

## OWNERSHIP STRUCTURE, BOARD OF DIRECTORS AND R&D INVESTMENTS: EVIDENCE FROM FRANCE

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### Abstract

The purpose of this research is to analyze the impact of the characteristics related to the ownership structure and board of directors, as mechanisms of governance, on the research and development (R&D) intensity. The study carried out on a sample of French companies belonging to the SBF 250 index shows that ownership concentration and duality of chief executive officer and chairman roles have no significant effect on the R & D intensity. The board sizes as well as the proportion of inside directors in the board have a positive and significant effect on R & D intensity. However, the participation of outside directors in capital tends to urge managers to reduce R&D investment level

**Keywords:** R&D, Corporate governance, Board of directors, Ownership structure, SBF 250

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### Introduction

Research and development (R&D) investment has become increasingly important in recent years. One view is commonly shared that this investment plays a major role in the growth and the maintenance of the competitive position of companies. Now, the sustainability of high-tech companies is based on their ability to generate innovation and they should therefore proceed to intense spending in R&D. Indeed, companies carrying out R & D investments have strong growth opportunities (Loof and Heshmati, 2004-2005). While R&D expenditures decreased current cash flows and profits, they positively affect the prospects of companies to have higher long-term profits. Previous research has highlighted the positive contribution of R&D activities to the performance, productivity (Sougiannis, 1994; Ding et al, 2007) and the market value of companies (Griliches 1981; Bosworth and Rogers, 1998; Blundell et al, 1999; Toivanen et al, 2002).

However, although R&D investment is a major driver to value creation (Lev, 1999) and synonymous with good growth opportunities (McConnell and Muscarella, 1985), it is well known that it is inherently risky long-term investment (Baysinger et al, 1991) with a high probability of failure (Finkelstein and Boyd, 1998). Thus, in the presence of interests conflicts between shareholders and managers resulting in the difference of risk aversion and planning horizon between the two parties (Byrd et al, 1998), R & D investment can not be targeted by managers. Indeed, if managers have a preference for the short term, that is the period in which they are

running the firm, shareholders have a longer horizon associated with the infinite life of the company. Thus, while shareholders search for long-term profitability maximization, managers are assumed to be short-sighted. Consequently, managers will be reluctant to invest in risky long term R&D projects. According to Narayanan (1985), managers preferred short term investment projects to quickly reveal the performance of these investments and dispel uncertainty about their own value on the job market. Similarly, Thurow (1993) asserts that managers often proceed to a reduction in R&D expenditure in order to increase short-term results and therefore protect the firm against the threat of takeovers, usually associated with a fall in stock prices.

In addition, shareholders and managers have different degrees of risk aversion. Indeed, shareholders, with a diversified portfolio, are willing to support a higher level of risk than managers. Since the outcomes of R&D projects are excessively uncertain, managers tend to avoid such risky projects which fell during their careers can be harmful. This could lead to myopic behavioural in investment (Porter, 1992) and lead to problems regarding the efficient allocation of firm resources (Jensen and Meckling, 1976). Thus, the most direct impact of these conflicts of interest between shareholders and managers appears on investment decisions, in particular in R&D activities.

Therefore, as the decision to invest in R&D is in the responsibility of managers and that they carry most often to a dosage of the level invested in R&D according to their own objectives, strict control

should be exercised over them to ensure an effective decision-making in ways that generate future profits.

In the context of corporate governance theory, various internal and external control mechanisms have been identified to compel managers to make strategic corporate decisions such as R&D investment in accordance with the interests of shareholders in order to improve shareholder value (Fama and Jensen, 1983; Shleifer and Vishny, 1997). In particular, ownership structure and board of directors are two internal governance mechanisms that can play an important role in curbing managerial opportunism in making strategic decisions such as R&D investment. In fact, the existing literature on the subject, especially in the US context, confirms partly the role played by both internal mechanisms of governance in disciplining the behaviour of managers in terms of investment in R&D without reaching unanimity (Baysinger et al, 1991; Bushee, 1998; Lee and O'Neil, 2003; Lee, 2005). At this level, looking at the french context a question arises: *What impact have internal governance mechanisms (ownership structure, board of directors or supervisory board<sup>1</sup>) on managers investment decisions in R&D activities?*

This research has an extensive nature to the extent that few studies have been conducted to explain the decision to invest, particularly in R&D activities via governance especially in the French context. Indeed, most of studies on the relationship between corporate governance and level of R&D investments are principally focused on the US context (Baysinger et al, 1991; Hill and Snell, 1988; Bushee, 1998; Lee and O'Neill, 2003) and Japanese context (Hosono et al, 2004; Yafeh and Yosha, 2003; Lee, 2005). It is only recently that there are few studies on this subject have been conducted in the European context, such as the study of Berrone et al (2005) made in the context of Spanish companies and the study of Munari et al (2005) carried out on western European firms (France, Italy and United Kingdom). The results of these studies remain mixed. Available

So we propose to extend the analysis of the effect of the internal mechanisms of governance on the R&D investment level on the context of French firms. The choice of this context is motivated by the fact that differences in the governance systems among countries (Europe continental / Anglo-Saxon) in several aspects (ownership concentration, shareholders identity ...), as demonstrated by LaPorta et al (1999) and Faccio and Lang (2002) might have different effects on R&D investment. Moreover, the choice of French context is interesting to the extent that we are assisted in France in recent years, great changes in corporate governance following the publication of three reports: the two reports "Viénot"

<sup>1</sup> The French law provides for limited companies two modes of organization, one is the board of directors, the other is the supervisory board and managing board. The board's role is to monitor the managers. The Supervisory Board shall exercise control over the managing Board (Commercial Code Article L 225-35).

