A MEDIATION ANALYSIS: BOARD OF DIRECTORS' COMPOSITION, R&D INVESTMENT, AND INTERNATIONAL FIRM PERFORMANCE

Rim Zouari-Hadiji *, Ghazi Zouari **

* Faculty of Economic Sciences and Management, University of Sfax, Tunisia
** *Corresponding author,* Faculty of Economic Sciences and Management, University of Sfax, Tunisia
Contact details: Faculty of Economic Sciences and Management, University of Sfax, Street of Airport, km 4.5, LP: 1088, Sfax 3018, Tunisia

Abstract

The comprehension and the explanation of the research and development (R&D) investment behaviour are done within the framework of a reflection on corporate governance. This investment does not contribute to creating value only if it is framed by governance mechanisms which role is to keep organizational, agency, or transaction costs as low as possible. In this context, we try to determine whether an integrating model exists; one that measures the simultaneous effect of the characteristics of the board of directors on R&D and the firm performance in an international context. Our model seeks to identify whether the dominance of inside directors and the dual structure influence the level of R&D investment, the mediating variable, and hence the firm performance. Our empirical study was carried out on a total sample of 509 firms divided between 165 American firms, 173 Japanese firms, and 171 French firms over the period 2014 to 2019. The findings of the mediation analysis according to the approach of Preacher and Hayes (2004, 2008) show the significant role of mediation by R&D investment between, on the one hand, the dominance of inside directors and duality, and on the other hand, the firm performance. Differences in the configuration of board of directors (BD) in different countries thus lead to different attitudes to the fulfillment of the control task and the R&D investment decision, value creator.

Keywords: Inside Director, Dual Structure, R&D, Performance

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1. INTRODUCTION

The majority of the works with financial theoretical bases try to grant an important role to the board of directors (henceforth referred as BD) as an internal mechanism of governance limiting the opportunist behaviour of the managers and to study its role and its attributes in the achievement of the performance.

Seldom the studies which examined the indirect relation between the BD, which markedly differs according to the type of the national systems of governance, and the firm performance through the level of investment in research and development (henceforth referred as R&D), except for the works of Zouari and Zouari-Hadiji (2014a, 2014b).

In fact, a firm's ability to invest in R&D is considered one of the determinants of its performance (Yoo & Sung 2015; Zouari & Abdelmalek, 2020). Uncertainty as to the profitability of the R&D activity, the need for confidentiality of the project, and the risk of failure can amplify the informational asymmetry between the firm and the potential capital providers (Baysinger, Kosnik, & Turk, 1991; Zouari & Zouari-Hadiji, 2014a, 2014b; Zouari-Hadiji, 2021).

The importance of intangible assets in R&D investment further increases the risk bound to these projects as far as this is turning to be of little effect in terms of the guarantee. It does not generally contribute to the value of the firm in the case of liquidation (Wang, Liang, Li, & Yang, 2016). R&D investment, apart from its characteristics, theoretically leads to an increase in conflicts of interest and agency costs compared to other types of investments. Moreover, it can without any effective control over the managers, strengthen managerial latitude.

Because managers may have to invest in R&D to maximize their own usefulness rather than the shareholders' wealth, works in corporate governance assume that the examination of appropriate governance mechanisms capable of influencing the behaviour of managers is essential. As a legal authority responsible for ratifying and supervising managerial decisions (in the sense of Fama and Jensen, 1983a, 1983b)[1], the BD plays an important role in resolving conflicts of interest.

Indeed, most of the works dealing with the link between corporate governance systems[2] and R&D investment are mainly of American and Japanese origins (Hill & Snell, 1988; Baysinger et al., 1991; Lee & O'Neill, 2003; Hosono, Tomiyama, & Miyagawa, 2004; Lee, 2005; Zouari-Hadiji & Zouari, 2010a, 2010b) and partially confirm the role played by the BD in the reduction of conflicts of interest between stakeholders and, therefore, the managers' behaviour with regard to R&D investment.

