

R&D Narrative Disclosure, Corporate Governance and Market Value: Evidence from France

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ABSTRACT

We investigate the impact of R&D narrative disclosure on the market value of equity for a sample of French companies during the period 2000–2004. Using 3SLS estimation on a panel data of 98 French firms, we find, *ceteris paribus*, positive (but insignificant) association between R&D voluntary disclosure and the market value of equity. Both R&D intensity and R&D capitalization lead French firms to disclose more R&D narrative information. However, they impact differently the relationship between R&D-related disclosure and market value. Indeed, a positive and significant association is found when we control for R&D capitalization. In contrast, when controlling for R&D intensity, we find a negative association. We also find that equity-based compensation and audit committee independence are the most important drivers for R&D narrative disclosure.

Keywords: Research and development; Voluntary disclosure; Market value; Corporate governance

1. INTRODUCTION

In a recent article, Merkley (2014) argues that the R&D setting offers a unique research area to examine the importance of narrative disclosure to external stakeholders, who need to evaluate the levels of risk and information asymmetry associated with R&D investments. To date, little effort has been undertaken to examine the determinants and economic consequences of R&D narrative disclosure. This paper studies the R&D narrative disclosure of French listed firms for the years 2000 through to 2004. In France, the disclosure of consolidated financial statements pursuant to IFRS started in December 2004. Thus, the financial reporting for year ends in the calendar year 2004 represents one of the few periods that had only voluntary disclosure. It is for this reason that our study uses data for a period ends on 2004 as this represents a rare opportunity to examine R&D disclosures in a purely voluntary environment.

The principal research question we consider is whether, controlling for R&D intensity and R&D capitalization, the willingness of firms to voluntarily disclose R&D information in their narrative sections of annual reports influences the market value of the French listed companies? We also ask whether the quality of corporate governance system affects the R&D narrative disclosure practice. We expect to see a positive association between R&D narrative disclosure and firms' market value. We also expect to see that better-governed firms disclose more R&D narrative information in their annual reports.

R&D activities are considered to be a source of agency problems between insiders (managers) and outsiders (stakeholders) (Cheng, 2004). Hence, voluntary narrative disclosure may provide an important mechanism that reduces information asymmetry and agency conflicts between insiders and outsiders (Jensen and Meckling, 1976; Patelli and Prencipe, 2007). A rich information environment and low information asymmetry lead to desirable economic consequences; one of these is the improvement in firm value (Healy and Palepu, 1993). However, competitive disadvantage affects firms' incentives to disclose information voluntarily on their R&D activities (Healy and Palepu, 1993). The proprietary cost of R&D disclosure is higher in that it may benefit competitors (Verrecchia, 1983; Dye, 1985; Jones, 2007).

Whilst there are an increasing number of relevant studies dealing with R&D disclosure (Entwistle, 1999; Ding et al., 2004; Jones, 2007; Zéghal et al., 2007), to the best of our knowledge, only Nekhili et al. (2012) examine the impact of R&D voluntary disclosure on market value of firms. At least two potential reasons could lead us to conclude that there is a positive association between R&D narrative disclosure and the market value of equity. First, previous empirical studies show a positive relationship between increasing R&D expenditure and firm value (see, e.g., Chan et al., 1990; Chauvin and Hirschey, 1993; Healy and Palepu, 1993; Chan et al., 2001; Hall and Oriani, 2006). Second, prior research finds a positive association between voluntary information and firm value (see, e.g., Haggard et al., 2008; Hassan et al., 2009). On the basis of these studies, we expect that R&D narrative disclosure positively influences the market value of companies. In addition, prior research shows that R&D voluntary disclosure varies dramatically across companies and countries. For example, Ding et al. (2004) compare the practices of R&D disclosure in France and Canada. They find divergent practices between firms in the two countries, which they attribute to the capital market and cultural differences. Another explanation may be that the disparity in terms of corporate governance practices affects the R&D disclosure practice. Our perusal of the literature indicates that, although many studies document a relationship between corporate governance and voluntary disclosure (Ho and Wong, 2001; Eng and Mak, 2003; Wang and Hussainey, 2013; Samaha et al., 2014), little research (Lim et al., 2007; Zéghal, 2007; Abdelbadie and Elshandidy, 2013) has examined specifically the link between corporate governance and R&D voluntary disclosure. In addition, a little research (Merkley, 2014) has examined the impact of R&D disclosure on current earnings performance. Within this context, the second goal of this study is to empirically assess the impact of R&D voluntary disclosure on the market value of firms.

We complement Nekhili et al. (2012) by considering several corporate governance attributes (board size, board independence, CEO duality, equity-based management compensation, and audit committee independence). Using a sample of 98 French firms over the period 2000-2004, we hand-collect 32 items from annual reports to develop an R&D voluntary disclosure index. The robustness of our empirical specification was confirmed by a number of diagnostic tests. Using 3SLS estimation, our results provide some interesting insights. We find that R&D voluntary disclosure does not boost *ceteris paribus* firm market value. However, both R&D intensity and R&D capitalization lead French firms to disclose more R&D narrative information but impact differently the relationship between R&D-related disclosure and market value. Indeed, when controlling for R&D intensity, an increase in the R&D voluntary disclosure index is significantly associated with a lower market value. Otherwise, investors pay more attention and react positively to R&D disclosure in the case when managers choose to capitalize R&D expenditures. R&D capitalization leads to greater managerial discretion and investors appreciate the disclosure efforts by managers in this particular situation. Finally, we find that equity-

based compensation and audit committee independence are the most important governance mechanisms that drive firms to disclose R&D narrative information.

The rest of this paper is organized as follows. The next section reviews relevant literature and develops the research hypotheses. Section 3 describes the data and the research methodology. Section 4 presents and discusses our main findings. Section 5 concludes.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. R&D Voluntary Disclosure and Firm Market Value

In France, the regulation of financial disclosure is primarily based on the accounting legislation established by the ‘Code of Commerce’ and the ‘General Accounting Plan’. This legislation specifies the rules for the preparation and disclosure of financial information by companies. However, firms can resort to many communication channels to disclose information about their performance and activities. These include quarterly/annual reports, announcements concerning profits, meetings with financial analysts, press interviews and statements, letters to shareholders, and corporations’ websites. In terms of disclosure and publication, only legislation is binding. In France, the disclosure of consolidated financial statements pursuant to IFRS started in December 2004. Prior to January 1st, 2005, international standards and recommendations on R&D were not mandatory and were considered to be within the scope of the voluntary disclosure.

