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An Analysis of the R&D Effect on Stock Returns for European Listed Firms

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Abstract

Almost all studies on research and development (R&D) activity are based on US and British companies, and most of them show that this activity positively influences both stock returns and corporate value.

This empirical study evaluates the effects of R&D on stock returns for a sample of listed companies from thirteen European countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Sweden and United Kingdom. We find that this effect is positive, and also significant, in predicting future returns.Other variables appear to be important too, such as book-to-market ratio and firm size.

We also test a different set of hypotheses that aim to capture the many differences and peculiarities between these countries such as the development of the national equity and credit markets, the grade of disclosure for listed firms and the protection of minority shareholders. Generally, financial markets value R&D investment better in investor-friendly environments and those with a high level of legal protection.

Keywords: European financial markets, market value, R&D, Stock returns, Valuation.

1. Introduction

The market value of a firm's share reflects the value of its net assets. When most of the assets are physical, such as plant and equipment, the link between asset values and stock prices is relatively straightforward. This link is more difficult when a relevant part of a firm's assets is intangible such as research and development expenditure (R&D). The last twenty years have witnessed a huge growth in R&D investment in all developed economies of the world; a great number of companies reliant on scientific research (software, biotechnology, telecommunications) have become very successful corporations. The importance of this activity can be shown simply by the fact that the amount of R&D expenditure in some of the biggest technology companies is greater than their earnings.

The importance of R&D for firm growth raises the question of whether investors correctly price these assets in their everyday trading. In an efficient market, investors should assess the sources of corporate value by taking into account both tangible and intangible assets. On the other hand, certain important factors make the evaluation of a company active in R&D more complicated. The prospect of success of companies of this nature could be linked, for example, to the success of new untested technologies and therefore be largely unpredictable. Large expenses are generally required at the beginning of research and development projects and the results are far from assured. The benefits, if any, will only materialize in the future.

Accounting information about a firm's R&D activity is generally of limited usefulness as well. A more important issue concerns the accounting treatment of R&D expenditure, as there are countries which are obliged to completely expense the cost in the year incurred. Therefore, some yardsticks commonly used by investors, such as price-earnings ratios and market-to-book ratios, may be mis-stated. In others, capitalization of these expenses is permitted under certain circumstances.

Given these difficulties, the link between research and development expenditure and stock performance is unclear. Different studies have argued that high R&D intensity companies are more likely to benefit from technological innovation in terms of a better market valuation and therefore invest more (Chambers et al., 2002; Daniel and Titman, 2006; Duqi and Torluccio, 2010). Given the uncertainty of the results of R&D activity, it is also possible that the market may ignore any future benefit. If an investor values a company based only on accounting values, the distorting effects of research and development could lead to misleading or erroneous assessment. Some scholars believe that investors can be myopic or fail to reward long-term company investments in its assessments (Hall, 1993b). On the other hand, other studies have noted that the market valuation of technology companies with high R&D rates is excessive, as a result of unjustified optimism about the R&D effects on future profits. Fama and French (1992) found that stocks with low book-to-market ratios generally perform worse in the future, mainly due to the overestimated expectations of investors on future returns.

The study of the effects of R&D expenditures on corporate performance in general has been of great interest for researchers, in particular for the last thirty years. Most of the literature on this topic focuses on US or British traded companies, and only a few studies concern European countries. The continental European countries differ in many aspects from Anglo-Saxon markets; for example, the former have a reduced presence of professional investors and a strong presence of long-term shareholders such as banks, state-owned companies or family investors. This may lead firms to long-term investments, given the lack of obligations on quarterly results. Differences also exist in the legal and financial framework.This may include law enforcement systems that differ primarily in civil law and common law countries, or other differences in terms of shareholder and investor protection. The accounting treatment of R&D is also different, with some peculiarities. UK laws require disclosure of annual research and development expenditures, and they should be expensed when incurred; this is not the case in other countries where disclosure is not compulsory, thereby creating a potential risk for sample selection problems. The financial markets of Continental European countries are also smaller than those of US and UK; many companies are not listed and are financed mainly by private debt. These are just some of the differences between Continental Europe and Anglo-Saxon countries that can influence company valuation by the investors, and consequently also the valuation of R&D.

This study will therefore consider thirteen of the most important industrialized countries in Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Portugal, Spain, Sweden and United Kingdom. The objective of this study is to evaluate the influence of R&D outlays on stock returns after controlling for significant variables at the firm and country level.

The next section will summarize the previous research related to R&D market valuation. The following two sections will give a presentation of the sample and sub-samples and an illustration of the key variables. Section 5 will then provide the estimates and results. Some brief remarks and conclusions follow.

