R&D EXPENDITURE AND EARNINGS TARGETS

Beatriz García Osma[1]

Universidad Autónoma de Madrid

Steven E. Young

Lancaster University

Forthcoming in *European Accounting Review*

---

[1] Corresponding author: Beatriz García Osma, Departamento de Contabilidad, Avda. Fco Tomás y Valiente 5, Universidad Autónoma de Madrid, Madrid 28049 (SPAIN). E-mail: beatriz.garcia@uam.es, Tel.: +34 91 4972970.

We gratefully acknowledge helpful comments and suggestions from two anonymous reviewers. We are also grateful to Philip Brown, John Christensen, Pelham Gore, David Gwilliam, Christian Leuz, Peter F. Pope, Alfred Wagenhofer, conference participants at the 2002 EAA PwC Doctoral Colloquium, the 2002 BAA Colloquium, the 2002 EIASM EuroConference meeting, and the 2003 EAA annual meeting, and seminar participants at Queens University and Warwick University. Financial support was provided by the EC Human Potential Programme (contract HPRN-CT-2000-00062). We also acknowledge financial contribution from the Spanish Ministry of Science and Technology (SEJ2005-08644-C02-01/ECON) and the INTACCT Research Network (contract MRTN-CT-2006-035850).

R&D EXPENDITURE AND EARNINGS TARGETS

ABSTRACT

This paper examines whether firms cut R&D spending in response to short-term earnings pressures and how equity markets interpret such behaviour. Failure to report positive earnings and earnings growth increases the probability of a subsequent cut in R&D spending, while pressure to report positive earnings and earnings growth in the current period leads to contemporaneous cuts in R&D investment. On average, investors place less weight on earnings increases accompanied by unexpected cuts in R&D spending. However, the magnitude of the valuation discount varies according to the perceived reason for the cut and the importance of R&D investment as a driver of firm value.

Keywords: R&D expenditure, real earnings management, earnings targets, valuation.

R&D EXPENDITURE AND EARNINGS TARGETS

1. INTRODUCTION

Accounting standards generally require expenditure on uncertain investment activities such as research and development (R&D) to be expensed as incurred, leading to tension between short-term earnings performance and long-term value creation. On the one hand, relentless advances in technology and globalisation mean that competitive advantage and corporate success are increasingly reliant on firms' internal resources and capabilities (Wernerfelt 1984, Barney 1995, Lev and Sougiannis 1996, Chan Lakonishok and Sougiannis 2001). Yet paradoxically, the weight attached to meeting and beating short-term earnings targets appears to be increasing (Dechow and Skinner 2000: 242). How managers and investors respond to these competing forces is an issue that has exercised policymakers and academics for many years. Against this backdrop, we assess whether UK managers adjust R&D spending in response to short-term earnings pressures and how the capital market evaluates such behaviour.

Prior US research documents evidence of apparently myopic investment behaviour with managers pruning R&D expenditure to boost current-period earnings performance (Baber, Fairfield and Haggard 1991, Perry and Grinaker 1994, Bange and De Bondt 1998, Bushee 1998, Cheng 2004). While little comparable large sample empirical evidence exists in the UK, policymakers have repeatedly expressed concern about the low levels of R&D investment undertaken by UK firms relative to their international counterparts, and the possibility that capital market pressures encourage excessive emphasis on short-term earnings performance (Department of Trade and Industry 2003, HM Treasury 2004 and 2005).[i]

Using a large sample of R&D-active UK firms between December 1989 and December 2002, our first set of tests examine whether R&D spending is sensitive to achieving current and lagged earnings targets. Controlling for underlying firm performance, we find that failure to report positive earnings levels and changes increases the probability of R&D expenditure being cut in the next accounting year. We also find that pressure to report positive earnings levels and changes leads to contemporaneous cuts in R&D expenditure as management shave expenses in an attempt to reach the target. Further analysis reveals this association is less pronounced for high R&D intensity firms, suggesting a lower propensity to cut R&D in the face of short-term earnings pressure when such investment represents an important source of competitive advantage.

While strategists, researchers and policymakers have largely focused on the costs of cutting R&D to boost reported earnings (Stein 1988 and 1989, Rappaport 2005), recent evidence from the accounting literature documents significant market-based rewards when firms report earnings numbers in excess of certain predefined thresholds (Bernard, Thomas and Abarbanell 1993, Barth, Elliot and Finn 1999, Bartov, Givoly and Hyan 2002, Kasznik and McNichols 2002, Skinner and Sloan 2002). In our second set of tests, we examine how market participants interpret favourable earnings performance achieved at the expense of unexpected cuts in R&D spending. We find that the response coefficient associated with earnings increases is substantially lower for firms that cut R&D compared to those that maintain or increase R&D spending. Partitioning the sample by R&D intensity, we find that cuts in R&D are viewed most negatively for high R&D intensive firms. These findings support the view that the net benefit of manipulating R&D investment to beat earnings benchmarks is lower for firms where current R&D investments represent an important driver of future value. Finally, we test whether the market discriminates between cuts in R&D spending driven by benchmark beating considerations and cuts motivated by other factors. Full sample tests reveal some (weak) evidence that the market applies a lower multiple to earnings increases accompanied by R&D cuts when the reduction is likely to have been motivated by benchmark beating considerations. Further analysis reveals this result is confined to moderate R&D intensity firms. For low R&D intensity firms, unexpected R&D spending cuts in the presence of earnings growth go unpunished regardless of whether or not target-driven manipulation is a factor. Conversely, investors penalise all cuts in R&D spending made by high R&D intensity firms with equal severity in the presence of earnings growth. The contrasting patterns observed for high and low R&D intensive firms are consistent with differences in the perceived importance of R&D investment for long-term value creation across the two groups.

Our paper contributes to the extant literatures on R&D manipulation and benchmark beating on several levels. First, we provide evidence that speaks to the ongoing debate in the UK over whether management make discretionary R&D investment decisions with an eye to reported earnings performance. Our results suggest that R&D spending is indeed sensitive to short-term earnings targets. Findings concerning the contemporaneous link between R&D spending and earnings targets confirm prior US research, while evidence that missing an earnings benchmark leads to subsequent cuts in R&D expenditure is new to the literature. Second, our analysis is the first to our knowledge that attempts to reconcile the R&D manipulation and benchmark beating literatures by examining how investors interpret favourable earnings performance in the presence of unexpected cuts in R&D spending. Results reveal that investors appear to trade-off the costs of R&D cuts against the benefits of earnings growth in a relatively sophisticated manner. In particular, we show that the market's response to unexpected cuts in R&D spending depends on both the presumed reason for the cut and the perceived importance of R&D investment as a driver of firm value.

The remainder of the paper is organised as follows. The next section develops our primary research questions. Section 3 presents details of our sample and data. Section 4 reports results of tests linking the probability of a cut in R&D spending to contemporaneous and lagged earnings performance. Section 5 presents results of market-based tests exploring the trade-off between the rewards to benchmark beating and the penalties to R&D cutbacks. Section 6 concludes.

2. BACKGROUND AND RESEARCH QUESTIONS

R&D expenditure and earnings targets

An increasing body of evidence supports the view that corporate management face significant pressure to avoid reporting losses, earnings declines and negative earnings surprises (Burgstahler and Dichev 1997, Degeorge, Patel and Zeckhauser 1999, Skinner and

Sloan 2002, Gore, Pope and Singh 2007). Precisely why management place such weight on achieving simple earnings thresholds is not entirely clear, although one possibility is stakeholders' reliance on heuristic cutoffs such as zero changes and levels of earnings to assess managerial and firm performance (Burgstahler and Dichev 1997). Given their potential importance, it is not surprising that management occasionally resort to manipulating earnings upwards to meet or beat these key benchmarks. Research indicates that management employ a range of manipulation techniques to achieve earnings targets, including aggressive cash flow recognition (Burgstalher and Dichev 1997), discretionary accruals (Bartov, Givoly and Hayn 2002, Gore, Pope and Singh 2007), reclassification of core expenses as special items (McVay 2006), and share repurchases (Bens, Nagar, Skinner and Wong 2003, Hribar, Jenkins and Johnson 2004).

Although potentially more costly, management also have the option of manipulating earnings through real operating and investing decisions. A number of studies provide compelling evidence that US managers shave discretionary R&D investments to boost current-period reported earnings (Baber, Fairfield and Haggard 1991, Perry and Grinaker 1994, Bange and DeBondt 1998, Bushee 1998). These findings are confirmed by survey evidence reported by Graham, Harvey and Rajgopal (2005) for a sample of 401 financial executives, 80% of whom indicated that they would consider reducing R&D spending to meet an earnings target. Similar conclusions regarding managers' attitude toward R&D expenditure and earnings targets have also been reported for the UK (Demirag 1995, Grinyer, Russell and Collison 1998). The UK evidence is particularly pertinent given concern over the lack of long-term investment by UK firms relative to their international counterparts. To date, however, no large sample empirical evidence concerning the link between R&D expenditure and short-term earnings targets exists for the UK. The first research question examined in this paper, therefore, is whether UK managers prune R&D spending when there is a risk of unmanaged earnings falling short of target.

