R&D and Performance Persistence: Evidence from the UK

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Abstract

There is compelling evidence from both the US and UK suggesting that R&D expenditure has a positive impact on operating and/or market performance. Nonetheless, there is still debate both about the long-term impact of R&D on company's profitability and the rationale of the apparent positive relation between R&D expenditure and excess stock market returns.

We examine the relation between R&D investment and persistence in operating and market performance using a large dataset of UK companies during the period 1990-2003. Our findings confirm the relation between R&D intensity and consistent growth in sales and gross income but only in the cases when a firm needs to engage in R&D activity because of the industry in which it operates. Moreover, our evidence indicates a positive relation between R&D intensity and subsequent risk-adjusted excess stock returns among firms that engage in R&D. We also show that R&D intensity improves persistence in excess stock returns: the highest R&D intensity firms are found to earn higher risk-adjusted excess returns than the sample median return more consistently, compared to lower R&D intensity firms, as well as firms with no R&D.

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1. Introduction

Research and Development (R&D) spending is widely recognised as a key policy priority in achieving long term economic growth. The UK government, for example, has set ambitious R&D spending targets for the next decade to catch up with US and international competition. The new R&D policy aims to assist the UK economy to compete effectively in sectors where R&D is already important and also to achieve competitive advantages in sectors where this is not yet the case (R&D Scoreboard, 2005).

The rationale for the policy priority on R&D is fully supported by strong academic evidence suggesting that R&D has a positive impact on company operating and market performance. Sougiannis (1994), Lev and Sougiannis (1996, 1999), Chan, Lakonishok and Sougiannis (2001), Eberhart, Maxwell and Sidique (2004), Chambers, Jennings and Thompson (2002) and Lev, Nissim and Thomas (2002), for example, provide evidence of a positive relation between R&D and various measures of operating and/or stock market performance in the US. Al-Horani, Pope and Stark (2003), Green, Stark and Thomas (1996) and Toivanen, Stoneman and Bosworth (2002) reach similar conclusions for stock market performance in the UK.

Moreover, Chan, Karceski and Lakonishok (2003) show that firms in R&D intensive sectors generate more persistent growth rates in their operating performance; more specifically, they find exceptionally persistent operating growth rates in sales and earnings for the technology and pharmaceutical stocks. They also identify the R&D-to-sales ratio as the most predictor, among a number of fundamental factors, for growth rates of operating performance measures over longer horizons.

In spite of the strength of the evidence linking R&D to enhancements in operating and market performance, there are still at least two fundamental and interrelated issues concerning the impact of R&D spent on corporate performance that require further consideration. The first relates to the effectiveness of R&D to add value across a wide spectrum of companies and industrial sectors. The second, concerns the underlying rationale of the apparent positive relation between R&D expenditure and excess stock market returns.

On the first issue, Lev (2001) argues that intangible investments as R&D, are characterised by inherent non-rival use and scalability and they benefit from economies of network a great deal more than tangible investment do. The possibility for non rival use implies that there also exists the possibility to use the resource simultaneously and repetitively without being subject to diminishing returns. The initial (sunk) cost remains the same no matter what the scale of production is. Investments in intangibles have also been empirically linked to economies of scale (Hand, 2003) while there is also evidence on the synergies stemming from intangible investments, and that cross-industry and geographic diversification only add value in the presence of intangibles, both R&D and marketing (Morck and Yeung, 2003). Moreover, Wyatt (2002) identifies two additional sources of value coming from investments in intangibles: the first one relates to the operating and investing flexibility that past intangible investments give to the management, and the second one relates to the strategic value, stemming from the interaction between existing accumulated options and capabilities generated by intangibles.

The underlying rationale behind the apparent relation between R&D and stock market performance remains an issue of academic controversy and practical relevance. Lev, Sarath and Sougiannis (2005)[1] tend to attribute this relation to some form of "mispricing" driven by the potential of current R&D accounting practices to mislead investors about the true level of earnings. On the other hand, Chambers, Jennings and Thompson (2002) and Ho, Xu and Yap (2004) appear to attribute the positive relation between R&D investment and excess returns to the failure to fully control for risk.

The mispricing explanation relates to the conservative accounting treatment of R&D (immediate expensing), and argues that investors may get confused by this accounting treatment and fail to see through 'artificially' understated earnings; if investors fail to see through these 'artificially' reduced earnings, firms that report R&D conservatively will be undervalued and vice versa (Lev, Sarath and Sougiannis, 2005). In addition, Eberhart, Maxwell and Sidique (2004) show that the market adjusts slowly for the mispricing in stock returns due to the change in the level of R&D activity.

With respect to the market compensating for risk as the explanation for excess returns driven by R&D, the rationale behind this theoretical expectation relates to the fact that R&D investments, compared to investments in physical assets, involve inherently greater risk, which is justified by the uncertainty of the future benefits. R&D investments have also been empirically associated with greater risk (Kothari, Laguerre and Leone, 2002). Chambers, Jennings and Thompson (2002) provide evidence in favour of the risk, as opposed to the mispricing explanation, but cannot discard mispricing in the cases of change in the level of R&D.

[1] For evidence on mispricing see also Penman and Zhang (2002) and Eberhart, Maxwell and Sidique (2004).

The purpose of this paper is to build on the existing literature on R&D investments and subsequent operating and market performance, by focusing on the aspect of persistence in future performance in the context of the UK evidence during the period 1990-2003. At the same time it provides, for the first time, a complete characterisation of the UK pattern of growth and persistence of sales, gross earnings and earnings per share across the whole spectrum of firms listed on the London Stock Exchange and the Alternative Investment Market. The paper first examines the association between R&D investments and subsequent persistence in growth rates of operating performance. It then takes the persistence question one step further and examines the relation between R&D and subsequent persistence this time with respect to market performance

These issues are examined for the UK, for listed companies except financial firms, for the time period 1990-2003, following the application of the accounting standard that makes compulsory the disclosure of R&D activity in the UK after 1989. Corporate R&D activity in the UK has significantly increased in importance during that time period, starting with a total value of firm R&D expense for our sample firms of 5,135 million GBP in 1990, to more than double that amount, with 11,351 million pounds in 2003, following steady increases every year.

We argue that R&D intensity should be positively associated with persistent growth in operating performance. The rationale behind our expectation mainly relates to the fundamental or economic characteristics of the R&D intangible investments. As already mentioned, R&D intangible investments are characterised by inherent non-rival use, economies of scale and network as argued by Lev (2001). These investments also require significantly smaller marginal costs after the initial investment in them. Within this context, it is plausible to link the basic inherent characteristics of intangible assets, and thus investments in intangibles, with the possibility for persistent operating growth across a wide spectrum of economic activity. Once the initial result of an innovation is successful, due to the economic characteristics mentioned, intangible investments will tend to work in a way that favours consistency in the growth rates of operating performance. We define persistence as achieving growth rates in sales and gross income (and in EPS) above the median growth rate of the overall sample under examination for a consecutive number of years, using thus the definition of persistent growth introduced by Chan, Karceski and Lakonishok (2003).

We also build on the existing literature on R&D and subsequent stock market performance, by examining the relation between R&D intensity and persistence in subsequent stock returns. We define persistence with respect to the performance of the rest of the market:

achieving risk-adjusted excess stock returns (both cumulative and buy-and-hold) above the median excess return of the overall sample under examination for a consecutive number of years. Risk-adjusted returns are calculated with reference to the value-weighted returns of six size-value portfolios. We hypothesise in favour of a positive relation between R&D and consistency in stock market performance that could in theory be attributed to either a mispricing or a risk explanation.

In the case the market compensation for risk as the explanation for persistent excess returns driven by R&D, this relates to the fact that R&D investments, compared to investments in physical assets, involve in theory greater risk, which is associated with the uncertainty of the future benefits, as is the case with any kind of innovation. R&D investments have also been empirically associated with greater risk (Kothari, Laguerre and Leone, 2002; Shi, 2003). Ho, Xu and Yap (2004) also document theoretically and empirically the relation between R&D and systematic risk and provide evidence on the stocks of R&D intensive firms having greater systematic risk in capital markets. This risk, justified by the uncertainty of the future benefits of the R&D investments, can affect the operating performance of a firm for more than one year after the year when the expenditure initially took place. In addition, in case the initial investment is successful, the benefits of R&D are likely to materialise and be observed at some point of time in the future (Chan, Lakonishok and Souigiannis, 2001). Thus, it is reasonable to expect that the market should compensate for this risk over a number of periods in the future and result to a positive relation between R&D and consistency in subsequent market performance.

We expect that factors that can influence excess returns due to R&D, risk or mispricing, should be able to influence the consistency of these returns at the same time and therefore in this context, we argue that R&D intensity should be positively related with excess stock return persistence. As we expect that the market should be compensating for the inherent risk of R&D for more than one periods from the year the expenditure initially took place, there also exists evidence that the market needs a significant amount of time to adjust for the mispricing due to conservative accounting (Eberhart, Maxwell and Sidique, 2004). Both these factors though would not lead to contradictory results and work towards the same direction of linking high R&D with excess returns. Until this point, there exists no conclusive evidence in the literature as to weather risk or mispricing is at the source of these excess returns.

Our main findings are as follows. First, we find that on average, an R&D intensive firm is not found to show more persistent growth compared to a non-R&D firm. But when we assess persistence in growth only among firms that engage in R&D, because of the sector to which they belong, R&D intensity appears to be playing a role for persistent growth. We therefore document a relation between R&D and consistent growth in sales and gross income (GI) only in the cases when a firm needs to engage in R&D activity because of the nature of its operations, after controlling for firm size and the book-to-market factor. Second, this finding applies only to measures of operating performance that we find in the higher steps of the income statement (sales and GI), since we do not find that R&D plays any role for persistent growth in EPS for R&D intensive industries. Third, judging from the results about the significance of the R&D intensity variable when we regress future growth in sales, GI and EPS on R&D intensity and other control variables, R&D intensity appears to be consistently an influencing factor for future growth in operating performance. Fourth, in the case of stock returns, we show a positive relation between R&D intensity and subsequent risk-adjusted excess stock returns among firms that engage in R&D. But the returns of the R&D firms are on average, not higher than the returns of the zero-R&D firms, with the exception of the highest R&D intensity portfolios. More importantly, we take this finding on the relation between R&D and subsequent excess returns one step further and show that R&D intensity also improves persistence in excess stock returns: this is expressed as achieving excess returns above the market median excess return for consecutive years. We find that the highest R&D intensity firms earn higher risk-adjusted excess returns than the sample median return more consistently, compared to lower R&D intensity, as well as zero-R&D firms.

Our results regarding the persistence growth rates of operating performance for the UK market are generally not very far away from the relevant results that Chan, Karceski and Lakonishok (2003) get for the US. The main visible difference relates to the results on persistence in growth in earnings, as opposed to sales and gross income, which is observed to be quite higher in the UK. R&D intensity is also found to be an influencing factor for future operating growth, but we additionally show that in the UK, R&D intensity can play a role for persistence in future operating growth after controlling for the industry.

The paper is organised as follows: In Section 2, we present the sample selection process and a draft of the methodology used. Sections 3 and 4 contain the empirical results, and finally, Section 5 concludes by including reference to some limitations of the study.

2. Data and Methodology

The sample of companies used in this study is based on all UK listed (in both the London Stock Exchange and the Alternative Investment Market) non-financial firms during the period 1990-2003. As the revised SSAP 13, which makes mandatory the disclosure of the amount of R&D expensed on the income statement, was introduced in the UK for accounting periods beginning on or after the 1st of January 1989, we take 1990 as the starting year in our analysis. Firms have been identified through the London Share Price Database (LSPD-Version 2003). Accounting figures have been taken from the Worldscope database (accessed through Thompson One Banker Analytics), and information on stock returns and market values has been taken from Datastream. For a firm to be included in the study, it must have data on the book-to-market ratio, market value of equity, sales and total assets at year end. Given that accounting years end at different times during the calendar year in the UK, we use accounting year ends for accounting data, and calendar year ends for market based data. For example, for a company whose accounting year ends on the 30th of September 1990, there is used the market value of equity at the end of December 1990, and with respect to the book-to-market ratio, we use the book value at financial year end divided by the market value at the end of December 1990. Sales and total assets are the ones for the accounting year 1990. Firms are classified according to the FTSE Actuaries industry classification.

For purpose of the analysis, we use the R&D expense taken from the income statement. Although in the UK SSAP 13 allows the conditional capitalisation of development costs, the dominant practice in the UK is for R&D to be immediately expensed. Previous studies on R&D for the UK (e.g. Al-Horani, Pope and Stark, 2003; Green, Stark and Thomas, 1996) have also relied solely on the R&D expense that appears on the income statement. In our sample of companies only 3.3% of firm-year observations report capitalised development costs on the balance sheet, and 2.7% of firm-year observations report amortised development costs on the income statement (8.5% and 6.9% of firms respectively) [2]. The magnitude of the yearly amounts of development costs amortised is also very much lower than the amounts of R&D expensed on the income statement [3]. This way, it is unlikely that relying solely on income statement R&D should result in much loss of information.

