diether et al (2002) argumentation.

4. Conclusion

Existing research for the US has identified R&D intensity as a contributing factor to analyst forecast errors, a result which has been in theory attributed to the uncertain future benefits and the risky nature of the investment. This study builds on previous research on R&D and forecast errors by focusing on another aspect of analyst forecast accuracy as a result of R&D intensity, by examining whether R&D investments have the strength to influence revisions in earnings' forecasts as they do with forecast errors. Since forecast revisions indicate changes in expectations by financial analysts on future operating results, evidence that R&D affects revisions could further indicate that R&D can significantly affect changes in analyst expectations. The assumption is that evidence on an influence of R&D on changes in expectations might indicate that analysts give such importance to R&D when they are producing their forecasts that they act as if they were capitalising inherently on the investment. The study this way contributes to the discussion on whether R&D investments are actually treated in practice by financial statement users as assets or expenses by not using a market based approach as done in prior literature for this issue. The expectation is in favour of a positive relation between R&D and forecast revisions, given that when financial analysts revise their earnings forecasts for R&D intensive firms, they are called to improve their accuracy in the presence of a highly uncertain investment. In such a case, the amount by which they adjust their predictions would also be uncertain and therefore earnings revisions are expected to be greater in the presence of high R&D intensity.

The study uses all UK listed non-financial firms during the period 1990-2003 with analyst forecast data on the IBES database and there is not found any linear positive trend for signed revisions (and errors) to increase as R&D intensity increases, without controlling for other factors. There is though observed such a trend when using *unsigned* revisions (and errors). The study additionally testifies a contradiction in the behaviour of errors and revisions: interestingly, the direction of forecast errors indicates a decrease in analyst optimism as year end approaches, but at the same time, forecast revisions are also found to be positive. This latter observation implies that forecasts get *more* optimistic as year end approaches, when there are indications from errors that earnings' forecasts become *less* optimistic. The justification for this contradiction lies on the observation that optimism may decrease for forecast errors in terms of mean and median errors, but the values in absolute terms of the positive errors are much larger than the ones of the negative errors. This way, revisions are positive in terms of mean and median values, when the magnitude of the errors indicates a decrease in optimism as year end approaches.

More importantly, the study testifies that R&D intensity is positively associated with changes in analyst expectations, as represented by forecast revisions. This relationship is found to be generally statistically significant only when there exists a reasonable amount of time between the initial and the revised analyst forecast, and not for shorter term revisions, after controlling for other factors. Confirming the research hypothesis, this finding is interpreted as evidence R&D investments have the power to influence changes in the expectations of the users of financial statements about future earnings and cash flows, and therefore financial analysts in practice inherently capitalise on R&D when they produce earnings' forecasts. The study also finds evidence on greater magnitude of forecast revisions (and errors), both signed and unsigned for high analyst forecast dispersion firms.

As a final comment, there are certainly two issues that have to be taken into consideration as possible study limitations. The first one relates to the probability that a firm may try to manage/smooth its earnings by deciding on how much R&D it should spend. This way, the amount of R&D that we observe on the income statement and which is used in the study will receive influence by factors we cannot control. This issue becomes even more serious if one considers that a firm may try to meet analyst EPS targets by managing the amount of R&D spending. In such cases, the R&D amount is clearly affected by managerial/earnings management decisions and would not reflect the real amount of R&D that a firm would need to spend in order to reach corporate or competition targets. The second issue relates to the fact that the EPS figures, actual or forecasted, refer to earnings *after* the expensing of R&D. Any change therefore in R&D spending, or any major managerial decision to increase/decrease R&D will affect the final EPS figures. The result will be increased or decreased earnings that simply reflect changes in R&D spending, and not sales or gross income changes. This problem exists by definition when an earnings measure in the lower steps of the income statement such as EPS is used. These issues though, appear more or less self built in the very design of the study, but nonetheless they are acknowledged.