While the contemporaneous link between R&D spending and earnings benchmarks has been previously examined in a non-UK setting, the consequence of missing an earnings target for R&D spending in subsequent years remains an unexplored issue in the empirical literature. Prior research, however, suggests that such a link may exist. For example, Barth et al. (1999) demonstrate that although the valuation premium for firms reporting a string of earnings increases diminishes when the pattern is broken, a portion of the premium is preserved for firms that immediately return to an earnings growth trajectory. An implication of this result is that management are likely to be very sensitive to reported performance in the year following an earnings disappointment and that this sensitivity may lead to temporary cuts in discretionary investment spending aimed at ensuring an immediate earnings turnaround. Consistent with this view, of the 226 UK directors surveyed by Demirag (1998), 41% identified lagged earnings performance as a key determinant of the resources available for current-period R&D projects; only 10% of directors considered R&D spending to be insensitive to lagged earnings performance. Accordingly, the second research question explored in this paper is whether missing an earnings target leads management to cut R&D spending in the following year.

Market-based rewards and penalties

Precisely how market participants interpret favourable earnings performance achieved at the expense of unexpected cuts in R&D spending is unclear *a priori*. On the one hand, evidence on the capital market returns to benchmarking beating reveals significant valuation rewards to target attainment (Barth et al. 1999, Bartov et al. 2002, Kasznik and McNichols 2002), and disproportionately large valuation penalties when earnings targets are missed (Bernard et al. 1993, Skinner and Sloan 2002). Conversely, prior research reveals a positive association between unexpected changes in R&D expenditure and shareholder wealth (Chan, Martin and Kensinger 1990). These findings imply market participants generally view R&D investment as helping to create and maintain firms' competitive advantage, and that shaving R&D spending purely to achieve an earnings benchmark is likely to be value-destroying. Further, research also indicates that the valuation premium associated with meeting or beating an earnings target is lower for firms suspected by the market of having managed earnings (Bartov et al. 2002, Hribar et al. 2004).

To date, the R&D management and benchmark-beating reward literatures have largely evolved in isolation. Accordingly, the third research question on which this paper seeks evidence is how investors trade-off the valuation rewards to benchmark beating against the valuation penalties of unexpected cuts in R&D spending, and whether the market discriminates between target-driven cuts in R&D expenditure versus reductions in R&D spending driven by real economic considerations.

3. SAMPLE AND DATA

Our sampling frame comprises the population of Datastream UK non-financial firms that reported positive R&D expenditure at least once between December 1989 and December 2002. Before the switch to International Financial Reporting Standards, accounting for R&D in the UK was governed by Statement of Standard Accounting Practice No.13 Revised (SSAP 13 Revised). Our sampling period excludes pre-December 1989 year-ends because SSAP 13 Revised only applied to financial years beginning on or after 1 January 1989. Empirical tests require three consecutive years of R&D data. We therefore retain only those firm-years where contemporaneous, one- and two-period lagged values are non-missing. We also require data for our control variables (see below) to be available. Fiscal years longer than thirteen months and shorter than eleven months are excluded to ensure time-series comparability of accounting data, and we minimise the impact of extreme observations by trimming the top and bottom one percentiles of the sample according to (scaled) R&D expenditure and reported earnings. The resulting sample comprises 3,866 firm-year observations. Although twenty-one Datastream level-4 industries are represented in the final sample, a high degree of clustering is apparent with just five industries (software & computer services, engineering & machinery, electronic electrical equipment, support services, and pharmaceuticals) accounting for 51% of the sample.

SSAP 13 Revised allowed UK managers the option of either expensing all R&D as incurred or capitalising development expenditure when certain feasibility conditions were satisfied. Consistent with patterns documented by Oswald and Zarowin (2007a), R&D was expensed in the majority (88%) of sample cases, with management electing to capitalise all or part of their development expenditure in the remaining 456 firm-years. While it is straightforward to determine the change in R&D expenditure for firms that expensed R&D as incurred, this is not the case for firms that capitalised development spending because Datastream only reports the net change in the R&D asset (i.e., after deducting amortisation).[ii] We therefore simplify the subsequent analysis by focusing exclusively on firms that expensed all R&D. The cost of this simplification is sample selection bias, which could affect the validity of our conclusions if executives use their discretion over the accounting treatment of development expenditure to manage earnings (Oswald and Zarowin 2007b).[iii] We therefore employ Heckman (1976, 1979) sample selection methods in our multivariate tests to correct for any bias introduced by our sampling method. (Further details provided below.) Table 1 summarises the sample selection procedure.

Table 2 reports descriptive statistics for the subsample of 3,410 R&D expensers that form the basis of our tests. Year-on-year increases in R&D expenditure are more common than decreases during our sample period. The average (median) market-to-book ratio is well in excess of one, as expected for a sample of R&D-active firms with significant growth options. Positive mean (median) values for changes in sales, capital expenditure, and earnings before R&D provide further evidence that our sample loads on growth firms.

4. EARNINGS TARGETS AND R&D EXPENDITURE

Method

The focus of our analysis is on R&D spending cuts made in response to short-term earnings targets, which we label 'unexpected' reductions in R&D activity. We treat such changes as distinct from those driven by business fundamentals such as shifts in corporate strategy, changes in funding constraints, and variation in the set of positive NPV opportunities, which we classify as part of 'normal' or 'expected' variation in R&D activity. Empirical tests therefore rely on our ability to reliably partition total R&D spending into expected and unexpected components. Results reported in the body of this paper rely on a simple random walk model of expected R&D expenditure, with negative (positive) first differences interpreted as unexpected decreases (increases) in R&D spending (Bushee 1998). We focus on results from this naïve expectations model for reasons of parsimony. Repeating all tests using Berger's (1993) more sophisticated regression-based expectations model that explicitly controls for the fundamental determinants of R&D spending yields results that are entirely consistent with those reported below.

We employ two measures of target earnings in our empirical tests: positive earnings and positive earnings growth.[iv] We examine the lagged association between targets and R&D spending using two indicator variables. The first variable ($EARN_{t-1} \leq 0$) takes the value of one if last period's earnings were less than or equal to zero, and zero otherwise; the second variable ($\Delta EARN_{t-1} \leq 0$) takes the value of one if last period's earnings change was less than or equal to zero, and zero otherwise.[v] If failure to beat last period's earnings benchmark has a detrimental impact on current-period R&D spending then the incidence of unexpected cutbacks in R&D investment should be positively related to $EARN_{t-1} \leq 0$ and $\Delta EARN_{t-1} \leq 0$.

The contemporaneous association between target earnings performance and R&D is examined using the procedure employed by Baber et al. (1991), Perry and Grinaker (1994), Bushee (1998), Cheng (2004) and Oswald and Zarowin (2007b). We begin by constructing a measure of premanaged earnings by adding R&D expenditure back to reported earnings. Then we partition the sample according to the level of premanaged earnings relative to target. Firm-years where premanaged earnings exceed target are allocated to the ABOVE partition. Firm-years where premanaged earnings undershoot target by an amount that could be reversed by pruning R&D expenditure are allocated to the WITHIN partition. Finally, observations where premanaged earnings are so low that the target remains beyond reach even if R&D spending were reduced to zero are allocated to the BELOW partition. If managers use their discretion over R&D expenditure to achieve current-period earnings benchmarks, the frequency of unexpected R&D cuts should be higher in WITHIN relative to ABOVE. The behaviour of firms in BELOW is more ambiguous. On the one hand, if managers prefer to minimise the earnings shortfall then they may behave as predicted in WITHIN, sacrificing current-period R&D in an effort to move earnings closer to target. On the other hand, if managers take the view that "a miss is as good as a mile", then the incentive to shave R&D spending diminishes and hence the frequency of unexpected R&D cuts may be more similar to that observed in ABOVE. Precisely how managers in BELOW exercise their discretion over R&D expenditure is therefore an empirical issue.

Univariate results

Preliminary insights concerning the association between earnings targets and R&D expenditure are presented in table 3. Panel A reports evidence on the link between current-period abnormal R&D expenditure and lagged target attainment. The fraction of cases with a negative change in R&D expenditure is clearly higher when last year's earnings fall short of target than when last period's earnings benchmark is achieved. Current-period R&D expenditure falls in 46% (42%) of cases where $EARN_{t-1}$ ($\Delta EARN_{t-1}$) ≤ 0 compared with only 33% (32%) of cases when $EARN_{t-1}$ ($\Delta EARN_{t-1}$) > 0. A chi-square test rejects the null hypothesis that current-period R&D expenditure and lagged target attainment are independent at the 1% level. Panel B reports evidence on the contemporaneous association between abnormal R&D expenditure and the proximity of premanaged earnings to the target. Independence is again rejected at the 1% level. Reductions in R&D spending appear to occur more frequently when premanaged earnings undershoot the benchmark than when they exceed it. Overall, these univariate findings support the view that R&D expenditure is sensitive to both current and lagged earnings performance.