(1995<sup>2</sup>, 1999<sup>3</sup>) and the Bouton Report in 2002<sup>4</sup>, as well as the adoption of the NRE law (Nouvelles Régulations Economiques) on 15 May 2001. All these reports and laws resume, with multiple modifications, the provisions on the effective functioning of boards of directors and their specific committees, on the independence of directors and the compensation arrangements.

This article is structured in four parts. In the first part, we intend to explore the managerial opportunistic behaviour in making R&D investment decision stimulated by the characteristics of this investment. We present in the second part, the theoretical framework and hypotheses. The third part is devoted to the presentation of the research methodology. The analyses and results are subject to the fourth part.

## 1. R&D Investment and Managerial Opportunism

R&D investment has specific characteristics that differentiate it from other firm investments. We distinguish four: the specificity, the long term horizon, the high rate risk of failure and the risk of imitation. Together these characteristics can lead managers to have opportunistic behaviour in order to maximize their wealth at the expense of shareholders.

### 1.1. Specificity

R&D investment is a specific asset at the meaning of Williamson (1988)<sup>5</sup> as it presents for any officer other than the company a value much lower than that attributed to it by its owner. It requires, for example, the acquisition of sophisticated technology and the recruitment of staff with exceptional skills. In this regard, the manager, because of its central role within the company, has an interest to engage it in R&D activities that capitalizes its own unique capabilities and skills so that it becomes hardly and costly substitutable. Its aim is to demonstrate to other stakeholders its crucial role within the firm, on the one hand, and to make his dismissal more difficult and costly on the other.

### 1.2. The long term horizon

R&D projects are regarded as long-term investments in connection with their payback. Indeed, in the case of a discovery even rapid of a new product or process,

<sup>2</sup> Available on the site web : <http://www.worldbank.org/html/fpd/privatesector/cg/docs/vienot1-fr.pdf>

<sup>3</sup> Available on the site web : <http://www.worldbank.org/html/fpd/privatesector/cg/docs/vienot2-fr.pdf>

<sup>4</sup> Available on the site web : [http://www.medef.fr/fr/A/Adoc/A2002/A\\_09-23-02\\_rapport-bouton.pdf](http://www.medef.fr/fr/A/Adoc/A2002/A_09-23-02_rapport-bouton.pdf)

<sup>5</sup> According to this author, an asset is specific if is not reusable without losing all or part of its value.

it takes some time for the construction of a new productive capacity and the products marketing. In the presence of a conflict of interest between shareholders and managers resulting in different planning horizon (Byrd et al, 1998), R&D investment policy might not be followed by managers. Indeed, managers have an objective of results over short horizons. Their wealth is tied to the performance of the company during their mission or the period in which they are running the firm<sup>6</sup>. Shareholders interested in contrast to the present value of all future cash flows. Their wealth is tied to the predictable performance of the company for a period of time generally unlimited. Their horizon is therefore longer. The most direct impact of this type of conflict occurs in R&D investment decisions. Thus, according to Narayanan (1985), manager preferred investment projects in the short term to quickly reveal the performance of these investments and dispel uncertainty about their own value on the labour market. Heirshleifer (1993) corroborates this idea and think that managers invest in short-term projects to generate, as soon as possible, a positive cash flow in order to increase their pensions and their managerial reputation in the labour market. Therefore managers will tend to reduce R&D investments that are essential for the company if it wants to ensure its long-term competitiveness. Since then the preference of short-term investments can be harmful and destructive to shareholder value.

### 1.3. The risk of failure

In general, all researches agree on the complexity of the innovation process and the ambiguity of R&D activities (Chowdhury and Geringer, 2001) in the fact that there is some discretion as to the process of research or its results (Lev, 1999). The uncertainty about the success of innovations developed induces, for example, a risk of making a technological breakthrough suddenly obsolete discovery.

Mairesse and Sassenou (1991), for example, stressed that a direct relationship between R&D spending and firm productivity or performance is difficult to establish and lack of robustness resulting in the uncertainty in the success of R&D activities. Thus, the excessively uncertain nature of innovation outcomes and, in particular, the R&D outcomes, tends to exacerbate the conflict of interests between shareholders and managers mostly because they do not have the same degree of risk aversion. Indeed, the shareholders are ready to support a higher level of risk than managers since they usually have a diversified portfolio. However, the manager has a wealth that depends on the value of the company led during their mission. The interest of the manager is from this point of view to choose a less risky strategy than what would be consistent with the interests of shareholders.

This may aggravate the managerial myopia and cause problems with regard to the efficient allocation of resources of the firm (Jensen and Meckling, 1976)

### 1.4. The risk of imitation

Kamien and Schwartz (1978) show that when a company is embarking on a research project, nothing guarantees that it will be the first to find and could impose the fruits of its research to market, the research is apparent then in a race where only the first is winning. There is thus a risk of imitation. To protect against this risk, two strategies can be adopted by the company: either it decides not patented and is a total discretion would protect the firm from any imitations, or she opts for an acceleration of its research programs in order to minimize the likelihood of obtaining a patent by other firms.