It is important to note that some companies limit their disclosure to mandatory information, while others opt for transparency and the dissemination of additional information. The disclosure of information is necessary when the asymmetry of information is very high (Dye, 1985; Healy and Palepu, 2001; Verrecchia, 2001). High R&D-intensive firms often operate in rapidly changing environments, with customer demands that make their future returns relatively uncertain. Thus, investors have difficulty in valuing high-R&D activities firms correctly, and incur higher trading costs, leading to a decrease in the firm’s stock liquidity, and to higher financing costs (Aboody and Lev, 2000). Traditional mandatory disclosure fails to capture value-relevant information (Healy and Palepu, 1993; Hussainey and Walker, 2009). Compared to mandatory disclosure, voluntary disclosure has many advantages. Literature shows that firms disclosing more information should have a lower cost of capital than those disclosing more information (Botosan and Plumlee, 2002; Francis et al., 2008). Therefore, managers may choose to disclose more information about their R&D activities voluntarily, in order to convey the firm’s true value to outsiders (Jones, 2007; Merkley, 2014).

Voluntary disclosure by R&D firms may nonetheless have some disadvantages. Indeed, any voluntary disclosure regarding R&D projects increases proprietary costs (Verrecchia, 1983; Dye, 1985; Jones, 2007). Besides using disclosure as a mechanism to reduce information asymmetry, managers may find themselves facing a dilemma: whether to disclose to inform investors, at the risk of providing strategic information to competitors. As a consequence, managers should pay more attention to controlling the information to be disclosed, and the timing of its disclosure. Studying R&D disclosure, Entwistle (1999) provides evidence of a trade-off between the costs of disclosing proprietary information and the advantages of having a more accurate share price. The author undertakes a series of interviews of firm CEOs about the ‘effective’ management of R&D disclosure, including concerns about revealing proprietary information and bad news about R&D projects. He finds that firms fear disclosing strategic information that may be adversely used by competitors. These firms are sometimes forced to disclose bad news, notably to manage the market’s expectations and to maintain their credibility with outside stakeholders.

Nekhili et al. (2012) test the association between ownership structure, R&D disclosure, and firm value for a sample of French companies. They provide evidence that voluntary R&D disclosure has positive economic consequences as it improves the market value of equity. They also provide evidence that French firms with family and domestic institutional ownership withhold R&D information, whilst firms with foreign investors are more likely to disclose more R&D disclosure. In a recent paper, Merkley (2014) provides evidence that the quantity of R&D narrative disclosure is negatively associated with current earnings performance in US firms.

Based on the above discussion, it is clear that the relationship between R&D disclosure and firm market value is under-researched. Prior research shows that R&D expenditures could lead to a higher market value (Chan et al., 2001; Hall and Oriani, 2006). Therefore, we expect, based on agency and signaling theories, that higher levels of R&D disclosure are more likely to have a positive impact on firm value. Lim et al. (2007) and Nekhili et al. (2012) find a positive association between R&D disclosure and firm value. Based on the above discussion and agency and signaling theories, we formulate our first research hypothesis as follows:

H1. There is a positive relationship between the level of R&D voluntary disclosure and firm market value.

2.2. Governance Mechanisms and R&D Voluntary Disclosure

In our study, we use a set of mechanisms that are more likely to influence voluntary R&D disclosure decisions, which in turn affect firm value. These mechanisms are board size, board independence, CEO duality, Equity-based management compensation and audit committee independence.

2.2.1. Board size

Singh et al. (2004) find that experienced large boards are more able than small boards to make consistent corporate disclosure decisions. Hussainey and AlNajar (2011), Elshandidy et al. (2013) and Samaha et al. (2014) highlight the positive link between the board size and the level of voluntary disclosures. In a recent paper, Abdelbadie and Elshandidy (2013) provide evidence that large board-sized firms, with more reliance on the R&D activities, are motivated to disseminate incremental information on their undertaken R&D investments. Therefore, the second hypothesis is stated as follows:

H2. There is a positive association between board size and the level of voluntary R&D-related disclosure.

2.2.2. Board Independence

Extant studies highlight the advantages of appointing outside directors as a corporate governance mechanism. They support the hypothesis that outside directors are more independent and better able than insiders to monitor managers. Indeed, their presence is usually related to changes in the corporate disclosure strategy. Recent researches have pointed out that the more independent directors there are on a board, the more information the firm discloses to outside investors (Eng and Mak, 2003; Leung and Howitz, 2004; Cheng and Courtenay, 2006; Lim et al., 2007; Patelli and Principe, 2007, Elshandidy et al. 2013). However, the question here is whether independent directors ensure better disclosure about firms' R&D activities. Using a sample of 181 Australian companies, Lim et al. (2007) find that independent boards provide more voluntary disclosure of strategic information. Strategic information includes five items related to R&D: company policy on R&D, the forecast of R&D expenses, number of employees in the R&D department, discussion about future R&D activities and new product development. The above reasoning leads us to formulate our third hypothesis as follows:

H3. There is a positive relationship between board independence and the level of R&D voluntary disclosure.

2.2.3. CEO Duality

If the board chairman plays a dual role, it is expected that the chairman-CEO will manage the information flow to serve his/her interests. Therefore, the level of voluntary disclosure is expected to be relatively low. Existing empirical evidence appears to support the conclusion that there is a negative association between CEO duality and voluntary disclosure (Eng and Mac, 2003; Gul and Leung, 2004; Hussainey and AlNajar, 2011; Elshandidy et al., 2013). In the Canadian context, Zéghal et al. (2007) analyze the determinants of the R&D voluntary disclosure of 150 firms, and find that the separation of the CEO and chairman functions is the most important decision, because it leads to higher levels of voluntary R&D-related disclosure. Samaha et al. (2014) document the presence of a negative association between CEO duality and voluntary disclosure for OECD high-income countries. Abdelbadie and Elshandidy (2013) did not find an association between CEO duality and R&D disclosure. Following these arguments, we formulate our fourth hypothesis as follows:

H4. There is a negative relationship between CEO duality and the level of R&D voluntary disclosure.