Multivariate analysis

Univariate tests reported in table 3 fail to control for factors correlated with earnings performance that may also affect R&D spending. In particular, if the failure to meet or beat an earnings threshold is simply a manifestation of more pervasive performance problems, then these results could be capturing expected variation in R&D spending resulting from changes in business fundamentals, rather than unexpected R&D cuts motivated by short-term target-beating behaviour. The analysis also fails to demonstrate whether contemporaneous and lagged target considerations are associated with incrementally significant effects on R&D spending or whether they merely capture the same underlying phenomenon (i.e., poor performance). Finally, the analysis takes no account of selection bias resulting from our decision to exclude R&D capitalisers. We therefore estimate the following multivariate logistic regression relating the probability of an unexpected cut in R&D spending to current and lagged earnings performance (relative to target), and a vector of control variables:

$$\log\left[\frac{p_{it}}{1-p_{it}}\right] = \gamma_0 + \gamma_1 EARN_{ii-1} \leq 0 + \gamma_2 \Delta EARN_{it-1} \leq 0 + \gamma_3 WITHIN_{it} + \gamma_4 BELOW_{it} + \sum_{k=1}^{K} \lambda_k Control\_R\&D_{kit} + \sum_{j=1}^{J} \delta_j Control\_OTH_{jit}, \qquad (1)$$

where p_{it} is the latent probability that firm i unexpectedly cuts R&D spending in year t (y_{it} = 1) and $1 - p_{it}$ is the latent probability that firm i maintains or increases R&D expenditure in year t ($y_{it} = 0$); $EARN_{it-1} \leq 0$ is an indicator variable equal to one if lagged reported earnings for firm i were less than or equal to zero, and zero otherwise; $\Delta EARN_{it-1} \leq 0$ is an indicator variable equal to one if the lagged reported earnings change was less than or equal to zero, and zero otherwise; $WITHIN_{it}$ is an indicator variable equal to one for firm-years in the WITHIN portfolio and zero otherwise; $BELOW_{it}$ is an indicator variable equal to one for firm-years in the BELOW portfolio and zero otherwise; $Control\_R\&D_{it}$ is a vector of k variables controlling for expected changes in periodic R&D expenditure; and $Control\_OTH_{it}$ is a vector of j controls for the propensity or opportunity for management to adjust R&D spending in response to short-term earnings pressures.

Following Berger (1993), Bange and DeBondt (1998) and Bushee (1998), *Controls_R&D* includes firm-level changes in sales ($\Delta SALES_{it}$), capital expenditure ($\Delta CAPX_{it}$), funds available for investment ($\Delta FUNDS_{it}$), and lagged changes in R&D expenditure (ΔRD_{it-1}). The $\Delta SALES$ variable proxies for growth: growth firms are considered less likely to cut R&D. Negative $\Delta CAPX$ may signal a decline in investment opportunities associated with transition to a more mature stage of the investment cycle: firms entering a more mature stage of their investment lifecycle are also expected to trim spending on R&D. The $\Delta FUNDS$ variable captures internal funding constraints: an increase (decrease) in funds available for investment is expected to reduce (increase) the probability of a cut in R&D expenditure. In addition to these firm-level drivers of R&D spending, we also include the median change in R&D expenditure for firm *i*'s industry (computed after excluding firm *i*) ($\Delta INDRD_{it}$) to control for industry-wide shifts in R&D spending during period *t*.

The *Controls_OTH* vector includes measures of firm size ($SIZE_{it}$), leverage (LEV_{it}), the market-to-book ratio ($MKTB_{it}$), R&D intensity (RDI_{it}), and the magnitude of operating accruals ($|ACC_{it}|$). All else equal, larger firms face richer information environments that serve to constrain the opportunity for earnings management (Wiedman 1996). In addition, *SIZE* may also be negatively associated with the probability that a firm is cash constrained (Opler et al. 1999) and therefore facing incentives to cut R&D. Leverage captures potential debt covenant incentives to manipulate earnings (Duke and Hunt 1990). The probability of cutting R&D expenditure to avoid costly debt contract violation is expected to be increasing in *LEV*. The market-to-book ratio proxies for Tobin's Q: Bushee (1989) argues that high Q firms face more valuable R&D growth opportunities and therefore face a higher cost of cutting R&D in response to short-term earnings pressures. The *RDI* variable captures the expectation that R&D-intensive firms face greater market scrutiny of their R&D expenditure decisions (Barth et al. 2001), thereby reducing the opportunity to adjust R&D spending programmes to achieve short-term earnings targets. Accounting accruals represent an alternative to real earnings management. All else equal, naturally high $|ACC|$ provide managers with greater scope for accrual-based manipulation, thereby reducing the need to engage in real earnings management. Finally, since our sample selection procedure excludes firms where management chose to capitalise R&D spending, *Controls_OTH* also includes a correction for sample selection bias ($BIAS_{it}$). The *BIAS* variable is the inverse Mills ratio retrieved from a first-stage probit regression modelling the decision to expense versus capitalise periodic R&D expenditure (Heckman 1976, 1979).[vi]

Table 4 reports coefficient estimates and model summary statistics for equation (1). The probability of an unexpected cut in period *t* R&D spending is generally less evident for growth firms, R&D intensive firms, and large firms. Cuts in R&D spending partially reverse prior-year increases. The estimated coefficient on the inverse Mills ratio is insignificant in most specifications, signifying that sample selection bias resulting from omission of R&D capitalisers does not appear to be a serious problem in our analysis.

Models 1 and 2 focus on the lagged association between the likelihood of an R&D cut and benchmark beating. Consistent with our univariate findings, model 1 reveals that a reduction in current-period R&D expenditure is more likely when lagged earnings fall below target. Both lagged target indicator variables are incrementally significant at the 5% level, suggesting that positive earnings levels and changes represent distinct benchmarks.

Model 2 extends the basic regression to test whether the relation between R&D expenditure and lagged earnings performance differs with the level of R&D intensity. If R&D intensive firms suffer less short-term earnings pressure due to longer performance horizons, we would expect to observe a weaker association between lagged earnings performance and the probability of shaving R&D investment as R&D intensity increases. R&D intensity is measured as the R&D expense scaled by lagged sales**.** Model 2, however, reveals no such association.

The final six columns in table 4 explore the contemporaneous association between abnormal R&D expenditure and the proximity of premanaged earnings to target in period *t*. Target earnings in models 3-5 (6-8) are defined as $EARN_t > 0$ ($\Delta EARN_t > 0$). Focusing first on results for models 3-5, the indicator variables $WITHIN_t$ and $BELOW_t$ are both positive and significant at the 1% level, with the exception of $BELOW_t$ in model 5 that is significant at the 5% level. This confirms our univariate result that firms prune R&D expenditure when contemporaneous premanaged earnings are negative. The effect appears stronger for the *WITHIN* partition, consistent with management's ability to fully overturn the earnings shortfall by cutting R&D spending. In model 4 we interact $WITHIN_t$ and $BELOW_t$ with R&D intensity (RDI_t). Estimated coefficients on both interaction terms are negative and significant, signifying that the propensity to cut R&D in the face of short-term earnings pressure is lower for firms where R&D activity represents a potentially important source of future value. Finally, in model 5 we test whether contemporaneous and lagged earnings pressures are associated with incrementally significant effects on R&D spending or whether they merely capture the same underlying phenomenon (e.g., poor performance). Both contemporaneous and lagged variables are significant, suggesting they are capturing distinct effects. Similar results to those reported in models 3-5 are evident in models 6-8 when the earnings target is defined as $\Delta EARN_t > 0$. The one notable exception is the interaction between $BELOW_t$ and RDI_t in model 7, which fails to attain significance at conventional levels.

Further analysis

While findings in table 4 are consistent with real earnings management in response to short-term earnings targets, we cannot rule out the possibility that these results are simply capturing rationale changes in R&D spending in response to underlying performance problems. In particular, if missing an earnings target in the previous period, or facing the risk of reporting below-target earnings in the current period, are indicative of a more general decline in productive R&D opportunities, then one would expect efficient managers to prune R&D spending so as to avoid destroying shareholder value through overinvestment. Equation (1) controls for changes in expected R&D spending driven by fundamental factors; however, we acknowledge that this approach may be less than perfect and that consequently our findings could be driven by a correlated omitted variable problem. We therefore performed two supplementary tests designed to shed further light on this issue.

Our first test compares the relative magnitude of coefficient estimates for *BELOW* and *WITHIN* in table 4. Since the incentives to cut R&D spending to achieve target earnings are expected to be stronger for firms in WITHIN, the earnings management hypothesis predicts a stronger association between unexpected R&D cuts and *WITHIN*. In contrast, the poor performance hypothesis predicts a stronger association between R&D cuts and *BELOW* because firms in *BELOW* are more likely characterised by pervasive performance problems where cutbacks in discretionary investment expenditures are unavoidable. Visual inspection of the coefficient estimates in table 4 reveals that those on *WITHIN* are always larger than the corresponding estimates on *BELOW*. This is inconsistent with the poor performance hypothesis. Indeed, a Wald test rejects the null hypothesis of coefficient equality at the 0.06 (0.04 and 0.08) level in model 4 (6 and 8) in favour of the alternative *WITHIN* > *BELOW*.[vii] The absence of larger coefficient estimates on *BELOW* coupled with evidence of significantly larger estimates on *WITHIN* in three of the six models in table 4 supports the view that earnings management to meet short-term targets is at least partially driving the association between the probability of a cut in R&D spending and *WITHIN*.

