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Research & Development And Volatility Of Equity Returns In The French Market

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ABSTRACT
This paper examines the link between research and development (R&D) and idiosyncratic volatility for a panel of large French quoted companies. We investigate whether the intensity of R&D investment makes the firm’s stocks riskier. We suggest that R&D activities generate information asymmetry and uncertainty about the firm’s future cash flows and make its idiosyncratic volatility higher. Our results show that R&D investment intensity should be considered as a determinant of the idiosyncratic volatility and that R&D increases the riskiness of the firm.

Keywords: R&D, volatility, asymmetric information, risk, CAPM.

INTRODUCTION
In financial theory, equity return volatility is seen as a central measure of risk. Shiller (1981) considers that stock price fluctuations cannot be explained either by the fluctuation of dividends nor by that of earnings. Schwert (1989) argues that macroeconomic variables can only explain a small portion of volatility fluctuation in the American stock market. Portfolio management theory dictates that idiosyncratic stock volatility can be wholly eradicated by proper portfolio diversification. In practice, investors do not always follow this rule. Barber and Odean (2000) showed that individual investors tend to hold a portfolio with just 4.3 stocks. Goetzman and Kumar (2008) found that in a sample of 62,000 American households, over 25% hold only one type of share. Several studies have concluded that idiosyncratic volatility (obtained from the CAPM) can help to predict market yield and that it can be taken into account in the risk premium required for a given stock. Thus, Goyal and Santa Clara (2003) found that aggregate idiosyncratic volatility (the weighted mean determining the idiosyncratic volatility of individual stocks) considerably improves stock market equity return forecasts. Fu (2009) found a significant and positive link between idiosyncratic volatility and expected return. Stocks with high idiosyncratic volatility generate a higher return compared to low idiosyncratic volatility stocks.

In this paper, we attempt to demonstrate how research and development (R&D) spending can be a crucial factor in idiosyncratic volatility. Some studies have highlighted the positive link between equity return and intensive investment in R&D (Griliches, 1981; Hirschey and Weygandt, 1985; Lev and Sougiannis, 1996). Hall and Oriani (2006) obtained similar findings in the French context. Other authors consider that announcing R&D investment tends to generate unusually high returns (Chan et al., 1990; Eberhart et al., 2004). Other studies however, conclude that companies which invest heavily in R&D are riskier than others (Chan et al., 2001; Kothari et al., 2002).

Our study on the French market contributes to the existing literature in two ways: 1/ American companies invest far more in R&D than their European counterparts (Moncada-Paterno, 2010) ; 2/ R&D accounting is managed differently in France and the United States: while American companies record their R&D spending under expenses, French accountants draw a distinction between research and development costs (which can be considered as fixed assets under certain conditions). Stock market volatility is positively related to the degree of asymmetry surrounding the company’s future earnings (Gennette and Leland, 1990; Eden and Jovanovic, 1994). R&D investment generates more information asymmetry when compared to investments in tangible assets (Lantz and Sahut, 2005).

We test the hypothesis that stock market volatility increases according to the intensity of investment in R&D. Our empirical results validate the hypothesis tested and corroborate the findings identified in an American context. In effect, R&D investment makes equities riskier. The accounting method used for research and development has no impact whatsoever.

These results also contribute to the literature on equity volatility factors, as well as the literature on R&D spending. The implications and recommendations will be discussed at the end.

The paper is organised as follows: section 2 consists of a review of the literature. In section 3, we introduce the hypotheses, the sample and the research methodology employed. Section 4 outlines our findings. The last section presents our conclusions and recommendations.
REVIEW OF THE LITERATURE

Stock market volatility and information asymmetry

The theoretical models suggest that stock market volatility increases in line with information asymmetry. Gennotte and Leland (1990) put excessive volatility and stock market crashes (for example the stock market crash of 1987) down to the large number of transactions carried out by traders who are poorly informed in a context of information asymmetry. Eden and Jovanovic (1994) consider that fluctuations in the amount of information available can lead to excessive volatility.

Since the degree of information asymmetry cannot be measured directly, empirical studies employ approximate variables to assess it. Sahut et al. (2011) corroborate the theoretical models used in the French context and found that stock market volatility is negatively impacted by the number of institutional investors in the risk capital and the number of financial analysts who track a company.