[2] Given that Worldscope, which is used in the study for accounting data, does not provide separate items for the amount of Capitalised Development Costs as well as Development Cost Amortisation, there have been used the items EX.FixedAssetsDevelopCostsGross and EX.FixedAssetsDevelopCostsAmort from the Extel Database which provides the relevant items separately.

[3] This data is not included in this paper but is available upon request.

The above sample selection process results in a total of 15,488 firm-year observations (2,182 firms) for the period 1990-2003, out of which 31.4% report R&D (4,851 firm-year observations and 770 firms). Table I shows R&D reporting according to industry using both firm-year observations as well as numbers of firms; increased R&D reporting is observed in the sectors where one would expect significant R&D activity, such as IT Hardware with and Pharmaceuticals, with percentages close to 80% (using firm-year observations). Electronics and Engineering also exhibit high rates of R&D activity with 69.5 and 54.5% of firm-year observations reporting R&D respectively. It is worth noting that only 54.7% of Software & Computer Services companies report R&D, compared to a significantly higher percentage for Hardware companies. Not surprisingly, firms in Retailing, Household Goods, Leisure, Media and Support Services are engaging in limited R&D activity.

Insert Table I here.

An issue that arises with respect to any research about valuation issues on R&D relates to the use of yearly R&D expense, or some form of calculated R&D capital. This is because the latter takes into account past year R&D expenditures and thus could be a better proxy for R&D activity. The calculation of R&D capital though makes necessary the use of lagged R&D values. Given that the sample period for the study starts in 1990 for the reason explained, and covers only 13 years in total, the calculation of R&D capital would mean that there would be lost some valuable years from the beginning of the sample period in order exactly to calculate this R&D capital.

In order to overcome this problem, we have applied the methodology first used by Al-Horani, Pope and Stark (2003); we first estimate R&D capital using the Chan, Lakonishok and Sougiannis (2001) five year uniform amortisation technique for the period 1994-2003, and then we calculate the Pearson correlation coefficients between the yearly R&D expense and estimated R&D capital before and after deflating R&D and calculated R&D capital by sales, total assets, and market value of equity. In every case, in line with the results of Al-Horani, Pope and Stark (2003), the Pearson correlation coefficients are steadily above 0.9, with one or two of exceptions, where the coefficients are just above 0.8[4]. Given the high the Pearson coefficients, it is assumed that yearly R&D expense is a good proxy for R&D activity and therefore we don't make use of calculated R&D capital.

In addition, when dividing the sample into quartiles according to R&D intensity (R&D/Sales and R&D/TA), it is observed that, on average, more than 75% and more than

[4] Data for these calculations are not presented in the paper, but they are available upon request.

60% of firms from the lowest and top R&D intensity quartiles, fall into the same (bottom and top respectively) quartile for the next one and two years respectively. This way, the R&D activity that a firm undertakes over time appears to exhibit a certain degree of stability.

R&D intensity is defined in two ways: first, as R&D expense from the income statement divided by annual sales, and second, as R&D expense divided by firm Total Assets. These definitions apply to the case where we assess persistence in terms of operating performance growth. This way, in the case of operating performance, we choose two R&D intensity measures that are not market-based (such as for example R&D/MVE), given that the analysis focuses on operating results. In the case of market performance though, when we assess consistency in terms of stock returns, we also use R&D-to-market value of equity as a proxy for R&D intensity. This addition is justified by the fact that Chan, Lakonishok and Sougiannis (2001) find an increased relation between R&D and stock returns when forming R&D intensity portfolios according to R&D/MVE instead of R&D/Sales.

Persistence in growth in operating performance is defined as achieving growth rates, on a per share basis, in the measures of operating performance used, above the median of the overall sample for up to five years ahead from each base year, following thus the definition by Chan, Karceski and Lakonishok (2003). We use three measures of operating performance, sales, gross income (defined as sales minus cost of goods sold) and EPS (profit after tax, minority interest, and preferred dividends, excluding extraordinary items prior to 1993 and including them after that year due to the implementation of FRS3). We then assess persistence in growth according to R&D intensity, by including controls for the possible risk factors of firm size and the book-to-market ratio, as well as the industry in certain cases. We also include a control in order to assess the magnitude of survivorship bias, and finally regression analysis, in order to assess the influence of R&D, among other fundamental factors for future growth rates in our measures of operating performance.

Persistence in stock market performance is defined as achieving risk-adjusted cumulative abnormal returns (CAR) or abnormal buy-and-hold returns (BAHR) above the median excess return of the overall sample for up to five years ahead from each base year. Risk-adjusted returns are calculated with reference to the value-weighted returns of six size-book-to-market portfolios. We then assess persistence in stock returns according to R&D intensity, when R&D intensity is defined in various ways. Finally, given the mixed expectation as to whether consistency in excess returns due to R&D is a result of risk or mispricing, we include some relevant controls.

3. Persistence in Operating Performance Growth

Table II (Panel A) shows summary statistics on the R&D/Sales and R&D/TA ratios for the sample firms throughout the sample period 1990-2003 according to quintiles, giving the median values for each variable in the middle of the quintile breakpoints for each year. The R&D/Sales and R&D/TA ratios have increased steadily from around 1.2% (median values) in 1990 to slightly higher than 4% in 2003. We also observe a very high increase in the value of the top R&D intensity quintile as we move towards the end of the sample period. For both R&D/Sales and R&D/TA ratios, the breakpoint for the top 20% of firms started right above 3% for 1990 to end at above 20% for R&D/Sales and almost 15% for R&A/TA at the end of the sample period.

Table II (Panel B) provides yearly quintile breakpoint values data on R&D expense (in £ million) for the R&D reporting firms only. The table also reports the total and mean value of the R&D expense for the firms in the sample for each year, and shows the number of firm-year observations and firm-year observations that report R&D for each year as supplementary information. We observe that although the R&D quintile breakpoints and median values have not changed much throughout the sample period, implying a high degree of stability in the dispersion of these values across the sample firms (median firm R&D starts from £1.9 million in 1990 to end at £1.91 million in 2003), the mean R&D expense has increased from £19.98 to £29.48 million during that time. Interestingly, the total amount of firm R&D activity has more than doubled between 1990 with £5,135 million and 2003 with £11,351 million, following steady annual increases, while the number of observations in our sample has only risen by 3.7% during that same period.

Insert Table II here.

Before moving on to the persistence question, Table III provides evidence on the growth rates in sales, positive Gross Income (GI), positive EPS and Total Assets (TA) per share according to quintiles on a year by year basis during the sample period 1990-2003 for the whole sample (Panel A) and for R&D firms only (Panel B). The number of shares used to calculate growth per share has been adjusted for splits. Starting with the results for the whole sample in Panel A, we observe that the median growth rates in sales, GI and TA start from slightly negative during the first years of the sample period, to generally positive after 1992, reaching their peak between1994-2000. Between 1992 and 1994, the median growth rates in sales range between 3% and less than 9%. Interestingly, median growth rates in TA go back to being negative after 2001, which is not the case for either sales or GI. Growth rates in GI are generally larger than growth rates in sales, both in terms of median values as well as quintile breakpoints but in general there are no big differences between the median values in the growth rates of sales and GI. In addition, the values of the top quintile breakpoint have increased dramatically (almost doubled from slightly above 10% to a little bit lower than 30%) for both the sales and GI growth rates, which is not the case for the growth rate in TA. EPS growth follows steady increases until 1998, and starts declining afterwards. We also report on Table III the average values for the breakpoints that define the quartiles for growth in sales, GI, EPS and TA during the sample period at the right of the table.

Panel B shows that the equivalent growth rates for the R&D firms only follow the trends of the growth rates of the sample firms in general for all three variables. The only difference between the R&D firms and the whole sample is in the growth rate quintile breakpoints and median values are in every case slightly lower, compared to the figures we get for the whole sample. This fact is well reflected into the average values for the breakpoints that define the quintiles for growth in sales, GI and TA during the sample period at the right of the table for the R&D firms. EPS growth for the R&D firms only follows steady increases until 1998, and starts declining thereafter, as was the case for the whole sample. The median EPS growth rates for the R&D firms are generally lower than the ones for the whole sample, a fact that could imply the influence that this particular measure of operating performance receives from the expensing of R&D.

Insert Table III here.

We define and measure persistence as in Chan, Karceski and Lakonishok (2003); thus, we estimate how many times a company can achieve growth rates per share in the measures of operating performance in question above the median of the overall sample for up to five years ahead from every base year. The measures of operating performance used are annual sales and gross income (GI), and for reasons of completeness, we repeat the analysis using also EPS as a measure of operating performance. Then the number of firms with growth rates above the sample median growth rate for the next one to five years is divided by the total number of firms that survive for the next one to five years. Median growth rates are calculated using all the available firm observations in a particular year. In the case of GI and EPS, also following Chan, Karceski and Lakonishok, we do not follow the growth in this measure for the five year horizon if GI or EPS in the base year is negative. Regarding the EPS measure of operating performance, it is the only one among the three measures used that measures operating performance *after* the expensing of the R&D figure. It can this way be heavily influenced and distorted by this procedure of immediate expensing, especially in the presence of significant R&D. At the same time though, this very fact of assessing the persistence in growth behaviour of a profit measure *after* the expensing of R&D may provide us with valuable information about how different measures of performance in growth, that may be affected or not by the expensing of R&D can behave in terms of persistent growth.

For example, if a firm achieves a growth rate for sales or GI above the median growth rate for 1990-1991 (that is -0.024 for sales and -0.048 for GI according to Table IV), it is included in the 'persistence' sub sample. If it achieves a growth rate above the median growth rate for 1991-1992, given that it was above the median for 1990-1991, it is also counted etc up to 1994-1995 for the base year 1990. Of course, as we approach the end of the sample period, the number of subsequent years available is less than five e.g. 1999+4, 2001+2, 2002+1, since the last year in the sample is 2003. We then calculate the average number of firms with growth rates above the median for the next one to five years, the average number of firms that survive for the next one to five years from each base year, and finally the average percentage of firms with growth rates above the median for the next one to five years from every base year, which is the figure reported in our tables. It should be noted here that when assessing persistence according to sub-samples (e.g. R&D vs. non-R&D firms), the number of firms in the sub-sample with growth rates above the sample median is divided with the total number of firms from the specific sub-sample that survive for the next one to five years.

Table IV presents exactly this information on the average percentage of firms with growth rates above the sample median growth rate for t+1 to t+5 from every base year for the whole sample, for R&D and zero R&D firms, then for the R&D firms only according to R&D/Sales and R&D/TA quartiles, and finally for the whole sample divided in quartiles according to Total Assets, B/M and MVE, for all of sales, GI and EPS. On average, 5.2% of the sample firms achieve growth rates in sales above the median growth rate of the sample five years after each base year. This percentage becomes 4.8% for gross income. These results for the UK, for both sales and GI, are quite close to the ones Chan, Karceski and Lakonishok (2003) get for the US market for their five year window, i.e. 6.3% for sales and 3.6% for GI. As one would expect intuitively, the percentages for sales are slightly higher compared to the ones for GI, given that a firm has to translate growth in sales into growth in GI. Interestingly, the average percentage of firms that achieve a growth rate above median in EPS five years after portfolio formation is quite high at 5.6%. This finding, which appears to be quite counter-intuitive given that the relevant result for sales is 5.2%, is driven mainly by the relevant high percentage of the zero-R&D firms, with 7% of firms achieving a growth rate in positive EPS above the sample median growth rate after five years. This result could also be affected by survivorship bias; there are the growth rates in positive EPS of the surviving, and thus more successful, firms that are used in order to come to this result.

Insert Table IV here.

On average, zero-R&D firms exhibit more persistent growth rates compared to the R&D firms for sales, GI ad EPS for every time window from t+1 to t+5. As can also be observed from the table, persistence in growth relates negatively to the BM ratio, with better results for smaller BM firms, although this result is less pronounced in the case of EPS growth. Interestingly, there does not appear to exist a clear trend for persistence in growth according to firm size, when size is expressed either in terms of TA or MV. Limiting the analysis within the R&D sample only, the top R&D intensity quartile clearly exhibits the best persistence results, in terms of Sales, GI and EPS, no matter which proxy for R&D intensity is used (R&D/Sales or R&D/TA) and generally persistence in growth tends to improve as R&D intensity increases.

Next we assess persistence in growth for R&D firms, R&D intensive firms and zero R&D firms matched according to firm size, using MVE as the proxy for size, and the book-to market ratio. This way, the sample firms are divided into two market value of equity portfolios, using the median MVE as of the end of December in each year. Then the firms in each of the two MVE portfolios are divided into three book-to-market (BM) portfolios: one containing the lower 30% values for BM, another one with the middle 40%, and finally, a portfolio containing the top 30% of BM ratios. This results in six size-value portfolios (2 by 3 size-BM portfolio analysis). Portfolio breakpoints are rebalanced every year, and there are calculated the average percentages of firms with growth rates in sales, GI and EPS above the sample median growth rates, for t+1 to t+5 from every base year, for the R&D and zero R&D firms, as well as firms with R&D/Sales and R&D/TA ratios above the sample median every year (the R&D intensive firms), which belong to each portfolio.

Insert Table V here.