Our second supplementary test seeks to better distinguish between temporary earnings shortfalls relative to target and more pervasive performance problems. All else equal, R&D cuts made by firms with temporary earnings shortfalls are less likely to be driven by fundamentals such as tighter funding constraints or a decline in their R&D opportunity set. Accordingly, evidence of the predicted association between R&D cuts and *WITHIN* for these cases is more likely to reflect target-driven earnings management than underlying performance difficulties. Firms facing temporary earnings shortfalls are defined as those where contemporaneous (lagged) premanaged (reported) earnings are below (above) target. In contrast, firms where both lagged reported earnings and contemporaneous premanaged earnings undershoot the target are viewed as having more persistent performance problems. We therefore split the sample according to lagged earnings relative to target and then examine the association between cuts in R&D spending and *WITHIN* separately for each subsample. Results are reported in table 5. Coefficient estimates on *WITHIN* are slightly larger for the persistent poor performance subsamples (*$EARN_{t-1} \leq 0$* and *$\Delta EARN_{t-1} \leq 0$*) compared with the temporary poor performance subsamples (*$EARN_{t-1} > 0$* and *$\Delta EARN_{t-1} > 0$*). This is consistent with the view that poor underlying performance (rather than target-driven earnings management) may account for part of the observed link between R&D cuts and *WITHIN*. Nevertheless, coefficient estimates in the temporary poor performance subsamples remain positive, large in magnitude, and highly significant. To the extent that these observations face fewer fundamental performance problems associated with a loss of R&D opportunities, findings in table 5 suggest that previous results and conclusions are not being driven by expected changes in R&D spending link to underlying performance problems. Instead, these findings confirm the role of earnings management incentives as an economically important determinant of R&D spending decisions.

In sum, findings reported in this section provide evidence of a statistically and economically significant link between unexpected cuts in R&D spending and reporting pressures associated with short-term earnings targets. Consistent with US findings, UK managers appear to prune R&D spending when there is a risk that contemporaneous earnings will undershoot target performance. Low R&D intensity firms have a higher propensity to cut R&D spending in response to contemporaneous earnings performance, perhaps because they face greater short-term earnings pressure. In contrast to previous studies, we also examine the sensitivity of R&D spending to prior-period earnings performance. Findings reveal that missing an earnings benchmark increases the probability that R&D spending will be cut the following year. Both high and low R&D intensity firms are equally sensitive to lagged earnings pressures.

5. MARKET-BASED ANALYSIS

Trading-off the rewards and penalties to benchmark beating

In this section we explore the capital market implications of shaving R&D investment to boost earnings performance. Prior research suggests that share markets reward firms that meet earnings targets with price increases while penalising firms that unexpectedly cut R&D spending with price decreases. We combine these two distinct literatures and test whether investors discount earnings growth achieved at the expense of an unexpected cut in R&D investment.[viii] We permit the valuation multiple on earnings growth to vary with unexpected R&D spending decisions using the following regression model (Barth et al. 1999, Skinner and Sloan 2002, Kasznik and McNichols 2002):

$$R_{it} = \gamma_0 + \gamma_1 \Delta EARN_{it} > 0 + \gamma_2 \Delta RD_{it} < 0 + \lambda_1 \Delta EARN_{it} > 0 \times \Delta RD_{it} < 0 + v_{it}\,, \qquad (2)$$

where R_{it} is the 12-month share return for firm *i* ending three months after the balance sheet date in period *t*; $\Delta EARN_{it}>0$ is an indicator variable taking the value of one for positive earnings changes for firm *i* in period *t* and zero otherwise; $\Delta RD_{it}<0$ is an indicator variable taking the value of one for cuts in R&D spending during period *t* and zero otherwise; and v_{it} is the regression residual. The estimated coefficient on $\Delta EARN_{it}>0$ captures the association between growth in reported earnings and the change in firm value, and is predicted to be positive. The estimated coefficient on $\Delta RD_{it}<0$ captures the link between unexpected cuts in R&D investment and changes in firm value, and is predicted to be negative. The interaction term $\Delta EARN_{it}>0 \times \Delta RD_{it}<0$ permits the estimated coefficient on earnings growth to differ as a function of contemporaneous R&D spending. We interpret $\lambda_1 < 0$ as evidence that the pricing rewards to benchmark beating are (at least partially) offset by the market penalties to unexpected cuts in R&D investment.[ix]

Results are reported in table 6. Sample size is reduced to 3,309 observations as a result of missing returns data and exclusion of extreme return observations. The multiple on earnings growth is positive and significant for the full sample in panel A model 1: growth firms are associated with 28% higher returns on average compared with firms reporting an earnings decline. In contrast, the multiple on R&D cuts is negative in model 1: firms that prune R&D spending experience 10% lower returns on average compared with firms that maintain or increase their R&D spending. These findings are consistent with prior evidence from the benchmark beating and R&D valuation literatures, respectively. Model 2 extends the basic regression to include the earnings-R&D interaction effect. The estimated coefficient on the interaction term is negative and significant, signifying lower market rewards when earnings growth is accompanied by a reduction in R&D expenditure. The net effect (0.32 – 0.09) remains positive and significant, however, suggesting that the average market penalty to cutting R&D is outweighed by the reward to benchmark beating.

Findings reported previously in section 4 indicate that the probability of shaving R&D to boost earnings is a decreasing function of R&D intensity. One explanation for this result is that the net benefit of managing R&D expenditure to beat an earnings benchmark declines with the importance of R&D as a source of future value creation. We examine this conjecture by testing whether the interaction between earnings increases and R&D cutbacks varies according to the importance of R&D as a driver of future value. Using R&D intensity to proxy for the significance of R&D investment for future performance, we divide the sample into low, moderate and high intensity portfolios by sorting firms annually according to the lagged ratio of R&D expenditure to sales, and then re-estimate equation (2) separately for each portfolio. The results are presented in panel B of table 6. The magnitude and significance of the earnings-R&D interaction coefficient increases monotonically with R&D intensity. Cuts in R&D spending appear to be viewed more negatively where current R&D activity represents an important driver of future value: the earnings multiple for low intensity firms with unexpected R&D cuts is 0.23 (0.24 – 0.01), compared with 0.18 (0.37 – 0.19) for high intensity firms. These findings, which are consistent with our logistic results reported in table 4, support the view that the net benefit of manipulating R&D investment levels to deliver earnings growth is lower for firms whose future earnings performance is heavily reliant on current R&D spending. Note also that in the absence of a cut in R&D spending, the magnitude of the earnings multiple is increasing in R&D intensity, perhaps reflecting the fact that R&D intensive firms are more likely to be classified as growth stocks for which an increasing pattern of earnings might be considered particularly important (Barth et al. 1999).

Does the market see through R&D manipulation?

Not all R&D cuts are undertaken with the aim of boosting reported earnings performance. Pruning R&D spending may represent the most appropriate course of action as technological feasibility improves, a firm matures, or the stream of positive NPV projects dries up. All else equal, we expect the penalty associated with a reduction in R&D spending to be more pronounced when the market suspects the cut to have been motivated more by benchmark beating considerations than by real economic factors. Therefore, as a final test we examine the extent to which the market discriminates between target-driven reasons for cutting R&D expenditure and other reasons. To address this question, we extend regression (2) as follows:

$$\begin{aligned} R_{it} = \gamma_0 + \gamma_1 \Delta EARN_{it} > 0 + \gamma_2 \Delta RD_{it} < 0 + \lambda_1 \Delta EARN_{it} > 0 \times \Delta RD_{it} < 0 \\ + \lambda_2 \Delta EARN_{it} > 0 \times WITHIN_{it} + \lambda_3 \Delta EARN_{it} > 0 \times \Delta RD_{it} < 0 \times WITHIN_{it} + \omega_{it} \end{aligned}, \qquad (3)$$

where $WITHIN_{it}$ is an indicator variable equal to one for observations where premanaged earnings undershoot last year's earnings by an amount that could be reversed by pruning R&D expenditure and zero otherwise; ω_{it} is the regression residual; and all other variables are as previously defined.[x] As in regression (2), $\Delta EARN_{it}>0 \times \Delta RD_{it}<0$ permits the estimated coefficient on earnings growth to differ for R&D cutters. The main focus of our test is the three-way interaction term, which captures the incremental effect of R&D spending cuts that are most likely to have been driven by target-beating considerations. We interpret $\lambda_3 < 0$ as evidence that the market penalises manipulation-driven cuts in R&D spending more heavily than reductions motivated by other reasons. Results are reported in table 7.

Focusing initially on findings reported in column two for the full sample, the estimated coefficient on the three-way interaction term is negative and marginally significant (probability value = 0.1 for a two-tailed test). This is evidence that investors discount earnings increases in conjunction with R&D cuts more heavily when the reduction in R&D spending is likely to have been motivated by benchmark beating considerations. Nevertheless, the earnings multiple for suspected R&D manipulators remains positive (0.32 – 0.09 – 0.09), suggesting that on average the reward to reporting an earnings increase still outweighs the penalty associated with cutting R&D even when the market strongly suspects that investment spending is being shaved to deliver earnings growth. However, we caution against placing undue weight on these findings given the low levels of statistical significance.

The final three columns of table 7 report results partitioned according to R&D intensity. Evidence that the market discriminates between target-driven reasons for unexpected R&D cuts and other possible reasons is confined to moderate R&D intensity firms. For such firms, the market penalty for R&D cuts in the presence of earnings growth is statistically insignificant for cuts that appear to be driven by non-benchmark beating considerations (coefficient estimate equals -0.06; two-tailed probability value equals 0.15). By contrast, earnings increases that appear to be the result of R&D management are heavily penalised by the market, as evidenced by the negative and significant coefficient estimate on the three-way interaction term. Indeed, the market reward to earnings growth is entirely wiped out for firms suspected of pruning R&D to boost earnings performance (0.31 – 0.06 – 0.26).