Based on corporate governance theory, we intend to justify the theoretical link between the BD and R&D investment. To our knowledge, very few studies have attempted to link the three dimensions into a single perspective, namely: the BD, R&D investment, and performance, except for Zouari and Zouari-Hadiji (2014a, 2014b). This leads to the justification of the theoretical foundation of these complex relationships. These interrelationships must be specified by including the mediating concept of R&D activities. This assumes that the direct relationship between the BD and performance is rather indirect through the influence of the firms' R&D investment level. In this configuration, the R&D investment level acts as a mediating variable between this internal corporate governance mechanism and performance.

Taking into account the scarcity of the works and the divergence results, our research goal consists in answering the following question: *To what extent does the composition of the BD have an indirect effect on the firm performance through its R&D investment level? And according to what governance systems?*

To address this problem, our study aims to scrutinize the indirect effect of the BD on R&D investment level and firm performance.

The remainder of this paper is structured as follows. Section 2 presents the underlying literature and develops the hypotheses. Section 3 describes the data, variable descriptions, and empirical specifications. Section 4 presents and discusses empirical results. Section 5 concludes.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Investment in R&D activities has characteristics that differentiate it from other investments, worth knowing a long-term horizon, a high level of risk, and strong asset specificity. These characteristics, sources of information asymmetry, and agency problems are all factors that favour the development of managerial latitude at the expense of shareholders' interests. To reduce these opportunistic behaviors and favor R&D investment, value-creating[3], an examination of the role played by the BD structure is an obligation. The managers' tendency to opt for such investments may then be a function of the presence of a dominant structure in the BD which differs markedly according to the nature of the national systems of governance.

Fama (1980), Fama and Jensen (1983a, 1983b) attribute to the BD the mission of controlling the principal managers to ensure the maximization of the shareholders' wealth. The influence of the BD on the nature of the decisions made by the managers depends in part on its composition. The board can also influence the performance thanks to four attributes, namely its composition (size, insiders[4] vs outsiders[5]), its characteristics (level of directors, the personality of the board), its structure (committee, organization, information flow, president), and the followed process (meeting, managers board, consensus, evaluation, formality, Zahra & Pearce, 1989).

Within the framework of our research, we seek to focus on the structure and the composition while limiting ourselves to the accumulation of the functions of decision-making (general manager) and control (chairman) as well as to the distinction between inside and outside directors. Being the legal representatives of the shareholders, the outside directors are supposed to be more independent and more competent than the inside directors to perform more effective control on managers.

The respective situation of both categories of directors (internal and external) as well as the

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[1] Fama and Jensen (1983a, 1983b) distinguish four stages in the processes of decision-making and firms' control: the initiative (proposals emission), ratification (choice of proposals to be implemented), implementation (execution of ratified decisions) and the surveillance.
[2] At firm level, any decision to invest in R&D requires financing which can be either: financing based on the market (Anglo-Saxon system) or a financing bank oriented (Germano-Nippon system). These two forms of financing are two alternative systems of corporate governance in which interests' conflicts between shareholders and managers is more or less attenuated. Charreaux (1997b) defines corporate governance as "the set of mechanisms that has the effect of delimiting powers and influencing the decisions of managers, in other works, of governing their conduct and defining their discretionary space" (p. 421).

[3] Studies of Jarrell, Lehn, and Marr (1985), McConnell and Muscarella (1985), Chan, Martin, and Kensinger (1990), Godard (1996), Zouari and Zouari-Hadiji (2015) confirm the positive influence of R&D spending (for high risk, strategy-high profitability, see Mansfield, 1969) on the firm performance.
[4] These directors are executives or employees that hierarchically depend on the management.
[5] Outside directors serve on the BD but do not exercise any function of management within the firm (Charreaux, 1997a).

accumulation/separation of decision functions (chief executive officer, CEO) and control (Chair) lead to differences in the pattern of BD in different countries and induce different attitudes to the performance of the control task. In principle, it seems that the nature of directors, through financial and/or strategic controls[6], as well as the structure providing the separation or overlapping of functions can influence the manager's discretionary latitude towards favoring R&D investment and increasing the firm performance. The R&D investment mediating role in the relationship between the BD and the performance varies significantly according to the nature of national governance.