A casual comparison of the persistence patterns between R&D and zero R& firms is sufficient to suggest that R&D expense does not enhance consistency; in every one of the six portfolios, for all of sales, GI and EPS, the zero-R&D firms generally exhibit higher persistence in growth, compared to the R&D and R&D intensive firms. However, when we focus only on the R&D population, on average, the R&D intensive firms, show improved persistence compared to the general population of the R&D firms. This result holds when R&D intensity is expressed either in terms of the R&D/TA and the R&D/Sales ratio, and is as strong in the case of EPS growth as it is when assessing persistence in growth for sales and GI.

The above size-BM matching analysis though, performed for the whole sample, lacks controls for possible industry effects. This fact could pose significant limitations to the analysis, given that differences in performance among the sample firms could be due to industry effects. Thus, in addition to size-BM matching, we repeated the above separate analysis for three separate industries with enough firm-year observations to permit meaningful portfolio construction for R&D, zero R&D and R&D intensive firms; these are: Information Technology (that groups, according to FTSE Actuaries classification, the sectors of Information Technology Hardware and Software & Computer Services), General Industries (which includes Aerospace & Defence, Diversified Industrials, Electronic & Electrical Equipment, Engineering and Machinery, according again to the FTSE Actuaries classification), and the Health and Pharmaceuticals & Biotechnology sectors grouped together (called 'Pharma' onwards). This latter 'Pharma' grouping does not correspond to a specific FTSE Actuaries Industry definition, but we chose to group together given the closeness of their operations.

We perform a simpler 2x2 MVE-BM portfolio construction within each of the three industry groups defined. We first divide the firms that belong to each industry in two MV groups within the industry (employing MV as of the end of December), using the median industry MV, and then each MV portfolio is divided into two BM portfolios. Portfolios are rebalanced annually. We then assess the persistence in growth results for the R&D firms, zero R&D firms, and R&D intensive firms (firms with R&D/TA and R&D/Sales ratios above the industry median) that belong in each of the four MVE-BM portfolios.

Table VI (Panels A, B and C) show persistence estimates for IT, General Industries and Pharmaceuticals respectively. In sharp contrast to the previous table, we now observe for each of the three industry groups, compared to the zero-R&D firms, there are the R&D intensive firms that show the most persistent growth rates in sales and GI. This result does not hold for each of the four MVE-BM portfolios every time, but for the majority of the portfolios in each of the three industries, and is more pronounced for the three year window. This result is underlines the positive influence of R&D for performance consistency within an R&D intensive industry.

Insert Table VI here.

More specifically, in the case of Information Technology, with the exception of the low MVE-low BM portfolio, for both sales and GI, generally there are the R&D intensive firms within the industry (when expressing R&D in terms of both R&D/Sales and R&D/TA) the ones that exhibit the most persistent growth rates, followed by the R&D firms in general and then by the zero R&D firms. For General Industries, the results are more in favour of the R&D intensive firms, given that here they are the ones that generally exhibit the best persistence in growth results for all four portfolios, compared to the R&D firms overall and the zero R&D firms. Finally, the same results are more or less observed for the Pharmaceuticals sector, with the exception of the low MVE-low BM portfolio, for which, as was the case for the IT industry, there are the zero R&D firms the ones that show the most persistent growth in sales and GI.

In the case of persistence in EPS growth within these industries though, there appears to exist no general evidence about R&D intensity being able to influence persistence in a positive way. As can be observed from Table VII, the most R&D intensive firms appear to exhibit improved persistence in EPS only in the case of General Industries. For IT and Pharma, the highly R&D intensive firms do not exhibit signs of improved persistence in EPS, and thus the trend that had been observed for persistence in their sales and GI growth does not seem to hold for EPS as well.

In short, our findings from Tables V and VI indicate that R&D intensity plays a role for persistence only within industry sectors that are intensive in R&D by definition, due to the very nature of their operations; all four industry groups included in the industry matching analysis present high percentages of R&D reporting according to Table I. Although we do not imply that 'R&D investments are a proxy for industry membership' (Al-Horani, Pope and Stark, 2003), we expect that R&D activity will be more important for firm operations and competitive advantage in certain sectors and less in others, due to the nature of the operations in each sector. In the first stage of our MV-BM portfolio matching analysis, when all the sample firms were used without industry matching, the sample included a large number of observations from very big sectors such as Support Services, Media and Leisure, all of which report very little R&D. These sectors have been generally successful during the 1990's, and we would expect that R&D activity can be less crucial in these sectors than it is for example for IT. It could be therefore be the case that the very good persistence results of very large sectors that do not need to engage in significant R&D activity are actually driving the persistence results in favour of the zero R&D firms when we perform MV-BM matching without controlling for the industry. In the second case though, when we compare the performance among firms in the same sector and we assess persistence within industries that by construction should engage in R&D in order for a firm to remain competitive, the R&D investment appears to be playing a much more important role for persistent growth.

In trying to understand the lack of evidence of a direct link between R&D and EPS growth persistence, even after taking the industry sector into account, with the exception of General Industries, one cannot ignore the influence that this item receives by the accounting treatment of R&D. The finding appear to be particularly interesting if we consider that the median R&D/Sales ratios for IT, General Industries and Pharma during the period 1990-2003 are 7.1, 1.6 and 4.8% respectively (7.5, 2.2 and 9.5 for R&D/TA). Thus, IT and Pharma are significantly more R&D intensive sectors than General Industries. EPS is the only item after the expensing of R&D that we use, and thus it can very well be 'understated' by the amount of R&D involved in a particular year, especially in the case of very R&D intensive firms. This way, a trend that is observed in measures of operating growth *before* the expensing of R&D appears to be reversed in the case of very R&D intensive industries, such as IT or Pharmaceutical sectors.

A self-built limitation of this type of study on persistence is that it only uses the firms that survive for the next one to five years from each base year. The analysis is only based on the growth rates of the surviving, and therefore probably more successful firms. Thus, by including the growth rates of more successful firms, the persistence results could be biased upwards. In order to evaluate the extent of this problem, that exists by construction in the study, we performed a control similar to one used by Chan, Karceski and Lakonishok (2003) (untabulated data[5]). We calculated the average percentages of firms with growth rates in sales, GI and EPS above the sample median for the next one to three years, for these firms that survive for a full five year period after each base year, and for the firms that do not survive for more than three years. The analysis is performed only for this part of the sample period for which there exist data for full five years ahead, that is for the period 1990-1998. As one would intuitively expect, firms that survive exhibit improved persistence results over the three year window, compared to non-survivors, with higher percentages of firms with growth rates above the median for both sales, GI and EPS. When we repeat the analysis only among the R&D, zero R&D and R&D intensive firms (R&D/TA and R&D/Sales above sample median), the direction of the result does not change: there are the survivors that exhibit more persistent growth compared to the non survivors, a fact that only confirms the expected bias arising from the self-built limitation of the study to be dealing only with surviving firms.

After performing the descriptive analysis and portfolio matching steps, for reasons of completeness of the analysis, we use regression analysis to asses the extent R&D intensity,

[5] Data for the calculations described at this part are not presented in the paper, but are available upon request.

among a few other control variables and past persistence, can influence growth rates in measures of operating performance for up to five years ahead of every base year. A similar type of analysis is also employed by Chan, Karceski and Lakonishok (2003). This involves a model close to the one they develop, with some modifications in the right hand side variables included and on the treatment of possible econometric problems.

More specifically, we use an addition to their model, with the inclusion of a dummy variable in order to assess the influence of past persistence. Moreover, our this model contains a significant difference compared to the one Chan, Karceski and Lakonishok (2003) use, in terms of the time period to which the independent variables apply. In Chan, Karceski and Lakonishok (2003), all the right hand side variables are taken at time zero, given that their objective is to draw conclusions about the predictive power of these variables for future growth in operating performance. In this model, the objective is to assess whether R&D intensity, among other control variables, is able to influence future growth rates in sales, gross income and EPS. Therefore, where applicable, there are used averages of the independent variables during the time period which the dependent variable involves.

The following regression is run with OLS using panel data for the whole sample for the period 1990-2002:

$$GR = \beta_0 + \beta_1 RD + \beta_2 MV + \beta_3 BM + \beta_4 PERSDUMMY + \beta_5 PASTR + e_{it} \quad (1)$$

where:

GR - cumulative growth in a) sales, b) gross income (Sales –COGS) or c) EPS (profit after tax, minority interest, and preferred dividends, excluding extraordinary items prior to 1993 and including them after that year due to the implementation of FRS3) for the next one to five years from each base year (using 1+growth).

RD - average R&D/Sales or R&D/Total Assets ratio during the time period for which GR applies.

MV - average MVE during the time period for which GR applies.

BM - average book-to-market ratio during the time period for which GR applies.

PERSDUMMY - dummy variable taking the value of 1 of the company exhibited persistence in the measure of operating performance that GR represents each time (sales or gross income or EPS) over the past two years (achieved growth rates above the sample median in each of the past two years), and zero otherwise.

PASTRET - the stock's prior to the end of t six month of t compound rate of return (geometric mean).

We also include industry dummy variables for 4 industries which are perceived as intensive in R&D activity: Information Technology, Chemicals, General Industries and Health grouped together with Pharmaceuticals and Biotechnology ('Pharma'). The dummy variable takes the value of 1 if the firm belongs to the specific industry, and 0 otherwise.

A possible limitation of the above regression is that in the twelve regressions where we use the growth in sales, GI and EPS for the next two to five years as the dependent variable, a number of companies are lost in the way as move on into future years. In order to adjust for sample selection bias arising from this survivorship issue, we have used Heckman's two step selection correction estimation, as described in Heckman (1979) and Greene (1981). So, in the cases where we use growth in sales, GI and EPS for the next 2-5 years as our regressors (twelve regression equations in total), before running the actual regressions, our first step is to use a probit model with panel data in order to estimate the likelihood of a company to be included in the sample of the ones that survive for the next two to five years.

$$Selection = \alpha_0 + a_1 SP + \alpha_2 PASTSA + \varepsilon_{it}$$

where *Selection* equals one if we have an observation for sales or GI or EPS growth for the next 2-5 years, depending on the regression, and zero otherwise. SP equals the sales-to-price ratio at the end of year t and PASTSA equals the sales growth over the two years prior to year t (geometric mean).

In the second stage, we run (1) with panel data, but in order to obtain consistent errors, there is added an extra regressor $\beta_{7it}\lambda$, where λ is the Heckman correction, that is included as a control and that we obtained from the first step. All variables have been transformed by using natural logs, which permits reducing the variation of the variables as well as the interpretation of the results in the form of elasticities. Observations above the 98 and below the 2 percentile were eliminated for all variables.

Table VII Panel A presents the coefficient estimates and values of t-statistics (in parentheses) that have been estimated by running the panel data regression (1), when the dependent variable GR equals the growth in sales or GI or EPS for the next year. The regression is run using OLS and White's Heteroskedasticity robust standard errors. Table VI Panel B reports the regression coefficients and related z statistics for the Heckman two-stage correction model, when the dependent variable GR cumulative growth in Sales, GI and EPS for the next 2 to 5 years. In total, there are run fifteen regressions: five for the dependent variable sales, assessing growth in sales from year t to year t+1 (Panel A), t+2, t+3, t+4 and t+5 (Panel B), and five similar regressions for GI and EPS.

Insert Table VII here.

According to the results reported on Panel A, all independent variables except for the past persistence dummy variable appear statistically significant for the Sales regression, and this is also the case for the GI and EPS regression, with the exception of the past return variable in the EPS regression, which is not significant. All variables appear to have the expected sign in the sales regression: they are all positive with the exception of BM, a fact that is quite intuitive. In the GI and EPS regressions, the persistence dummy, in addition to BM, contrary to what we would expect, is also negative. The variable with the highest economic significance is PASTR for both the Sales and GI regressions, but becomes insignificant even at 10% significance level in the EPS regression. The constant term is also negative and significant[6]. We observe that, even after having controlled for other variables, the R&D/Sales variable is positive and statistically significant at 1% significance level in all regressions. When we replace R&D/Sales by R&D/TA (data does not appear on table), there is no change in the results, and the variable has a positive sign and is statistically significant at 1% as well. Coefficients though for R&D/TA are slightly lower than the ones for R&D/Sales, and the same applies for the values of the t statistics. When we include dummy variables to account for the four R&D intensive industries of Information Technology, Chemicals, General Industries and Health grouped together with Pharmaceuticals and Biotechnology ('Pharma') (data does not appear on table), there is no change in the result with respect to the rest of the variables: the dummy variables for General Industries and Pharma are the only ones that appear significant at 1%, whereas the other two are not significant at any reasonable level of significance for the sales and GI regressions. No dummy variable is statistically significant in the EPS regression. Finally, all dummy variables with the exception of the one for Pharma get negative signs in the sales and GI regressions, when all dummy variables, although statistically insignificant get negative values with the exception of IT in the EPS regression.

Table VII (Panel B) first presents the results of the first step of the Heckman 2-step procedure. This first step refers to the probit model described, and the sales-to-price SP variable appears in every case statistically significant and with a negative sign for all of the Sales, GI and EPS regressions, whereas the past sales PASTSA variable is almost in every

[6] In the case of the EPS regressions, given the accounting changes imposed by the implementation of FRS3 for accounting years ending on or after the 22nd of June 1993, we have repeated the EPS regressions only for the period 1994-2002 with no great change in the direction or significance of the results (untabulated data).

one of the twelve regressions negative, contrary to what one would expect but not significant. The constant term is also positive and significant. The lambda correction term that has been estimated by this first step and that will be used in the second step appears in every case statistically significant at 1% and negative for the sales and GI regressions, but positive for the EPS regressions.