For low R&D intensity firms, unexpected R&D spending cuts in the presence of earnings growth go unpunished regardless of whether or not target-driven manipulation is a factor. This is consistent with investors perceiving a weak link between R&D investment and long-term value creation for such firms. The three-way interaction term in the high R&D intensity portfolio is insignificant (two-tailed probability value equal to 0.34), indicating that the market does not discriminate between target-driven reasons for R&D cuts and other reasons. Instead, investors penalise all reductions in R&D spending with equal severity in the presence of earnings growth, as evidenced by the negative and significant coefficient estimate on the $\Delta EARN>0 \times \Delta R\&D<0$ interaction term. Note also that the earnings multiple for high R&D intensity firms reporting earnings growth in the presence of R&D cuts (0.38 – 0.21 = 0.17), although statistically significant at the five percent level, is noticeably lower than firms with low (0.23 – 0.00 = 0.23) and moderate (0.31 – 0.06 = 0.25) levels of R&D intensity. This result provides further evidence of how investors appear to discount the relevance of earnings growth for high R&D firms when combined with a reduction in R&D spending.[xi] Overall, these results suggest that investors interpret cuts in R&D spending in a relatively sophisticated manner by conditioning their response on both the perceived reason for the cut and the importance of R&D investment as a driver of firm value.

6. SUMMARY AND CONCLUSIONS

Policymakers repeatedly express concern that market pressure for short-term earnings growth may contribute to the low levels of R&D investment undertaken by UK firms relative to their international counterparts. This paper speaks to this ongoing debate by testing if UK firms cut R&D spending in response to short-term earnings pressures and how capital market participants interpret such behaviour. While prior US research documents evidence of apparently myopic investment behaviour with management shaving R&D expenditure to boost current-period earnings performance, little comparable large sample empirical evidence exists for the UK. Further, while separate literatures document the market-based rewards to beating earnings benchmarks and penalties to cutting R&D expenditure, extant research has not sought to evaluate the net product of these two competing effects.

Empirical tests are based on a large sample of R&D-active UK firms during the period 1989 through 2002. Tests focus exclusively on firms that expense all R&D as incurred, with a Heckman selection model used to control for possible selection bias resulting from the exclusion of firms that capitalise all or part of their development expenditure. We find that R&D expenditure is sensitive to both current and lagged earnings performance relative to target (where target is defined as either earnings > 0 or earnings growth > 0). Specifically, failure to beat an earnings benchmark increases the probability of R&D being cut in the next accounting period, while pressure to achieve current-period earnings targets leads to contemporaneous cuts in R&D investment. These contemporaneous and lagged effects are incrementally significant suggesting that they are not merely capturing the same underlying phenomenon of poor performance. Although we cannot entirely rule out the possibility that our results are capturing a rationale response to poor performance, we believe that on balance these findings are consistent with UK managers pruning R&D spending in response to target-driven earnings pressures. We also find that the strength of the contemporaneous association between R&D spending and benchmark beating weakens as R&D intensity increases, consistent with management being less inclined to sacrifice long-term value creation for short-term earnings gains in firms where R&D investment represents a particularly important source of future earnings.

Having established a link between R&D spending and earnings targets, we proceed by exploring how market participants interpret positive earnings growth in the presence of unexpected cuts in R&D spending. Results indicate that investors appear to discount earnings increases associated with unexpected cuts in R&D spending. The average response coefficient for earnings increases is lower for firms that cut R&D compared with those that maintain or increase R&D expenditure. Further analysis reveals that the market's response to unexpected cuts in R&D spending is contingent on (i) the importance of R&D investment as a driver of firm value and (ii) the perceived reason for the cut. For low R&D-intensive firms, unexpected R&D spending cuts in the presence of earnings growth go unpunished regardless of whether or not target-driven manipulation is a factor. Conversely, investors penalise all cuts in R&D spending made by high R&D-intensive firms with equal severity in the presence of earnings growth. For firms with moderate levels of R&D activity, investors discriminate between manipulation-driven cuts in R&D spending and unexpected reductions motivated by other (non-earnings management) reasons, with the valuation penalty imposed on the former group entirely offsetting the valuation gain associated with positive earnings growth.

ENDNOTES

[i] According to the UK R&D scoreboard (Department of Trade and Industry 2003), average R&D intensity (i.e., R&D investment as a percentage of sales) for the US, Japan, and the European Union (EU) is 5.2%, 4.3% and 3.7%, respectively. This compares with an R&D intensity of 2.5% for the UK. Government perceptions about underinvestment in R&D have recently led to the implementation of a series of measures designed to stimulate R&D activity.

[ii] Under SSAP 13 (Revised), UK firms were required to disclose the amount of R&D capitalised during the period in a footnote.

[iii] Based on a sample of Australian firms, Chan, Faffe, Gharghori and Ho (2007) document higher positive risk-adjusted future stock returns for R&D expensers relative to capitalisers. Chan et al. (2007) interpret their findings as evidence that immediate write-off of R&D leads to contemporaneous underpricing (and therefore higher future abnormal returns when these pricing errors subsequently unwind). It is unclear whether such mispricing exists in the UK; and even if expensers are mispriced, we do not expect this phenomenon to impact the validity of our empirical tests and associated conclusions for several reasons. First, our earnings management tests do not utilise market data. Second, where returns are used in section 5, they form the dependent variable in our regression models. Accordingly, any measurement error caused by mispricing will be captured by the regression residual; coefficient estimates will remain unbiased.

[iv] Recent evidence suggests analysts' consensus forecasts are emerging as the salient target for US management (Dechow, Richardson and Tuna 2003, Brown and Caylor 2005). We therefore repeated our tests using earnings benchmarked against the IBES consensus analyst forecast. Results and conclusions are similar to those reported in the body of the paper. We choose not to emphasise these findings, however, due to research design and data problems. First, prior research suggests that forecasts formed late in the reporting cycle represent the key targets against which reported earnings performance is assessed (Kasznik and McNichols, 2002; Burgstahler and Eames 2006). This creates a serious timing problem in the context of our study, however, because most of the annual R&D spend is likely to have occurred before these final forecasts are set. Second, analysts' forecasts are endogenously determined, with managers using both expectations management and earnings management to ensure reported earnings meet of exceed the forecast (Bartov et al. 2002). Our tests using analysts' forecasts do not control for forecast endogeneity because the issue of expectations management lies beyond the scope of our research. Third, requiring that firms have forecast data on IBES reduces sample size by almost 60%.

[v] Throughout this paper, earnings are defined as earnings before extraordinary and non-operating exceptional items. Accordingly, earnings are equal to Datastream item 625 pre-FRS 3 and Datastream items 625+1083–1094–1097 post-FRS 3.

[vi] The vector of explanatory variables in the first stage probit regression modelling the decision to expense R&D is based on Oswald and Zarowin (2007a). (Datastream item codes in parentheses).

Earnings variability is the variance of earnings per share (183) computed using at least three annual observations; positive earnings is an indicator variable equal to one if earnings (625) are positive and zero otherwise; profitability is defined as earnings (625) scaled by lagged total assets; size is defined as the natural logarithm of the year-end market value of equity (MV); the market-to-book ratio is calculated as the market value of equity divided by the book value of shareholders' funds (305); R&D intensity is defined as the R&D expense (119) scaled by lagged total assets for expensers and the R&D expense plus the increase in the R&D asset (342) scaled by lagged total assets for capitalisers; and risk is calculated as the market model beta (Beta).

[vii] A similar pattern is apparent for marginal effects and odds ratios. Marginal effects in models 3-8 for *WITHIN* range from 35% (model 3) to 86% (model 5) larger than the corresponding value for *BELOW*, while odds ratios for *WITHIN* range from 18% (model 7) to 60% (model 2) larger than the corresponding value for *BELOW*.

[viii] Tests focus on earnings changes rather than earnings levels due to problems with sparse data, particularly when regression models are estimated separately for subsets of observations partitioned on R&D intensity. For example, the three-way interaction variable in model (3) is equal to one in only 15 (eight and nine) cases in the low (medium and high) R&D intensity portfolios, raising serious doubts about the reliability of coefficient estimates derived from such data.

[ix] Similar conclusions to those based on equation (2) are obtained using a price levels specification (Barth et al. 1999). We present results based on the changes specification in the main body of the paper because we are more confident that these results are not attributable to firm-specific factors omitted from a levels model. In additional analyses we extended equation (2) by adding other potential determinants of stock returns including R&D intensity, firm size, and the market-to-book ratio. Results and conclusions are robust to these alternative specifications.

[x] In untabulated tests we estimated an expanded version of equation (3) that also included *BELOW* and its associated interaction terms. Probability values for the three-way interaction $\Delta EARN>0 \times \Delta RD<0 \times BELOW$ are large (> 0.5) in all estimations, while findings for *WITHIN* and its associated interactions do not change.

[xi] This effect appears to be particularly acute for high R&D firms suspected of using their R&D discretion to deliver reported earnings growth: the earnings growth multiple for these firms (0.38 – 0.21 – 0.1 = 0.07) is statistically indistinguishable from zero (two-tailed probability value equal to 0.67).

REFERENCES

Baber, W. R., P. M. Fairfield and J. A. Haggard (1991), 'The Effect of Concern About Reported Income on Discretionary Spending Decisions: The Case of Research and Development', *The Accounting Review*, 66(4), pp.818-829.

Bange, M. M. and W. F. M. De Bondt (1998), 'R&D Budgets and Corporate Earnings Targets', *Journal of Corporate Finance*, 4(2), pp.153-184.