2.1. The dominance of inside directors, R&D investment, and the firm performance

The agency's theorists suggest that the BD represents and protects the interests of shareholders. Its fundamental role is to control the managerial decisions and to ensure that managers fully assume their responsibilities with respect to the social interest of the firm. Their tendency to increase the firm performance by making investments in R&D depends on the role played by the BD which differs significantly according to the nature of national governance.

In the U.S. and French, BD is characterized by the dominance of outside directors who are likely to be objective and independent. Their experience and their particular circumstances enable them to exercise effective control over managers and thus improve the firm performance (Zahra & Pearce 1989; Yoo & Sung 2015; Liao, Luo, & Tang, 2015; Kuo, Wang, & Yeh, 2018). Those administrators who choose to evaluate managers on the basis of the synthetic financial criteria practice financial controls. If the BD decides to evaluate the manager based on stock market performance, he transfers a portion of the risk to the manager, which increases the likelihood of liability and revocation (Godard, 1996). The manager is risky. Therefore, financial controls based on market values in boards dominated by outside directors lead managers to invest less in R&D projects.

The American and French BDs take the initiative in dismissing managers who realize poor performance. By evaluating the managers on the basis of accounting criteria, they increase the intensity of managerial effort in favor of the maximization of the short-term profits. Goold and Quinn (1990) postulate that controls based on financial or budgetary indicators generally focuses on short-term performance. Several studies confirm this reflection. Hoskisson and Hitt (1988), Hill and Snell (1988), Baysinger et al. (1991), Ellstrand, Tihanyi, and Johnson (2002), Xie, O'Neill, and Cardinal (2003), Zouari-Hadiji and Zouari (2010a), and Yoo and Sung (2015) find a significant negative relationship between the dominance of outside directors in the board and R&D investment. This allows the reduction of the firm performance. Instead, Pearce and Zahra (1992), Krivogorsky (2006) and Sallemi, Zouari-Hadiji, and Zouari (2021) find a positive and significant relationship between

the dominance of outside directors and the firm performance.

In Japan, the BD is dominated by inside directors. By virtue of their position in the firm, they have a fairly thorough knowledge of the firm and make changes in the environment into account (Kuo et al., 2018). Maintaining interactive and open relationships with the managers, they are able to assess the competence and performance of the managers as well as the conformity of their strategic initiatives. Relying on subjective and complex methods of performance evaluation, inside directors practice strategic control. Through these controls, they induce subjective relationships with managers, and therefore reduce the employment risk (Godard, 1996). When managers are evaluated on the basis of strategic controls, they do not undergo a transfer of risk, unlike the case where financial controls are used[7] and therefore encourage risky R&D investments, thus improving the firm performance.

In this line, Zahra (1991) showed that inside directors are more oriented towards the pursuit of risky projects. These highly involved directors are able to carry out an ex-ante control of the sources of uncertainty engendered by risky investments. Considering the evolution of the environment, they are able to revise the management systems and change the key hypotheses on which the strategy is based. Therefore, the management and subjective piloting of uncertainty, linked to risky investments, allow inside directors to increase the value of the firm through an effective policy of investment in R&D.