With respect to the second step of the Heckman procedure presented in Panel B, the Wald statistics we get after running (1) after having used the lambdas from the first step have p-values close to zero for every one of the twelve regressions. The constant terms are positive and significant for the Sales and GI regressions, but get negative in the case of the EPS regressions. The past persistence dummy variable PERSDUMMY, although it has a positive sign most times as one would expect, does not appear to be statistically significant at any reasonable level for sales and GI. In the case of the EPS regressions though, it is in every case statistically significant but gets a negative sign, contrary to what one would expect. The coefficient of the past returns variable PASTR gets both positive and negative signs, but is of limited overall significance in the GI and EPS regressions. In the case of the sales regressions though, except for the five year time window, PASTR is positive and significant at 1%.

In all twelve regressions, the coefficient for BM is negative as intuitively expected, and exhibits very strong significance almost in every regression. The behaviour of the MV variable is not consistent across regressions: it has a positive sign for the GI and EPS regressions but its sign depends on the time window for the sales regressions. Overall, with the exception of a case or two, it does not appear to be statistically significant for sales and GI, but this situation reverses in the EPS regressions.

More importantly, the coefficient for the R&D/Sales variable appears positive and significant at 1% in all twelve regressions. Replacing R&D/Sales with R&D/TA (data does not appear on the table) causes no changes in the results. The coefficients though for R&D/TA are slightly lower than the ones for R&D/Sales, and the same applies to the values of the z statistics. This shows that R&D intensity, even after having controlled for other variables, appears to be an influencing factor for growth in future sales, GI and EPS, as was found by Chan, Karceski and Lakohishok (2003) for the US market. Finally, the inclusion of the industry dummy variables dos not cause any distortion in the results: in the sales and GI regressions, the only dummy with positive signs is the one for Pharma, as was the case with Panel A, whereas contrary to the relevant results of Panel A, the only dummy that appears as consistently statistically significant at 1% is the one for IT. For the EPS regressions, the industry dummy variables get negative sings and are statistically not significant in most regressions, with the one for Pharma being statistically not significant in every regression.

The overall findings on the relation between R&D and consistency in subsequent operating performance growth indicate that, after controlling for firm size and the book-to-market factors, there seems to exist an relation between R&D and consistent growth, but only in the cases when a firm needs to take on R&D activity as a result of the nature of its operations. On average, an R&D intensive firm does not show more persistent growth compared to a non-R&D firm. When though one is comparing among firms that engage in R&D, because of the industry sector in which they belong, R&D intensity seems to be playing a role in persistence. This finding applies to measures of operating performance that we find in the higher steps of the income statement e.g. sales and GI, since we do not find that R&D plays any role for persistent growth in EPS for R&D intensive industries. Finally, judging from the results about the significance of the R&D intensity variable in the sales, GI and EPS regressions, after controlling for other factors, R&D intensity appears to be consistently an influencing factor of future growth in sales and GI and EPS.

4. Persistence in Stock Returns

4.1 Calculating Risk-Adjusted CAR and BAH

To assess long term stock market performance we calculate both cumulative and buy-and-hold (BAH) risk-adjusted abnormal returns calculated using reference portfolios, similar in terms of firm size (MVE) and value (book-to-market-BM). Sample firms are divided into two size portfolios, using the median MVE as of the end of June in each year t. Then the firms in each of the two portfolios are divided into three BM portfolios: one containing the lower 30% of values for BM, another one with the middle 40%, and finally, a portfolio containing the top 30% of BM ratios. The BM ratio is calculated using the book value at the end of the accounting year t-1 and the MVE at the end of December of t-1. In order to allow for financial data to be made public, the first month for which returns are calculated is July at year t. This results in six size-value portfolios, for which the breakpoints are rebalanced every year. The abnormal return for a firm for a specific month equals its return for the month minus the value-weighted return of the corresponding size-value reference portfolio for the specific month. The value weights for the calculation of the value weighted returns are rebalanced every year, and have been calculated according to market values at the end of June in year t. There are used total returns, which include dividends.

We then calculate both cumulative abnormal returns (CAR) and abnormal buy-and-hold returns (BAHR), for each firm and for the reference portfolios for a particular time window, and compute the abnormal return for a firm as the difference of these two values. Table VIII shows the average equal weighted CAR and abnormal BAHR over the next one to five years from each base year for the whole sample, then for the R&D versus the zero R&D firms, and finally according to R&D intensity quartiles, expressing R&D intensity as R&D/TA, R&D/Sales and R&D/MVE. It is worth noting that there are not any qualitative differences in the direction of the two measures of stock market performance. Zero R&D firms exhibit higher returns compared to R&D firms, but when calculating returns among R&D firms only, returns increase as R&D intensity increases, whatever the proxy for R&D intensity used. Interestingly, the relation between returns and R&D intensity is higher when R&D/MV is used as a proxy for R&D intensity. This stronger relation when using R&D/MV as a proxy for R&D intensity is consistent with a relative finding by Chan, Lakonishok and Sougiannis (2001), who find for the US an increased relation between R&D and returns when they replace R&D/Sales with R&D/MV as a proxy for R&D intensity. Interestingly, when we switch from equal-weighted returns to value weighted ones, calculated as with equal weighted returns with respect to the value weighted returns of the reference portfolios, as shown on Table IX, R&D firms outperform the whole sample as well as zero R&D firms. Excess returns in this case too are higher for the top R&D intensity portfolios, whatever the proxy used for R&D intensity. Overall, there appear to exist not great differences with respect to the direction of the results when we replace CARs with BAHRs, despite the fact that the returns are more pronounced in the case of BAHRs, due to the compounding effect[7].

Insert Tables VIII and IX here.

Consistent with Chan, Lakonishok and Sougiannis (2001), we also find that although zero-R&D firms exhibit improved risk-adjusted returns compared to R&D firms overall, the highest returns are observed in the top R&D intensity portfolio for both CAR and BAHR. This portfolio, no matter whether R&D/TA, R&D/Sales or R&D/MV is used to define it, exhibits by far the highest returns, compared to the zero R&D firms.

[7] We have also calculated the average equal and value weighted returns with respect this time to the *equal-weighted* returns of the six MV-BM reference portfolios, with no qualitative differences in the direction of the results (untabulated data).

4.2 Persistence in Stock Returns

Persistence in stock returns is defined as achieving either excess cumulative or excess buy-and-hold stock returns (risk-adjusted) above the median excess CAR or BAH return (risk-adjusted) of the overall sample under examination for up to five years ahead from each base year. This measure of persistence is comparative, assessing persistence with respect to the performance of other firms in the sample.

Both CAR and abnormal BAHR are calculated on a yearly basis, using monthly data from July at year t until June at t+1, July at t+1 until June at t+2, and finally July at t+4 until June at t+5 for the five year window. The persistent estimates show measured how many times a company can achieve an excess return, either CAR and BAH, above the median yearly excess CAR and BAH of the overall sample for up to five years ahead from every base year. Then the number of firms with returns above the median is divided by the total number of firms for which there exist returns for the next one to five years. We then calculate the average number of firms with returns above the median for the next one to five years, the average number of firms for which there exist returns for the next one to five years, and finally the average percentage of firms with returns above the median return for the next one to five years from every base year, which is the figure reported in our tables. It should be noted here that when assessing persistence according to sub samples (e.g. R&D vs. non-R&D firms), the number of firms in the sub sample with returns above the sample median is divided with the total number of firms from the specific sub sample for which there exist returns for the next one to five years. Median CAR and BAHR are calculated using all the available firm observations in a particular year from July until next June. If a firm delists during that period, there is kept the last month for which there exists a return. The excess risk-adjusted CAR and BAH returns of the sample firms and subsequently the median excess risk-adjusted CAR and BAHR for the overall sample that are used as reference returns in order to define persistence in market performance have been calculated with reference to the monthly value-weighted returns of six MV-BM portfolios[8].

Table X shows the average percentage of firms with risk-adjusted CAR and BAH returns above the median the next one to five years from every base year for the whole sample, the R&D firms, zero R&D firms, and R&D firms R&D firms divided into R&D intensity quartiles according to R&D/TA, R&D/Sales and R&D/MV. On average, 3.4% of the

[8] We have also calculated the persistence results using risk adjusted CARs and BAHRs that have been calculated this time with respect to the *equal-weighted* returns of the six annually rebalanced MV-BM portfolios, with no qualitative differences in the direction of the results (untabulated data).

sample firms can achieve an excess CAR above the median CAR of the sample after five years, which becomes 4.3% for BAHR. As was the case for operating performance, the zero R&D firms are the ones that exhibit higher persistence in returns (both CAR and BAHR), compared to the R&D firms. When persistence is assessed after dividing the R&D firms into quartiles according to R&D intensity, using all of R&D/Sales, R&D/TA and R&D/MV as proxies for R&D intensity, persistence generally improves as R&D intensity increases. The most interesting finding though is that no matter whether R&D/Sales, R&D/TA or R&D/MV is used as a proxy for R&D intensity, the top R&D intensity portfolio exhibits by far the highest average percentages of firms with returns above the median, and thus shows the highest consistency in both CARs and BAH returns, compared to the zero R&D firms. Persistence results are slightly higher for the top R&D intensity quartile according to R&D/MV.

Insert Table X here.

The finding just mentioned is absolutely in accordance with the previous observation that the top R&D intensity firms exhibit the highest cumulative CAR or BAH returns, and that the result is especially pronounced for the top R&D/MV firms. In this case, though, we go one step further and find that the top R&D intensity firms can earn higher risk-adjusted excess returns than the sample median in a consistent manner, for one year after another, for up to five years ahead, compared to the zero R&D firms. That is, the empirical finding that firms with very high R&D intensity can earn superior returns is found to hold also in terms of performance persistence: the market compensates for risk and these firms can earn higher risk-adjusted excess returns for one year after another.

To account for the possible interaction among variables that may have an impact on market performance we regress 12 month risk-adjusted abnormal CAR and BAH, from July of year t until June of year t+1, on R&D/MV and four industry dummy variables, that represent industries intensive in R&D investment. In specific, we run the following regression using panel data for the period 1990-2002:

$$RET_{it} = \beta_0 + \beta_1 RD + \beta_2 INDDUMMY1 + \beta_3 INDDUMMY2 + \beta_4 INDDUMMY3 + \beta_5 INDDUMMY4 + \varepsilon_{it}$$

where:

RET - the 12 month risk-adjusted equal-weighted abnormal 1) CAR and 2) BAH, from July of year t until June of year t+1. CAR and abnormal BAHR have been calculated with respect to the monthly value-weighted total returns of 6 annually rebalanced MV-BM portfolios. The first month for which the return is included is July 1991 and the last one is June 2004.

RD - R&D/MV ratio as at the end of year t-1. R&D represents the R&D expense for the accounting year that ended during the calendar year t-1, and MV the market value of equity at the end of December of year t-1.

INDDUMMY 1, 2, 3 and 4 - industry dummy variables for 4 industries which are perceived as intensive in R&D activity: Information Technology (INDDUMMY1), Chemicals (INDDUMMY2), General Industries (INDDUMMY3) and Health grouped together with Pharmaceuticals and Biotechnology ('Pharma' - INDDUMMY4). INDDUMMY takes the value of 1 if the firm belongs to the specific industry, and 0 otherwise.

The regression is run using OLS and White's heteroskedasticity robust errors. Observations above the 0.98 or below the 0.2 percentile have been eliminated. The results for this regression are presented in Table XI.

Insert Table XI here.

As we observe from the results on Table XI, the R&D intensity ratio appears to be both economically and statistically significant for both the CAR and BAHR regressions. The coefficients for the industry dummy variables get negative signs in every case, apart from the coefficient for IT in the CAR regression. With the exception of the Chemicals industry, for which the dummy variable is statistically significant at 5% in both the CAR and the BAHR regressions, the other three industry dummy variables are generally not statistically significant at any reasonable level of significance in no regression. Finally, it should be noted that the inclusion of the four dummy variables in the regression does not cause qualitative changes in the statistical and economical significance of the R&D intensity variable.

To summarise, we find a positive relation between R&D intensity and subsequent risk-adjusted excess stock returns. The returns of the R&D firms though, are on average not higher than the returns of the zero-R&D firms, with the exception of the highest intensity portfolios, which exhibit by far the highest returns. We take here the finding on the relation between R&D and subsequent stock returns one step further and show that high R&D intensity also improves persistence in stock returns, expressed as being able to achieve returns above the median excess return of the sample for a consecutive number of years: the highest R&D intensity firms are found to be earning higher risk-adjusted excess returns than the sample median more consistently, compared to lower R&D intensity, as well as zero-R&D firms.