2.2.4. Equity-based management compensation

When well designed, the CEO compensation package plays an important role as an incentive mechanism. The allocation of stock options seems to be much more influenced by the nature of both in-place assets and growth opportunities, than by the firm's overall financial performance. Studying 371 U.S. companies ranked by degree of R&D intensity, Kole (1997) finds that innovative companies with high R&D allocate more remuneration in the form of shares. Indeed, the author notes that a 1% increase in the ratio of R&D intensity increases by 0.8% the probability that the company will put in place an incentive-based compensation plan. Similarly, 77% of low R&D spending companies offer equity-based compensation, against nearly 95% of those that invest heavily in R&D. Hence, R&D spending contributes significantly to raising executive stock option compensation. Cheng (2004) confirmed such a conclusion, after surveying 157 industrial companies that invested significantly in R&D over the period 1984-1991. Cheng (2004) also finds that R&D spending contributes significantly to an increase in executive stock option compensation. He concludes that the indexation of CEO compensation to R&D expenditures reduces the managerial incentives to focus only on short-term accounting earnings and helps to solve the underinvestment problem.

H5. There is a positive relationship between equity-based management compensation and R&D voluntary disclosure.

2.2.5. Audit Committee Independence

The audit committee plays an important role in ensuring the quality of a company's financial information (Samaha et al., 2014). This committee is charged with the oversight of financial reporting and disclosure. It may also be responsible for evaluating the effectiveness of financial control procedures and risk management activities. Ho and Wong (2001) suggest that the presence of an active and independent audit committee is positively related to the extent of voluntary disclosure. Pandit et al. (2006) examine audit committees' reports over 2003-2004 for a sample of 100 randomly selected companies listed on the NYSE. They find that some audit committees go beyond the regulatory requirements, in order to provide more voluntary disclosure, although many others continue to provide only the minimum information required in their reports. Samaha et al. (2014) use the meta-analysis approach and conclude that the presence and the independence of the audit committee play an important role in enhancing the level of voluntary disclosure.

To the best of our knowledge, this is the first study to examine the relationship between the characteristics of the audit committee (i.e. independence) and R&D voluntary disclosure. The audit committee can be seen as a monitoring tool that enhances financial disclosure and reduces agency costs, on the one hand while R&D activities may generate asymmetric information between managers and shareholders, on the other hand. Hence, it is relevant to test the association between the independence of the audit committee and R&D voluntary disclosure. Therefore, we formulate our sixth hypothesis as follows:

H6. There is a positive relationship between the independence of the audit committee and the level of R&D voluntary disclosure.

3. RESEARCH DESIGN

3.1. Sample

We use a sample of French listed companies belonging to the SBF 250 Index, over a five-year period from 2000 to 2004. This period precedes the adoption by the European Union of the IAS and IFRS standards, the implementation of which became mandatory on January 1st, 2005. Prior to that date, the lack of uniform accounting principles meant that the provision of any information on R&D spending was voluntary. We begin our sample in 2000 because of the lack of corporate governance data in earlier periods. Given the initial population of 250 firms, we remove financial and real estate companies (33 companies), those that do not mention R&D in the audited components of their financial statements (111 companies) and those with missing corporate governance and/or financial data (8 companies). Hence, the final sample consists of 98 companies covered over a 5-year period, a total of 490 observations. Corporate governance variables and voluntary disclosure information were hand-collected from firm's annual reports, published on the AMF's and companies' websites. Financial data and R&D intensity information were gathered from the Worldscope database.

3.2. Dependent Variable: Market-To-Book Ratio

This research focuses on the association of R&D voluntary disclosure with firm's market value. In the light of the considerable debate about whether voluntary disclosure should be a mechanism intended to meet investors' information demands, our objective is to study the extent to which R&D voluntary disclosure can reduce the information asymmetry generated by R&D activities, given the associated high proprietary cost. Many studies provide evidence that voluntary disclosure reduces the information asymmetry component of the cost of capital (Botosan and Plumlee, 2002). Given the costs associated with R&D-related information, the only information that affects positively the firm's market value will be disclosed by managers (Verrecchia, 1983). Since proprietary costs are a function of growth opportunities, we consider that the market-to-book ratio is a suitable measure for capturing these two elements.

3.3. Endogenous Variable: R&D Voluntary Disclosure

We adopt the same R&D disclosure index as in Nekhili et al. (2012). This score is based on information contained in annual reports. The level of disclosure is the sum of the scores achieved in five different categories of information. R&D-related disclosures include (i) current and future information on spending, (ii) inputs, (iii) outputs, (iv) accounting and budgeting, and (v) strategy. We use the R&D disclosure score (R&D_DISC), which compiles a list of 32 items that are useful for valuing R&D activities (5 items for current and future information about R&D spending; 7 items for R&D inputs; 6 items for R&D outputs; 8 items for R&D accounting and budgeting; and 6 items for R&D strategy). The appendix shows the complete list of items. We preserve items as dichotomous and all information to be equally important, although their information content may be very different. Further, Lim et al. (2007) consider that weighting may not reflect the preferences of the annual report

users. Similarly, Meek et al. (1995) argue that companies that disclose substantial information disclose fewer but important items. Thus, companies are scored in the same way, regardless of whether the items are weighted or not. We define the dependent variable (R&D_DISC) by the ratio between the assigned total score and the potential maximum score (i.e., equals 32).

3.2. Control Variables

The control variables are proxies for other factors that are likely to impact the extent of R&D voluntary disclosure. These variables are R&D intensity, R&D accounting, ownership structure, audit quality, leverage, return on assets, and firm size.