Similarly, Goold and Quinn (1990) notice that inside directors are more oriented towards the long term since they consider the competitive position of the firm and use qualitative data. These evaluation mechanisms are not only set goals over the long term, but they also establish references in the short term (launching a new product, new service, etc.) that are oriented to long-term objectives. In general, strategic controls give a greater priority to the market growth and the long-term performance of the firm. The exercise of strategic controls by inside directors, therefore, encourages Japanese managers to invest in long-term projects. Zahra (1996) shows that inside directors are more oriented towards the pursuit of projects that have the potential to generate long-term returns. Thus, the positive effect of the dominance of inside directors over R&D investment is confirmed by the results of the studies by Hill and Snell (1988), Baysinger et al. (1991), Zouari-Hadiji and Zouari (2010a), Zouari and Zouari-Hadiji (2014a, 2014b) and Yoo and Sung (2015).

Based on the foregoing, the influence of the BD on performance through the R&D investment level varies according to the percentage of inside directors. The BD that is dominated by inside directors helps to improve the performance of Japanese firms through the realization of R&D investments. In contrast, the dominance of outside directors over the BD reduces the performance of U.S. and French firms through a diversification strategy. We deduce the following hypothesis:

H1: R&D investment positively mediates (negatively) the relationship between the BD dominated by inside directors (external) and the performance of Japanese (American and French) firms.

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[6] Financial controls are based on objective financial criteria, while strategic controls constitute a more open subjective assessment permitting the capture of the finer aspects of the action of the person responsible.

[7] A justification for this assertion is given in Godard's (1996) study.

2.2. The duality of functions, R&D investment, and firm performance

Attempts to regulate the behaviour of managers through the control of the BD may affect the orientation of their decisions. The examination of the intervention of the BD in the strategy partially depends on the effect of combination or, on the contrary, of the separation of decision and control functions. The tendency of the managers to undertake R&D investments and increase performance comes from the dominant decision-making structure (separation or combination of the functions of the CEO and the chairman of the board) which varies from one country to another.

In the U.S., the BD is characterized by a dual structure (Daily & Dalton, 1994). The position of the CEO and that of the Chairman of the Board are held by the same person. The combination of decision and control functions by the manager gives him great decision-making power and a great opportunity for entrenchment (Fama & Jensen, 1983a, 1983b). This dual structure allows neither the directors to effectively exercise their control over the manager nor the shareholders to make sure that decisions are in accordance with their interests. Having an informational advantage thanks to their experience within the firm and released from the control of the board, U.S. managers are incited to pursue their own interests at the expense of the shareholders. In this respect, they emphasize diversification strategies whose performance is short-term. The combination of functions is thus associated with low levels of R&D investment (Kor, 2006; Zouari-Hadiji & Zouari, 2010a), contributing to the reduction of the firm's value (Zouari & Zouari-Hadiji, 2014a, 2014b; Sallemi et al., 2021).

In French, the dual structure is relatively more frequent (Godard & Schatt, 2005) awarding the CEO of the firm greater power of decision and control. The combination of the two functions makes it difficult to determine the respective responsibilities of the chairman of the BD and the CEO. For French shareholders, the adoption of a dual structure might be risky, since it offers the managers the opportunity to more easily defend the projects initiated and implemented at the expense of their well-being. Recognizing the inefficiency of the BD at performing its control function[8], managers have an incentive to reduce R&D investment (Kor, 2006; Zouari-Hadiji & Zouari, 2010a), negatively affecting the firm performance (Zouari & Zouari-Hadiji, 2014a, 2014b; Sallemi et al., 2021).

Unlike France and the U.S., the Japanese chairman of the board does not perform the functions of a CEO (Yoshimori, 1998). This implies a clear separation between decision and control functions, facilitating the control of the CEO by the Chairman of the Board. The BD, supposed to represent and protect the interests of the various stakeholders, consists of two organs, an Executive Board[9] and a Supervisory Board[10] that are completely separated at the institutional and functional levels. Fama and Jensen (1983a, 1983b) show that in firms where agents making decisions are not the main owners, for decision systems, to be effective, must be designed in such a way that a decision initiated and implemented by a given agent is not ratified and controlled by the same agent. In this context, the role of the board is all the stronger given that functional separation is pronounced. The stable control of the principal shareholders as the creditors[11] allows reducing the problems of the agency by limiting the powers of the managers to expropriate the interests of the firm. It favors, in this respect, a decision-making process oriented towards the adoption of R&D investment strategies as well as the achievement of partnership performance (Chen, Ho, & Hsu, 2013; Zouari-Hadiji, 2021).