Barney, J. (1995) 'Looking inside for competitive advantage', *Academy of Management Executive*, 9(4), pp. 49-61.

Barth, M. E., J. A. Elliott and M. W. Finn (1999), 'Market Rewards Associated with Patterns of Increasing Earnings', *Journal of Accounting Research*, 37(2), pp.387-413.

Barth, M.E., R. Kasznik, and M.F. McNichols (2001), 'Analyst Coverage and Intangible Assets', *Journal of Accounting Research*, 39(1), pp.1-34.

Bartov, E., D. Givoly and C. Hayn (2002), 'The Rewards to Meeting or Beating Earnings Expectations', *Journal of Accounting and Economics*, 33(2), pp.173-204.

Berger, P. G (1993), 'Explicit and Implicit Tax Effects of the R&D Tax Credit', *Journal of Accounting Research*, 31(2), pp.131-171.

Bens, D.A., V. Nagar, D. J. Skinner and M. H. F. Wong (2003), 'Employee Stock Options, EPS Dilution, and Stock Repurchases', *Journal of Accounting and Economics*, 36(1-3), pp.51-90.

Bernard, V. L., J. K. Thomas and J. S. Abarbanell (1993), 'How Sophisticated is the Market in Interpreting Earnings News?', *Journal of Applied Corporate Finance*, 6(2), pp. 54-63.

Brown, L. D. and M. L. Caylor (2005), 'A Temporal Analysis of Quarterly Earnings Thresholds: Propensities and Valuation Consequences', *The Accounting Review*, 80(2), pp.423-440.

Burgstahler, D. and I. Dichev (1997), 'Earnings Management to Avoid Earnings Decreases and Losses', *Journal of Accounting and Economics*, 24(1), pp.99-126.

Burgstahler, D. and M. Eames (2006), 'Management of Earnings and Analysts' Forecasts to Achieve Zero and Small Positive Earnings Surprises', *Journal of Business Finance and Accounting*, 33(5-6), pp.633-652.

Bushee, B. J. (1998), 'The Influence of Institutional Investors on Myopic R&D Investment Behavior', *The Accounting Review*, 73(3), pp.305-333.

Chan, H. W. H., R. W. Faffe, P.Gharghori and Y. K. Ho (2007), 'The Relation Between R&D Intensity and Future Market Returns: Does Expensing Versus Capitalisation Matter?', *Review of Quantitative Financial Accounting*, 29, pp.25-51

Chan, L.K.C., J. Lakonishok and T. Sougiannis (2001), 'The Stock Market Valuation of Research and Development Expenditures', *The Journal of Finance*, 56(6), pp.2431-2456.

Chan, S. H., J. D. Martin and J. W. Kensinger (1990), 'Corporate Research and Development Expenditures and Share Value', *Journal of Financial Economics*, 26(2), pp.255-276.

Cheng, S. (2004), 'R&D Expenditures and CEO Compensation', *The Accounting Review*, 79(2), pp.305-328.

Dechow, P. M. and R. G. Sloan (1991), 'Executive Incentives and the Horizon Problem: An Empirical Investigation', *Journal of Accounting and Economics*, 14(1), pp.51-89.

Dechow, P.M. and D. J. Skinner (2000), 'Earnings Management: Reconciling the Views of Accounting Academics, Practitioners, and Regulators', *Accounting Horizons*, 14(2), pp.235-251.

Dechow, P. M., S. A. Richardson and I. Tuna (2003), 'Why Are Earnings Kinky? An Examination of the Earnings Management Explanation', *Review of Accounting Studies*, 8(2-3), pp.355-384.

Degeorge, F., J. Patel and R. Zeckhauser (1999), 'Earnings Management to Exceed Thresholds', *The Journal of Business*, 72(1), pp.1-33.

Demirag, I. S (1995), 'An Empirical Study of Research and Development: Top Managers' Perceptions of Short-Term Pressures from Capital Markets in the United Kingdom', *European Journal of Finance*, 1(2), pp.180-202.

Demirag, I. S. (1998), 'Boards of Directors' Short-Term Perceptions and Evidence of Managerial Short-Termism in the UK', *European Journal of Finance*, 4(3), pp.195-211.

Department of Trade and Industry (2003), '*R&D Scoreboard'*, London: Company Reporting.

Duke, J.C. and H.G. Hunt (1990), 'An Empirical Examination of Debt Covenant Restrictions and Accounting-Related Debt Proxies', *Journal of Accounting and Economics*, 12(1-3), pp.45-63.

Gore, P. O., P. F. Pope and A. Singh (2007), 'Earnings Management and the Distribution of Earnings Relative to Targets: Evidence from the U.K', *Accounting and Business Research*, 37(2), pp.123-150.

Graham, J. R., C. R. Harvey and S. Rajgopal (2005), 'The Economic Implications of Corporate Financial Reporting', *Journal of Accounting and Economics*, 40(1-3), pp.3-73.

Grinyer, J., A. Russell and D. Collison (1998), 'Evidence of Managerial Short-Termism in the UK', *British Journal of Management*, 9(1), pp.13-22.

Heckman, J. J. (1976), 'The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models', *Annals of Economic and Social Measurement*, 5(4), pp.475-492.

Heckman, J. J. (1979), 'Sample Selection Bias as a Specification Error', *Econometrica*, 47(1), pp.153-162.

HM Treasury (2004), '*Long-Term Global Economic Challenges and Opportunities for the UK*', London: HM Treasury.

HM Treasury (2005), '*Supporting Growth in Innovation: Enhancing the R&D Tax Credit'*, London: HM Treasury.

Holgate, P. and S. Kirby (1994), 'FRS 3: The Story Continues', *Accountancy*, 114(1126), pp.142-143.

Hribar, P., N. T. Jenkins, and W. B. Johnson (2004), 'Stock Repurchases as an Earnings Management Device', Cornell University, working paper.

Kasznik, R. and M. F. McNichols (2002), 'Does Meeting Earnings Expectations Matter? Evidence From Analyst Forecast Revisions and Share Prices', *Journal of Accounting Research*, 40(3), pp.727-759.

Lev, B., and T. Sougiannis (1996), 'The Capitalization, Amortization, and Value-Relevance of R&D', *Journal of Accounting and Economics*, 21(1), pp.107-138.

McVay, S. E. (2006), 'Earnings Management Using Classification Shifting: An Examination of Core Earnings and Special Items', *The Accounting Review*, 81(3): 501-531.

Opler, T., L. Pinkowitz, R. Stulz and R. Williamson (1999), 'The Determinants and Implications of Corporate Cash Holdings', *Journal of Financial Economics*, 52(1), pp.3-46.

Oswald, D. R. and P. Zarowin (2007a), 'Capitalization of R&D and the Informativeness of Stock Prices', *European Accounting Review*, forthcoming.

Oswald, D. R. and P. Zarowin (2007b), 'Capitalization vs. Expensing of R&D and Earnings Management', New York University, working paper.

Perry, S. E. and R. Grinaker (1994), 'Earnings Expectations and Discretionary Research and Development Spending', *Accounting Horizons*, 8(4), pp.43-51.

Rappaport, A. (2005), 'The Economics of Short-Term Performance Obsession', *Financial Analysts Journal*, 61(3), pp.65-79.

Skinner, D. J. and R. G. Sloan (2002), 'Earnings Surprises, Growth Expectations, and Stock Returns: Don't Let an Earnings Torpedo Sink Your Portfolio', *Review of Accounting Studies*, 7(2-3), pp.289-312.

Stein, J.C. (1988), 'Takeover Threats and Managerial Myopia', *Journal of Political Economy*, 96(1), pp.61-80.

Stein, J.C. (1989), 'Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behaviour', *The Quarterly Journal of Economics*, 104(4), pp.655-669.

Wernerfelt, B. (1984) 'A resource-based view of the firm', *Strategic Management Journal*, 5(2), pp.171-180.

Wiedman, C. (1996), 'The Relevance of Characteristics of the Information Environment in the Selection of a Proxy for the Market's Expectation for Earnings: An Extension of Brown, Richardson, and Schwager (1987)', *Journal of Accounting Research*, 34(2), pp.313-324.

Table 1
Sample selection procedure used to identify U.K.-resident R&D active firms with fiscal year-ends between December 1989 and December 2002.

		Firms	Firm-years
UK non-financial firms with at least three consecutive years of non-zero R&D expenditure between December 1989 and December 2002 (inclusive)		867	5,009
Less:			
Missing data for lagged variables		(48)	(377)
Changes in financial year-end		(33)	(169)
Insufficient industry data		(8)	(52)
Missing data to compute explanatory variables		(42)	(291)
Outliers removed		(36)	(254)
Final sample (expensers and capitalisers)		700	3,866
Firm-years partitioned by accounting treatment of R&D:			
Capitalisers	456		
Expensers	3,410		
	3,866		

Table 2
Descriptive statistics for R&D active U.K.-resident firms listed on the London Stock Exchange. The sample is composed of firms that expense all R&D as incurred and comprises 3,410 firm-year observations.