Table 1. Signed forecast errors for R&D firms, zero R&D firms and according to R&D intensity for the period 1990-2003
Panel A: There are reported the average forecast errors for the whole sample, R&D firms and zero R&D firms. Forecast errors have been calculated as a) (Forecasted EPS-Actual EPS)/Absolute value of Actual EPS and b) (Forecasted EPS-Actual EPS)/Stock Price twelve months prior to year end. In the case of the mean forecasted one year ahead EPS, there have been used all of the minus twelve, six and one month prior to year end median forecasts. Actual and forecasted EPS observations above the 0.98 and below the 0.02 percentile have been eliminated. There are also reported the sample period averages of the median error values in the middle of each quintile.
Panel B: There are reported the sample period average forecast errors according to R&D intensity quartiles using all of R&D/Sales, R&D/TA and R&D/MVE as proxies for R&D intensity (R&D firms only).

Panel A:	Error (F-A)/A Abs	Forecast -12m	Forecast -6m	Forecast -1m	Error (F-A)/P	Forecast -12m	Forecast -6m	Forecast -1m
Sample		0.802	0.530	0.129		0.175	0.159	0.155
R&D firms		0.904	0.647	0.519		0.127	0.124	0.126
Zero R&D firms		0.688	0.448	-0.119		0.201	0.178	0.171
Panel B:								
R&D firms according to R&D/Sales								
Low		0.938	0.680	0.623		0.131	0.106	0.114
		0.973	0.879	0.582		0.172	0.170	0.144
		0.819	0.626	0.556		0.086	0.100	0.095
High		0.686	0.309	0.252		0.117	0.119	0.159
R&D firms according to R&D/TA								
Low		0.756	0.558	0.438		0.082	0.081	0.099
		0.944	0.601	0.590		0.204	0.169	0.135
		1.300	1.097	0.653		0.133	0.149	0.144
High		0.529	0.231	0.378		0.087	0.097	0.128
R&D firms according to R&D/MVE								
Low		0.441	0.288	0.244		-0.023	0.005	0.031
		0.425	0.367	0.367		0.058	0.059	0.074
		1.140	0.969	0.695		0.159	0.166	0.168
High		1.689	0.920	0.765		0.332	0.282	0.244

Table 2. One year ahead absolute analyst forecast errors according to R&D intensity

Panel A: There are reported the absolute average forecast errors for the whole sample, R&D firms and zero R&D firms. Forecast errors have been calculated as a) (Forecasted EPS-Actual EPS)/Absolute value of Actual EPS and b) (Forecasted EPS-Actual EPS)/Stock Price twelve months prior to year end. In the case of the mean one year ahead EPS forecast, there have been used all of the minus twelve, six and one month prior to year end median forecasts. Actual and forecasted EPS observations above the 0.98 and below the 0.02 percentile have been eliminated. There are also reported the sample period averages of the median error values in the middle of each quintile

Panel B: There are reported the sample period absolute average forecast errors according to R&D intensity quartiles using all of R&D/Sales, R&D/TA and R&D/MVE as proxies for R&D intensity (R&D firms only).

Panel A:	Error (F-A)/A Abs	Forecast - 12m	Forecast - 6m	Forecast - 1m	Error (F-A)/P	Forecast - 12m	Forecast - 6m	Forecast - 1m
Sample		1.615	1.449	1.213		0.345	0.268	0.195
R&D firms		1.657	1.494	1.218		0.347	0.271	0.197
Zero R&D firms		1.671	1.569	1.327		0.368	0.285	0.206
Panel B:								
R&D firms according to R&D/Sales								
Low		1.187	0.906	0.796		0.293	0.226	0.167
		1.315	1.111	0.893		0.302	0.231	0.174
		1.482	1.197	0.928		0.275	0.216	0.158
High		2.172	1.816	1.631		0.352	0.284	0.204
R&D firms according to R&D/TA								
Low		1.003	0.773	0.620		0.273	0.207	0.151
		1.377	0.940	0.929		0.324	0.246	0.188
		1.755	1.562	1.231		0.284	0.229	0.166
High		1.998	1.708	1.453		0.337	0.270	0.195
R&D firms according to R&D/MVE								
Low		0.756	0.534	0.407		0.216	0.162	0.112
		0.941	0.841	0.680		0.260	0.188	0.146
		2.021	1.690	1.512		0.309	0.244	0.187
High		2.486	1.913	1.634		0.445	0.372	0.266