However, although a company can reduce the risk of imitation by the use of different instruments for the protection of the results, it is often difficult to combat opportunistic behaviour of managers in terms R&D investment decision making. In this context, Levin et al (1987) believe that firms may choose not to patent the results of their research efforts in innovation in order to maintain discretion and not to disseminate information on their R&D programs, but they may in this case offer to managers a large freedom for manipulating the results of innovation. Thus, the managers, under the pretext of fear of a possible imitation, try to legitimize the fact that they only possess strategic information to prevent them from being used by potential competitors. Thus, the problems of informational asymmetry between the firm and the market are accentuated.

The characteristics of R&D activities, as presented, are all factors that could widen the discretion of managers. However, if this proposal is more sustainable, the review of the governance mechanisms that can exert an influence on the behaviour of managers is essential.

## 2. Theoretical Framework and Hypothesis

### 2.1. Ownership Structure and Firm's R&D Investment Level

Ownership structure has been widely recognized as a major driver of a firm's investment decisions (Porter, 1990) but its particular effect on R&D investment is much less studied. However, it is well known that the degree of control exercised by shareholders on the managers' behaviour in investment making decision depends on two factors, namely: the concentration of ownership and the nature of shareholders. But in this study we are interested only by the effect of the ownership concentration on R&D investment

Shleifer and Vishny (1986) and Agrawal and Mandelker (1990), and Bethel and Liebeskind (1993), and Knoeber and Agrawal (1996) suggest that ownership concentration is a guarantee of effective

<sup>6</sup> Dechow and Sloan (1991) show that R & D spending fell when the officer approached the end of its functions in the firm.

supervision of managers by shareholders. Large shareholders who hold a significant stake of firm's stock have an interest in investing in managerial control in order to limit the risk of a managerial opportunism and to assure a well allocation of resources and a maximisation of firm's value.

Now, studies that have examined the effect of ownership concentration on R&D investment level have only provided mixed results. On the one hand, McConnell and Wahal (2000) as well as Hosono et al (2004) found that the share of capital held by large shareholders is positively linked with R&D investment. Hill and Snell (1988) also confirm the existence of a positive and significant relationship between the R&D spending and ownership concentration. These results show that, given their high share in the capital, large shareholders are encouraged to carefully monitor managers' decisions in order to promote the long-term performance of the company. They have a positive influence on the managers to pursue strategies to high risk/return rate as R&D investment.

Hansen and Hill (1991) argue that concentrated shareholding firms adopt long term investments. Indeed, in such firms shareholders have more power and may use their voting rights and oppose to takeovers attempts following a drop in securities prices. This confirms that blockholders are less concerned by fluctuations in short-term results and more oriented to long-horizon investments maximizing their wealth in the long term. By contrast, in firms with a dispersed ownership, a significant drop in stock prices may lead minority shareholders to sell their shares and thus expose the firm to attempts of takeovers. The managers for fear of job loss, will oppose these takeovers of directing their decisions to short-term investments that likely generate cash flows as soon as possible and alleviate the decline in stock prices.

On the other hand, Yosha and Yafeh (2003) found that the ownership concentration is negatively correlated with R&D level. Similarly, Czarnitzki and Kraft (2003) show that ownership is more dispersed in the case of companies engaged in innovative activities. Francis and Smith (1995), found no significant differences in the level of R&D spending between firms with dispersed ownership structure and those with concentrated ownership structure. The disparity in previous studies' results may depend on national differences in the ownership structures across countries as demonstrated by La Porta et al (1999) and Faccio Lang (2002) that could cause different effects on R&D investment policy. Indeed, Lee and O'Neil (2003) and Lee (2005) show that the differences in ownership structures between the United States and Japan lead to disparities in the levels of R&D investment. Ownership concentration is positively related to the R&D intensity in US companies. However, this relationship is non-existent in Japanese companies. Drawing on arguments presented below, we expect that:

*Hypothesis 1: Ownership concentration positively affects firms' R&D investment level.*

## **2.2. Board of Directors and Firm's R&D Investment Level**

From an agency theory perspective, the primary function of the board is to control managers' opportunistic behaviour in the objective to align shareholders' and managers' interests (Jensen, 1993). The board of directors can practice two control systems depending on the indicators used: the strategic control and financial control as distinguished by Hoskisson and Hitt (1988). The strategic control requires a deep knowledge of the firm's business and is largely based subjective criteria and on long-term performance indicators. In contrast, financial control is based solely on objectives financial criteria (ex-ante (budgets), or ex-post (accounting or financial results)). Thus, the Board, through the control system used, may constrain the managers' behaviour and influence the nature of strategic decisions and subsequently the choice of investment adopted by managers. At this level, insofar as the decision to engage in R&D activities is most often subject to conflicts of interest between shareholders and managers, what influence has the board on the managers' behaviour in term of R&D investment?

It was well-known that the effectiveness of the board in monitoring managers depends on its characteristics. According to Jensen (1993), in a disciplinary perspective, a board of directors with a small size, dominated by independent directors and chaired by a person who does not undertake the role of Chief Executive Officer would be preferable to monitor managers and look after the interests of shareholders.