R&D Intensity (R&D): As mentioned above, mandatory information on R&D is inadequate in the French context. To reduce information asymmetry, the users of annual reports will require information about R&D activities. Literature documents a positive correlation between R&D intensity and R&D disclosure (Lang and Lundholm, 1993; Entwistle, 1999; Percy, 2000; Ding et al., 2004; Nekhili et al., 2012; Merkley, 2014). Following prior research, we measure the intensity of R&D by annual R&D expenditures, deflated by total sales.

R&D Accounting (R&D_ACC): Under certain conditions, the French law gives companies the choice of capitalizing the R&D costs or not. R&D can be capitalized only if it is considered as an investment project, in which one can evaluate the project's technical feasibility, cost-effectiveness, and cost of capital. Otherwise, it is considered as an expense in the period in which it is recorded. This dual mode of treatment of R&D costs is consistent with the US GAAP (the cost of R&D is treated as an expense), and with the International Financial Reporting Standards (IFRS), which requires the capitalization of profitable R&D projects. Zhao (2002) and Oswald and Zarowin (2007) study the influence of R&D accounting on the market value. They show that R&D capitalization has a positive effect on firm market value. These findings support the idea that R&D capitalization provides incentives for companies to reveal more information about depreciation, future profitability, and the amounts of these investments. Cazavan-Jeny and Jeanjean (2006) explore the appropriateness of R&D accounting treatment in the French context and find a negative impact of R&D capitalization on stock prices. They explain this result by arguing that R&D capitalization leads to a situation with more managerial discretion.

Ownership structure: Five features of ownership structure are considered in our study: minority ownership (*MIN_OWN*), family ownership (*FAM_OWN*), managerial ownership (*MAN_OWN*), domestic institutional ownership (*DOMINS_OWN*) and, finally, foreign institutional ownership (*FORINS_OWN*). In respect of the French context, Nekhili et al. (2012) document that foreign institutional investors are more likely to influence positively the level of R&D-related disclosure whilst family and domestic institutional investors act as insiders and are more prone to retain R&D information. However, Abdelbadie and Elshandidy (2013) find no association between ownership structure and R&D disclosure. Based on these mixed results, the relationship between ownership structure and R&D disclosure is an empirical issue that still requires investigation. Consequently, the paper adds ownership structure to the analysis as a control variable.

Audit quality (BIG): For Aboody and Lev (2000), the 'Big Five' auditors have both the tools to assess the viability of R&D spending, and sufficient expertise to do so. 'Big' auditors devote more resources to staff training and to the development of industry expertise than other audit firms. Also, given their important size, big auditors are more likely to invest in information technology, in order to detect performance management deficiencies. In France, at least two (joint) auditors are required by law, for listed companies. To the best of our knowledge, no empirical studies have as yet addressed the relationship between joint audit and the level of voluntary disclosure of non-financial (or financial) information. Following the previous studies (Eng and Mak, 2003; Leung and Horwitz, 2004), we consider that a joint audit with two 'Big' auditors is more efficient than a joint audit with only one 'Big' auditor, because it encourages firms to disclose more information in their annual reports. To take into account the auditor-pair choices under France's joint audit requirement¹, we use a trichotomous variable coded 'one' if only one of the two statutory auditors is a Big 5/4 accounting firm, 'two' if both statutory auditors are a Big 4/5, and 'zero' if company is audited by two non-Big auditors.²

Leverage (LEVERAGE): Many empirical studies have used leverage as a determinant of the extent of voluntary corporate disclosure. Highly indebted firms are more likely to disclose more information, to minimize legal risk (Watts and Zimmerman, 1990). Debt may be a source of agency problems between shareholders and creditors, or between managers and shareholders (Jensen and Meckling, 1976). Both shareholders and creditors may be able to reduce the agency costs of debt, by ensuring more voluntary information disclosure. Firms with high debt

¹ Since 1966, French regulations have obliged companies with consolidated accounts to be audited by at least two auditing firms.

² Until 2002, the Big 4 were the Big 5 audit companies. After the Enron Scandal, Andersen was involved in the fraudulent accounting and auditing and filed for bankruptcy. Ever since, the number of the big audit companies down to four (PricewaterhouseCoopers, KPMG, Ernst & Young and Deloitte).

levels are expected to incur higher monitoring costs, and they can reduce these costs by disclosing more information in their annual reports. The positive association between financial leverage and voluntary disclosure has been established by Zéghal et al. (2007) and Ahmed and Courtis (1999). Regarding R&D information, Abdelbadie and Elshandidy (2013) reported a negative relationship between firm leverage and voluntary disclosure.

Return on Assets (ROA): The Return on assets (*ROA*) is used as a proxy for firm profitability. Meek et al (1995) argue that well-performing companies have incentives to disclose more accounting information when they plan to raise additional capital on the financial market. In fact, highly profitable firms may have incentives to pursue an active disclosure policy, in order to communicate their quality. Ahmed and Courtis (1999) provide a meta-analysis of 12 studies and find a positive association between voluntary disclosure levels and firm profitability, as proxied by the return on assets. However, Ho and Wong (2001) and Eng and Mak (2003) do not find any significant relationship between ROA and the level of voluntary disclosures. Regarding R&D information, Lim et al. (2007) provide evidence that profitability has an impact on historical financial information, but it does not impact the disclosure of strategic information related to R&D activities.

Firm Size (SIZE): Watts and Zimmerman (1990) argue that large companies are more likely to disclose more information to avoid political pressure. Compared with small firms, large companies disclose more information voluntarily because of their ability to cover the cost of disclosure and the greater demand for information by different stakeholders (Hossain et al., 2005). An extensive number of research papers find a positive association between firm size and voluntary disclosure (see for example Ho and Wong, 2001; Eng and Mak, 2003; Gul and Leung, 2004; Hossain et al., 2005; Lim et al., 2007). In addition, Jones (2007) and Abdelbadie and Elshandidy (2013) find a positive association between firm size and R&D disclosure. Following the above-cited studies, we proxy for firm size using the natural logarithm of total assets.

Industry (INDUSTRY): Lev and Zarowin (1999) find that change in R&D intensity bears significant additional information and that it is necessary to control for industry effect in R&D accounting research because industrial R&D is industry specific by nature (Lev and Sougiannis, 1996).