Table 3. One year ahead signed analyst forecast revisions according to R&D intensity

The table reports the average sample period signed forecast revisions for the whole sample, R&D firms, zero R&D firms (Panel A) and for the R&D firms only according to R&D intensity quartiles, using R&D/Sales, R&D/TA, R&D/MVE as proxies for R&D intensity (from low to high - Panel B).
There are used four types of forecast revisions defined as follows:
Scaling revisions by stock price:
Forecast Revision: 12 6 (Forecast 6m prior to year end-Forecast 12m prior to year end)/Share price 12m prior to year end*100
Forecast Revision: 12 1(Forecast 1m prior to year end-Forecast 12m prior to year end)/Share price 12m prior to year end *100
Scaling revisions by the absolute value of median forecast 12m prior to year end:
Forecast Revision: 12 6 (Forecast 6m prior to year end-Forecast 12m prior to year end)/Abs value of median forecast 12m prior to year end *100
Forecast Revision: 12 1(Forecast 1m prior to year end-Forecast 12m prior to year end)/Abs value of median forecast 12m prior to year end *100
One year ahead mean forecasts are used. If revision exceeds +/-100% data are considered outliers and are removed.

Panel A:	Scaled by price 12 6	12 1	Scaled by median 12 6	12 1
Sample	0.940	1.577	2.269	3.545
R&D firms	0.570	1.494	1.332	3.330
Zero R&D firms	1.175	1.716	2.860	3.729
Panel B:				
R&D/Sales				
Low	0.198	1.246	1.265	2.258
	0.870	0.810	1.692	3.098
	0.090	0.230	0.572	2.002
High	1.446	4.299	2.055	7.052
R&D/TA				
Low	0.899	2.354	1.962	2.907
	-0.204	-0.747	0.201	1.876
	0.245	0.141	0.927	1.997
High	1.737	4.889	2.602	7.603
R&D/MVE				
Low	3.521	5.349	4.865	6.869
	0.604	1.324	2.676	5.084
	0.201	1.720	-0.059	2.612
High	-2.467	-3.039	-3.239	-2.402

Table 4. One year ahead absolute analyst forecast revisions according to R&D intensity

The table shows the absolute average sample period forecast revisions for the whole sample, R&D firms, zero R&D firms (Panel A) and according to R&D intensity quartiles (R&D firms only) formed according to R&D/Sales, R&D/TA, R&D/MVE (from low to high). There are used four types of forecast revisions defined as follows:
Scaling revisions by stock price:
Forecast Revision: 12 6 (Forecast 6m prior to year end-Forecast 12m prior to year end)/Share price 12m prior to year end*100
Forecast Revision: 12 1(Forecast 1m prior to year end-Forecast 12m prior to year end)/Share price 12m prior to year end *100
Scaling revisions by the absolute value of median forecast 12m prior to year end:
Forecast Revision: 12 6 (Forecast 6m prior to year end-Forecast 12m prior to year end)/Abs value of median forecast 12m prior to year end *100
Forecast Revision: 12 1(Forecast 1m prior to year end-Forecast 12m prior to year end)/Abs value of median forecast 12m prior to year end *100
One year ahead mean forecasts are used. If revision exceeds +/-100% data are considered outliers and are removed.

Panel A:	Scaled by price	12 6	12 1	Scaled by median	12 6	12 1
Sample		14.790	19.078		18.115	23.602
R&D firms		14.811	19.125		18.274	23.779
Zero R&D firms		15.523	20.049		18.819	24.500
Panel B:						
R&D/Sales						
Low		13.502	17.386		14.761	18.997
		14.367	17.944		17.160	21.509
		12.540	16.120		17.449	23.371
High		13.681	17.885		19.428	25.399
R&D/TA						
Low		12.822	16.627		14.273	18.009
		14.570	17.860		17.334	21.861
		12.487	16.881		17.327	23.408
High		14.204	17.849		19.483	25.541
R&D/MVE						
Low		11.649	14.691		14.534	17.762
		12.045	15.509		15.388	20.354
		14.160	18.241		17.290	22.815
High		16.631	21.592		21.717	28.629

Table 5. The magnitude of positive and negative errors and revisions

Panel A shows the magnitude (mean and median values) of signed forecast errors and revisions for the whole sample, and then for positive and negative errors and revisions separately for the period 1990-2003. For the calculation of errors, there have been used minus twelve, six and one month prior to year end forecast data when actual and forecasted EPS observations above the 0.98 and below the 0.02 percentile have been eliminated.