### **2.2.1. Board size**

Lipton and Lorsch (1992) argue that large boards make the process of communication and decision-making heavier and more difficult. Similarly, Jensen (1983) believed that a large board is less efficient than a small one in monitoring managers. that promotes the dominance and expanding the discretion of managers. The large boards deemed to be neutral and relatively inefficient in their functioning. Their ability to supervise more actively managers is being undermined. As a result, a limited size of the board seems desirable to monitor the conduct of officers and ensuring the effectiveness of strategic decision-making such as the decision to invest in R&D activities in order to improve the long-term firm's performance. Yermack (1996) and Eisenberg et al (1998) found that size board is negatively correlated with the firm's performance. However, Chaganti et al (1985) find that the non-failed firms, as compared to failed ones, tend to have bigger board size. This finding can be argument by the fact that the presence of a large number of directors in the board might mean that the firm is coopting directors from wide

ranging backgrounds and is using them rather profitably (Chaganti et al, 1985). Then, a smaller board is easy to manage and plays a controlling function, whereas a larger board may not be able to function effectively as a controlling body leaving a large freedom to managers. Thus Boone et al (2005) suggest that the board of directors of large size is negatively correlated with the level of spending on R&D. According to the different attitudes suggested by previous researches, we expect that:

*Hypothesis 2: The board size negatively affects firms' R&D investment level*

### 2.2.2. Board Composition (Inside Directors/Outside Directors)

The composition of the Board of Directors refers to the proportion of outside and inside directors within the board. In theory, it is possible to distinguish three categories of directors:

- *Inside directors:* They are those who are current employees of the firm (of the company or one of its subsidiaries) or former employees who are currently retired.
- *Affiliated outside directors:* They are those who have business relationships with the company without being employees of it as investors, banks, consultants, suppliers and customers.
- *Independent outside directors:* They are those who have no affiliation, past or present, with the firm other than their position in the board of directors (private investors, executives from other firms with no business dealings with the firm)

Fama and Jensen (1983) consider that the existence of independent outside directors<sup>7</sup> increases the efficiency of the board of directors in the control and limitation of managers' opportunism since these directors are mostly guided by the protection of shareholders' interests. Inside directors have not enough power to oppose to managers' decisions since they depend hierarchy of management and are not free from managerial influence. Thus, their lack of independence severely injures their effectiveness in monitoring managers and serving the interests' shareholders. These arguments in favour of independent outside directors allow us to assume that a board dominated by this category of directors is encouraged to promote R&D activities beneficial to the maximisation of shareholders' wealth over the long term.

While most of the research underscores the relevance and effectiveness of the board's independent outside directors' presence of external members on the board, the impact of such directors on R&D investment is still mixed. In reviewing many of these studies testing the relationship between the dominance of outside directors in the board and the R&D expenditures, we find that the results are

contradictory. While some authors have found a positive relationship (Boone et al, 2005; Waisman et al, 2005; Chung et al, 2003), others suggest the existence of a negative relationship (Hill and Snell, 1988; Baysinger et al, 1991) In fact, Hill and Snell (1988) and Baysinger et al (1991) found that a high insider representation on a positively affected firms' R&D spending. Similarly, Zahra (1996) note that the inside directors are more concerned towards projects that have potential to generate positive returns in the long term. These results seem inconsistent with the agency theory which assigns to the external members of the board of directors the role of guardian of shareholders' interests (Jensen and Meckling, 1976). This may be motivated by the idea supported by Baysinger and Hoskisson (1990) that a firm's emphasis on financial controls rather than strategic controls in the evaluation of managers' performance encourages them to prefer short-term projects over long-term R&D projects. Furthermore, it is assumed that inside directors practise a strategic control focused on the future since they have better access to information and better knowledge of the decision-making process while outside directors practise financial control based on financial and accounting results. Thus, a board dominated by inside directors tend to favour the strategic control and therefore to encourage managers to invest in long-term projects such as R&D projects. However, if the board is dominated by outside directors who prefer financial control, the managers will be concerned with maximizing short-term profits, and consequently they will be reluctant to invest in risky R&D projects. Thus we expect that:

*Hypothesis 3: The presence of inside directors within the board positively affects firm's R&D investment level.*

### 2.2.3. Board Ownership

The detention of directors of a share of a company's capital is a way of aligning the interests of directors with those of shareholders and to exercise more effective control of the managers' decisions. According to Hitt et al (1993), the directors in this case tend to use the strategic control and therefore to encourage the managers to bear more risk and undertake R&D investments. in Based on these arguments, we can say that board shareholdings will urge managers to run more risk and to keep their time horizons more longer. Thus Huse et al (2000) argue that board ownership encourage innovation activities. Malekzadeh et al (1999) argue that board shareholdings positively affect the firm's R&D investment. When the authors further categorize share ownership by director type, the results suggest that increases in R&D expenditures subsequent to anti-takeover amendments adoption are related to increases in share ownership of directors who have some affiliation with the firm rather than to ownership of those who are independent of the firm. However, Dutta et al (2004) found that directors' ownership is

<sup>7</sup> It should be noted that in most empirical studies, there is some confusion between the two groups of outside directors (affiliate and independent), since the researchers use the term indifferently "outside directors".

negatively and significantly correlated with a firm's R&D intensity.