3.3. Model

The objective of our work is to study the relationship between the level of R&D voluntary disclosure and firm market value. Furthermore, the governance features and the others selected variables can act directly on the firm market value (*MTB*) or indirectly through their impact on R&D disclosure. To this end, we built a simultaneous equation model into which R&D voluntary disclosure is a strategic choice that depends on corporate governance mechanisms, ownership structure, and others firms' characteristics. In this situation, ordinary least squares method (*OLS*) produces biased and inconsistent estimates since it does not tackle the endogeneity problem. We choose to apply the method of three stages least squares (*3SLS*). Unlike the method of two stages least squares (*2SLS*), this method takes into account the dependence between the error terms. We perform the Hausman (1978) specification test to determine which estimation method is most appropriate.

The design of the 3SLS estimation requires the specification of at least two equations that are interconnected through several variables in equations. The first equation regresses the R&D narrative disclosure index on corporate governance and a selected control variable. In the first stage, all independent variables and control variables are included. In the second stage, we regress market-to-book ratio on R&D narrative disclosure (*R&D_DISC*), independent variables and the same panel of control variables. Hence, our system of simultaneous equations is as follows:³

First stage:

$$R\&D_DISC_{it} = \beta_0 + \beta_1 BOARD_SIZE_{it} + \beta_2 BOARD_IND_{it} + \beta_3 DUAL_{it} + \beta_4 STK_OPT_{it} + \beta_5 AUDCOM_{it} + \beta_6 AUDCOM_IND_{it} + \beta_7 MIN_OWN_{it} + \beta_8 FAM_OWN_{it} + \beta_9 MAN_OWN_{it} + \beta_{10} DOMINS_OWN_{it} + \beta_{11} FORINS_OWN_{it} + \beta_{12} BIG_{it} + \beta_{13} LEVERAGE_{it} + \beta_{14} R\&D_{it} + \beta_{15} R\&D_ACC_{it} + \beta_{16} ROA_{it} + \beta_{17} FIRM_SIZE_{it} + \beta_{18} INDUSTRY + \beta_{19} YEAR + \varepsilon_{2it}$$

Second stage:

$$MTB_{it} = \alpha_0 + \alpha_1 R\&D_DISC_{it} + \alpha_2 BOARD_SIZE_{it} + \alpha_3 BOARD_IND_{it} + \alpha_4 DUAL_{it} + \alpha_5 STK_OPT_{it} + \alpha_6 AUDCOM_{it} + \alpha_7 AUDCOM_IND_{it} + \alpha_8 MIN_OWN_{it} + \alpha_9 FAM_OWN_{it} + \alpha_{10} MAN_OWN_{it} + \alpha_{11} DOMINS_OWN_{it} + \alpha_{12} FORINS_OWN_{it} + \alpha_{13} BIG_{it} + \alpha_{14} LEVERAGE_{it} + \alpha_{15} ROA_{it} + \alpha_{16} FIRM_SIZE_{it} + \alpha_{17} INDUSTRY + \alpha_{18} YEAR + \varepsilon_{1it}$$

³ The application of the simultaneous equations model requires compliance with two conditions (verified in our case): one so-called order condition and another called rank condition.

Where:

MTB = market value of common shares divided by book value of ordinary shareholders' equity.

R&D_DISC = total disclosure score divided by the potential maximum score out of 33 items.

BOARD_SIZE = natural logarithm of the number of directors on board

BOARD_IND = ratio of independent directors to total directors on the board.

DUAL = binary variable coded one if the company's CEO is also the chairman of the board and zero otherwise.

STK_OPT = dummy variable coded one if the firm offers equity-based compensation for the CEO and zero otherwise.

AUDCOM = dummy variable coded one if the firm has an audit committee and zero otherwise.

AUDCOM_IND = ratio of independent directors to total directors on the audit committee.

MIN_OWN = proportion of shares owned by minority shareholders.

FAM_OWN = binary variable equals one if some shares are owned by family members, 0 otherwise.

MAN_OWN = proportion of shares owned by managers.

DOMINS_OWN = cumulative proportion of shares above 5% owned by French institutional investors.

FORINS_OWN = cumulative proportion of shares above 5% owned by foreign institutional investors.

BIG: trichotomous variable coded two if each of the two statutory auditors is a Big 4/5 accounting firm, one if only one of the two statutory auditors is a Big 5/4, and zero otherwise.

LEVERAGE = total liabilities to total assets ratio.

R&D = ratio of R&D expenditures to total sales.

R&D_ACC = binary variable coded one if R&D is capitalized, and zero otherwise.

ROA = return on assets measured as the ratio of EBIT (earnings before interest and taxes) to total assets.

FIRM_SIZE = natural logarithm of total assets.

INDUSTRY = binary variable that takes the value one if the company belongs to the sector in question and 0 otherwise. The industry classification is based on Industry Classification Benchmark (ICB).

4. RESULTS

4.1. Descriptive Statistics

Table 1 shows the descriptive statistics. The average market-to-book variable (*MTB*) is 1.456, with a minimum value of 0.008 and a maximum value of 13.297. The mean R&D narrative disclosure index (*R&D_DISC*) is 22.15%. This index ranged from zero to 62.50%. The mean ratio of R&D intensity (*R&D*) is 5.89%, ranging from 0.05% to 49.60%. The number of directors on the board (*BOARD_SIZE*) ranges from 3 to 21 with a mean of 11 members. The mean ratios of board and audit committee independence (*BOARD_IND* and *AUDCOM_IND*) are 27.17% and 46.57%, respectively, with a minimum of zero for both variables, and a maximum of 94.12% and 100%, respectively. Minority ownership (*MIN_OWN*) varies from 3.57% to 99.99%, with a mean of 50.46%. The mean percentage of family ownership (*FAM_OWN*) and managerial ownership (*MAN_OWN*) of the sample firms are equal to 37.14% and 12.79%, respectively. The mean ratios of domestic (*DOM_OWN*) and foreign institutional ownership (*FORINS_OWN*) are 10.39% and 9.92%, respectively. *LEVERAGE* ranges from zero to 81.80%, with a mean of 23.18%. The *ROA* ratio ranges from -64.47% to 28.00%, with a mean of 2.41%. Finally, that the table shows that the size (total assets) of the sampled firms varies from 22.06 to 150737.9 million euro. Panel B of Table 1 shows that 69.80% of our sample firms have CEO duality (*DUAL*) and that 81.84% use equity-based management compensation (*STK_OPT*). Sampling firms have an audit committee (*AUDCOM*) in 65.10% of cases, are audited by one "Big four" auditor (*BIG*) in 53.06% of cases, and by two "Big four" auditors in 25.71% of cases. Finally, we note that only 25.71% of our sample firms capitalize their R&D activities (*R&D_ACC*).