Panel B presents the same information as in Panel A (mean and median signed revisions for the sample and then for positive and negative revisions) for forecast revisions (revisions +/-100% have been eliminated) between twelve and six (12 6) and twelve and one (12 1) month prior to year end. Forecast revisions are scaled by the absolute value of the median EPS forecast twelve months prior to year end.

Panel A: Forecast Errors

	Sample			>0			<0		
	12	6	1	12	6	1	12	6	1
mean	0.780	0.530	0.129	2.727	2.098	1.364	-0.730	-0.848	-1.000
median	-0.088	-0.031	-0.012	0.400	0.267	0.202	-0.211	-0.167	-0.089

Panel B: Forecast Revisions

	Sample		>0		<0	
	12 6	12 1	12 6	12 1	12 6	12 1
mean	2.269	3.545	17.602	21.614	-18.107	-24.987
median	3.694	7.178	13.021	16.753	-10.732	-18.683

Table 6. The impact of R&D intensity on one year ahead mean EPS forecast revisions

The table reports the coefficient estimates and values of t-statistics (in parentheses) that have been estimated by running the following panel data regression for the period 1990-2003: Revisions $=\alpha_0+\alpha_1 RD+\alpha_2 BM+\alpha_3 MV+\alpha_4 PASTR+\alpha_5 STDEV+\varepsilon_{it}$. The dependent variable Revisions is defined in four ways, using one year ahead mean EPS analyst forecasts scaled either by stock price or by median EPS forecast:

Forecast Revision: 12 6 (Mean Forecast 12m prior to year end-Mean Forecast 6m prior to year end)/Share price 12m prior to year end *100 or the Absolute value of median forecast 12m prior to year end *100

Forecast Revision: 12 1 Mean Forecast 12m prior to year end-Mean Forecast 1m prior to year end)/Share price 12m prior to year end *100 or the Absolute value of median forecast 12m prior to year end *100

There have been used both absolute (Panel A) and non absolute revisions (Panel B). RD equals R&D/Sales or R&D/Total Assets or R&D/Market value of equity at year end, BM the Book to market ratio at year end, MV the MVE at year end, PASTR equals the 6 month prior to previous year end geometric average of monthly stock returns, STDEV equals the standard deviation of reported EPS for a three year period prior to base year. The regression is run using OLS and Whites Heteroscedasticity robust standard errors. Observations above the 98 and below the 2 percentile were eliminated. Non absolute revisions have been adjusted as follows in order to be able to use logs: (100+revision)/100 e.g. if a revision was 3%, it will appear as 103 or 97 for -3% In the last column appear the F statistics and their p-values.