It is worth mentioning as a final comment that in our paper, we hypothesise in favour of a positive relation between R&D and subsequent positive excess stock returns as a result of either a risk or a mispricing explanation. Assessing whether the abnormal stock returns for R&D intensive firms that we observe on Tables VIII and IX, and especially the exceptionally persistent abnormal returns for high R&D firms that we observe on Table X, are the result of market compensation for excessive risk or simply market mispricing is seen as an issue that goes well beyond the scope of this paper. This examination of this particular issue forms part of our work in progress in another paper that targets exactly to assess this question of whether persistent returns for R&D intensive firms are the result of the market rewarding for the inherent risk of R&D, risk that is not captured by other proxies for systematic risk e.g MVE or BM, or imply a manifestation of market mispricing due to investors being misled by the effects of the conservative accounting treatment of R&D.

5. Conclusion

In this paper, we build on existing evidence about the relation between R&D and future operating and stock market performance by focusing on the consistency and persistence aspect of future performance. At a first stage, we examine whether R&D investments lead to higher subsequent operating growth in a persistent manner, which means achieving growth rates above the sample growth rate median for a consecutive number of years. We argue in favour of a positive relation between R&D intensity and future persistent operating growth due to certain fundamental economic characteristics of the R&D investment. After controlling for firm size and the book-to-market factors, we find a relation between R&D intensity and consistent growth is sales and gross income, but only in the cases when a firm needs to engage in R&D activity because of the sector in which it operates. On average, an R&D intensive firm is not found to show more persistent growth compared to a non-R&D firm. However, when we assess persistence in growth among firms that engage in R&D, because of the sector in which they belong or the general nature of their operations, R&D intensity appears to be playing a role for persistent growth. This result could also be a manifestation of the fact that company resilience depends not only on the amount of R&D spent being wise and balanced, but also on good choices from a strategic point of view and excellence in firm operations. The above finding though applies only to measures of operating performance that we find in the higher steps of the income statement (sales and GI), since we do not find that

R&D plays any role for persistent growth in EPS for R&D intensive industries. Finally, judging from the results about the significance of the R&D intensity variable when we regress future growth in sales, GI and EPS on R&D intensity and other control variables, R&D intensity appears to be consistently an influencing factor for future growth in operating performance.

We also build on the existing literature on R&D and subsequent stock market performance by examining the relation between R&D intensity and persistence in risk-adjusted excess stock returns for up to five years ahead, taking into account risk differences that arise from differences in firm size and book-to-market ratios. We hypothesise in favour of a positive relation between R&D and consistency in excess market returns, that could in theory be attributed to either a mispricing or a risk explanation. We find for the UK market a positive relation between R&D intensity and subsequent abnormal risk-adjusted stock returns, both CAR and BAH. But the returns of the R&D firms are on average, not higher than the returns of the zero-R&D firms, with the exception of the highest R&D intensity portfolios, which exhibit the highest returns. More importantly though, we go one step further and find that R&D intensity also improves persistence in stock returns, expressed as achieving excess returns above the median excess return of the sample for a consecutive number of years: the highest R&D intensity firms earn higher risk-adjusted excess returns than the sample median return more consistently, compared to lower R&D intensity, as well as zero-R&D firms.

A limitation that exists by construction in this type of study has to do with the existence of possible survivorship biases: when assessing persistence in growth or stock returns for the next one to five years, there are taken into account only the firms that survive during this time period. Given that they survive, these firms could be more successful. By including the growth rates and returns of the surviving firms, we could be including the rates and returns of the more successful firms, and thus the growth rates and returns could be biased upwards. This problem is also recognised by Chan, Karceski and Lakonishok (2003) as a limitation of their study on persistent growth. This problem, on the other hand, although well admitted, appears to be self-built in a study on persistent performance, and therefore we proceed with the study despite recognising a limitation it contains by construction.

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Tables

Table I: R&D reporting according to industry sector 1990-2003 for the sample

The table reports for every sector the total number of firm-year observations included in the sample, the corresponding number of firms, the total number of firm-year observations that report R&D, the corresponding number of firms that report R&D, and finally the % of firm-year observations that report R&D.

Sector	Total firm-year observations	Corresp. No of firms	Firm-year obs. with R&D	Corresp. No of firms with R&D	% of Firm-year obs. with R&D
Tobacco	17	3	14	1	0.824
Information Technology Hardware	224	36	175	31	0.781
Pharmaceuticals & Biotechnology	381	63	296	55	0.777
Forestry & Paper	49	4	38	3	0.776
Water	169	17	130	12	0.769
Aerospace & Defense	223	22	161	18	0.722
Electronic & Electrical Equipment	722	92	502	74	0.695
Chemicals	416	50	277	33	0.666
Electricity	161	25	90	12	0.559
Software & Computer Services	1,130	222	618	139	0.547
Engineering & Machinery	1,231	148	671	96	0.545
Health	388	65	208	36	0.536
Diversified Industrials	106	16	43	7	0.406
Personal Care & Household Products	104	9	39	3	0.375
Food Producers & Processors	644	65	207	23	0.321
Steel & Other Metals	81	9	23	2	0.284
Beverages	167	19	42	7	0.251
Gas Distribution	20	4	5	3	0.250
Household Goods & Textiles	1,032	124	257	31	0.249
Telecommunication Services	145	28	35	6	0.241
Automobiles & Parts	422	51	96	12	0.227
Distributors & Other Business	336	59	70	15	0.208
Mining	240	43	47	5	0.196
Construction & Building Materials	1,379	154	256	32	0.186
Oil & Gas	362	61	66	10	0.182
Support Services	1,458	206	227	43	0.156
Media & Photography	1,142	200	115	32	0.101
Transport	506	66	46	9	0.091
Food & Drug Retailers	213	28	12	3	0.056
General Retailers	979	127	43	9	0.044
Leisure, Entertainment & Hotels	1,001	166	42	8	0.042
Total	**15,448**	**2,182**	**4,851**	**770**	**0.314**

Table II: R&D intensity for the period 1990-2003

Panel A: Values for the R&D/Sales and R&D/TA ratios for the sample firms for the period 1990-2003 are reported according to quintiles. Median values are reported in the middle.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
R&D/Sales														
Low	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.006	0.007	0.008	0.008
	0.007	0.007	0.008	0.008	0.008	0.009	0.010	0.009	0.012	0.013	0.020	0.029	0.026	0.026
Median	**0.010**	**0.010**	**0.012**	**0.012**	**0.011**	**0.013**	**0.014**	**0.014**	**0.018**	**0.018**	**0.032**	**0.053**	**0.049**	**0.044**
	0.014	0.015	0.016	0.016	0.017	0.017	0.018	0.020	0.024	0.030	0.055	0.094	0.092	0.064
High	0.032	0.030	0.030	0.036	0.041	0.044	0.047	0.057	0.068	0.078	0.179	0.293	0.254	0.206
R&D/TA														
Low	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.009	0.008	0.009
	0.009	0.009	0.008	0.010	0.010	0.011	0.011	0.012	0.013	0.012	0.016	0.024	0.026	0.026
Median	**0.012**	**0.012**	**0.013**	**0.014**	**0.015**	**0.015**	**0.017**	**0.018**	**0.021**	**0.020**	**0.027**	**0.034**	**0.041**	**0.041**
	0.019	0.017	0.017	0.019	0.021	0.023	0.024	0.026	0.032	0.034	0.039	0.052	0.060	0.061
High	0.036	0.036	0.038	0.043	0.048	0.056	0.061	0.066	0.084	0.077	0.085	0.124	0.138	0.148

Panel B: Values (in millions of GBP) for the R&D expense for the period 1990-2003 are reported according to quintiles. Median values are reported in the middle. We also report the total and mean value of the aggregate R&D expense for the sample firms for 1990-2003, and the total number of sample firm observations and firm observations that report R&D according to year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Low	0.40	0.36	0.31	0.34	0.36	0.53	0.51	0.55	0.58	0.54	0.45	0.42	0.51	0.41
	1.28	1.09	1.12	1.16	1.20	1.40	1.39	1.59	1.77	1.80	1.46	1.20	1.40	1.11
Median	**1.90**	**1.59**	**1.75**	**1.72**	**1.69**	**2.12**	**2.10**	**2.28**	**2.66**	**3.02**	**2.34**	**2.28**	**2.30**	**1.91**
	2.79	2.50	2.66	2.55	2.83	3.03	3.31	3.33	4.29	4.55	3.67	3.60	3.89	3.72
High	10.80	8.59	8.15	8.57	9.80	10.10	10.60	10.90	11.80	13.20	9.33	9.30	10.84	11.31
Total R&D expense	5,135	5,163	5,397	6,041	5,880	5,808	6,283	6,424	6,781	8,387	10,771	11,280	11,240	11,351
Mean R&D expense	20.00	18.38	17.80	18.10	16.50	16.30	17.10	18.50	19.80	26.20	28.57	26.79	27.89	29.48
Firm observations	1,075	1,068	1,043	1,063	1,092	1,089	1,110	1,079	1,071	992	1,171	1,282	1,198	1,115
Firm observations with R&D	257	281	303	334	357	356	367	348	342	320	377	421	403	385

Table III: Growth rates per share during 1990-2003 for Sales, GI EPS and TA for the whole sample and for R&D firms only

Panel A: Growth rates per share during 1990-2003 for Sales, GI EPS and TA on a year by year basis are reported for the whole sample according to Quintiles. Median values for the growth rates are reported in the middle of the quintile breakpoints. Average breakpoint values for the whole sample period are also reported. Growth rates per share have been adjusted for stock splits.

Sample	**90-91**	**91-92**	**92-93**	**93-93**	**94-95**	**95-96**	**96-97**	**97-98**	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**	**Average**
Sales														
Low	-0.178	-0.161	-0.116	-0.096	-0.041	-0.053	-0.075	-0.109	-0.107	-0.101	-0.085	-0.141	-0.127	-0.107
	-0.060	-0.041	-0.006	0.021	0.051	0.038	0.012	0.011	0.016	0.027	0.043	-0.024	-0.007	0.006
median growth rate	**-0.024**	**-0.010**	**0.032**	**0.055**	**0.081**	**0.069**	**0.046**	**0.055**	**0.055**	**0.072**	**0.090**	**0.026**	**0.039**	**0.045**
	0.013	0.025	0.066	0.090	0.115	0.102	0.083	0.087	0.093	0.111	0.149	0.073	0.084	0.084
High	0.125	0.109	0.150	0.200	0.227	0.201	0.200	0.209	0.233	0.247	0.339	0.250	0.235	0.210
GI														
Low	-0.252	-0.207	-0.167	-0.099	-0.071	-0.088	-0.084	-0.137	-0.136	-0.167	-0.163	-0.178	-0.147	-0.146
	-0.096	-0.059	-0.008	0.033	0.044	0.034	0.025	0.016	0.016	0.008	0.020	-0.016	0.000	0.001
median growth rate	**-0.048**	**-0.010**	**0.031**	**0.074**	**0.087**	**0.071**	**0.070**	**0.067**	**0.065**	**0.065**	**0.076**	**0.040**	**0.053**	**0.049**
	0.009	0.034	0.075	0.122	0.132	0.113	0.114	0.112	0.109	0.115	0.131	0.097	0.093	0.097
High	0.140	0.166	0.200	0.270	0.265	0.228	0.259	0.226	0.245	0.286	0.350	0.286	0.285	0.247
EPS														
Low	-0.440	-0.337	-0.179	-0.051	-0.116	-0.131	-0.191	-0.250	-0.313	-0.317	-0.364	-0.379	-0.304	-0.259
	-0.209	-0.087	0.046	0.125	0.085	0.069	0.059	0.054	0.004	-0.029	-0.066	-0.063	0.032	0.001
median growth rate	**-0.108**	**0.008**	**0.120**	**0.176**	**0.154**	**0.131**	**0.136**	**0.133**	**0.077**	**0.070**	**0.039**	**0.070**	**0.112**	**0.086**
	-0.005	0.076	0.180	0.273	0.220	0.196	0.205	0.200	0.153	0.152	0.130	0.147	0.207	0.164
High	0.162	0.254	0.452	0.608	0.511	0.439	0.484	0.434	0.395	0.399	0.370	0.477	0.617	0.431
TA														
Low	-0.137	-0.136	-0.126	-0.087	-0.036	-0.071	-0.070	-0.082	-0.080	-0.068	-0.154	-0.214	-0.182	-0.111
	-0.043	-0.033	-0.017	0.009	0.034	0.003	0.005	0.019	0.024	0.038	-0.022	-0.065	-0.052	-0.008
median growth rate	**-0.008**	**0.007**	**0.015**	**0.046**	**0.060**	**0.038**	**0.035**	**0.052**	**0.058**	**0.087**	**0.019**	**-0.025**	**-0.012**	**0.029**
	0.021	0.033	0.045	0.073	0.085	0.068	0.070	0.088	0.098	0.141	0.061	0.014	0.030	0.064
High	0.117	0.114	0.127	0.149	0.172	0.163	0.171	0.214	0.258	0.298	0.201	0.125	0.144	0.173

Table III Cont'd:

Panel B: Growth rates per share during 1990-2003 for Sales, GI, EPS and TA on a year by year basis are reported for the R&D firms only according to Quintiles. Median values for the growth rates are reported in the middle of the quintile breakpoints. Average breakpoint values for the whole sample period are also reported. Growth rates per share have been adjusted for stock splits.