*Hypothesis 4: The directors' ownership affects positively firm's R&D investment level.*

#### **2.2.4. Chief executive officer and chairman duality**

Fama and Jensen (1983) argue that consolidating the positions of Chief executive officer (CEO) and chairman of the board in one person reduces the board's effectiveness in monitoring top management. Indeed, since the function of the board is to appoint, pay and dismiss the officer, the presence of the latter as chairman of the board is likely to impair the monitoring functioning of a Board. Thus, the concentration of power into the hands of the CEO can lead to an inefficient and opportunistic behaviour on the part of the manager who will have an adverse impact on the wealth of shareholders. In contrast, separation of chairman of the board and the CEO duties is seen as a means to enhance the independence and effectiveness of the board, allowing him an objective assessment of the performance of the manager. The discretion of the latter is therefore reduced. In light of the arguments presented, it is presumed that a separation of functions of decision and control is preferable to promote R&D activities and limit the managers opportunism related to these activities. However, this idea was not supported by Dutta et al (2004) who found that the presence of an outside chairperson does not encourage managers to engage in R&D activities. Such a result may be motivated by the fact that the combination of the two functions by the same person is a factor, which facilitates access to information and communication between the board and the management team and therefore offer more flexibility to capture better growth opportunities.

*Hypothesis 5: Chief executive officer and chairman duality negatively affects firm's R&D investment level.*

### **2.3. Control Variables**

The characteristics related to the ownership structure and board of directors are not the only factors that influence the R&D of investment level. Other characteristics associated with the firm may also play a role in determining the level of R&D investment, namely, firm's size (Hansen and Hill 1991), leverage (Bhagat and Welch, 1995; Hansen and Hill, 1991), and growth opportunities (Lee and O'Neill, 2003).

*Firm's size:* Only big companies can have enormous resources to afford to invest in R&D projects often expensive. They are forced to undertake such projects and invest more aggressively in R & D activities in order to adapt to the rapidly changing and maintain their competitive advantage. By supporting this idea, several empirical studies have found a positive relationship between the firm's size and the

level of R&D spending (Hill and Snell, 1988; Baysinger and Hoskisson, 1989; Baysinger et al, 1991). This result was, however, reversed by Graves (1988) and Barker and Muller (2002).

*Leverage:* It is commonly shared by the studies is that debt discourages managers to invest in R&D projects in order to increase the cash flow available for the repayment of debts. Researchers found a negative relationship between the level of debt and expenditure on R&D (Baysinger and Hoskisson 1989, Barker and Mueller, 2002), although this relationship is not always significant. These results allow us to conclude that companies with high level of R&D activities should focus on internally generated funds rather than the use of external funding such as debt for financing these activities. Because of their specificity and riskiness, R&D as intangible assets constitute low guarantee for debt holders. Thus, the empirical evidence supports that firms that invest heavily in R&D should avoid debts and promote equity (Balakrishnan and Fox, 1993; Vincente-Lorente, 2001).

*Growth opportunities:* Companies with strong growth opportunities would likely invest more heavily in R&D activities in order to tap the future market potential. This result was confirmed by Lee and O'Neill (2003) and Dutta et al (2004).

## **3. Research Methodology**

Before presenting the results and their interpretation, we expose our method of investigation, i.e. the sample selection, the research design as well as measures of our variables.

### **3.1. Sample**

Our sample consists of French companies belonging to the SBF 250 index. Companies belonging to the financial sector (banking, financial services, insurance companies...) were rejected because they present a specific financial structure. Similarly, foreign companies belonging to the SBF 250, but subject to specific regulations and the companies that were the subject of merger in the year 2006 were not taken into account. Among the remaining companies from SBF 250, we looked at their annual reports for the year 2006, to determine whether these companies investing in R&D activities on the one hand and whether they communicated the amount of R & D spending, on the other. It is important to note that when we conducted our study, some reports were not available. In addition, some companies have been removed from the sample because they lacked the necessary data to our analysis. A total of 111 companies were selected. The determination of the sample as well as its distribution by industry are summarized in tables 1&2 presented below.

**Table 1.** Sample determination

Firms	Number
Firms belonging to the SBF 250 index	250
- Financial firms	-27
- Foreign firms (not french)	-4
- Firms subject to merger in 2006	-1
- Firms with missing annual reports	-2
= Firms whose reports were investigated	216
- Firms with no R&D	-82
= Firms undertaking R&D investments	134
- Firms with missing data on R&D expenditures amount	-23
= Firms forming the final sample	111

**Table 2.** Sample distribution by industry

industries	Number of firms	Percentage
Aerospace/ Defense	5	4,5%
Oil and gaz	3	2,7%
Automobile	7	6,31%
Industries (industrial goods and services, construction and materials)	24	21,63%
Software and services/ Information technology	28	25,23%
Pharmaceuticals/ Health/ /Biotechnologi/ Chemical	13	11,71%
Télécommunications	2	1,8%
Consumer goods (food, household goods, cosmetics and other)	13	11,71%
Services (média, retail,..)	16	14,41%
Total	111	100%