Panel A: Absolute revisions, revisions scaled by price								
12 6	c	RD	BM	MV	PASTR	STDEV	Adj. R-sq.	F-stat.
RD=RDS	2.7826	-0.0112	0.0584	-0.2270	0.5704	0.3021	0.1753	189.8803
	(34.0227)	(-1.1433)	(1.8033)	(-13.9930)	(1.3984)	(13.2781)		(0.0000)
RD=RDTA	2.7852	-0.0183	0.0572	-0.2300	0.5710	0.3023	0.1757	190.2922
	(34.0844)	(-1.8615)	(1.7653)	(-14.1176)	(1.4002)	(13.2984)		(0.0000)
RD=RDMV	0.3024	0.1753	0.0606	-2.7853	-0.0113	0.0606	0.2272	189.8687
	(34.0166)	(1.1190)	(1.8695)	(-13.9402)	(1.3846)	(13.2876)		(0.0000)
12 1								
RD=RDS	2.9748	0.0076	0.0132	-0.2046	2.4557	0.4391	0.2061	238.1093
	(46.8908)	(1.0044)	(0.5442)	(-16.7082)	(6.6016)	(23.5869)		(0.0000)
RD=RDTA	2.9745	0.0040	0.0130	-0.2057	2.4563	0.4390	0.2060	237.9536
	(46.8639)	(0.5179)	(0.5377)	(-16.6513)	(6.6055)	(23.5857)		(0.0000)
RD=RDMV	2.9718	0.0126	0.0113	-0.2027	2.4628	0.4387	0.2064	238.4261
	(46.8668)	(1.6026)	(0.4638)	(-16.5150)	(6.6214)	(23.5652)		(0.0000)
Panel B: Absolute Revisions, Revisions scaled by abs. value of -12m median EPS forecast								
12 6	c	RD	BM	MV	PASTR	STDEV	Adj. R-sq.	F-stat.
RD=RDS	2.8282	0.0064	-0.0885	-0.1800	-0.6659	0.2780	0.1511	158.5143
	(33.0947)	(0.6298)	(-2.6713)	(-10.6330)	(-1.6352)	(12.0148)		(0.0000)
RD=RDTA	2.8286	-0.0018	-0.0894	-0.1829	-0.6651	0.2779	0.1510	158.4460
	(33.0978)	(-0.1808)	(-2.6954)	(-10.7471)	(-1.6328)	(12.0142)		(0.0000)
RD=RDMV	2.8274	0.0033	-0.0895	-0.1810	-0.6640	0.2779	0.1510	158.4581
	(33.0650)	(0.3106)	(-2.6986)	(-10.6329)	(-1.6299)	(12.0062)		(0.0000)
12 1								
RD=RDS	3.0166	0.0235	-0.1449	-0.1616	1.1397	0.4309	0.1802	200.7703
	(43.2652)	(2.8211)	(-5.4595)	(-11.9673)	(3.1030)	(21.6189)		(0.0000)
RD=RDTA	3.0143	0.0190	-0.1444	-0.1626	1.1431	0.4306	0.1798	200.1747
	(43.1730)	(2.2549)	(-5.4343)	(-11.9251)	(3.1139)	(21.5904)		(0.0000)
RD=RDMV	3.0099	0.0272	-0.1496	-0.1599	1.1527	0.4300	0.1805	201.1418
	(43.2047)	(3.1203)	(-5.6133)	(-11.8240)	(3.1374)	(21.5684)		(0.0000)

Table 6. Continued

Panel C: Non absolute revisions, Revisions scaled by Price

12 6	c	RD	BM	MV	PASTR	STDEV	Adj. R-sq.	F-stat.
RD=RDS	-0.0151	0.0033	-0.0288	0.0047	1.1632	-0.0324	0.0914	89.5801
	(-0.8261)	(1.6963)	(-4.1183)	(1.3569)	(10.2923)	(-5.6300)		(0.0000)
RD=RDTA	-0.0155	0.0034	-0.0287	0.0049	1.1629	-0.0325	0.0914	89.6070
	(-0.8503)	(1.7245)	(-4.0945)	(1.3881)	(10.2897)	(-5.6404)		(0.0000)
RD=RDMV	-0.0153	0.0014	-0.0293	0.0041	1.1641	-0.0325	0.0910	89.1515
	(-0.8333)	(0.7644)	(-4.1614)	(1.1634)	(10.2969)	(-5.6396)		(0.0000)
12 1								
RD=RDS	-0.0412	0.0048	-0.0443	0.0111	2.4658	-0.0362	0.1544	164.4701
	(-2.3161)	(2.5186)	(-6.2402)	(3.3524)	(18.8245)	(-5.8019)		(0.0000)
RD=RDTA	-0.0417	0.0047	-0.0441	0.0112	2.4659	-0.0363	0.1543	164.3952
	(-2.3448)	(2.4162)	(-6.2064)	(3.3643)	(18.8254)	(-5.8176)		(0.0000)
RD=RDMV	-0.0420	0.0037	-0.0450	0.0108	2.4672	-0.0363	0.1540	163.9797
	(-2.3550)	(2.0544)	(-6.3380)	(3.2501)	(18.8359)	(-5.8197)		(0.0000)