R&D Firms	**90-91**	**91-92**	**92-93**	**93-93**	**94-95**	**95-96**	**96-97**	**97-98**	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**	**Average**
Sales														
Low	-0.137	-0.115	-0.073	-0.074	-0.035	-0.036	-0.093	-0.156	-0.089	-0.167	-0.117	-0.179	-0.133	-0.108
	-0.051	-0.035	0.015	0.024	0.049	0.036	-0.012	-0.011	-0.006	0.020	0.019	-0.062	-0.024	-0.003
median growth rate	**-0.024**	**-0.011**	**0.043**	**0.049**	**0.071**	**0.061**	**0.016**	**0.022**	**0.036**	**0.066**	**0.068**	**-0.024**	**0.024**	**0.031**
	0.007	0.020	0.076	0.075	0.104	0.093	0.044	0.060	0.066	0.094	0.124	0.021	0.059	0.065
High	0.098	0.106	0.155	0.157	0.193	0.178	0.143	0.131	0.169	0.249	0.317	0.219	0.214	0.179
GI														
Low	-0.184	-0.156	-0.097	-0.093	-0.071	-0.054	-0.125	-0.127	-0.132	-0.200	-0.216	-0.234	-0.171	-0.143
	-0.082	-0.050	0.011	0.024	0.040	0.044	-0.012	-0.016	0.012	0.000	-0.054	-0.070	-0.006	-0.012
median growth rate	**-0.045**	**-0.009**	**0.042**	**0.059**	**0.075**	**0.070**	**0.023**	**0.033**	**0.064**	**0.055**	**0.028**	**-0.008**	**0.040**	**0.033**
	0.006	0.035	0.091	0.092	0.118	0.112	0.063	0.067	0.093	0.109	0.088	0.042	0.072	0.076
High	0.126	0.154	0.205	0.200	0.222	0.211	0.183	0.172	0.219	0.275	0.279	0.192	0.215	0.204
EPS														
Low	-0.398	-0.264	-0.211	-0.116	-0.064	-0.145	-0.245	-0.371	-0.319	-0.260	-0.468	-0.408	-0.363	-0.279
	-0.192	-0.033	0.034	0.086	0.117	0.061	-0.021	-0.022	-0.031	-0.020	-0.158	-0.127	0.033	-0.021
median growth rate	**-0.098**	**0.049**	**0.091**	**0.135**	**0.169**	**0.108**	**0.069**	**0.068**	**0.063**	**0.067**	**-0.051**	**-0.005**	**0.098**	**0.059**
	-0.007	0.106	0.164	0.197	0.222	0.171	0.139	0.138	0.139	0.162	0.089	0.101	0.203	0.140
High	0.150	0.249	0.362	0.436	0.480	0.399	0.302	0.331	0.571	0.557	0.370	0.661	0.632	0.423
TA														
Low	-0.110	-0.087	-0.085	-0.059	-0.024	-0.075	-0.091	-0.100	-0.107	-0.062	-0.169	-0.256	-0.226	-0.112
	-0.027	0.010	-0.015	0.019	0.034	-0.005	-0.018	0.005	0.006	0.031	-0.041	-0.100	-0.067	-0.013
median growth rate	**0.003**	**0.031**	**0.019**	**0.043**	**0.059**	**0.028**	**0.015**	**0.033**	**0.046**	**0.070**	**-0.001**	**-0.062**	**-0.022**	**0.020**
	0.025	0.058	0.044	0.065	0.077	0.064	0.037	0.069	0.095	0.119	0.041	-0.014	0.011	0.053
High	0.115	0.139	0.121	0.125	0.133	0.136	0.119	0.193	0.220	0.362	0.145	0.071	0.108	0.153

Table IV: Persistence in operating growth according to R&D intensity, TA, BM and MV

There is reported the average % of firms with growth rates in Sales, Gross Income (Sales-COGS) and EPS above the sample Median for the next 1 to 5 years firstly for the whole sample, for R&D and zero R&D firms, then for the R&D firms only according to R&D/Sales and R&D/TA quartiles, and finally for the whole sample divided in quartiles (from low to high) according to Total Assets, B/M, MVE.

Sales	**1**	**2**	**3**	**4**	**5**	**GI**	**1**	**2**	**3**	**4**	**5**	**EPS**	**1**	**2**	**3**	**4**	**5**
Sample	0.500	0.277	0.158	0.092	0.052		0.500	0.269	0.147	0.083	0.048		0.500	0.263	0.143	0.085	0.056
R&D	0.462	0.237	0.120	0.060	0.026		0.461	0.230	0.114	0.058	0.025		0.468	0.215	0.097	0.041	0.015
Zero R&D	0.519	0.298	0.178	0.109	0.065		0.519	0.288	0.164	0.097	0.060		0.514	0.285	0.164	0.105	0.074
R&D/TA																	
Low	0.459	0.237	0.116	0.063	0.034		0.464	0.233	0.113	0.064	0.036		0.450	0.195	0.085	0.033	0.012
	0.407	0.186	0.087	0.036	0.006		0.410	0.189	0.085	0.038	0.011		0.455	0.186	0.069	0.025	0.011
	0.455	0.221	0.119	0.061	0.021		0.453	0.213	0.115	0.054	0.016		0.472	0.220	0.107	0.045	0.011
High	0.527	0.304	0.158	0.077	0.039		0.523	0.293	0.145	0.076	0.033		0.518	0.273	0.126	0.065	0.030
R&D/Sales																	
Low	0.422	0.204	0.099	0.057	0.027		0.430	0.200	0.087	0.041	0.019		0.453	0.188	0.089	0.039	0.018
	0.415	0.197	0.098	0.044	0.014		0.423	0.210	0.113	0.066	0.034		0.450	0.207	0.080	0.023	0.003
	0.469	0.236	0.124	0.055	0.021		0.463	0.219	0.104	0.039	0.008		0.464	0.199	0.087	0.041	0.011
High	0.542	0.308	0.159	0.083	0.040		0.537	0.302	0.154	0.086	0.037		0.534	0.261	0.132	0.065	0.032
TA																	
Low	0.510	0.292	0.173	0.103	0.059		0.516	0.287	0.155	0.086	0.051		0.525	0.278	0.160	0.104	0.075
	0.507	0.276	0.160	0.099	0.063		0.501	0.254	0.132	0.074	0.043		0.505	0.275	0.156	0.093	0.062
	0.498	0.282	0.164	0.096	0.050		0.496	0.273	0.156	0.091	0.047		0.499	0.275	0.147	0.084	0.051
High	0.485	0.260	0.138	0.074	0.039		0.488	0.261	0.143	0.081	0.050		0.478	0.227	0.114	0.065	0.043
BM																	
Low	0.601	0.361	0.219	0.141	0.090		0.592	0.337	0.191	0.108	0.060		0.567	0.304	0.166	0.094	0.063
	0.529	0.298	0.171	0.091	0.047		0.516	0.278	0.155	0.086	0.048		0.486	0.246	0.130	0.077	0.045
	0.478	0.251	0.132	0.074	0.038		0.479	0.247	0.125	0.070	0.039		0.460	0.242	0.131	0.083	0.055
High	0.385	0.190	0.106	0.060	0.029		0.405	0.207	0.112	0.067	0.043		0.480	0.260	0.148	0.087	0.064
MV																	
Low	0.422	0.211	0.114	0.065	0.030		0.447	0.233	0.113	0.058	0.034		0.510	0.278	0.143	0.079	0.052
	0.504	0.277	0.164	0.101	0.063		0.496	0.255	0.136	0.079	0.050		0.486	0.265	0.164	0.110	0.078
	0.543	0.317	0.184	0.105	0.059		0.530	0.294	0.172	0.100	0.055		0.517	0.275	0.152	0.096	0.062
High	0.522	0.292	0.161	0.092	0.051		0.517	0.282	0.155	0.087	0.049		0.488	0.238	0.118	0.060	0.037

Table V: Persistence in operating growth for R&D, zero R&D and R&D intensive firms matched according to MV and BM

A total of 6 BM-MV annually rebalanced portfolios were created. There is reported the average % of firms with growth rates in Sales, Gross Income and EPS above the sample median for the next 1 to 5 years for the R&D, zero R&D and R&D intensive firms that belong to each of the 6 portfolios. R&D intensive firms are defined as the ones with R&D/Sales or R&D/TA assets above the sample median R&D/Sales or R&D/TA for a particular year.

Sales	**1**	**2**	**3**	**4**	**5**	**GI**	**1**	**2**	**3**	**4**	**5**	**EPS**	**1**	**2**	**3**	**4**	**5**
R&D firms																	
MVE-BM																	
low-low	0.516	0.273	0.141	0.070	0.042		0.537	0.267	0.114	0.078	0.045		0.577	0.247	0.131	0.086	0.095
low-mid	0.410	0.190	0.081	0.030	0.004		0.420	0.200	0.080	0.033	0.009		0.444	0.253	0.127	0.075	0.027
low-high	0.342	0.135	0.050	0.026	0.007		0.336	0.130	0.043	0.005	0.007		0.478	0.275	0.113	0.000	0.000
high-low	0.563	0.315	0.181	0.102	0.044		0.555	0.305	0.167	0.080	0.028		0.527	0.260	0.120	0.047	0.014
high-mid	0.457	0.224	0.110	0.052	0.020		0.440	0.200	0.092	0.043	0.014		0.425	0.163	0.072	0.032	0.005
high-high	0.391	0.209	0.104	0.051	0.028		0.399	0.220	0.128	0.080	0.043		0.421	0.193	0.071	0.018	0.007
Zero R&D firms																	
MVE-BM																	
low-low	0.625	0.386	0.259	0.177	0.133		0.573	0.316	0.188	0.109	0.083		0.553	0.324	0.196	0.153	0.117
low-mid	0.519	0.262	0.142	0.089	0.047		0.483	0.257	0.127	0.068	0.038		0.471	0.235	0.137	0.086	0.060
low-high	0.396	0.193	0.103	0.051	0.014		0.394	0.197	0.098	0.056	0.026		0.474	0.282	0.155	0.082	0.050
high-low	0.651	0.413	0.257	0.167	0.116		0.632	0.385	0.229	0.135	0.082		0.594	0.328	0.184	0.108	0.082
high-mid	0.589	0.347	0.199	0.105	0.052		0.575	0.324	0.190	0.109	0.062		0.515	0.277	0.143	0.080	0.034
high-high	0.485	0.279	0.166	0.108	0.065		0.486	0.266	0.162	0.110	0.077		0.478	0.264	0.169	0.127	0.117
R&D/TA above median firms																	
MVE-BM																	
low-low	0.523	0.272	0.125	0.057	0.031		0.560	0.288	0.129	0.101	0.058		0.592	0.265	0.159	0.112	0.108
low-mid	0.428	0.200	0.089	0.034	0.000		0.445	0.219	0.098	0.039	0.009		0.462	0.271	0.133	0.057	0.012
low-high	0.403	0.218	0.093	0.034	0.000		0.365	0.211	0.099	0.000	0.000		0.476	0.351	0.124	0.000	0.000
high-low	0.589	0.343	0.197	0.113	0.055		0.567	0.317	0.185	0.087	0.031		0.540	0.266	0.121	0.039	0.009
high-mid	0.455	0.227	0.125	0.063	0.031		0.432	0.206	0.100	0.049	0.012		0.402	0.186	0.094	0.063	0.017
high-high	0.316	0.157	0.069	0.014	0.000		0.307	0.136	0.046	0.029	0.018		0.445	0.177	0.065	0.017	0.000
R&D/Sales above median firms																	
MVE-BM																	
low-low	0.527	0.274	0.128	0.057	0.031		0.564	0.280	0.129	0.100	0.057		0.615	0.266	0.163	0.112	0.107
low-mid	0.450	0.225	0.085	0.033	0.000		0.459	0.229	0.077	0.033	0.009		0.488	0.304	0.110	0.051	0.012
low-high	0.415	0.224	0.080	0.037	0.000		0.361	0.213	0.120	0.000	0.000		0.335	0.261	0.061	0.000	0.000
high-low	0.600	0.356	0.204	0.116	0.054		0.581	0.332	0.189	0.091	0.031		0.529	0.266	0.121	0.044	0.009
high-mid	0.469	0.225	0.132	0.062	0.034		0.441	0.197	0.098	0.047	0.012		0.416	0.179	0.081	0.057	0.015
high-high	0.358	0.172	0.062	0.007	0.000		0.350	0.184	0.066	0.021	0.008		0.394	0.187	0.095	0.000	0.000

Table VI: Persistence in operating growth for R&D, zero R&D and R&D intensive firms matched according to MV and BM within their industry

A total of 4 BM-MV annually rebalanced portfolios were created for 3 industry groups: IT, General Industries and Health grouped together with Pharmaceuticals & Biotechnology ('Pharma'). There is reported the average % of firms with growth rates in Sales, Gross Income and EPS above the sample median for the next 1 to 5 years for the R&D, zero R&D and R&D intensive firms that belong to each of the 4 portfolios for a particular industry. R&D intensive firms are defined as the ones with R&D/Sales or R&D/TA assets above the industry median R&D/Sales or R&D/TA for a particular year. The results for IT, General Industries and Health grouped together with Pharmaceuticals & Biotechnology are reported in Panels A, B and C respectively.