2. Literature Review on the Effect of R&D on Firm Stock Performance

Numerous studies in economics, finance, and accounting suggest that investors view R&D expenditures as investments that are expected to produce future benefits. Some of them evidence that corporate value is positively affected by R&D investment (Sougiannis, 1994; Toivanen, 2002; Pindado et al. 2010, Duqi and Torluccio, 2011). Other studies show how changes in market values are positively related to new announcements about R&D projects (Chan et al. 2001; Eberhart et al. 2004).

There is also a consistent literature that concerns the effect of R&D outlays on stock returns. Generally, authors of this research mainstream have tried to understand if current share prices fully reflect expected benefits from past or present R&D expenditures. The first papers in this direction produce a positive link between current R&D investment and future excess returns. Lev and Sougiannis (1996, 1999) report that R&D stock can significantly explain future excess returns over the 12 months subsequent to the end of the fiscal year (when accounting information is released). Chan et al. (2001), show that firms with high spending in R&D generate abnormal returns over the next three years. Similar results are shown in Al-Horani et al. (2003) for UK data. They point out that a measure of research and development activity helps explain cross-sectional variation in UK stock returns.

A second group of studies finds that future excess returns of R&D firms are posively related to the growth rate of R&D outlays in prior years, or they may be generated even by changes in the stock of R&D in the current year (Penman and Zhang, 2002; Eberhart et al., 2004).

An important issue that researchers have tried to tackle is whether these abnormal future returns are generated by a constant misleading due to the accounting treatment of R&D outlays or by a higher level of risk of R&D projects. Penman and Zhang (2002) provide empirical results that support the first point of view. Chamber et al. (2002), show that the positive association between the level of R&D investment and subsequent excess returns persists for at least ten years following the investment. Moreover, the excess returns are more variable through time for R&D intensive firms and future earnings follow the same pattern for this group of firms. So, overall, their results support the view that abnormal returns are generated by a failure to control adequately for risk than from accounting mispricing. Other authors have evidenced that the systematic risk for firms which invest persistently in R&D is greater compared to non R&D-intensive firms. Their results generally confirm that the total risk is higher in firm with higher R&D expenditure (Chan et al. 2001), and the systematic risk of this firms is moderately greater (Xu and Zhang, 2004)

The differences between the Continental European countries, and the UK and the US, for this topic as briefly mentioned in the previous section, have produced only a few comparative papers. Previous work has shown, for example, how financial constraints on firms' R&D and capital investments are looser in Continental European countries than in the UK and the US (Hall, 1999; Mulkay et al., 2000; Bond et al., 2003a). These differences could have important implications for the market valuation of R&D investments in Europe. The analysis using data on French, German and Italian companies (to name just three) is further complicated by specific differences in markets structure: they are smaller thanthe companies in the US and UK (many companies are not listed), and disclosing R&D expenses is not compulsory. Once again Italy is an even more of a particular case: almost all of the companies are small and medium-sized with credit lines from intermediaries (local), and only a few large companies are publicly traded (Pagano et al. 1998).

With respect to capital markets, it is generally recognized that publicly traded firms in Continental European countries receive weaker pressure on investment decisions (see for example Franks and Mayer, 1990; Black and Fraser, 2000). This could be an advantage; managers are not pressed by short-term results so they are able to undertake long-term innovation programs, while on the other hand, as shareholders exercize low pressure on them, there might be incentives to undertake unsuccessful projects with a negative net cash flow (Bae and Kim, 2003; Tylecote and Ramirez, 2006).

Ownership structures are another vital aspect for correctly valuing R&D in Europe. As pointed out before, main shareholders differ significantly between the US and UK on the one side and Continental Europe on the other. In countries such as France, Germany or Italy there is a widespread presence of a main shareholder that might be a family, bank or State. This shareholder holds typically more than 50% of the voting rights or manages to control the company across some interlocking directories with other relevant shareholders (Faccio and Lang, 2002). In these cases an agency problem may rise between majority and minority shareholders, unlike the manager-owner problem typical of Anglo-Saxon countries. Controlling shareholders have incentives to transfer a firm's profits to their own benefit. La Porta et al. (1998, 2002, 2006) have extensively studied the legal protection of investors in different countries. They report that investors are less protected in civil law countries such as France and Italy compared to common law systems typical of Anglo-Saxon countries. So, in these countries an underpricing phenomenon might be noticed, because R&D investment is generally opaque and difficult to evaluate. There exists the risk that in countries with poor investor protection such as Germany, France and Italy, the R&D investments of firms with a controlling shareholder are undervalued by the stock market because they expose minority investors, who have limited anti-director rights, to a greater risk of expropriation by insiders (Hall and Oriani, 2006).