In the context of corporate governance, the value creation is then based on the ability to invest in R&D on a continuous basis. It turns out that the distribution of powers within firms has both direct and indirect effects in guiding the behavior of managers towards achieving performance. The dual structure in which the manager is also the chairman of the BD increases the intensity of the managers' efforts in favor of the realization of the diversification strategies and the low concentration of R&D activities. On the other hand, an independent structure within which there is a separation of the decision and control function allows managers to favor R&D investment, which is an essential component of value creation. The indirect effect is thus mediated by the establishment of an R&D investment policy, an essential component of value creation.

H2: R&D investment positively mediates (negatively) the relationship between an independent structure (dual) and the performance of Japanese (American and French) firms.

As in the foregoing, we consider two variables that determine the firm performance through the R&D investment: the dominance of inside directors and the dual structure. The theoretical predictions are presented in Table 1.

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[8] Because it possesses a power of influence on the board.

[9] The Executive Board is principally engaged in defending the interests of shareholders and making quick and decisive choices to ensure the efficient operation of the firm.
[10] The Supervisory Board is responsible for ensuring the inclusion of all stakeholders' interests.
[11] The importance of the shareholding lines held by the largest banks in the country gives them significant control power over the management of firms.

Table 1. Summary of the main explanatory variables of the firm performance through R&D investment

Hypotheses	Explained variables	Mediator variables	Explanatory variables	Expected signs		
				U.S.	JP	FR
H1	Firm performance	R&D investment	Dominance of inside directors	+	+	+
H2	Firm performance	R&D investment	Dual structure	-	-	-

3. RESEARCH METHODOLOGY

The question that arises is the following: *How do differences in the configuration of the countries' BD influence the R&D investment and the firm performance?* In this analysis, we test the indirect effect of the dominance of the inside directors as well as the dual structure on the firm performance through R&D investment. Firstly, we will present our sample, the explained and explanatory variables, and the method of multivariate analysis (mediation analysis by bootstrap and the Sobel tests, Preacher and Hayes, 2004, 2008). The presentation and interpretation of the results of this study will make up a second sub-section.

3.1. Presentation of data and variables' measurements

The study data come from two databases (Osiris and Thomson One Banker) and annual reports of publicly traded U.S. (NYSE) and Japanese (NIKKEI 225) and French (CAC40) firms over the period 2014-2019.

These firms belong to the industrial, commercial, tourism, technological, and service sectors. The sectoral heterogeneity allows establishing the external validity and generality of the results (Lee, 2005).

The companies belonging to the financial sector (banks and insurance companies) are excluded from the sample, owing to their unique financial structure and their specific governance mechanisms.

The firms whose number of employees was less than 500 were also removed to get the most interesting theoretical plausibility[12]. For comparative statistical analysis, we selected all the firms for which we have data on the composition of BD, R&D investment (risk and horizon), and performance, that is, a total sample of 509 firms (171 French, 165 American, and Japanese 173).

Given that the return of R&D appears only in the long term (Xu & Zhang, 2004), we must choose an indicator of long-term performance to study the relationship between R&D investment and firm performance. Lin and Chen (2005) point out that 5 years seems to be appropriate for the evaluation of the fallout of R&D strategies for the firm performance[13]. Thus, and as in previous studies (Pandit, Wasley, & Zach, 2011; Zouari & Zouari-Hadiji, 2014a, 2014b), we define the firm performance by two measurements:

• the average operating return (return on assets) on five consecutive years (Zouari & Zouari-Hadiji, 2014a, 2014b; Zouari & Abdelmalek, 2020):[14] *ROA = operating income before depreciation and R&D expenses/total sales;*