### 3.2. Data sources

To carry out our research, we need primarily to have a quantitative data on R&D expenditures. Then in gathering the amount invested in R&D activities we had to tackle a significant problem, namely the disclosure of R&D expenditures. The adoption of IAS/IFRS standards by all listed firms of European Union was introduced some changes in the accounting treatment of R&D expenditures<sup>8</sup>. In fact, while in the French rules the capitalization of R&D costs remains a choice for the manager (if the R&D project meets the conditions), in IAS 38 "Intangible assets", the capitalization of R&D costs become compulsory. Research expenditures and development costs (that not meet the criteria fixed by IAS 38) are recognised as expenses. Then, to have the annual amount

invested in R&D we have to know either R&D expensed and capitalized in 2006. To determine R&D expenditures we have combined the data available in Worldscope and EXTEL databases with those contained in the firms' annual reports for the year 2006. Worldscope database reports the amount of expensed R&D as a percentage of sales. Using the Extel database that provides financial statements as reported, we are able to identify the amount of capitalized R&D reported in the balance sheet, as well as its gross value and its amortization. To verify the accuracy of the databases, we also crosscheck the data gathered from Extel with the information disclosed in annual reports. Data on ownership structure and board of directors were extracted from firm's annual reports. We extract all other financial variables from Worldscope database.

<sup>8</sup> Starting in 2005, all listed firms of European Union (EU) countries have to prepare their annual reports to shareholders using International Financial Reporting Standards (or IFRS/IAS). In accordance with IAS 38 "Intangible Assets", R&D expenditures shall be recognised as an expense when they are incurred except for certain development costs that shall be recognised as intangible asset if, and only if, an entity can demonstrate all of the following criteria:

- The technical feasibility of completing the development;
- The intention to complete the development;
- The ability to use or sell the development;
- The probability to generate future economic benefits;
- The availability of adequate technical, financial and other resources to complete the development;
- The ability to assess reliably the expenditure attributable to the intangible asset during its development.

### 3.3. Variables' definitions and measures

We define in Table 3 all variables used for statistical analysis as well as their predicted signs in the research model.

**Table 3.** Variables' definitions and measures

Variables (predicted signs)	Measures adopted by reference to previous studies
Dependent variable	
R&D	R&D expenditures of the year (ie R&D expensed plus R&D capitalized) scaled by total sales (Lee and O'Neill, 2003 ; Yafeh and Yosha, 2003 ; Dutta et al, 2004)
Board variables	
BD_SIZE(-)	Total number of directors within the board (Yermack, 1996)
IN_DIR (+)	Proportion of inside directors to total directors (Dutta et al, 2004 )
DUALITY (-)	1 if the same person undertakes the combined roles of chief executive officer and chairman of the board and 0 otherwise (Chung et al, 2006)
OWN_DIR(+)	Ownership share of outside directors (Zahra, 1996)
Ownership variables	
CONC(+)	- CONC_1 : ownership share of the largest shareholder - CONC_50 : 1 if the ownership share of the largest shareholder is above 50% (high concentration) and 0 otherwise (low concentration)
Les variables de contrôle	
LOG_TA (+)	Firm's size : natural logarithm of total assets.
DEBT (-)	Debt ratio : total debt divided by total assets (Agrawal and Knoeber, 1996 ; Kochhar and David, 1996)
MBR (+)	Market to Book ratio as a measure of Growth opportunities: market value of equity at the end of a year plus the book value of debt divided by the book value of total assets (Yermack , 1995 ; Lee et O'Neill, 2003).

### 3.4. Research model

All the assumptions we have made are focused on the impact of the board of directors and the ownership structure on the level invested in R&D. In other words, we try to explain the level of investment in R&D through the characteristics associated with the board of directors and the structure of ownership. In this perspective, the multiple linear regression analysis is the appropriate statistical analysis since it allows us to link the level of investment in R&D with certain characteristics of the board and the structure of

ownership. The equation of the linear regression is as follows:

$$R\&D = \beta_0 + \beta_1 BD\_SIZE + \beta_2 INT\_DIR + \beta_3 DUALITY + \beta_4 OWN\_DIR + \beta_5 CONC + \beta_6 LOG\_TA + \beta_7 DEBT + \beta_8 MBR + \varepsilon$$

## 4. Statistical Analysis and Results

### 4.1. Descriptive Statistics

Table 4 (Part A & B), located below, shows the descriptive statistics for the variables included in the study.

**Table 4.** Descriptive Statistics

#### Part A: Continuous Variables

Variables	Minimum	Maximum	Mean	Median	Standard Deviation
R&D	0,001	60,226	4,828	2,682	7,234
BD_SIZE	3	20	9,80	9	3,849
IN_DIR	0	83,33	18,858	12,5	18,65
OWN_DIR	0	80,09	16,839	2,152	23,542
CONC_1	1,88	89,2	35,81	31,985	24,766
LOG_TA	4,739	9,241	6,288	2,55	0,939
DEBT	0,18	49,42	20,942	21,21	12,26
MBR	0,6	9,31	2,935	6,084	1,669

#### Part B: Dichotomous Variable

	DUALITY		CONC_50	
	Combined roles	Separable roles	High concentration	Low concentration
Mode	1	0	1	0
Frequency	67	44	35	76
Percentage	60,4	39,6	31,5	68,5



As shown in table 4 (A&B) the following findings:

- A significant disparity in the R&D intensity expressed by a high standard deviation and a significant difference between the minimum (0.001) and the maximum (60.226) as shown by R&D variable. This may be due to industry effects. It is generally acknowledged that firms in high-tech industries spend more in R&D activities than firms in traditional industries.
- On average, 68.5% of firms in the sample have a low ownership concentration due to the largest shareholder (less than 50%). The percentage of the capital held by the first shareholder is an average of about 35.81%.
- The board of directors of firms belonging to the sample is, on average, with a size of 10 members, consisting of 18.858% of inside directors.