3. Sample Selection and Variable Definitions

This study is focused on listed companies available from Datastream database. The European countries considered in the research are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Portugal, Spain, Sweden and the United Kingdom. The time span observation of data is between 1999 (first useful observation) and July 2010 (last observation), using monthly data that allows us to have 128 observations for each company.

The main sample comprises 1837 companies from all countries considered, for a total of 6921 listed firms. The only method of sample selection was the availability of basic data for the model used (next section). A correction of missing data was made by cross searching in other databases such as Amadeus (Bureau Van Dijk) or the OCSE Stan Anberd Databes for country R&D data. The estimates and results will derive from three sub-samples taken from the main sample. The first of these will be all companies that have invested any amount greater than zero in R&D from 2006 to 2010 in a continuous way, a total of 601 companies (almost all of these companies show positive values in the R&D variable for any particular year even though the main condition is a positive R&D expenditure since 2006). The second sub-sample comprises all the firms that have invested for at least one year in R&D activity. The third sub-sample consists of the upper quartile of firms that invested continuously in R&D; these firms are the most R&D intensive and most innovative of the overall sample.

3.1. Key Variables and R&D Stock

All the main variables used in this research, taking into account the specifications of the model used, are provided exclusively by the Datastream database. The main variables used are market capitalization, stock price, research and development expenditure, debt, price-to-book value and R&D stock[1].

As Hughes (2008) points out, it is more correct to use a measure of R&D stock because it is more appropriate for capturing the past behavior of this variable. R&D expenditures may take a long time to show their benefits, and the effect of this investment is reflected not only in present but more often in future firm values. In any case other studies that have used a flow variable have reached similar results, such as Toivanen et al. (2002).

To construct a variable that measures the stock of R&D capital owned by a firm, we use a method adopted from Griliches (1981). This method is based on a standard perpetual inventory equation with declining balance depreciation:

$$K_t = (1-\delta)\,K_{t-1} + R_t$$

where K_t is the end-of-period stock of R&D capital and R_t are the (real) expenditures during the year. The depreciation rate δ is chosen to be 15 percent per year; Griliches and Mairesse (1981) found that

[1] See the Datastream database for the explanation of the construction of variables.

the exact choice of depreciation rate made little difference in production function estimates. This is not surprising since, if R&D expenditures are roughly constant in real terms, the stock of R&D capital is:

$$K_t = \sum_{i=0}^{\infty}(1-\delta)^i R_{t-i} = \frac{R}{\delta}$$

The variation across firms will then be approximately the same, regardless of the value of δ and the magnitude of the coefficient will just vary inversely with δ. This means that separate identification of δ and the coefficient of K_t in an equation will be difficult.

The initial stock of R&D expenditures is set equal to the value of R&D at the first year divided by the depreciation rate, summed with a growth rate of new R&D of 8% per year (Hall, 1990). Missing values of R&D across years can be substituted by interpolation of non-missing values. However, due to the low number of the firms involved this does not compromise the significance of the estimates.

3.2. Control Variables

The first three variables are taken from the model of Fama and French (1992). The first variable is the firm beta which controls for systematic risk. As Fama and French (1992) point out, beta has lost its power in explaining stock returns after 1969. Other authors have evidenced similar patterns for other countries such as Al-Horani and Stark (2003) for the UK, and Zu and Zhang (2004) for Japanese firms.

The book-to-market ratio (BTME) is then added along with some other variables to help in the prediction of future stock returns. The BTME ratio accrording to Fama and French (1992) captures other sources of risk, or according to Lev and Sougiannis (1996, 1999) it accounts for all the growth perspectives of the firm deriving from innovative activities. The firm size (ME) is one of the other variables. Different authors point out that firm risk is generally greater for smaller firms so we should expect higher returns for them (Banz 1981). Then we add financial leverage, as more leveraged firms should be more risky, other things being equal.

In the second part of our analysis certain country specific variables are added which try to account for some characteristics of national financial markets. La Porta et al. (1998) show that the legal and financial framework is important for a more developed equity market and for firm growth in general. So, inspired by their work, we add a variable for the origin of the legal system, common law or civil law, then a variable for the shareholders' rights, and finally a variable for the legislation.