R&D and information asymmetry

R&D investment can generate considerable information asymmetry (between the top executives who dispose of specific and detailed information on the productivity of a project and external investors who possess general and non-specific information. This can be explained by the fact that:
- firms that invest heavily in R&D are little inclined to divulge detailed information on their projects in order to protect their innovations and retain their competitive edge. Cohen et al. (2000) investigated the strategies used to protect innovation by around 1,500 American R&D centres. They found that most of these centres tend to keep innovations secret for as long as possible. They also use patents and licences only in the second instance;
- R&D projects are exceptional and specific to the companies that fund them;
- the accounting model applied to R&D investment means that full information on the true value and return on R&D investment cannot be provided. As a rule, these investments are not recorded on the balance sheet under assets but are instead written off as expenditure in the year they are contracted, despite the fact that such expenses are incurred to generate profit for many years into the future and could therefore be considered as assets. Lord (2002) argued that investment in intangible assets reduces the informational content of earnings and the balance sheet;
- finally, Barth et al. (2001) argued that the discrepancies in earnings forecasts by analysts is greater for companies with substantial R&D investment. This difference in opinion may be due to the degree of information asymmetry related to R&D investment.

R&D and corporate risks

The inherent uncertainty of R&D investment is markedly higher than for tangible assets. R&D investment increases exposure to a number of risks, such as the risk of product failure, earnings variability, systematic risk, risk linked to obligations and equity return volatility. Several findings can be highlighted:
1/ Mansfield and Wagner (1975) showed that investments in intangible assets present a higher failure risk;
2/ Kothari et al. (2002) consider that the variability in earnings from investment in R&D is three times higher than that of physical assets. Amir et al. (2007) found that investment in R&D contributes to operating variability that can be carried forward;
3/ empirical findings concerning the rapport between R&D investment and systematic risk (beta) present conflicting results. Wedig (1990) compared systematic risk in companies that invest in R&D with those that do not. His findings indicate that the former are riskier and that R&D investments are linked to a systematic risk premium. Lantz and Sahut (2005) found that, on average, beta for firms that invest heavily in R&D is twice as high as that of companies with low R&D investment. Nevertheless, McAlister et al. (2007) found that R&D spending combined with advertising reduces a company’s systematic risk;
4/ Chan et al. (2001) found a positive relationship between R&D investment and equity return volatility. They observed that the volatility of returns for companies that invest in R&D is 2.21% higher on average than that of other firms. Fung (2006) found that R&D investment and stock return volatility were positively linked. Chambers et al. (2002) indicated that excess returns are highly volatile for companies with a strong research and development culture. They define excess returns as the difference between actual return and expected return based on the model developed by Fama and French (1993).

HYPOTHESES, SAMPLE AND METHODOLOGY
**Hypotheses**

Investment in R&D generates information asymmetry regarding the likelihood of success for new products and future earnings. Since stock return volatility increases according to the degree of information asymmetry, we put forward the hypothesis that it increases in line with R&D investment. R&D investment is specific to the companies that fund it. We therefore expect these investments to be closely linked to the idiosyncratic component of volatility. We put forward two hypotheses:

(H1): overall stock return volatility is positively linked to the degree of R&D spending.
(H2): idiosyncratic volatility is positively linked to the degree of R&D investment.

**Sample**

Our paper aims to ascertain whether R&D investment is a determining factor for stock return volatility and, above all, for idiosyncratic volatility. We opted to focus on French companies listed on the SBF 250 index that invest in R&D. Our sample therefore includes 110 companies in the period between 2000 and 2010. Our panel includes 811 observations. The data was extracted from the Worldscope and Thomson Financial databases.

**Model and variables**

The model was designed to test the impact of R&D investments on stock-market volatility (dependent variable) with the following equation:

\[ \text{VOL} = f(\text{R&D, SIZE, DEBT}) \]

VOL: stock market volatility (total or idiosyncratic)

**Table 1- Variable description**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total volatility (VT)</th>
<th>Idiosyncratic volatility (VID)</th>
<th>Degree of R&amp;D</th>
<th>Company size (SIZE) (control variable)</th>
<th>Debt ratio (DEBT) (control variable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
<td>Annualised standard deviation of daily returns</td>
<td>Annualised standard deviation of daily errors by the CAPM</td>
<td>Ratio of R&amp;D spending to total sales</td>
<td>Stock market capitalisation logarithm</td>
<td>Ratio of long-term debt to total assets</td>
</tr>
</tbody>
</table>

The total volatility variable measures the overall financial risk for a stock. This can be subdivided into systematic risk (stock market-related) and idiosyncratic risk (specific to the firm). The use of total volatility enables us to study the impact that R&D investment can have on a company’s financial risk. Given the fact that R&D investment is specific to the firms that fund it, using idiosyncratic volatility enables us to analyse the impact of an organisation’s specific investment with respect to its own specific risk. To measure the intensity of R&D investment, we pursue the method adopted by Chambers et al. (2002) and Chan et al. (2001) among others, who use the research and development expenditure ratio compared to sales. Size and level of debt have been widely discussed in the literature due to their impact on stock market volatility. Black (1976) and Christie (1982), for instance, found that volatility increases in line with the level of debt. The latter impacts on future cash flow by way of interest payments, and increases the chances of payment default.