• the average stock returns (market-to-book), (Zouari & Zouari-Hadiji, 2014a, 2014b; Zouari & Abdelmalek, 2020): *MTB = market capitalization/book value of equity.*

To measure the R&D investment level (*R&D*)[15], we use the indicators found in the literature. It can be defined as the total expenditure on R&D divided either by the asset total (Hosono et al., 2004; Kor, 2006), by the employees' number (Hill & Snell, 1988; Baysinger et al., 1991), or by the sales total of the firm (Lee & O'Neill, 2003; Zouari & Zouari-Hadiji, 2014a, 2014b). In this study, we chose the last measurement of the intensity of R&D. It has been widely used in previous studies. This measurement allows the standardization of the R&D investment level with respect to the firm size.

The proportion of the inside directors is a quantitative variable measured by the ratio of inside directors to the total number of the directors. Those working in the firm and having family ties with its managers were considered inside directors (Godard & Schatt, 2005; Zouari & Zouari-Hadiji, 2014a, 2014b).

The cumulative function of CEO and Chairman of the BD is a dichotomous variable taking the value 1 if the two functions are held by the same person and 0 if otherwise. This measurement has been used by several previous research such Zouari-Hadiji and Zouari (2010a), Zouari and Zouari-Hadiji (2014a, 2014b).

For more reliable results, we introduced two control variables corresponding to the firm size (*SIZE*) and activity sector (*SECT*). The firm size is measured by the natural logarithm of the total assets of the firm. This measurement has been used in several studies such as Zouari and Zouari-Hadiji (2014a, 2014b, 2015).

The activity sector is a dummy variable taking the value 1 if firms belong to high-technology industry and 0, if otherwise. This measurement has been used by several studies such as Zouari and Zouari-Hadiji (2014a, 2014b, 2015).

The explanatory and control variables influence the realization of R&D investment and verify its multidimensionality. They are also distinct from each other and present, as shown in Table 2, a low and/or non-significant correlation between them.

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[12] According to Scherer (1984), only the large firms can have the motivation and ability to develop new products and engage in R&D projects. They have the ability to hedge against the inherent risks to the activity in R&D by committing several projects simultaneously.
[13] Some authors argue that the positive effect of R&D investment on stock returns is realized over periods ranging from five to seven years (Lev & Sougiannis, 1996; Lev & Zarowin, 1998).

[14] This measurement of the accounting performance has the advantage of eliminating the effect of accounting choices related to the treatment of R&D expenses in the financial statements largely subject to the managers' opportunism.
[15] Knowledge of the amount of R&D expenditures is closely related to the desire of managers to publish such strategic information, and select the accounting method for these expenses (fully charged or assets). Since the adoption of IAS/IFRS, capitalization of these costs has become mandatory as soon as the requirements of IAS 38 "intangible asset" are met. Thus, to determine the total annual expenditure on R&D, we need to know both parts of these expenses as capitalized expenditure. To collect this information, we have combined the data available in the Osiris and Thomson One database with those contained in the annual reports of firms.

Table 2. Correlations matrix

Panel A: U.S. firms				
	Percentage of inside directors	**Duality**	**Firm size**	**Activity sector**
Percentage of inside directors	1.00			
Duality	-0.172	1.00		
Firm size	0.030	0.273	1.00	
Activity sector	0.027	0.063	0.093	1.00
Panel B: Japanese firms				
	Percentage of inside directors	**Duality**	**Firm size**	**Activity sector**
Percentage of inside directors	1.00			
Duality	-0.110	1.00		
Firm size	0.113	0.017	1.00	
Activity sector	0.134	0.088	0.057	1.00
Panel C: French firms				
	Percentage of inside directors	**Duality**	**Firm size**	**Activity sector**
Percentage of inside directors	1.00			
Duality	0.023	1.00		
Firm size	0.102	0.123	1.00	
Activity sector	0.094	0.023	0.272	1.00

Note: All correlations between variables are significantly smaller than 0.6 (threshold at which we begin to experience serious problems of multicollinearity). In the Pearson test and the index of conditioning, we have found that these variables are distinct from each other and are not significant (correlation thresholds above 10% and the packaging is less than 1000).