Moreover, 60.4% of firms confuse the functions of CEO and Chairman of the Board. The average directors' shareholding is 16.839%.

## 4.2. Univariate analysis

### 4.2.1. Correlation Matrix

Examination of the correlation matrix (Table 5) shows that there is no significant univariate relationships between the dependent variable (R&D) and variables related to corporate governance with the exception of the variable IN\_ADM. Indeed, there is a positive and significant correlation between the proportion of inside directors within the board and the R&D intensity. In contrast, all the correlation coefficients between the control variables (LOG\_TA, DEBT and MBR) and R&D intensity is significant (at 1%)

**Table 5.** Pearson Correlation Matrix

	R&D	BD_SIZ E	IN_DIR	OWN_DI R	DUALIT Y	CONC_1	CONC_50	LOG_T A	DEBT	MBR
R&D	1	-0,117	0,229*	-0,004	-0,007	-0,095	-0,069	- 0,318**	- 0,277**	0,29**
BD_SIZ E		1	- 0,369**	-0,258**	0,088	-0,067	-0,122	0,626**	0,176	-0,101
IN_DIR			1	0,253**	0,38**	0,018	0,17	- 0,275**	-0,198*	0,177
OWN_D IR				1	-0,092	0,188	0,08	-0,436**	-0,236*	0,111
DUALIT Y					1	0,033	0,035	-0,026	-0,016	0,106
CONC_1						1	0,842**	-0,107	-0,133	0,042
CONC_50							1	-0,119	-0,02	0,17
LOG_TA								1	0,225*	-0,157
DEBT									1	-0,108
MBR										1

\*The correlation is significant at the 0.05 level (bilateral)

\*\* The correlation is significant at the 0.01 level (bilateral)

### 4.2.2. Multicollinearity problem

To verify the absence of a multicollinearity problem among the independent variables, we calculate the Pearson correlation coefficients (Table 5) between these variables and the VIF "Variance Inflation Factor" values (Table 7&8). As shown in Table 5, all correlation coefficients are below 0.8<sup>9</sup>, which corresponds to the threshold fixed by Kennedy (1985) and from which typically begins to have serious problems of multicollinearity. In addition, Tables 7&8 show that VIF values don't exceed 3, threshold suggested by Myers (1990). These results lead us to conclude the absence of a serious problem of multicollinearity.

<sup>9</sup> With the exception of the coefficient of correlation between the two variables CONC\_1 and CONC\_50 (0.842) that exceeding the threshold of 0.8. This is not a problem of multicollinearity because these two variables are two measures of ownership concentration and are not included in the same regression model.

## 4.3. Regression analysis

Table 6, that present the results of the linear regression analyses, shows that the explanatory power of the regression model is acceptable since the Fisher coefficient (F=5.777) is significant at 1% level (p = 0.000). Similarly when changing the measure of ownership concentration by a dichotomous variable, the Fisher coefficient (F = 5616) remains significant at 1% level (Table 7). The two tables (6 & 7) will produce the same results as regards as the effects of governance variables and control variables on R & D intensity.

**Table 6.** Results of linear regression analysis

Dependent Variable: R&D				
Variables	$\beta$ coefficients	t-Statistic	Sig	VIF
Constant	23,445	4,184	0,000	
BD_SIZE	0,241	2,017	0,047	1,998
IN_DIR	0,228	2,103	0,038	1,647
OWN_DIR	-0,262	-2,604	0,011	1,415
DUALITY	-0,133	-1,343	0,183	1,381
CONC_1	-0,097	-1,103	0,273	1,077
LOG_TA	-0,446	-3,651	0,000	2,096
DEBT	-0,243	-2,709	0,008	1,125
MBR	0,254	2,916	0,004	1,063
R <sup>2</sup> = 0,33    Adjusted R <sup>2</sup> = 0,273    F- statistics =5,777    F-significance =0,000    N= 111				

Ownership concentration has no significant effect on the R&D intensity. Indeed, whatever the measure used CONC\_1 (Table 6) or CONC\_50 (Table 7), the coefficient of ownership concentration variable is negative but not significant. Non significance of this variable may be due to the heterogeneity of shareholders holding the control. Indeed, the knowledge of the identity of the controlling shareholder may be important because they have different incentives (Shleifer and Vishny, 1997)). According to the agency theory, several

categories of shareholders are supposed to be better able to effectively discipline managers such as institutional investors who have experienced a strong presence in the United States in recent years. For example, several studies have shown that the effect of the ownership structure on the R&D intensity depends largely on the nature of shareholders holding the control (institutional investors, non-financial corporations, individuals, families...) (Berrone et al, 2005; Munari et al, 2005)