The shareholders' right variable which La Porta et al. (1998) call "antidirector's rights" measures how shareholders are protected against the oppression of the managers. The creditor's right then accounts for the right of the owners of a firm's bonds in cases of liquidation or reorganization. The legislation variables examine proxies for the efficiency of the judicial system, the level of corruption in the country, the risk of expropriation by the Government and the likelihood of contract repudiation by the State.

4. The Model

In choosing an appropriate model to study the influence of R&D on stock returns we should take into account all possible relevant variables that cannot be neglected in the study of cross-sectional returns. The previous literature provides great help in tackling this problem: notably, Fama and French in their study of 1992 ("The cross-section of expected returns") starting from previous studies incorporate a model which is now largely re-used by scholars and researchers. Simple and suitable, it can be further implemented by adding additional variables that can explain stock returns, in this case R&D activity.

Fama and French (1992), studying the role of certain variables (β, ME, E / P, leverage, and BE/ME), discover that when used alone or in combination with other variables, beta explains only a small amount of information on the average returns. There is evidence that capitalization (as a proxy for firm size), earnings to price ratio, book to market ratio, and debt, are more relevant in predicting stock returns. More recently, different authors have pointed out that along with these variables, R&D

helps to better explain future returns (Lev and Sougiannis, 1996, 1999; Al-Horani et al., 2003). They find that R&D capital is associated with subsequent future returns; this association may derive from a mispricing of these securities, and for investor underreaction to R&D information. R&D might also reflect an extra risk factor associated with R&D capital.

The final model to be used will take into account all the variations above, a model where stock returns are regressed on lagged values of the following fundamentals: systematic risk (β), firm size (market capitalization), the book-to-market ratio, and financial leverage. We add to these fundamentals the firm's estimated R&D capital scaled by its market value.

Evaluating the relation between returns and lagged R&D capital within this model ensures that the R&D variable does not proxy for other risk or mispricing variables (e.g., the book-to-market or the price-to-earnings ratios) present in the analysis. Accordingly, we estimate the following cross-sectional regression:

$$R_{i,t+j} = \theta_1 + \theta_2\beta_{i,t} + \theta_3 \ln(ME)_{\mathrm{i,t}} + \theta_4 \ln(BE/ME)_{\mathrm{i,t}} + \theta_5 \ln(D/E)_{\mathrm{i,t}} + \theta_6 \ln(RDC/ME)_{i,t} + \varepsilon_{i,t+j} \quad (1)$$

RDC/ME is the R&D stock scaled by firm market equity. Firm beta is estimated for 60 monthly stock returns up to month t, and a minimum period of 24 months is required for the estimation. The market size is calculated as stock price times the number of shares outstanding. The book-to-market ratio is the ratio of book value of common equity plus deferred taxes to market value at fiscal year end. The debt-to-equity ratio is the ratio between total debt and market equity at the end of fiscal year.

The accounting fundamentals, book value, total assets, and R&D capital *(RDC)* pertain to fiscal year t (months 1-12). Six months (13-18) are then allowed for the public disclosure of fiscal t annual financial statements by all firms, followed by 12 monthly stock returns, $R_{i,t+j}$ months (19-30) [2]. For each of the 10 years covered in our time range (December 1999 - August 2010) we performed a monthly cross-section regression with the Fama and Macbeth method (1973) for each of the 12 subsequent months for the model described above. A total of 120 regressions were performed (10 years x 12 regressions per year).

5. Estimates and Results

5.1. Descriptive Statistics

Descriptive statistics are shown in Table 1 and Table 2 in the Appendix. Table 1 shows the number of firms and the composition of the different samples, both in absolute and in percentage values. The total sample has 1837 companies: 860 are companies that invested in R&D for at least one year, only 601 companies performed R&D steadily from 2006 to 2010, and, 977 were companies that were the most R&D intensive in this period.

It can be observed that the 4 largest countries account for 50% of the sample (UK, 25%; Germany, 14.84 %, the first two). The same pattern is observed for firms that disclose R&D expenditures; half of them are of UK, German or French origin (Table 2). In absolute values, German firms invest more in R&D compared to other countries as their total spending is about 39% of total expenditures from all countries. UK, France and Sweden are next with respectively 12.35%, 16.42% and 11.62%. German firms are bigger on average and invest more in R&D than others.

5.2. Estimates and Results by Country

Table 3 in the Appendix shows the estimates of the model (1) for the United Kingdom. Future stock returns are the dependent variable. The table shows estimates for the total sample, the sample of companies performing R&D for at least one year, the companies that invested in R&D constantly from 2006 to 2010, and finally firms that invested more than others in R&D. These firms form the upper

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[2] Lev Baruch and Sougiannis Theodore, "The capitalization, amortization, and value.relevance of R&D", (1996). Journal of Accounting and Economics, 21, 107-138.

quartile of the sample. For each sample, the estimates were obtained by excluding the R&D variable in the model and then including it in a second step.