3.2. Statistic analysis

We want to explain the firm performance by the characteristics of the BD. We hypothesize in our conceptual model above that the impact of the dominance of the inside directors and the dual structure on firm performance is not direct, but is mediated by the R&D investment level.

Despite the superiority of the structural equation modeling to the "causal steps" approach of Baron and Kenny (1986), we choose the mediation analysis for its simplicity and because "it provides the researcher with a story about a sequence of effects that leads to something" (Kenny, 2008, p. 354)[16]. Actually, it is usual for the testing of the effects of mediation to resort to the step-by-step approach proposed by Baron and Kenny (1986)[17].

Their procedure for determining if an independent variable affects a dependent variable through some mediator is so well known that it is used almost systematically by authors. However, this procedure suffers from certain limits. Thus, its statistical power is limited in most situations and particularly in those where the sample under study is a small one with a non-normal distribution; moreover, the first step is not suitable as it requires a questionable significant direct link between the independent and dependent variables (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Zhao et al., 2010; Matoussi & Khemakhem-Jardak, 2012)[18].

Furthermore, Preacher and Hayes (2004, 2008) suggested that "types I and II errors"[19] are likely to occur with Baron and Kenny's (1986) method. These types of errors may result in erroneous conclusions about the mediation effect.

The above reasons explain why we used the bootstrap method for indirect effects of R&D investments (Edwards & Lambert, 2007; Preacher & Hayes, 2004, 2008). We have completed this analysis by the Sobel test (Sobel, 1982, 1986) of the indirect effects according to the recommendation of MacKinnon et al. (2002). The bootstrap method is a recent alternative to Baron and Kenny's (1986) procedure. It overcomes the limits of the latter, notably by using confidence intervals to get around the problem of statistical power (MacKinnon et al., 2002; Edwards & Lambert, 2007) and decreases types I and II errors (Preacher & Hayes, 2004, 2008). Based on Preacher and Hayes's works (2004, 2008), the bootstrap method relies on using an SPSS macro which combines the Sobel test with a step by step procedure; this makes it possible to test all the indirect effects of mediation while at the same time controlling for the other variables of the model. Our analyses were based on 5000 replications generated by the bootstrap method and generating

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[16] Iacobucci (2008) argues that structural equation (SEM) approaches dominate the "causal steps" approach of Baron and Kenny (1986). We agree that the SEM approach is superior to Baron and Kenny's because it estimates everything simultaneously instead of assuming that equations (1–3) are independent. However, the greater technical complexity of SEM makes it seem unlikely that SEM will supplant Baron and Kenny's approach soon (Zhao, Lynch, & Chen, 2010).

[17] See Zouari and Zouari-Hadiji (2014a, 2014b, 2015).

[18] To establish that an independent variable X affects a distal dependent variable Y through a mediating variable M, Baron and Kenny (1986) recommend three tests: (a) variations in levels of the independent variable significantly account for variations in the presumed mediator (i.e., path "a"), (b) variations in the mediator significantly account for variations in the dependent variable (i.e., path "b"), and (c) when paths "a" and "b" are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when path "c" is zero. Note that condition c) requires

a significance test for the "direct" path "c". Paths "a", "b", and "c" are tested and estimated by equations (1), (2), and (3):

$$Y = cX + e1 \quad (1)$$
$$M = aX + e2 \quad (2)$$
$$Y = c'X + bM + e3 \quad (3)$$

In Baron and Kenny (1986), the path "c" test has been labeled the "effect to be mediated". For them, without an effect to be mediated, there is no need for further investigating mediation. However, Zhao et al. (2010) specify that the path "c" represents only the total effect and there may be mediation, even if the coefficient "c" is not significant. To establish mediation, Preacher and Hayes (2004, 2008) put forward two approaches, the difference between the two regression coefficients $(c - c')$, or the multiplication of the two regression coefficients (a×b) must be significant. These authors recommend running the Preacher–Hayes script and generating "bootstrap results for indirect effects".