Variable[a]	Mean	Std dev	Min	Q1	Median	Q3	Max
CUT	0.358	0.479	0.000	0.000	0.000	1.000	1.000
MKTB	4.474	8.095	0.263	1.069	1.677	2.905	26.474
SIZE	11.708	2.125	7.454	10.153	11.609	13.178	16.349
LEV	0.532	3.915	0.065	0.346	0.464	0.565	1.065
RDI	0.470	0.499	0.000	0.000	0.000	1.000	1.000
$\lvert ACC \rvert$	0.076	0.123	0.001	0.026	0.052	0.092	0.441
ΔRD_{t-1}	0.465	2.247	-6.924	-0.056	0.083	0.336	8.818
$\Delta SALES$	0.091	0.500	-1.018	-0.033	0.057	0.165	1.837
$\Delta CAPX$	0.087	0.361	-0.832	0.011	0.071	0.158	1.073
$\Delta FUNDS$	0.019	0.275	-0.464	-0.026	0.015	0.054	0.612
$\Delta INDRD$	0.083	3.335	-5.750	-0.056	-0.004	0.029	10.583

[a] Variable definitions are as follows (Datastream item codes in parentheses): *CUT* is an indicator variable equal to one if the change in R&D expenditure (119) is negative and zero otherwise; *MKTB* is the unlevered market-to-book ratio (MV+306+321/391); *SIZE* is the natural logarithm of market capitalisation (MV); *LEV* is leverage (389+321/392); *RDI* is an indicator variable equal to one if R&D intensity exceeds the median value for the industry and zero otherwise (where R&D intensity is defined as R&D expenditure dividend by total sales (104)); $\lvert ACC \rvert$ is current period abnormal accruals (376-375-389+381-402-562) scaled by lagged total assets (392), computed using the modified-Jones model; ΔRD_{t-1} is the lagged change in the natural logarithm of R&D expenditure; $\Delta SALES$ is change in the natural logarithm of total sales; $\Delta CAPX$ is the change in the natural logarithm of capital expenditure (330); $\Delta FUNDS$ is the change in the natural logarithm of earnings before depreciation and R&D expenditure (625+119+402+562); $\Delta INDRD$ is the industry median change in the natural logarithm of R&D (computed after excluding the sample firm).

Table 3
Univariate tests of the association between contemporaneous and lagged earnings performance (relative to target) and changes in R&D expenditure. The sample comprises 3,410 firm-year observations for U.K.-resident, R&D active firms between December 1989 and December 2002.

Panel A: Lagged earnings performance

	Lagged earnings relative to target:[a]		Chi-square statistic
	ACHIEVED	MISSED	(probability value)
Target: $EARN_{t-1} > 0$			
$\Delta R\&D_t \geq 0$	1768 (0.67)	421 (0.54)	
$\Delta R\&D_t < 0$	869 (0.33)	352 (0.46)	41.18 (<0.01)
Target: $\Delta EARN_{t-1} > 0$			
$\Delta R\&D_t \geq 0$	1375 (0.68)	814 (0.58)	
$\Delta R\&D_t < 0$	636 (0.32)	585 (0.42)	37.27 (<0.01)

Panel B: Contemporaneous earnings performance

	Contemporaneous premanaged earnings relative to target:[b]			Chi-square statistic
	BELOW	WITHIN	ABOVE	(probability value)
Target: $EARN_t > 0$				
$\Delta R\&D_t \geq 0$	336 (0.52)	117 (0.58)	1736 (0.68)	
$\Delta R\&D_t < 0$	307 (0.48)	84 (0.42)	830 (0.32)	56.37 (<0.01)
Target: $\Delta EARN_t > 0$				
$\Delta R\&D_t \geq 0$	516 (0.56)	264 (0.59)	1409 (0.69)	
$\Delta R\&D_t < 0$	409 (0.44)	182 (0.41)	630 (0.31)	54.69 (<0.01)

[a] One-year lagged earnings relative to target, where the target is defined as either positive earnings (EARN > 0) or positive earnings growth (ΔEARN > 0). The column headed ACHIEVED contains firm-years where lagged earnings exceeded target. The column headed MISSED contains firm-years where lagged earnings fell short of target. Earnings are defined as reported earnings before extraordinary and non-operating exceptional items. For fiscal years preceding (following) 23 June 1993 earnings are equal to Datastream item 625 (625+1083–1094–1097).

[b] Contemporaneous premanaged earnings are defined as earnings before extraordinary and non-operating exceptional items plus R&D expenditure. Target earnings are defined as either positive earnings (EARN > 0) or positive earnings growth (ΔEARN > 0). The sample is partitioned according to the level of premanaged earnings relative to target. The column headed ABOVE contains firm-years where premanaged earnings exceed target. The column headed WITHIN contains firm-years where premanaged earnings undershoot target by an amount that could be reversed by pruning R&D expenditure. The column headed BELOW contains firm-years where premanaged earnings are so low that the target remains beyond reach even if R&D spending were reduced to zero.

Table 4
Summary statistics and coefficient estimates for logistic regressions relating the probability of a reduction in R&D spending to measures of contemporaneous and lagged earnings performance (measured relative to target) and a vector of control variables. The sample comprises 3,410 firm-year observations for U.K.-resident, R&D active firms between December 1989 and December 2002. Two-tailed probability values are reported in parentheses.

	Lagged earnings target		Contemporaneous earnings target					
			Target: $EARN_t > 0$			Target: $\Delta EARN_t > 0$		
Variable[a]	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	0.658	0.716	0.487	0.065	0.309	1.159	1.081	0.265
	(0.07)	(0.05)	(0.19)	(0.87)	(0.41)	(0.01)	(0.01)	(0.48)
ΔRD_{t-1}	0.051	0.050	0.047	0.048	0.049	0.044	0.043	0.048
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta SALES_t$	-0.222	-0.225	-0.219	-0.213	-0.221	-0.178	-0.195	-0.171
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.06)	(0.07)	(0.05)
$\Delta CAPX_t$	-0.917	-0.923	-0.972	-0.972	-0.923	-1.024	-1.033	-0.935
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta FUNDS_t$	-0.559	-0.545	-0.093	-0.081	-0.382	-0.020	-0.149	-0.170
	(0.01)	(0.01)	(0.61)	(0.66)	(0.07)	(0.91)	(0.47)	(0.38)
$\Delta INDRD_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.96)	(0.91)	(0.96)	(0.95)	(0.94)	(0.99)	(0.99)	(0.96)
$\lvert ACC_t \rvert$	-0.011	-0.041	0.057	0.152	-0.112	0.497	0.688	0.006
	(0.97)	(0.93)	(0.90)	(0.73)	(0.81)	(0.20)	(0.08)	(0.98)
$SIZE_t$	-0.046	-0.047	-0.053	-0.058	-0.042	-0.070	-0.077	-0.044
	(0.02)	(0.02)	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)
LEV_t	0.299	0.318	0.270	0.210	0.322	0.254	0.275	0.328
	(0.15)	(0.12)	(0.18)	(0.30)	(0.11)	(0.21)	(0.18)	(0.10)
$MKTB_t$	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001
	(0.38)	(0.37)	(0.42)	(0.44)	(0.41)	(0.38)	(0.37)	(0.37)
RDI_t	-0.899	-0.986	-0.915	-0.875	-0.943	-0.834	-0.772	-0.923
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$BIAS_t$	-0.339	-0.357	-0.159	0.110	-0.188	-0.462	-0.398	-0.246
	(0.06)	(0.05)	(0.37)	(0.59)	(0.29)	(0.01)	(0.04)	(0.17)
$EARN_{t-1} \leq 0$	0.609	0.541			0.442			0.642
	(0.01)	(0.01)			(0.01)			(0.01)
$\Delta EARN_{t-1} \leq 0$	0.198	0.139			0.180			0.185
	(0.01)	(0.08)			(0.02)			(0.02)
$RDI*EARN_{t-1} \leq 0$		0.102						
		(0.62)						
$RDI*\Delta EARN_{t-1} \leq 0$		0.153						
		(0.35)						
$WITHIN_t$			0.816	1.223	0.574	0.581	0.568	0.602
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$BELOW_t$			0.605	0.755	0.311	0.318	0.399	0.369
			(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
$RDI_t*WITHIN_t$				-2.641			-3.302	
				(0.02)			(0.02)	

$RDI_t*BELOW_t$				-1.042			-0.179	
				(0.09)			(0.80)	
Likelihood ratio	328.10	329.73	316.34	325.56	341.37	301.75	309.47	360.07
χ^2 statistic *p*-value	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Pseudo R^2	0.126	0.127	0.122	0.125	0.131	0.116	0.119	0.138

[a] The dependent variable is log (p_i / [1 – p_i]), where p_i is the probability of a cut in R&D spending. Explanatory variables are defined as follows (Datastream item codes in parentheses): ΔRD_{t-1} is the lagged change in the natural logarithm of R&D expenditure; *ΔSALES* is change in the natural logarithm of total sales; *ΔCAPX* is the change in the natural logarithm of capital expenditure (330); *ΔFUNDS* is the change in the natural logarithm of earnings before depreciation and R&D expenditure (625+119+402+562); *ΔINDRD* is the industry median change in the natural logarithm of R&D (computed after excluding the sample firm). $|ACC_t|$ is the absolute value of operating accruals (376-375-389+381-402-562) scaled by lagged total assets (392), computed using the modified-Jones model; *SIZE* is the natural logarithm of market capitalisation (MV); *LEV* is leverage (389+321/392); *MKTB* is the unlevered market-to-book ratio (MV+306+321/391); *RDI* is an indicator variable equal to one if R&D intensity exceeds the median value for the industry and zero otherwise (where R&D intensity is defined as R&D expenditure divided by total sales (104)); *BIAS* is the inverse Mills ratio retrieved from a first-stage probit regression modelling the decision to expense or capitalise R&D investment (See footnote five for details); $EARN_{t-1} \leq 0$ is an indicator variable equal to one for firm-years where lagged earnings are negative and zero otherwise; $\Delta EARN_{t-1} \leq 0$ is an indicator variable equal to one for firm-years where the lagged earnings change is negative and zero otherwise; *WITHIN* is an indicator variable equal to one for firm-years where premanaged earnings undershoot target by an amount that could be reversed by pruning R&D expenditure and zero otherwise; *BELOW* is an indicator variable equal to one for firm-years where premanaged earnings are so low that the target remains beyond reach even if R&D spending were reduced to zero and zero otherwise.