Untabulated pairwise correlation matrix indicates a high and significant correlation (0.836) between the presence of an audit committee and its independence. When they exist, most audit committees are independent. Therefore, we do not include the presence of the audit committee, to avoid correlation problems among the explanatory variables. The VIF values were also computed, to check the existence of this problem. They range between 1.16 and 4.47. The multicollinearity problem is problematic since the variance inflation factors exceed 10 (Neter et al., 1983). Thus the statistical properties of the variables computed in this study are not substantially biased by the effects of a possible collinearity problem, and the results of the regression analysis can be interpreted with a greater degree of confidence.

Table 1. Descriptive Statistics

Panel A: Continuous variables				
Variable	Mean	Std. Dev.	Min	Max
<i>MTB</i>	1.456	0.704	0.008	13.297
<i>R&D_DISC</i>	22.15%	13.49%	0	62.50%
<i>R&D</i>	5.89%	8.57%	0.05%	49.60%
<i>BOARD_SIZE</i> (number of Directors)	10.602	4.086	3	21
<i>BOARD_IND</i>	27.17%	27.93%	0	94.12%
<i>AUDCOM_IND</i>	46.57%	40.49%	0	100%
<i>MIN_OWN</i>	50.46%	24.36%	3.57%	99.99%
<i>FAM_OWN</i>	37.14%	48.37%	0	74.85%
<i>MAN_OWN</i>	12.96%	16.89%	0	68.87%
<i>DOMINS_OWN</i>	10.39%	13.26%	0	74.30%
<i>FORINS_OWN</i>	9.92%	16.18%	0	78.12%
<i>LEVERAGE</i>	23.18%	13.81%	0	81.80%
<i>ROA</i>	2.41%	7.97%	-64.47%	28.00%
<i>FIRM_SIZE</i> (in millions of euros)	9179.766	1021.361	22.06	150737.9

Panel B: Binary variables		
Variable		Frequency
<i>DUAL</i>	0	148 (30.20%)
	1	342 (69.80%)
<i>STK_OPT</i>	0	89 (18.16%)
	1	401 (81.84%)
<i>AUDCOM</i>	0	171 (34.90%)
	1	319 (65.10%)
<i>BIG</i>	0	104 (21.22%)
	1	260 (53.06%)
	2	126 (25.71%)
<i>R&D_ACC</i>	0	364 (74.29%)
	1	126 (25.71%)

Notes: *MTB*: market value of common shares divided by book value of ordinary shareholders' equity; *R&D_DISC*: total disclosure score divided by the potential maximum score out of 33 items; *BOARD_SIZE*: natural logarithm of the number of directors on board; *BOARD_IND*: ratio of independent directors to total directors on the board; *DUAL*: binary variable coded one if the company's CEO is also the chairman of the board and zero otherwise; *STK_OPT*: dummy variable coded one if the firm offers equity-based compensation for the CEO and zero otherwise; *AUDCOM*: dummy variable coded one if the firm has an audit committee and zero otherwise; *AUDCOM_IND*: ratio of independent directors to total directors on the audit committee; *MIN_OWN*: proportion of shares owned by minority shareholders; *FAM_OWN*: binary variable equals one if some shares are owned by family members, 0 otherwise; *MAN_OWN*: proportion of shares owned by managers; *DOMINS_OWN*: cumulative proportion of shares above 5% owned by French institutional investors; *FORINS_OWN*: cumulative proportion of shares above 5% owned by foreign institutional investors; *BIG*: trichotomous variable coded two if each of the two statutory auditors is a Big 4/5 accounting firm, one if only one of the two statutory auditors is a Big 5/4, and zero otherwise; *LEVERAGE*: total liabilities to total assets ratio; *R&D*: ratio of R&D expenditures to total sales; *R&D_ACC*: binary variable coded one if R&D is capitalized, and zero otherwise; *ROA*: return on assets measured as ratio of EBIT (earnings before interest and taxes) to total assets; *FIRM_SIZE*: natural logarithm of total assets.

4.2. Regression results

To test our hypotheses, we carry out three different models for our system of simultaneous equations. In Model 1, we only focus on R&D disclosure. In Model 2, we use the same variables in Model 1, and we control for the impact of R&D intensity on the firm value. In Model 3, we introduce R&D accounting in the second stage of the estimating system instead of R&D intensity. This step by step system allows us to know whether the market reaction to the R&D narrative disclosure depends on the R&D intensity and its accounting treatment. We then perform the Hausman test to determine which, between 2SLS and 3SLS, the most appropriate estimation method is. We find that the method for estimating the system of simultaneous equations matters and the Hausman test indicates that the 3SLS estimates are better specified. The results in Table 3 show that the sign of the R&D narrative disclosure impact on market-to-book value changes considerably from the Model 1 to the Model 3.

In fact, when we focus only on R&D disclosure, the estimated coefficient associated with *R&D_DISC* is positive (3.170) but insignificant. Our expectation, based on agency and signaling theories, that higher levels of

R&D narrative disclosure are more likely to have a positive impact on firm value is not met, and our hypothesis H1 is then not supported. In line with Nekhili et al. (2012), we find that both R&D intensity (*R&D*) and R&D capitalization (*R&D_ACC*) lead French firms to disclose more R&D-related information. Nonetheless, when introduced consecutively in the second stage of the estimating system (Models 2 and 3, respectively), R&D intensity (*R&D*) and R&D capitalization (*R&D_ACC*) impact differently the relationship between R&D narrative disclosure (*R&D_DISC*) and market value (*MTB*).