Panel A: Information Technology

Sales	**1**	**2**	**3**	**4**	**5**	**GI**	**1**	**2**	**3**	**4**	**5**	**EPS**	**1**	**2**	**3**	**4**	**5**
R&D firms																	
MVE-BM																	
low-low	0.413	0.122	0.018	0.000	0.000		0.508	0.211	0.041	0.025	0.000		0.482	0.104	0.030	0.000	0.000
low-high	0.476	0.226	0.092	0.033	0.000		0.479	0.290	0.123	0.068	0.028		0.559	0.350	0.089	0.000	0.000
high-low	0.595	0.411	0.265	0.123	0.037		0.567	0.355	0.238	0.146	0.074		0.611	0.397	0.254	0.058	0.000
high-high	0.468	0.260	0.202	0.129	0.055		0.493	0.267	0.169	0.089	0.032		0.546	0.281	0.102	0.057	0.000
Zero R&D firms																	
MVE-BM																	
low-low	0.504	0.295	0.223	0.212	0.168		0.595	0.315	0.234	0.241	0.216		0.575	0.295	0.208	0.148	0.100
low-high	0.381	0.211	0.127	0.103	0.056		0.337	0.215	0.078	0.033	0.037		0.462	0.436	0.129	0.000	0.000
high-low	0.579	0.376	0.233	0.112	0.044		0.619	0.338	0.180	0.078	0.022		0.637	0.425	0.127	0.083	0.000
high-high	0.474	0.285	0.176	0.075	0.056		0.526	0.261	0.130	0.033	0.009		0.447	0.433	0.288	0.167	0.133
R&D/TA above median firms																	
MVE-BM																	
low-low	0.360	0.134	0.000	0.000	0.000		0.459	0.211	0.045	0.000	0.000		0.504	0.083	0.045	0.000	0.000
low-high	0.507	0.264	0.182	0.100	0.000		0.544	0.292	0.185	0.100	0.000		0.590	0.361	0.091	0.000	0.000
high-low	0.597	0.461	0.312	0.050	0.000		0.562	0.385	0.289	0.050	0.000		0.703	0.433	0.273	0.000	0.000
high-high	0.483	0.285	0.235	0.133	0.000		0.520	0.308	0.182	0.117	0.000		0.391	0.306	0.121	0.050	0.000
R&D/Sales above median firms																	
MVE-BM																	
low-low	0.412	0.144	0.000	0.000	0.000		0.506	0.207	0.000	0.000	0.000		0.571	0.056	0.000	0.000	0.000
low-high	0.547	0.278	0.127	0.100	0.000		0.562	0.310	0.159	0.167	0.037		0.590	0.264	0.045	0.000	0.000
high-low	0.608	0.477	0.328	0.064	0.000		0.581	0.417	0.299	0.050	0.000		0.578	0.408	0.227	0.000	0.000
high-high	0.467	0.282	0.227	0.133	0.056		0.493	0.365	0.235	0.133	0.056		0.308	0.271	0.045	0.050	0.000

Table VI Cont'd:

Panel B: General Industries																	
Sales	**1**	**2**	**3**	**4**	**5**	**GI**	**1**	**2**	**3**	**4**	**5**	**EPS**	**1**	**2**	**3**	**4**	**5**
R&D firms																	
MVE-BM																	
low-low	0.441	0.215	0.114	0.047	0.024		0.452	0.206	0.105	0.077	0.056		0.472	0.261	0.176	0.163	0.136
low-high	0.332	0.131	0.061	0.021	0.000		0.353	0.133	0.043	0.007	0.000		0.513	0.248	0.118	0.034	0.019
high-low	0.564	0.310	0.161	0.100	0.072		0.544	0.307	0.156	0.082	0.026		0.473	0.213	0.086	0.037	0.011
high-high	0.345	0.158	0.076	0.036	0.009		0.370	0.171	0.093	0.047	0.026		0.450	0.198	0.103	0.049	0.012
Zero R&D firms																	
MVE-BM																	
low-low	0.451	0.221	0.127	0.057	0.004		0.505	0.229	0.124	0.041	0.000		0.533	0.307	0.161	0.120	0.084
low-high	0.344	0.194	0.097	0.051	0.014		0.368	0.186	0.089	0.049	0.016		0.392	0.201	0.070	0.029	0.026
high-low	0.544	0.261	0.089	0.043	0.025		0.543	0.276	0.053	0.050	0.007		0.505	0.126	0.057	0.028	0.010
high-high	0.396	0.164	0.068	0.025	0.009		0.413	0.155	0.070	0.028	0.000		0.427	0.154	0.063	0.017	0.000
R&D/TA above median firms																	
MVE-BM																	
low-low	0.468	0.254	0.133	0.060	0.032		0.498	0.251	0.160	0.118	0.087		0.516	0.310	0.208	0.170	0.157
low-high	0.376	0.193	0.115	0.062	0.000		0.361	0.185	0.105	0.017	0.000		0.563	0.326	0.136	0.033	0.000
high-low	0.583	0.351	0.206	0.151	0.107		0.540	0.320	0.171	0.106	0.038		0.494	0.245	0.108	0.044	0.014
high-high	0.369	0.175	0.045	0.007	0.000		0.384	0.168	0.072	0.027	0.011		0.543	0.273	0.208	0.123	0.111
R&D/Sales above median firms																	
MVE-BM																	
low-low	0.497	0.257	0.136	0.059	0.031		0.504	0.259	0.164	0.119	0.085		0.534	0.314	0.215	0.173	0.124
low-high	0.357	0.190	0.107	0.056	0.000		0.363	0.144	0.065	0.000	0.000		0.509	0.260	0.068	0.000	0.000
high-low	0.602	0.346	0.195	0.144	0.103		0.563	0.317	0.158	0.101	0.038		0.502	0.239	0.105	0.044	0.011
high-high	0.382	0.183	0.059	0.015	0.011		0.395	0.165	0.066	0.006	0.000		0.521	0.253	0.168	0.079	0.056

Table VI Cont'd:

Panel C: Health, Pharmaceuticals and Biotechnology ('Pharma')																	
Sales	**1**	**2**	**3**	**4**	**5**	**GI**	**1**	**2**	**3**	**4**	**5**	**EPS**	**1**	**2**	**3**	**4**	**5**
R&D firms																	
MVE-BM																	
low-low	0.624	0.344	0.234	0.223	0.111		0.616	0.352	0.297	0.182	0.065		0.385	0.208	0.000	0.000	0.000
low-high	0.522	0.321	0.140	0.058	0.037		0.511	0.310	0.092	0.033	0.000		0.481	0.208	0.091	0.000	0.000
high-low	0.639	0.398	0.191	0.103	0.034		0.636	0.353	0.169	0.062	0.046		0.512	0.216	0.100	0.025	0.000
high-high	0.500	0.242	0.104	0.054	0.042		0.542	0.306	0.180	0.156	0.066		0.465	0.259	0.041	0.000	0.000
Zero R&D firms																	
MVE-BM																	
low-low	0.697	0.439	0.308	0.193	0.165		0.566	0.347	0.227	0.189	0.148		0.509	0.109	0.013	0.000	0.000
low-high	0.489	0.293	0.191	0.093	0.011		0.560	0.275	0.119	0.043	0.012		0.317	0.145	0.078	0.031	0.000
high-low	0.462	0.181	0.045	0.000	0.000		0.500	0.319	0.182	0.067	0.037		0.192	0.000	0.000	0.000	0.000
high-high	0.530	0.330	0.137	0.064	0.056		0.556	0.335	0.164	0.025	0.028		0.556	0.366	0.162	0.067	0.056
R&D/TA above median firms																	
MVE-BM																	
low-low	0.509	0.241	0.180	0.167	0.056		0.528	0.315	0.303	0.250	0.056		0.154	0.083	0.000	0.000	0.000
low-high	0.577	0.383	0.124	0.000	0.000		0.359	0.208	0.091	0.000	0.000		0.154	0.083	0.091	0.000	0.000
high-low	0.626	0.372	0.108	0.075	0.028		0.611	0.357	0.153	0.058	0.093		0.462	0.229	0.061	0.000	0.000
high-high	0.685	0.360	0.170	0.058	0.037		0.659	0.313	0.152	0.117	0.000		0.481	0.250	0.030	0.000	0.000
R&D/Sales above median firms																	
MVE-BM																	
low-low	0.519	0.263	0.158	0.150	0.056		0.535	0.354	0.303	0.250	0.056		0.154	0.083	0.000	0.000	0.000
low-high	0.538	0.368	0.114	0.000	0.000		0.346	0.167	0.091	0.000	0.000		0.000	0.000	0.000	0.000	0.000
high-low	0.608	0.371	0.135	0.109	0.022		0.606	0.367	0.182	0.087	0.074		0.333	0.201	0.061	0.000	0.000
high-high	0.699	0.340	0.130	0.020	0.000		0.677	0.333	0.159	0.083	0.000		0.417	0.208	0.030	0.000	0.000

Table VII: R&D and the rate of growth in future Sales, Gross Income and EPS

Panel A: The table reports the coefficient estimates and values of t-statistics (in parentheses) that have been estimated by running the following panel Data regression run with OLS: $GR = \beta_{0+} \beta_1 MV + \beta_2 RDSALES + \beta_3 BM + \beta_4 PASTR + \beta_5 PERSDUMMY + \varepsilon_{it}$ (1).The dependent variable GR equals cumulative growth in a) sales b) gross income or c) EPS for the next year, MV, BM, RDSALES equal the average MV, BM and R&D/Sales respectively during the time period for which GR applies, PASTR equals the stock's prior to the end of t six month of t compound rate of return, PERSDUMMY is a dummy variable taking the value of 1 of the company achieved a growth rate in sales or GI or EPS above the sample median in each of the past two years, depending on which measure of operating performance that GR represents each time (Sales or GI or EPS), and zero otherwise. There have been used White's Heteroscedasticity robust standard errors. All variables have been transformed by using natural logs, and observations above the 98 and below the 2 percentile were eliminated. In the last column appear the p-values of the F statistics.

	MV	**RDSALES**	**BM**	**PASTR**	**PERSDUMMY**	**Constant**	**Adj R^2**	**F statistic**
Growth in:								
t,t+1								
SALES	0.0100	0.0057	-0.0115	0.5038	0.0005	-0.0137	0.0217	
	(7.8903)	(5.3044)	(-7.9148)	(7.1841)	(0.0847)	(-2.0483)		(0.0000)
GI	0.0119	0.0061	-0.0140	0.3379	-0.0220	-0.0233	0.0120	
	(7.3127)	(4.4937)	(-7.8206)	(3.8658)	(-2.9823)	(-2.6502)		(0.0000)
EPS	0.0183	0.0090	-0.0335	0.2921	-0.0677	-0.0547	0.0119	
	(5.2839)	(3.1694)	(-7.3615)	(1.5349)	(-5.4676)	(-2.8164)		(0.0000)

Table VII Cont'd

Panel B: The table reports the regression coefficients and related statistics for the Heckman two-stage correction model, when the dependent variable GR equals cumulative growth in Sales, GI and EPS for the next 2 to 5 years. The Heckman two-stage selection bias model is used when dependent variable GR equals growth in Sales or GI or EPS for the next 2 to 5 years to account for the lost companies as we move on into the future. So, before running the panel data regression with growth in sales, GI and EPS for the next 2-5 years as our regressors, our first step is to use a probit model in order to estimate the likelihood of a company to be included in the sample of the ones that survive for the next two to five years. This probit model is: Selection = $\alpha_0 + \alpha_1 SP + \alpha_2 PASTSA + \varepsilon_{it}$, where Selection equals one if we have an observation for sales or GI growth for the next 2-5 years, depending on the regression, and zero otherwise. SP equals the sales-to-price ratio at the end of year t and PASTSA equals the sales growth over the two years prior to year t (geometric mean). In the second stage, we run (1) with panel data, but in order to obtain consistent errors, there is added an extra regressor $\beta_7 \lambda$, where λ is the Heckman correction, that is included as a control and that we obtained from the first step probit model. We report the values we get for the coefficients for both the probit model as well as regression (1) that includes the Heckman control term. Values of z statistics are reported in parentheses below each coefficient. The Z-statistic tests whether the mean t-statistic equals zero. The 5% and 1% significance levels for the z statistic are 1.645 and 1.96 respectively. We also report the log-likelihood function and Pseudo-R^2 for the probit models as indicators of goodness of fit, as well as the Wald X^2 statistic for the second stage regression, with its p-value appearing below the value of the statistic.