**Table 7.** Results of linear regression analysis

Dependent Variable: R&D				
Variables	$\beta$ Coefficients	t-Statistic	Sig	VIF
Constant	23,283	4,189	0,000	
BD_SIZE	0,244	2,044	0,044	2,002
IN_DIR	0,25	2,328	0,022	1,609
OWN_DIR	-0,288	-2,911	0,004	1,358
DUALITY	-0,158	-1,6	0,113	1,366
CONC_50	-0,051	-0,59	0,556	1,027
LOG_TA	-0,454	-3,721	0,000	1,110
DEBT	-0,226	-2,54	0,013	1,061
MBR	0,24	2,762	0,007	2,086
R <sup>2</sup> = 0,321    Adjusted R <sup>2</sup> = 0,264    F- statistics =5,616    F-significance =0,000    N= 111				

Tables (6 & 7) show that the board size has a positive and significant effect (at the 5% level) on R&D. This result counter to the disciplinary vision of the board that assume that a board with a small size is better to ensure effective control of managers' actions. Thus, according to the agency theorists, a large board creates a fertile environment for the domination of the managers and the apparition of coalitions and group conflicts (Jensen, 1993). This may hinder the well-functioning of the board resulting in difficulties in reaching consensus on major decisions. This reasoning leads us to expect a negative relationship between the board size and R&D investment intensity, given that this investment is most often the subject of potential conflicts between shareholders and executives. However, the result leads us to reject the hypothesis H2. In fact, a large board tends to

encourage managers to pursue investments in R&D. This can be explained by referring to arguments borrowed from the resource dependence theory. They are based on the idea that a large board make possible for improving firms' relations with their environment. The board is a way to create links with the environment and absorb environmental uncertainty. Thus, referring to R&D investments, since they are risky and specific, the need to involve many information, experiences and different skills becomes increasingly important for research-intensive firms. In this sense, a large board would be one way to benefit from different experiences and skills of each board member that is needed to guarantee a better decision-making in R&D investment that promote the firm's future performance.

Regarding the composition of the board, the proportion of inside directors within the board has a positive and significant effect (at 5% level) on R&D intensity. This result confirms the hypothesis H3 that is consistent with previous studies (Hill and Snell, 1998; Baysinger and Hoskisson, 1990; Baysinger et al, 1991). This may be motivated by the idea supported by Baysinger and Hoskisson (1990), which they believe that inside directors practise a strategic control because they have better access to information and a better understanding of the decision making process, while outside directors practice a financial control. As a result, inside directors, being better informed, are able to participate actively in the strategic decisions. Thus, Baysinger and Hoskisson (1989) argue that inside directors, adopting a long-term vision for the management and control, tend to encourage innovation projects and hence to urge managers to invest in R&D activities.

Contrary to the hypothesis H4, directors' ownership has a negative and significant effect on the R&D intensity. One possible explanation for this result, which seems a little surprising, is that outside directors that are shareholders will exercise financial control focused on financial indicators such as accounting results. This will urge managers to reduce R&D investments in order to get better level of short-term results. Nevertheless, the duality of CEO and Chairman of the Board functions has no significant effect on R&D intensity.

As regards the control variables, contrary to what was expected, the relationship between firm size and R & D intensity is significantly negative (at 1% level). It can be concluded that small firms invest more heavily in R&D activities than larger firms in order to adapt to rapid change in technology. This result was confirmed by previous studies (Hansen and Hill, 1991; Barker and Muller, 2002)

In line with previous studies (Czarnitzki and Kraft, 2004; Dutta et al, 2004; Munari et al, 2005), debt has a significant and negative effect on R&D intensity. This result may be explained by the fact that, because of the specific characteristics of R&D (risky and long-term horizon), creditors, which are risk averse, will urge managers to decrease the amount invested in R&D in the objective to increase current cash flows and to guarantee repayment of debts.

As for growth opportunities, the results show that there is a positive relationship between growth opportunities and R&D intensity. Thus the prospect of future growth could be as an incentive to undertake R&D activities.

## Conclusion and Future Research

Our paper has analysed the relationship between corporate governance mechanisms and R&D investments, by focusing on the role of two main internal control mechanisms: the ownership structure and the board of directors. The survey of French

companies belonging to the SBF 250 index shows that the ownership concentration has no significant effect on the R&D intensity. However, as regards the characteristics of the board, except for the duality of executive chief officer and chairman functions, board size, the proportion of inside directors in the board as well as the board ownership have a significant effect on R&D intensity. A board with large size and dominated by inside directors favour an increase in R&D spending. However, the outside directors' shareholding affect negatively R&D intensity.

In conclusion, we believe that this research could be extended in different ways. An initial extension would be to refine the study of the effect of the ownership structure on R&D investment, taking into account the nature of shareholders holding control. The second extension would be beyond the disciplinary approach, to reconsider the role of the board in guiding the managers' behaviour in terms of R&D investment by adopting strategic approaches of governance. Within this framework, the board is a means to facilitate the development of skills, to help create new opportunities and contribute to the process of innovation. It would therefore be interesting to take into account in the study of the effect of the board of directors on R&D investment, for example, the skill and experience of directors, the presence of the strategic committee within the board. Finally, a possible extension of this research would be to study the effect of managerial variables (entrenchment, competence, experience, reputation ..) on R&D investment decision. In fact, Barker and Mueller (2002) argue that the level of R&D spending varies significantly with the characteristics of managers.

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