**Descriptive statistics**

Table 2 summarises the descriptive statistics related to the variables used. We highlight the disparity in the degree of R&D investment in firms. The R&D investment of some firms in the biotechnological and pharmaceutical sector, for example, can surpass their turnover for a given year. Other firms prefer to invest small amounts in R&D on the odd occasion.

**Table 2 - Descriptive statistics**

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT (%)</td>
<td>38.2</td>
<td>33.6</td>
<td>2</td>
<td>211</td>
<td>18.8</td>
</tr>
<tr>
<td>VID (%)</td>
<td>33.6</td>
<td>29.7</td>
<td>1.9</td>
<td>201</td>
<td>17.4</td>
</tr>
<tr>
<td>R&amp;D (%)</td>
<td>13.44</td>
<td>2.61</td>
<td>0</td>
<td>870.5</td>
<td>71.982</td>
</tr>
<tr>
<td>DEBT (%)</td>
<td>22.91</td>
<td>21.353</td>
<td>0</td>
<td>73.712</td>
<td>14.7</td>
</tr>
</tbody>
</table>

**EMPIRICAL FINDINGS**
Table 3 presents the findings obtained from the panel regression models. For the model of total volatility, the R&D coefficient is positive and statistically significant at a 1% threshold. The model is also significant in general at a threshold of 1%. This confirms hypothesis H1 which posits that the degree of R&D investment entails a significant increase in overall volatility. The result also correlates with the results of Chan et al. (2001) and Fung (2006) who found a positive correlation between overall volatility and the degree of R&D investment in an American setting.

For the total volatility model, the R&D coefficient is positive and statistically significant at a 1% threshold. This result validates hypothesis H2 which suggests that idiosyncratic volatility is positively linked to the degree of R&D investment. The adjusted coefficient of determination R² (15.4%) is higher in this model than in that of the total volatility model (7%). Indeed, R&D activities are exclusive to the companies that fund them and they have a substantial impact on the specific component of stock volatility. The coefficients for control variables are also significant, and are consistent with theoretical forecasts as well as with previous empirical findings. The size coefficient is significantly negative (small businesses are not often tracked by analysts and are characterized by a high degree of information asymmetry; Bhushan, 1989). The debt coefficient is significantly positive, corroborating the positive association identified by Christie (1982) for the American market.

Table 3 - Stock volatility and R&D intensity

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>R&amp;D</th>
<th>Size</th>
<th>Debt</th>
<th>R²</th>
<th>F - statistic (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT</td>
<td>0.689***</td>
<td>0.000445***</td>
<td>-0.016***</td>
<td>0.0013***</td>
<td>0.07</td>
<td>20.732</td>
</tr>
<tr>
<td></td>
<td>(19.055)</td>
<td>(4.525)</td>
<td>(-7.54)</td>
<td>(2.314)</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>VID</td>
<td>0.903***</td>
<td>0.00044***</td>
<td>-0.028***</td>
<td>0.00089*</td>
<td>0.154</td>
<td>50.242</td>
</tr>
<tr>
<td></td>
<td>(17.297)</td>
<td>(4.637)</td>
<td>(-10.65)</td>
<td>(1.61)</td>
<td></td>
<td>0.000</td>
</tr>
</tbody>
</table>

* Significant at a 10% threshold ** Significant at a 5% threshold *** Significant at a 1% threshold

CONCLUSION

Taking a sample of 110 companies listed on the SBF 250 index that invest in research and development activities, we found that total volatility and idiosyncratic volatility are positively linked to the degree of R&D investment. Indeed, R&D activities tend to increase the level of information asymmetry on projects and future earnings for a company, and this in turn generates an increase in stock return volatility. These findings also offer a twofold contribution to the existing literature on the following counts: first, the intensity of R&D investment can be viewed as a decisive factor for stock return volatility. Thus, the increase in R&D investment in the last few decades provides a plausible explanation for the increase in idiosyncratic volatility observed by Campbell et al. (2001). Second, the different accounting principles employed with respect to R&D in France and the United States has no bearing on the results. R&D investment increases the riskiness of stocks regardless of the accounting method used. This paper offers implications for company leaders who need to back up their R&D investment projects with an effective communication strategy to help reduce the information asymmetry. Business leaders should divulge information in order to reduce uncertainty regarding the likelihood of success for new products and potential future earnings.

REFERENCES