	1st Step: Probit Model					2nd Step: Regression (1)							
	SP	PASTSA	Constant	Pseudo-R^2	Log Likelihood	lambda	MV	RDSALES	BM	PASTR	PERSDUMMY	Constant	Wald X^2
t,t+2													
SALES	-0.1040	-0.0884	1.2831	0.0057	-2707.06	-2.1066	0.0010	0.0077	-0.0097	0.4069	0.0233	0.4715	49.00
	(-5.49)	(-0.88)	(61.35)			(-5.13)	(0.41)	(4.62)	(-2.60)	(3.97)	(1.57)	(5.26)	(0.0000)
GI	-0.0944	-0.0228	1.2501	0.0045	-2798.67	-1.9748	0.0065	0.0095	-0.0194	-0.0338	-0.0052	0.4348	40.31
	(-5.03)	(-0.23)	(60.85)			(-4.48)	(2.32)	(4.49)	(-4.62)	(-0.51)	(-0.41)	(4.33)	(0.0000)
EPS	-0.1425	-0.0170	0.8627	0.0081	-3045.24	0.4638	0.0161	0.0168	-0.0710	0.4688	-0.1129	-0.1452	118.40
	(-7.02)	(-0.16)	(43.41)			(2.38)	(3.23)	(4.45)	(-8.62)	(1.96)	(-5.79)	(-1.75)	(0.0000)
t,t+3													
SALES	-0.0846	-0.0351	0.8824	0.0034	-3695.02	-2.4390	-0.0011	0.0111	-0.0106	0.4232	0.0095	0.9203	43.66
	(-5.02)	(-0.39)	(48.36)			(-4.68)	(-0.36)	(4.96)	(-2.03)	(3.12)	(0.46)	(4.95)	(0.0000)
GI	-0.0755	-0.1400	0.8426	0.0028	-3727.82	-1.9658	0.0075	0.0140	-0.0233	0.2936	0.0180	0.7388	47.13
	(-4.44)	(-1.54)	(46.25)			(-4.04)	(2.07)	(5.12)	(-4.27)	(1.78)	(0.94)	(4.05)	(0.0000)
EPS	-0.1067	-0.0455	0.4173	0.0043	-3733.06	1.0406	0.0253	0.0231	-0.0749	0.2970	-0.1259	-0.5070	114.87
	(-5.68)	(-0.46)	(23.06)			(3.58)	(4.37)	(5.22)	(-8.29)	(1.00)	(-5.39)	(-2.86)	(0.0000)
t,t+4													
SALES	-0.0689	-0.0450	0.6174	0.0021	-4074.67	-2.8816	-0.0034	0.0120	-0.0039	0.5988	0.0151	1.4433	34.91
	(-4.12)	(-0.50)	(34.84)			(-3.89)	(-0.87)	(4.22)	(-0.54)	(3.42)	(0.55)	(4.13)	(0.0000)
GI	-0.0567	-0.1605	0.5852	0.0017	-4056.76	-2.2342	0.0063	0.0154	-0.0205	0.3974	0.0239	1.1225	32.03
	(-3.35)	(-1.77)	(32.95)			(-3.27)	(1.35)	(4.52)	(-2.71)	(1.81)	(0.99)	(3.37)	(0.0000)
EPS	-0.1160	0.0116	0.1264	0.0049	-3750.01	1.2728	0.0191	0.0257	-0.0792	-0.5755	-0.1593	-0.7127	90.97
	(-6.06)	(0.12)	(6.98)			(4.14)	(2.71)	(4.90)	(-6.45)	(-1.53)	(-5.63)	(-2.97)	(0.0000)
t,t+5													
SALES	-0.0918	-0.0634	0.4129	0.0035	-4136.87	-2.0897	-0.0050	0.0176	-0.0112	0.1077	-0.0176	1.3474	35.26
	(-5.34)	(-0.70)	(23.01)			(-4.75)	(-1.08)	(5.100	(-1.39)	(0.49)	(-0.68)	(5.18)	(0.0000)
GI	-0.0766	-0.1693	0.3828	0.0027	-4092.09	-1.6305	0.0045	0.0186	-0.0246	-0.1425	0.0124	1.0480	28.99
	(-4.40)	(-1.84)	(21.27)			(-3.71)	(0.83)	(4.58)	(-2.76)	(-0.53)	(0.48)	(3.92)	(0.0000)
EPS	-0.1406	-0.1809	-0.0790	0.0072	-3461.52	0.9036	0.0165	0.0361	-0.0776	-0.7889	-0.1480	-0.4383	81.13
	(-6.87)	(-1.72)	(-4.18)			(3.84)	(1.99)	(5.91)	(-5.30)	(-1.75)	(-4.46)	(-1.97)	(0.0000)

Table VIII: Average Equal Weighted Cumulative Abnormal returns and BAH Abnormal returns whole sample, R&D, zero R&D firms, and R&D intensive firms

The table reports the average Equally Weighted Cumulative Abnormal returns and BAH Abnormal returns for the next 1 to 5 years for the whole Sample, R&D firms, zero R&D firms, and R&D firms divided into R&D intensity quartiles (according to R&D/TA, R&D/Sales and R&D/MV). CAR and abnormal BAHR have been calculated with respect to the monthly value-weighted returns of 6 annually rebalanced MV-BM portfolios.

CAR						**BAH**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Sample	0.030	0.052	0.068	0.070	0.080	0.018	0.032	0.035	0.014	0.002
R&D Firms	0.035	0.048	0.063	0.065	0.062	0.024	0.023	0.009	-0.032	-0.057
Zero R&D Firms	0.029	0.055	0.072	0.074	0.090	0.016	0.038	0.051	0.042	0.036

CAR						**BAH**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
R&D/TA										
Low	0.021	0.024	0.017	0.001	-0.035	0.005	0.007	-0.025	-0.085	-0.184
	-0.020	-0.046	-0.057	-0.087	-0.117	-0.039	-0.086	-0.115	-0.191	-0.277
	0.066	0.079	0.081	0.049	0.011	0.054	0.038	0.014	-0.077	-0.104
High	0.081	0.166	0.240	0.336	0.430	0.085	0.162	0.185	0.282	0.420
R&D/Sales										
Low	0.014	0.013	0.017	-0.018	-0.075	0.002	-0.007	-0.020	-0.112	-0.237
	0.012	0.000	-0.006	-0.015	-0.030	-0.010	-0.034	-0.073	-0.118	-0.183
	0.054	0.066	0.053	0.016	0.006	0.024	-0.005	0.000	-0.045	-0.030
High	0.063	0.134	0.205	0.309	0.375	0.083	0.163	0.140	0.188	0.274
R&D/MV										
Low	-0.001	-0.015	-0.007	-0.013	-0.024	-0.011	-0.038	-0.061	-0.091	-0.152
	-0.022	-0.028	-0.042	-0.067	-0.116	-0.039	-0.055	-0.104	-0.190	-0.275
	0.039	0.044	0.058	0.031	0.032	0.024	-0.001	-0.023	-0.070	-0.147
High	0.135	0.230	0.283	0.366	0.414	0.134	0.227	0.262	0.272	0.422

Table IX: Average Value Weighted Cumulative Abnormal returns and BAH Abnormal returns whole sample, R&D, zero R&D firms, and R&D intensive firms

The table reports the average Value weighted Cumulative Abnormal returns and BAH Abnormal returns for the next 1 to 5 years for the whole sample, R&D firms, zero R&D firms, and R&D firms divided into R&D intensity quartiles (according to R&D/TA, R&D/Sales and R&D/MV). CAR and abnormal BAHR have been calculated with respect to the monthly value-weighted returns of 6 annually rebalanced MV-BM portfolios. Value weights are as of the end of June of year t, as is the case with the breakpoints for the MV portfolios, and they are rebalanced annually.

CAR						**BAH**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Sample	0.002	-0.002	0.007	0.020	0.041	-0.002	-0.001	0.006	0.011	0.018
R&D Firms	0.004	0.009	0.027	0.045	0.064	0.001	0.011	0.031	0.048	0.064
Zero R&D Firms	-0.001	-0.023	-0.032	-0.028	-0.003	-0.006	-0.023	-0.038	-0.058	-0.070

Average CAR and BAHR according to R&D/TA, R&D/Sales and R&D/MV quartiles (from lower to higher)

CAR						**BAH**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
R&D/TA										
Low	0.006	0.018	0.026	0.037	0.027	-0.002	0.002	-0.002	-0.011	-0.038
	-0.010	-0.045	-0.063	-0.082	-0.040	-0.010	-0.002	0.015	-0.008	-0.037
	-0.010	-0.005	0.038	0.053	0.057	0.001	-0.030	-0.048	-0.020	0.045
High	0.051	0.106	0.176	0.251	0.288	0.051	0.115	0.212	0.317	0.402
R&D/Sales										
Low	0.004	0.005	0.006	0.005	-0.002	-0.004	-0.015	-0.027	-0.057	-0.089
	-0.004	-0.017	0.008	0.008	-0.002	-0.015	-0.012	0.001	0.000	-0.037
	-0.006	-0.029	-0.033	-0.014	0.041	-0.010	0.001	0.026	0.038	0.098
High	0.068	0.150	0.172	0.221	0.256	0.085	0.139	0.154	0.238	0.306
R&D/MV										
Low	0.004	0.001	0.007	0.017	0.046	-0.001	0.008	0.023	0.034	0.039
	-0.034	-0.018	0.006	-0.010	-0.045	-0.028	-0.010	-0.034	-0.076	-0.130
	0.024	0.009	0.042	0.100	0.133	0.024	0.000	0.022	0.039	0.110
High	0.112	0.124	0.156	0.208	0.214	0.124	0.087	0.143	0.261	0.351

Table X: Persistence in returns for the sample, R&D, zero R&D and R&D firms according to R&D intensity

The table shows the average % of firms with risk-adjusted returns (CAR and BAH abnormal returns) above the sample median for the next 1 to 5 years for the whole sample, the R&D firms, zero R&D firms, and R&D firms divided into R&D intensity quartiles according to R&D/TA, R&D/Sales and R&D/MV (from low to high). Both CAR and abnormal BAHR are calculated on a yearly basis, using monthly data from July at year t until June at t+1, July at t+1 until June at t+2, and finally July at t+4 until June at t+5 for the five year window.

CAR	**1**	**2**	**3**	**4**	**5**	**BAH**	**1**	**2**	**3**	**4**	**5**
Sample	0.500	0.261	0.135	0.069	0.034		0.500	0.275	0.154	0.086	0.043
R&D Firms	0.496	0.249	0.126	0.063	0.031		0.499	0.267	0.146	0.079	0.036
Zero R&D Firms	0.503	0.267	0.140	0.073	0.036		0.502	0.280	0.159	0.090	0.046
R&D/TA											
Low	0.483	0.224	0.097	0.042	0.019		0.516	0.286	0.151	0.076	0.035
	0.442	0.203	0.096	0.048	0.019		0.459	0.223	0.103	0.055	0.023
	0.526	0.271	0.143	0.066	0.029		0.500	0.260	0.143	0.070	0.025
High	0.540	0.314	0.180	0.108	0.063		0.521	0.304	0.193	0.120	0.068
R&D/Sales											
Low	0.476	0.230	0.098	0.044	0.018		0.511	0.285	0.140	0.072	0.032
	0.470	0.215	0.113	0.054	0.025		0.473	0.237	0.126	0.064	0.032
	0.507	0.243	0.118	0.054	0.020		0.494	0.239	0.125	0.069	0.027
High	0.532	0.316	0.184	0.109	0.066		0.514	0.308	0.197	0.117	0.057
R&D/MV											
Low	0.456	0.206	0.089	0.040	0.019		0.500	0.265	0.137	0.070	0.034
	0.453	0.212	0.094	0.044	0.016		0.471	0.247	0.126	0.072	0.027
	0.519	0.268	0.148	0.069	0.034		0.501	0.254	0.144	0.065	0.030
High	0.564	0.324	0.188	0.110	0.062		0.529	0.308	0.180	0.111	0.058

Table XI: Controls for industry factors for stock returns

The table reports the coefficient estimates and values of t-statistics (in parentheses) that have been estimated by running the following panel data regression: RET = β_{0+} β_1RD+ β_2INDDYMMY1+β_3INDDUMMY2+β_4INDDUMMY3+β_5INDDUMMY4+ε_{it}. The dependent variable RET equals the 12 month equal-weighted risk-adjusted abnormal 1) CAR and 2) BAH, from July of year t until June of year t+1. CAR and abnormal BAHR have been calculated with respect to the monthly value-weighted total returns of 6 annually rebalanced MV-BM portfolios. RD equals the R&D/MV ratio as at the end of year t-1. R&D represents the R&D expense for the accounting year that ended during the calendar year t-1, and MV the market value of equity at the end of December of year t-1. INDDUMMY1, 2, 3 and 4 are industry dummy variables for 4 industries which are perceived as intensive in R&D activity: Information Technology (INDDUMMY1), Chemicals (INDDUMMY2), General Industries (INDDUMMY3) and Health grouped together with Pharmaceuticals and Biotechnology (‘Pharma’ –INDDUMMY4). INDDUMMY takes the value of 1 if the firm belongs to the specific industry, and 0 otherwise. The regression is run using OLS and White's Heteroscedasticity robust standard errors. Observations above the 98 and below the 2 percentile were eliminated. In the last column appear the p-values of the F statistics.

	Constant	**RD**	**INDDUMMY1**	**INDDUMMY2**	**INDDUMMY3**	**INDDUMMY4**	**Adj R^2**	**F statistic**
Dependent variable: CAR	0.0226	0.5382	0.0346	-0.0378	-0.0085	-0.0206	0.0045	
	(5.8476)	(4.1428)	(1.8065)	(-2.1871)	(-0.9013)	(-1.1810)		(0.0000)
Dependent variable: BAHR	-0.0101	0.4993	-0.0066	-0.0393	-0.0097	-0.0233	0.0026	
	(-2.4121)	(2.8612)	(-0.3503)	(-2.2866)	(-0.9549)	(-1.2172)		(0.0000)