In sample 1, it can be observed that when we include the R&D variable, other variables have no predicting power except for the book-to-market equity ratio. In samples 2 and 3, all variables remain significant at the 1% level, when RDC/ME is included. The significance and positive coefficient of the R&D stock, when included, show us not only that this factor positively influences the future returns but also that its presence in the model is important for the significance of other variables. The signs of the coefficients are positive except for the "beta" variable; no sign changes occur with the inclusion of the "ln (RDC/ME)" variable but in this case all coefficients are bigger. From this first comparison for the UK, research and development is designed as a key factor for explaining future returns. As Fama and French (1992) predicted, beta is not a reliable factor for explaining stock returns. It remains always negative and significant. Similar results are shown for UK firms in Al-Horani and Stark (2003).

The other samples generally follow the behavior of the total sample: the inclusion of the R&D variable in the model is a necessary condition for enhancing the efficiency of estimates, the significance of the coefficients often increases or, if already significant at 1% confirmed, the inclusion of R&D in the model is never a cause of loss or diminution in the significance of other variables. Looking more closely at the coefficients of the R&D variable in each sample we can see that they remain positive and vary slightly between the first three samples, and reach a larger value in the fourth sample for firms that invested in R&D more than others from 2006 until 2010.

Table 4 and Table 5 present similar estimates, for French and German firms. They generally confirm the influence of the R&D variable on future returns in the four samples used. The coefficients for this variable, when included in the regressions, are positive and significant, demonstrating how R&D is significantly and positively related to future returns. R&D continues to be a major factor of influence on future performance: the same coefficients, always positive, remain similar in the first three samples and then grow in the last sample which includes only the more R&D intensive firms.

There are different similarities between estimates in these three countries. Beta is never positive, and moreover it remains negative and significant for all samples in all countries, showing a strong pattern that does not confirm the CAPM model. The other variables show the same pattern for every country. The book-to-market ratio is positive and significant for UK and French firms, while it is positive only if we do not include in the regression the R&D stock variable for German firms. This might be due to the similarity between these two variables, as Lev and Sougiannis (1999) point out. The coefficients for the R&D stock seem to be stronger for German firms, confirming that investors there clearly appreciate new investment in innovation. Bae and Kim (2003) confirm this result, showing that in bank-based countries with a strong innovative tradition like Germany and Japan, R&D is valued better from financial markets compared to Anglo-Saxon markets like USA and UK.

5.3. Estimates and Results with Variables of Differentiation between Countries

Differences between countries can often significantly affect the market valuation of firms. To examine the influence of these factors in our case we will include in the model some variables that try to capture these differences between countries. In Table 6 we present a regression in cross-section for the European sample. We include in it a variable for the origin of the legal system: common law or civil law origin, a variable for the shareholders and creditors protection and various legal indicators: efficiency of the legal system, corruption, risk of expropriation by the government and likelihood of contract repudiation by the government. These variables are inspired by the papers of La Porta et al (1998, 2002, 2006).

Table 6 shows estimates of this integrated model with the new variables. We consider only the total sample and the companies involved in R&D from 2006 to 2010. The shareholder rights variable is significant only in the second sample showing a positive effect on future performance with a level of significance of 1% if we include the R&D stock. Creditors rights have a negative effect on future returns, both in total sample estimates (significant at the 10% level) and in companies involved in R&D since 2006 (always 10% level of significance).

The efficiency of the legal system shows a significant and positive effect on future returns: obviously a more efficient legal system has a positive effect on future performance. In the total sample this effect is stronger (significant at 5%), while if we consider the second sample, the effect is significant only if we include the R&D variable in the model. Corruption is to be seen as one of the most significant variables in the total sample, but not in the other one. The negative coefficients show that it is obviously a negative factor for future returns, and the significance at the 1% level in the first sample confirms the importance of this variable. The negative effect simply reflects the obvious danger of private benefits extraction by controlling shareholders that is automatically reflected by lower corporate performance and lower returns. The variable “risk of expropriation” shows that in countries with a higher risk, returns are higher, but the significance of the estimates never reaches 1%, even if we include the R&D variable.