Panel D: Non Absolute Revisions, Revisions scaled by abs. value of -12m median EPS forecast

12 6	c	RD	BM	MV	PASTR	STDEV	Adj. R-sq.	F-stat.
RD=RDS	0.0214	0.0033	-0.0351	-0.0003	1.6007	-0.0256	0.1030	101.2056
	(0.9433)	(1.6373)	(-4.2859)	(-0.0675)	(11.2361)	(-3.9848)		(0.0000)
RD=RDTA	0.0209	0.0036	-0.0349	-0.0001	1.6011	-0.0257	0.1031	101.2549
	(0.9198)	(1.7493)	(-4.2588)	(-0.0191)	(11.2427)	(-3.9952)		(0.0000)
RD=RDMV	0.0210	0.0020	-0.0356	-0.0007	1.6022	-0.0257	0.1028	100.9520
	(0.9225)	(1.0274)	(-4.3465)	(-0.1673)	(11.2500)	(-3.9984)		(0.0000)
12 1								
RD=RDS	-0.0103	0.0058	-0.0453	0.0109	3.3704	-0.0374	0.1577	167.7805
	(-0.5083)	(2.7464)	(-4.7108)	(2.6979)	(19.1041)	(-4.6722)		(0.0000)
RD=RDTA	-0.0111	0.0060	-0.0450	0.0112	3.3709	-0.0375	0.1578	167.8409
	(-0.5449)	(2.8493)	(-4.6713)	(2.7472)	(19.1123)	(-4.6902)		(0.0000)
RD=RDMV	-0.0113	0.0049	-0.0462	0.0107	3.3736	-0.0376	0.1574	167.3851
	(-0.5570)	(2.4087)	(-4.8208)	(2.6401)	(19.1094)	(-4.6986)		(0.0000)

Table 7. Forecast errors for different degrees of analyst forecast dispersion

The table reports the average signed (Panel A) and Unsigned (Panel B) analyst forecast errors according to five annually rebalanced analyst forecast dispersion portfolios, from D1 (low) to D5 (High). Analyst forecast dispersion is defined as the standard deviation in analyst forecasts for a particular month scaled by the absolute value of the mean forecast in the month in question, using 1 year ahead EPS analyst forecasts 12 (D12m), 6 (D6m) and 1 (D1m) month before year end for dispersion calculation. Analyst forecast errors have been calculated as a) (Forecasted EPS-Actual EPS)/Absolute value of Actual EPS and b) (Forecasted EPS-Actual EPS)/Stock Price 12 months prior to year end. In the case of the mean forecasted one year ahead EPS, there have been used all of the minus 12, 6 and 1 month prior to year end median forecasts. Actual and forecasted EPS observations above the 0.98 and below the 0.02 percentile have been eliminated.

Panel A: Signed errors

Error (F-A)/P	-12 month error data			Error (F-A)/A Abs	-12 month error data		
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	0.182	0.206	0.226	D1	0.760	0.794	0.597
D2	0.052	-0.013	-0.031	D2	0.498	0.310	0.241
D3	0.118	0.051	0.006	D3	0.709	0.601	0.315
D4	0.202	0.205	0.126	D4	1.150	0.954	1.121
D5 (High)	0.289	0.348	0.431	D5	1.188	1.426	2.319
	-6 month error data				-6 month error data		
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	0.169	0.175	0.202	D1	0.535	0.532	0.430
D2	0.076	0.031	0.010	D2	0.407	0.374	0.257
D3	0.113	0.081	0.021	D3	0.560	0.729	0.387
D4	0.164	0.203	0.118	D4	0.955	0.838	0.778
D5 (High)	0.244	0.262	0.356	D5	0.464	0.441	1.229
	-1 month error data				-1month error data		
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	0.167	0.167	0.178	D1	-0.161	-0.103	-0.180
D2	0.071	0.049	0.042	D2	0.391	0.337	0.250
D3	0.112	0.076	0.051	D3	0.473	0.516	0.363
D4	0.148	0.184	0.124	D4	0.791	0.674	0.709
D5 (High)	0.249	0.277	0.340	D5	0.338	0.350	0.734