The results of Model 2, into which we control for R&D intensity, indicate that the coefficient associated with R&D disclosure becomes negative (−4.444) and significant at 5% level. The fact that the coefficient R&D intensity is positive (6.662) and significant at 1% level indicates that R&D intensity plays a more role in explaining market value than the disclosure of details about R&D programs. Furthermore, the difference obtained in the coefficient associated with *R&D_DISC* between Model 1 and Model 2 suggests that an increase in the R&D voluntary disclosure index is associated with a lower market value when considering R&D intensity simultaneously. This result supports the inherent proprietary costs of R&D disclosure (Verrecchia, 1983; Dye, 1985; Jones, 2007). Most likely, investors are more reluctant to the disclosure of strategic information in more R&D intensive firms fearing that R&D narrative disclosure benefits potential competitors (Botosan and Stanford, 2005).

The results of Model 3, into which we control for R&D accounting, shed light on another aspect related to the voluntary R&D disclosure. Indeed, the coefficient associated with *R&D_DISC* is strongly positive (14.263) and significant at 1% level. The estimated coefficient associated with R&D accounting is negative (−1.431) and significant at 1% level. This result is in line with the result of Cazavan-Jeny and Jeanjean (2006) and Nekhili et al. (2012) in the French context arguing that R&D capitalization leads to more managerial discretion. In this particular situation, investors seem to pay, from an agency and signaling perspectives, more attention to the voluntary disclosure of narrative R&D-related information. To the extent that R&D capitalization treatment leads to a managerial discretionary problem, investors use voluntary disclosure as a major platform to scrutinize the activities of the top management (Jensen and Meckling, 1976), leading to a positive relationship between R&D narrative disclosure and firm market value.

Table 3 indicates the absence of significant impacts of both board size (*BOARD_SIZE*) and board independence (*BOARD_IND*) on R&D narrative disclosure. Therefore, H2 and H3 are rejected. No significance is also shown for the impact of CEO duality (*DUAL*) on R&D voluntary disclosure (*R&D_DISC*), and H4 is rejected. Our result is consistent with those of Ho and Wong (2001) and Cheng and Courtenay (2006), who conclude that CEO duality is not related to the level of voluntary disclosure, in both the Hong Kong and Singaporean contexts.

In addition, the coefficient related to the impact of equity-based remuneration (*STK_OPT*) is, as expected, positive and significant at 1% level. This result remains stable even if we introduce R&D intensity (*R&D*) or R&D capitalization (*R&D_ACC*) in the second stage of our system. Henceforth, French firms use equity-based management remuneration to ensure better communication on R&D activities. This finding confirms hypothesis H5 and is also consistent with Lim et al. (2007), which shows a positive association between equity-based managerial compensation and strategic information disclosure in the Australian context.

In respect of our sixth hypothesis, we find evidence that the independence of the audit committee (*AUDCOM_IND*) is positively related to the extent of R&D voluntary disclosure (*R&D_DISC*). The impact is significant at the 1% level. Our result is consistent with Ho and Wong (2001) and Samaha et al. (2014) and tends to support an active role for the independent audit committee in disclosing information to the market. Before July 2009, the date of implementation of the 8th European Directive, the French approach to the audit committee was more flexible than the US Sarbanes-Oxley Act, and defined it as a mere advisory body on the board. Indeed, companies have the choice to develop its functioning according to their needs. Given the importance of this committee, not only its existence, but also its independence and expertise that ought to be more regulated.

Finally, for control variables, our results are in line with Nekhili et al. (2012) regarding the relationship between ownership structure and R&D voluntary disclosure. Indeed, we find a negative and positive impact of family and foreign institutional ownership on R&D-related disclosure, respectively. These impacts are both significant at 1% level. Unexpectedly, and in contrast to the political and legal approaches of Watts and Zimmerman (1990), we find a negative relationship between firm size and voluntary disclosure of R&D activities. Otherwise, no significance is shown for others control variables.

Table 3. Regression analysis

Variables	Model 1				Model 2				Model 3			
	First stage		Second stage		First stage		Second stage		First stage		Second stage	
	Coef.	t-test	Coef.	t-test	Coef.	t-test	Coef.	t-test	Coef.	t-test	Coef.	t-test
<i>R&D_DISC</i>			3.170	1.88			-4.444*	-2.10			14.263**	3.60
<i>R&D</i>	0.447**	6.57			0.356**	5.06	6.662**	5.45	0.356**	5.06		
<i>R&D_ACC</i>	0.063**	5.20			0.076**	6.17			0.076**	6.17	-1.431**	-3.56
<i>BOARD_SIZE</i>	0.009	0.56	-1.173**	-5.53	0.004	0.28	-0.954**	-4.65	0.004	0.28	-1.036**	-3.34
<i>BOARD_IND</i>	-0.034	-1.41	-1.061**	-3.13	-0.033	-1.39	-1.332**	-4.10	-0.033	-1.39	-0.707	-1.41
<i>DUAL</i>	0.021	1.80	0.089	0.53	0.021	1.78	0.265	1.62	0.021	1.78	-0.131	-0.52
<i>STK_OPT</i>	0.034*	2.38	0.097	0.49	0.037**	2.59	0.265	1.38	0.037**	2.57	-0.428	-1.31
<i>AUDCOM_IND</i>	0.055**	3.40	0.291	1.16	0.056**	3.47	0.672**	2.72	0.056**	3.47	-0.382	-0.93
<i>MIN_OWN</i>	-0.052	-1.86	0.843*	2.11	-0.056*	-2.00	0.580	1.52	-0.056*	-2.00	1.630**	2.62
<i>FAM_OWN</i>	-0.038**	-3.18	0.129	0.73	-0.038**	-3.16	-0.171	-0.97	-0.038**	-3.16	0.542	1.92
<i>MAN_OWN</i>	-0.059	-1.50	-0.775	-1.45	-0.074	-1.88	-0.684	-1.35	-0.074	-1.88	0.714	0.81
<i>DOMINS_OWN</i>	-0.010	-0.22	1.001	1.52	-0.013	-0.28	1.032	1.66	-0.013	-0.28	1.282	1.34
<i>FORINS_OWN</i>	0.121**	2.84	-0.729	-1.19	0.123**	2.89	0.114	0.19	0.123**	2.89	-1.196	-1.23
<i>BIG</i>	0.006	0.71	0.266*	2.36	0.008	0.98	0.229*	2.15	0.008	0.98	0.079	0.47
<i>LEVERAGE</i>	-0.001	-0.01	-0.973	-1.83	-0.018	-0.47	-0.324	-0.63	-0.018	-0.47	0.024	0.03
<i>ROA</i>	0.007	0.12	3.914**	4.43	-0.004	-0.06	4.372**	5.20	-0.004	-0.06	4.445**	3.45
<i>FIRM_SIZE</i>	-0.019**	-6.00	-0.002	-0.03	-0.020**	-6.07	-0.145*	-2.27	-0.020**	-6.07	0.231	2.09
Intercept	0.149*	2.19	2.958**	2.89	0.157*	2.30	3.818**	3.88	0.157*	2.30	0.872	0.55
<i>INDUSTRY</i>		Yes		Yes		Yes		Yes		Yes		Yes
R-squared	42.90%		32.69%		43.21%		39.60%		43.21%		41.51%	
chi2	280.98		372.10		369.09		342.85		369.09		146.34	
Prob > chi2	0.000		0.000		0.000		0.000		0.000		0.000	