These new models estimated show mixed results and are often different between the samples and sub-samples; everything would indicate different influences of the enforcement variables and creditors’ or shareholders’ rights variables, particularly when they are included in the main model. Some of them are more important in the total sample, others seem to be significant if we choose more R&D intensive firms, such as the “creditor rights” variable, the "likelihood of contract repudiation by the government" variable and, more significantly the “efficiency of the legal system” variable. In particular, in the total sample there is no increase in significance if we include the R&D factor, which shows that these characteristics and differences between countries will affect future returns, but regardless of the presence of R&D investment. If we repeat the same estimates in a specific sub-sample of R&D companies some key variables such as creditor rights, efficiency of the legal system and corruption are no longer significant or observable.

6. Conclusions

Several previous studies have shown that research and development is an important factor that influences returns as well as the corporate value in general. Most of these studies consider Anglo-Saxon and US companies, and only a few have extended their research to Continental European countries. Expanding the empirical evidence on these countries is considered very important for several reasons: the importance of these economies, the specificity of their capital markets, corporate governance regimes and judicial systems. The analysis exposed faced two main problems. The first was the limited data accessibility in the countries concerned: the fact that disclosing R&D expenditure is not mandatory drastically reduced the number of available observations. The second problem was the small size of capital markets, compared with the United Kingdom or United States, which restricted the number of listed companies that might be included in the sample.

The research was based on a model that considered future returns of each company, specifically 7 month delayed returns from the end of fiscal year in order to ensure that prices fully incorporated accounting information. This model was estimated separately for each country, then for all countries with the inclusion of variables capturing some key differences in the legal and financial environements in different markets.

The sample was dominated by companies in three key countries, United Kingdom, France and Germany, which invested more in R&D, in fact more than 60% of the total sample of 13 countries. The results for these three countries generally confirmed the evidence of previous studies. When the R&D variable was included, the level of significance generally improved in all regressions, showing the strong influence of this variable in the context.

Results were also confirmed by observing more R&D specific sub-samples consisting only of companies engaged in R&D occasionally or throughout the time period considered, with coefficients estimated, in this case, more significant. The effect of R&D on stock returns was higher in countries that spend more on research and development compared to others on average, such as Germany.

The model was subsequently integrated with important country specific variables: creditor rights, shareholder rights and law enforcement variables. In this case the estimates on different samples showed significant results but varied greatly depending on whether the total sample or the specific sub-samples of companies R&D active were considered. Estimates showed that the inclusion or exclusion of the R&D stock in the model is irrelevant if we consider the total sample. In most R&D intensive companies, when we included the variables in question, estimates gained in significance. There were several aspects that affected the future returns: in the total sample, the efficiency of the juridical system variable showed a positive influence on future returns, while corruption showed the opposite effect. In R&D intensive firms, in addition to the aforementioned importance of the implementation of the R&D factor in the model, the effeciency of law had a negative effect on stock returns while the impact of the likelihood of contract repudiation by the government was positive.

Appendix

Table 1: Number of companies and percentage of the samples divided by countries

COMPANIES BY COUNTRIES								
Country	**Total sample**		**Performed R&D for one year**		**Performed R&D from 2006 to 2010**		**NO R&D**	
	number	**perc.**	**number**	**perc.**	**number**	**perc.**	**number**	**perc.**
AUSTRIA	30	1.63%	18	2.09%	12	2.00%	12	1.23%
BELGIUM	54	2.94%	22	2.56%	16	2.66%	32	3.28%
DENMARK	74	4.03%	28	3.26%	22	3.66%	46	4.71%
FINLAND	82	4.46%	61	7.09%	50	8.32%	21	2.15%
FRANCE	279	15.19%	131	15.23%	82	13.64%	148	15.15%
GERMANY	311	16.93%	166	19.30%	132	21.96%	145	14.84%
GREECE	123	6.70%	53	6.16%	16	2.66%	70	7.16%
IRELAND	26	1.42%	6	0.70%	6	1.00%	20	2.05%
ITALY	103	5.61%	28	3.26%	16	2.66%	75	7.68%
NETHERLANDS	72	3.92%	32	3.72%	21	3.49%	40	4.09%
PORTUGAL	32	1.74%	2	0.23%	0	0.00%	30	3.07%
SPAIN	61	3.32%	22	2.56%	5	0.83%	39	3.99%
SWEDEN	135	7.35%	77	8.95%	63	10.48%	58	5.94%
UNITED KINGDOM	448	24.39%	214	24.88%	160	26.62%	234	23.95%
TOT	**1830**	**100%**	**860**	**100%**	**601**	**100%**	**977**	**100%**

Table 2: R&D expenditure totals and percentages divided by countries, total sample and firms that implemented R&D since 2006