Table 5
Summary statistics and coefficient estimates for logistic regressions relating the probability of a reduction in R&D spending to measures of contemporaneous earnings performance (measured relative to target) and a vector of control variables controlling for past performance. The sample comprises 3,410 firm-year observations for U.K.-resident, R&D active firms between December 1989 and December 2002. Two-tailed probability values are reported in parentheses.

	Earnings relative to target			
	Target: $EARN_t > 0$		Target: $\Delta EARN_t > 0$	
Variable[a]	$EARN_{t-1} \leq 0$	$EARN_{t-1} > 0$	$\Delta EARN_{t-1} \leq 0$	$\Delta EARN_{t-1} > 0$
Intercept	2.306	-0.238	3.102	-0.403
	(0.01)	(0.57)	(0.01)	(0.35)
ΔRD_{t-1}	0.083	0.041	0.085	0.037
	(0.01)	(0.03)	(0.01)	(0.06)
$\Delta SALES_t$	-0.032	-1.501	-0.017	-1.304
	(0.74)	(0.01)	(0.86)	(0.01)
$\Delta CAPX_t$	-0.685	-0.766	-0.690	-0.791
	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta FUNDS_t$	-0.055	-1.473	-0.355	-0.980
	(0.76)	(0.01)	(0.14)	(0.03)
$\Delta INDRD_t$	0.000	0.000	0.000	0.000
	(0.27)	(0.61)	(0.20)	(0.55)
$\lvert ACC_t \rvert$	-0.095	-0.165	0.215	0.170
	(0.86)	(0.82)	(0.70)	(0.81)
$SIZE_t$	-0.112	-0.014	-0.122	-0.015
	(0.01)	(0.53)	(0.01)	(0.48)
LEV_t	0.746	0.064	0.695	0.054
	(0.02)	(0.82)	(0.01)	(0.84)
$MKTB_t$	0.001	-0.001	0.001	-0.001
	(0.53)	(0.83)	(0.54)	(0.77)
RDI_t	-0.843	-0.924	-0.801	-0.925
	(0.01)	(0.01)	(0.01)	(0.01)
$BIAS_t$	-0.714	0.067	-0.984	0.051
	(0.04)	(0.75)	(0.01)	(0.81)
$WITHIN_t$	0.565	0.401	0.796	0.665
	(0.01)	(0.05)	(0.01)	(0.01)
$BELOW_t$	0.092	0.213	-0.238	0.420
	(0.32)	(0.10)	(0.17)	(0.01)
Likelihood ratio	106.07	251.99	116.10	276.38
χ^2 statistic p-value	0.001	0.001	0.001	0.001
Pseudo R^2	0.172	0.127	0.187	0.139

[a] The dependent variable is log (p_i / [1 – p_i]), where p_i is the probability of a cut in R&D spending. Explanatory variables are defined as follows (Datastream item codes in parentheses): ΔRD_{t-1} is the lagged change in the natural logarithm of R&D expenditure; $\Delta SALES$ is change in the natural logarithm of total sales; $\Delta CAPX$ is the change in the natural logarithm of capital expenditure (330); $\Delta FUNDS$ is the change in the natural logarithm of earnings before depreciation and R&D expenditure (625+119+402+562); $\Delta INDRD$ is the industry median change in the natural logarithm of R&D (computed after excluding the sample firm). $\lvert ACC_t \rvert$ is the absolute value of operating accruals (376-375-389+381-402-562) scaled by lagged total assets (392), computed using the modified-Jones model; *SIZE* is the natural logarithm of market capitalisation (MV); *LEV* is leverage (389+321/392); *MKTB* is the unlevered market-to-book ratio (MV+306+321/391); *RDI* is an indicator variable equal to one if R&D intensity

exceeds the median value for the industry and zero otherwise (where R&D intensity is defined as R&D expenditure divided by total sales (104)); *BIAS* is the inverse Mills ratio retrieved from a first-stage probit regression modelling the decision to expense or capitalise R&D investment (See footnote five for details); $EARN_{t-1} \leq 0$ is an indicator variable equal to one for firm-years where lagged earnings are negative and zero otherwise; $\Delta EARN_{t-1} \leq 0$ is an indicator variable equal to one for firm-years where the lagged earnings change is negative and zero otherwise; *WITHIN* is an indicator variable equal to one for firm-years where premanaged earnings undershoot target by an amount that could be reversed by pruning R&D expenditure and zero otherwise; *BELOW* is an indicator variable equal to one for firm-years where premanaged earnings are so low that the target remains beyond reach even if R&D spending were reduced to zero and zero otherwise.

Table 6
Summary statistics and coefficient estimates from OLS regressions of 12-month share returns on changes in earnings and R&D expenditure. The sample comprises 3,309 firm-year observations for U.K.-resident, R&D active firms between December 1989 and December 2002 with returns data available from Datastream. Two-tailed probability values based on robust Huber-White t-statistics are reported in parentheses.

	Intercept	$\Delta EARN_t>0$	$\Delta RD_t<0$	$\Delta EARN_t>0 \times \Delta RD_t<0$	N	F	Adj-R^2
Panel A: Full sample[a]							
Model 1	-0.05	0.28	-0.10		3309	123.02	0.07
	(0.01)	(0.01)	(0.01)				
Model 2	-0.07	0.32	-0.04	-0.09	3309	85.08	0.08
	(0.01)	(0.01)	(0.09)	(0.01)			
Panel B: By R&D intensity[b]							
Low intensity	-0.08	0.24	-0.03	-0.01	1098	30.09	0.07
	(0.01)	(0.01)	(0.28)	(0.44)			
Medium intensity	-0.10	0.31	-0.05	-0.06	1109	43.86	0.10
	(0.01)	(0.01)	(0.13)	(0.17)			
High intensity	-0.04	0.37	-0.06	-0.19	1102	22.91	0.06
	(0.25)	(0.01)	(0.22)	(0.02)			

[a] Variable definitions are as follows. The dependent variable is 12-month share return ending three months after the balance sheet data; $\Delta EARN > 0$ is an indicator variable equal to one if the change in earnings (before extraordinary and non-operating exceptional items) is positive and zero otherwise; $\Delta RD < 0$ is an indicator variable equal to one if the change in R&D expenditure is negative and zero otherwise.
[b] For each sample year observations are partitioned into low, moderate and high R&D intensity portfolios by sorting according to the lagged ratio of R&D expenditure to sales.

Table 7
Summary statistics and coefficient estimates from OLS regressions examining the intervening effect of earnings management incentives on the association between 12-month share returns and changes in earnings and R&D expenditure. The sample comprises 3,309 firm-year observations for U.K.-resident, R&D active firms between December 1989 and December 2002 with returns data available from Datastream. Two-tailed probability values based on robust Huber-White t-statistics are reported in parentheses.

	Full	R&D intensity:[b]		
Variable[a]	Sample	Low	Moderate	High
Intercept	-0.08	-0.08	-0.10	-0.05
	(0.01)	(0.01)	(0.01)	(0.16)
$\Delta EARN_t>0$	0.32	0.23	0.31	0.38
	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta RD_t<0$	-0.04	-0.03	-0.03	-0.05
	(0.18)	(0.45)	(0.42)	(0.54)
$\Delta EARN_t>0 \times \Delta RD_t<0$	-0.09	0.00	-0.06	-0.21
	(0.01)	(0.93)	(0.15)	(0.02)
$\Delta EARN_t>0 \times WITHIN_t$	0.00	-0.05	-0.03	0.05
	(0.99)	(0.27)	(0.79)	(0.65)
$\Delta EARN_t>0 \times \Delta RD_t<0 \times WITHIN_t$	-0.09	0.03	-0.26	-0.10
	(0.10)	(0.39)	(0.05)	(0.34)
F	51.61	17.56	26.51	14.21
Adjusted-R^2	0.07	0.07	0.11	0.06
N	3309	1098	1109	1102

[a] *WITHIN* is an indicator variable equal to one for observations where premanaged earnings undershoot last year's reported earnings by an amount that could be reversed by pruning R&D expenditure and zero otherwise. All remaining variables are defined in table 6. The dependent variable is 12-month share return ending three months after the balance sheet date; $\Delta EARN > 0$ is an indicator variable equal to one if the change in earnings (before extraordinary and non-operating exceptional items) is positive and zero otherwise; $\Delta RD < 0$ is an indicator variable equal to one if the change in R&D expenditure is negative and zero otherwise.
[b] For each sample year observations are partitioned into low, moderate and high R&D intensity portfolios by sorting on the basis of the lagged ratio of R&D expenditure to sales.