Panel B: Unsigned errors

Error (F-A)/P	-12 month error data			Error (F-A)/A Abs	-12 month error data		
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	0.367	0.373	0.385	D1	1.957	1.954	1.869
D2	0.232	0.208	0.190	D2	0.723	0.548	0.485
D3	0.265	0.247	0.227	D3	0.972	0.852	0.603
D4	0.342	0.332	0.322	D4	1.443	1.287	1.420
D5 (High)	0.470	0.497	0.509	D5	2.039	2.439	2.965
	-6 month error data				-6 month error data		
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	0.292	0.288	0.294	D1	1.893	1.767	1.714
D2	0.182	0.164	0.141	D2	0.567	0.524	0.406
D3	0.201	0.191	0.185	D3	0.750	0.901	0.623
D4	0.252	0.274	0.255	D4	1.233	1.123	1.392
D5 (High)	0.369	0.385	0.417	D5	1.401	1.968	2.195
	-1 month error data				-1 month error data		
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	0.209	0.207	0.211	D1	1.530	1.418	1.420
D2	0.124	0.118	0.106	D2	0.506	0.428	0.330
D3	0.153	0.136	0.131	D3	0.628	0.646	0.521
D4	0.186	0.205	0.183	D4	1.034	0.894	1.249
D5 (High)	0.274	0.283	0.314	D5	1.140	1.599	1.610

Table 8. Forecast revisions for different degrees of analyst forecast dispersion

The table reports the average signed (Panel A) and unsigned (Panel B) analyst forecast revisions according to five annually rebalanced analyst forecast dispersion portfolios, from D1 (low) to D5 (High). Analyst forecast dispersion is defined as the standard deviation in analyst forecasts for a particular month scaled by the absolute value of the mean forecast in the month in question, using 1 year ahead EPS analyst forecasts 12 (D12m), 6 (D6m) and 1 (D1m) month before year end for dispersion calculation. There are used four types of forecast revisions defined as follows:
Scaling revisions by stock price:
Forecast Revision: 12 6 (Forecast 6m prior to year end-Forecast 12m prior to year end)/Share price 12m prior to year end*100 and Forecast Revision: 12 1(Forecast 1m prior to year end-Forecast 12m prior to year end)/Share price 12m prior to year end *100
Scaling revisions by the absolute value of median forecast 12m prior to year end:
Forecast Revision: 12 6 (Forecast 6m prior to year end-Forecast 12m prior to year end)/Abs value of median forecast 12m prior to year end *100 and Forecast Revision: 12 1(Forecast 1m prior to year end-Forecast 12m prior to year end)/Abs value of median forecast 12m prior to year end *100. One year ahead mean forecasts are used. If revision exceeds +/-100% data are considered outliers and are removed.

Panel A: Signed Revisions							
Revisions scaled by price							
12 6				12 1			
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	3.331	2.542	2.625	D1	3.977	3.581	3.515
D2	2.870	4.089	4.264	D2	3.024	5.832	7.259
D3	0.003	2.856	1.557	D3	0.539	3.452	4.482
D4	-2.027	0.417	-0.528	D4	-1.082	-1.299	-0.119
D5 (High)	-3.118	-7.876	-6.377	D5	-2.438	-7.531	-11.085
Revisions scaled by median							
12 6				12 1			
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	4.931	4.094	4.118	D1	5.980	5.765	5.653
D2	4.260	6.157	6.371	D2	5.566	9.230	10.630
D3	1.325	4.736	3.184	D3	2.843	6.046	7.461
D4	-0.678	2.046	0.679	D4	0.972	0.642	1.759
D5 (High)	-3.383	-9.794	-7.403	D5	-1.741	-9.338	-13.302
Panel B: Unsigned Revisions							
Revisions scaled by price							
12 6				12 1			
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	15.978	16.173	16.519	D1	19.737	20.250	20.613
D2	9.238	9.024	9.875	D2	13.520	13.259	13.176
D3	10.743	10.881	10.806	D3	15.686	15.386	14.554
D4	14.854	13.637	13.970	D4	19.839	18.677	19.135
D5 (High)	21.339	22.209	19.863	D5	26.026	26.743	25.758
Revisions scaled by median							
12 6				12 1			
	D12m	D6m	D1m		D12m	D6m	D1m
D1 (Low)	19.181	19.446	19.986	D1	24.019	24.521	25.254
D2	12.091	11.743	12.800	D2	17.372	17.383	17.554
D3	13.353	13.710	13.560	D3	19.380	19.334	18.763
D4	18.434	17.530	17.724	D4	24.494	23.588	23.558
D5 (High)	26.862	27.410	24.208	D5	33.344	33.687	31.805