*, ** denote significance at the 5% and 1% levels, respectively.
Variables as defined in Table 1.

5. CONCLUSION

This paper has investigated the impact of R&D voluntary disclosure on the market value of the firm. This was motivated by the observation that several empirical studies demonstrate a positive relationship between a firm's market value and increasing R&D expenditure (Chan et al., 2001; Hall and Oriani, 2006), and a positive association between voluntary information and market value (Haggard et al., 2008; Hassan et al., 2009). Managers, aware of the need to provide regular information to various external partners, must often deal with the nature and level of the information they disclose. Regarding R&D information, a disclosure decision is problematic, because of the inherent proprietary costs, and the risk that such strategic information may benefit competitors. To deal with endogeneity problem, we built a simultaneous equation model in which R&D narrative disclosure is a strategic choice that depends on corporate governance mechanisms, ownership structure, and others firms' characteristics. In order to apprehend R&D-related disclosures to shareholders, we built an index of narrative disclosure on R&D. The index is equal to the actual score obtained for the categories of information on R&D activities, divided by its theoretical score in relation to all categories of information on these investments.

In respect of the French context, Nekhili et al. (2012) test the association between ownership structure, R&D disclosure, and firm value and provide evidence that voluntary R&D disclosure improves the market value of equity. We complement Nekhili et al. (2012) by considering several corporate governance attributes (board size, board independence, CEO duality, equity-based management compensation, and audit committee independence). On the basis of 98 French firms rolled over the period 2000-2004, our results show that better R&D narrative disclosure cannot, *ceteris paribus*, raise firms' market value. However, when we consider R&D intensity, disclosing voluntary R&D-related information is significantly associated with a lower market value. It is worthwhile noticing, consistent with Lang and Lundholm (1993), Entwistle (1999) and Merkley (2014), that the R&D intensity is associated positively and significantly at 1% level with the R&D disclosures. However, R&D intensity reduces the relevance of the R&D narrative disclosure. Otherwise, the French market seems to pay more attention to the details disclosed about R&D investments when the R&D capitalization choice is made leading to a more managerial discretion. These findings shed light on the association between corporate governance and the extent of R&D disclosure. In particular, these findings generate a need for reflection and support an active role for the auditing committee in disclosing more information to the market.

While this research has relevant implications for investors and governance experts, it could be further extended by using the rate of returns in addition to market value. Taking into account the stock returns will contribute to moving forward from the study of the impact of R&D disclosure on firm's market value toward a comprehensive investigation of the value relevance of such a disclosure. Another research avenue could be to focus on the accounting harmonization process in France, following the adoption of IAS/IFRS standards, and in particular its impact in terms of R&D disclosure, under the IAS 38. Generally accepted accounting principles (GAAP) mandate that R&D expenditures, and the majority of intangible assets, should be immediately expensed in the income statement, even though they often benefit the firm over long periods. Thus, the adoption of IAS/IFRS in January 2005 would have affected investors' perceptions of the usefulness of financial reports. In this context, studies on whether French firms disclose more or better information on their R&D activities, and whether investors evaluate both R&D intensity and R&D disclosure differently, will provide additional useful insights.

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APPENDIX

R&D Disclosure Score and Items

Current and future R&D spending

- 1- Discussion of R&D intensity as a percentage of sales
- 2- Discussion of changes in R&D as a percentage of sales
- 3- Description of new R&D programs
- 4- Description of current R&D spending components
- 5- Description of future R&D spending components

R&D inputs

- 1- Number of research units
- 2- Geographic localization of research units
- 3- R&D spending by research unit
- 4- Distinction of R&D program partners: domestic or foreign
- 5- Number of R&D program partners (domestic and foreign)
- 6- Description of the relationship between R&D and corporate societal responsibilities
- 7- Number of employees in R&D programs

R&D outputs

- 1- Description of new products
- 2- Cost of new products
- 3- Customer satisfaction
- 4- Discussion of new products introduced
- 5- Date sales will begin
- 6- Discussion of patents

R&D accounting and budgeting

- 1- IFRS and/or GAAP used in R&D accounting
- 2- Accuracy of amount of R&D spending
- 3- Discussion of the impact of IFRS and/or GAAP application on operating income
- 4- Budget of future R&D spending
- 5- Comparison between real R&D spending and forecast budget
- 6- Identification of funding sources of R&D projects
- 7- Identification of the amount of each funding source
- 8- Comparison between current and past funding sources of R&D projects

R&D strategy

- 1- General discussion of R&D activities
- 2- R&D spending by activity
- 3- Separation of basic versus applied research
- 4- Distinction between headquarters R&D and subsidiaries R&D
- 5- Amount of R&D decentralization in each subsidiary
- 6- Comparison of R&D spending with competitors' spending