R&D EXPENDITURES BY COUNTRIES				
Paese	**Total sample**		**Implemented R&D from 2006 to 2010**	
	tot	**perc.**	**tot**	**perc.**
AUSTRIA	2,368,643	0.22%	2,211,688	0.22%
BELGIUM	10,458,483	0.99%	10,438,084	1.02%
DENMARK	17,214,413	1.63%	16,874,203	1.64%
FINLAND	53,015,579	5.03%	52,963,922	5.16%
FRANCE	172,880,721	16.42%	160,917,295	15.68%
GERMANY	414,159,161	39.33%	411,250,482	40.07%
GREECE	789,315	0.07%	380,179	0.04%
IRELAND	4,388,903	0.42%	4,388,903	0.43%

Table 2: R&D expenditure totals and percentages divided by countries, total sample and firms that implemented R&D since 2006 - continued

ITALY	55,986,109	5.32%	51,007,461	4.97%
NETHERLANDS	67,433,018	6.40%	67,157,925	6.54%
PORTUGAL	19,707	0.002%	0	0.00%
SPAIN	2,057,304	0.20%	741,452	0.07%
SWEDEN	122,347,317	11.62%	122,288,081	11.91%
UNITED KINGDOM	130,013,427	12.35%	125,814,329	12.26%
TOT	**1,053,132,101**	**100.00%**	**1,026,434,004**	**100.00%**

Table 3: Fama-MacBeth regression estimates, United Kingdom sample. (*p<0.1, **p<0.05, ***p<0.01, p-value in brakets)

UNITED KINGDOM								
	Total sample		**R&D for at least one year**		**R&D from 2006 to 2010**		**Top quartile for R&D**	
	(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
beta	-0.00373***	-0.00895	-0.00326**	-0.00594	-0.00317*	-0.00255	-0.00405**	-0.00278
	[0.001]	[0.124]	[0.038]	[0.193]	[0.079]	[0.156]	[0.024]	[0.503]
ln(ME)	0.00145***	0.000193	0.00122***	0.000788*	0.00141***	0.000800*	0.00164**	-0.000669
	[0.000]	[0.755]	[0.002]	[0.076]	[0.001]	[0.056]	[0.016]	[0.407]
ln(BT/ME)	0.00385***	0.00565***	0.00281***	0.00283***	0.00331***	0.00403***	0.00423**	0.00195
	[0.000]	[0.000]	[0.001]	[0.008]	[0.001]	[0.000]	[0.013]	[0.461]
ln(leverage)	0.00196***	0.000802	0.00164***	0.00144**	0.00180***	0.00148***	0.000892	0.00111
	[0.000]	[0.140]	[0.000]	[0.023]	[0.000]	[0.002]	[0.166]	[0.212]
ln(RDC/ME)	0.00211***		0.00137***		0.00185***		0.00771***	
	[0.000]		[0.002]		[0.001]		[0.000]	
cons	-0.00509	0.0109	-0.00701	-0.00439	-0.00696	-0.00477	-0.00878	0.00518
	[0.218]	[0.241]	[0.209]	[0.544]	[0.219]	[0.487]	[0.299]	[0.580]
N	11311	31614	9349	13701	9145	10146	5233	5981
R-sq	0.119	0.078	0.100	0.095	0.105	0.088	0.141	0.116

Table 4: Fama-MacBeth regression estimates, France sample. (*p<0.1, **p<0.05, ***p<0.01, p-value in brakets)

FRANCE								
	Total sample		**R&D for at least one year**		**R&D from 2006 to 2010**		**Top quartile for R&D**	
	(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
beta	-0.00337***	-0.00538	-0.00254**	-0.00241	-0.00568***	-0.00188	-0.00469***	0.00175
	[0.002]	[0.204]	[0.038]	[0.229]	[0.000]	[0.342]	[0.001]	[0.469]
ln(ME)	0.000110	-0.000626	0.000490	0.000219	-0.0000280	0.000225	-0.000974**	-0.00142
	[0.746]	[0.281]	[0.188]	[0.711]	[0.934]	[0.678]	[0.046]	[0.129]
ln(BTME)	-0.000409	0.00694***	-0.000480	0.00532**	-0.00155	0.0100***	-0.000628	0.00979***
	[0.746]	[0.002]	[0.744]	[0.045]	[0.245]	[0.000]	[0.675]	[0.000]
ln(leverage)	-0.000440	-0.000177	-0.00126*	0.000190	0.00118*	0.00114	-0.00105	0.000907
	[0.459]	[0.759]	[0.067]	[0.829]	[0.099]	[0.296]	[0.200]	[0.525]
ln(RDC/ME)	0.00191***		0.00144**		0.00113*		0.00619***	
	[0.000]		[0.013]		[0.061]		[0.000]	
cons	0.00409	0.0137*	-0.00247	0.00213	0.00540	0.00568	0.0138**	0.0146
	[0.403]	[0.080]	[0.626]	[0.821]	[0.239]	[0.433]	[0.034]	[0.213]
N	4337	22359	5439	9521	3846	5705	2566	3754
R-sq	0.208	0.108	0.174	0.130				