[1] The starting year of the sample period is 1990 because of the application of the revised SSAP 13 for accounting periods beginning on or after the 1st of January 1989. SSAP made mandatory the disclosure of the amount of R&D on the income statement.

[2] SSAP 13 allows the conditional capitalisation of development costs; the dominant practice though in the UK is immediate R&D expensing. Previous studies on R&D in the UK (e.g. Green et al 1996; Al-Horani et al 2003) also relied on R&D expense from the income statement for valuation purposes. In the sample used in this study, just 2.7% of firm-year observations report capitalised development costs on the balance sheet, and 2.2% of firm-year observations report amortised development costs on the income statement (6.4% and 5.5% of firms respectively - data on capitalised and amortised development costs have been extracted from the Extel Database since Worldscope does not provide data on these items). The amounts of capitalised development costs are also very much lower compared to the amounts of R&D expensed on the income statement (untabulated data). It is therefore expected not much loss of information by employing only the R&D expense taken from the income statement. Finally, the study does not make use of estimated R&D capital, since this would require the use of lagged R&D values for its calculation, and the sample period is quite small because the starting year is 1990 for the reason explained. In order to control for biases in the results because of not employing R&D capital, following Al-Horani et al (2003), there have been calculated the Pearson correlation coefficients between yearly R&D expense and estimated R&D capital for the period 1994-2003. The values of Pearson coefficients observed were very high and close of 1 almost in every case (with and without deflating R&D by sales, total assets and market value of equity). It is therefore deduced that yearly R&D expense is a good proxy for R&D activity in the sample firms and there is not employed any form of estimated R&D capital.

[3] Errors are defined as Forecasted minus actual EPS, and revisions as forecasts made six or one month prior to year end minus forecasts made twelve months prior to year end.

[4] In order to correct for 1st order serial correlation, when the Durbin Watson statistics were not at satisfactory levels, an AR(1) term was added in the regression. According to Park, Sickles and Simar (2003) and also Baltagi and Chang (1992) this estimation method adjusts for 1st order serial correlation and in the case of the regressions used in this study, it improved Durbin Watson statistics to values between 1.8 to 2. When the Durbin Watson statistics are not reported, it is because of absence of problematic values for these statistics.

[5] To control for industry effects, there have been added industry dummy variables in the regressions, both simple and multiplicative with R&D, to account for four R&D intensive industries: Information Technology Chemicals, General Industries and Health grouped together with Pharmaceuticals and Biotechnology. Upon the addition of the industry dummy variables, there were observed no qualitative differences in the direction of the results (untabulated data). In addition, in order to control for possible time period effects arising from influence from the New Economy in the late 1990's early 2000, regressions were rerun by excluding the base years 1999 until 2001, both inclusive, and again there were observed no significant difference in the direction of the results (untabulated data). Robustness check also include rerunning the regressions for the whole sample period 1990-2003 by including a dummy variable that took the value of 1 if the data referred to the base years 1999, 2000 or 2001 and zero otherwise, again with no qualitative differences in the direction of the results (untabulated data) Rerunning the regressions with period fixed and random effects model specifications again caused no qualitative change in the direction of the results (untabulated data).

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