Table 5: Fama-MacBeth regression estimates, Germany sample. (*p<0.1, **p<0.05, ***p<0.01, p-value in brakets)

GERMANY								
	Total sample		**R&D for at least one year**		**R&D from 2006 to 2010**		**Top quartile for R&D**	
	(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
beta	-0.00303***	-0.00618	-0.00382***	-0.00452**	-0.00449**	-0.00384**	-0.00220	-0.00229
	[0.006]	[0.162]	[0.008]	[0.025]	[0.011]	[0.027]	[0.210]	[0.190]
ln(ME)	0.0000410	-0.000419	0.000578	0.000572	0.000361	0.000297	0.000307	0.000407
	[0.907]	[0.353]	[0.191]	[0.269]	[0.462]	[0.602]	[0.651]	[0.536]
ln(BTME)	0.00790***	0.00443**	0.00421***	0.00667***	0.00399***	0.00744***	0.00473*	0.0112***
	[0.000]	[0.011]	[0.000]	[0.003]	[0.004]	[0.001]	[0.072]	[0.001]
ln(leverage)	-0.000158	0.000721	0.000530	0.000922	0.00111**	0.00154**	0.000746	0.00172*
	[0.662]	[0.169]	[0.185]	[0.231]	[0.013]	[0.025]	[0.305]	[0.070]
ln(RDC/ME)	0.00352***		0.00298***		0.00209***		0.00694***	
	[0.000]		[0.000]		[0.000]		[0.000]	
cons	0.0168***	0.00951	0.00694	0.00128	0.00866	0.00737	0.00793	0.00188
	[0.000]	[0.118]	[0.239]	[0.876]	[0.187]	[0.428]	[0.356]	[0.836]
N	8111	22140	6537	11864	7415	9670	4381	5547
R-sq	0.171	0.095	0.132	0.133	0.135	0.143	0.233	0.192

Table 6: Fama-MacBeth regression estimates, model with variables of differentiation between countries. (*p<0.1, **p<0.05, ***p<0.01, p-value in brakets)

VARIABLES OF DIFFERENTIATION BETWEEN COUNTRIES				
	Total sample		**R&D from 2006 to 2010**	
	(1)	**(2)**	**(1)**	**(2)**
common/civil law	0.000155	-0.00111	0.00224	0.000937
	[0.878]	[0.353]	[0.131]	[0.604]
shareholders rights	-0.00117	0.00128	-0.00136	0.000548
	[0.545]	[0.196]	[0.383]	[0.791]
creditors rights	-0.00185*	-0.00164*	-0.00423*	-0.000350
	[0.066]	[0.068]	[0.051]	[0.913]
efficiency of the juridical system	0.00780**	0.00383**	0.00986**	0.00504
	[0.033]	[0.035]	[0.012]	[0.389]
corruption	-0.00814***	-0.00828***	-0.000114	-0.00607
	[0.000]	[0.006]	[0.982]	[0.362]
risk of espropriation	0.00342	0.00981**	0.0125**	0.0234**
	[0.659]	[0.018]	[0.014]	[0.011]
likelihood of contract repudiation	-0.00716**	-0.00241	0.00380	-0.0100
	[0.047]	[0.409]	[0.482]	[0.226]
beta	-0.00338***	-0.00769	-0.00387***	-0.00299
	[0.000]	[0.122]	[0.001]	[0.237]
ln(ME)	0.000495**	-0.000255	0.000465	0.0000656
	[0.017]	[0.502]	[0.244]	[0.864]
ln(BTME)	0.00427***	0.00484***	0.00288***	0.00600***
	[0.000]	[0.000]	[0.002]	[0.001]
ln(leverage)	0.000847***	0.000285	0.000144	0.000576
	[0.000]	[0.347]	[0.669]	[0.262]
ln(RDC/ME)	0.00197***		0.00727***	
	[0.000]		[0.000]	
cons	0.0903	-0.0247	-0.120***	-0.0906*
	[0.451]	[0.334]	[0.004]	[0.051]
N	27365	125719	15785	20108
R-sq	0.130	0.104	0.154	0.134

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