[19] Holmbeck (2002) points out that it is possible to observe a change from a significant path "a" to a non significant path "a" upon the addition of a mediator to the model with a very small change in the absolute size of the coefficient. This pattern of results may lead a researcher to erroneously conclude that a mediation effect is present (type I error). Conversely, it is possible to observe a large change in the path "a" upon the addition of a mediator to the model without observing an appreciable drop in statistical significance (type II error) (Preacher & Hayes, 2004, p. 719).

thresholds of significance for each regression coefficient.

Zhao et al. (2010) identify three patterns consistent with mediation and two with non-mediation:

1. Complementary mediation: Mediated effect (a×b) and direct effect (c) both exist and point in the same direction.

2. Competitive mediation: Mediated effect (a×b) and direct effect (c) both exist and point in opposite directions.

3. Indirect-only mediation: Mediated effect (a×b) exists, but no direct effect.

4. Direct-only non-mediation: Direct effect (c) exists, but no indirect effect.

5. No-effect non-mediation: Neither direct effect nor indirect effect exists.

4. EMPIRICAL RESULTS AND DISCUSSIONS

This section is intended to present the results of the test of the two hypotheses that connect the BD apprehended by the dominance of inside and dual structure with the firm performance through the R&D investment level.

4.1. Assessing the hypotheses of the model "dominance of inside directors/R&D investment/firm performance"

The purpose of this hypothesis is to test the mediating role of the R&D investment level variable (*R&D*) in the relationship between the dominance of inside directors (*INSIDE.DIR*) and the firm performance (*ROA* and *MTB*). In order to test our hypothesis of indirect effect (a×b), we have estimated separate regression models for each of the measurements of the firm performance by the bootstrap method (Preacher & Hayes, 2004, 2008) allied to the Sobel test (Sobel, 1982, 1986).

4.1.1. Interpretation of results for U.S. firms

Table 3 shows the coefficients of the mediating effect of R&D investment in the relationship between the *INSIDE.DIR* and both measurements of the firm performance (*ROA* and *MTB*).

Hypothesis 1 (*H1*) specified that R&D investment acts as a positive mediator in the relationship between the *INSIDE.DIR* and the U.S.

firms' performance. Model 1 (testing the relationship between the variable *INSIDE.DIR* and *ROA*) shows an interesting explanatory power (R^2 = 26.06%). The overall quality of the model is significantly acceptable (F = 3.5115, p < 5%). It is likely that at least one of the explanatory variables brings a significant contribution amidst the overall fluctuations in the profitability of the assets. Nevertheless, once the performance is measured by *MTB*, Model 2 turns out to have a weak explanatory power (R^2 = 5.9%) along with an insignificant Fisher's test (F = 1.583; p > 10%).

For both models, the Student's tests reveal that the variable *INSIDE.DIR* is positively and significantly associated with the R&D investment of U.S. firms (β = 0.8784, p < 1%). The *SECT* variable is also positively and significantly associated with the performance of a U.S. firm's *ROA* (β = 0.0965, p < 1%).

Similarly, the R&D investment level has a positive and significant impact on the two indicators of the firm performance (for *ROA*: β = 0.0833, p < 1% and for *MTB*: β = 1.0064, p < 1%), in conformity with the studies conducted by Jarrell et al. (1985), McConnell and Muscarella (1985), Chan et al. (1990), Godard (1996), Zouari and Zouari-Hadiji (2014a, 2014b, 2015).

The Sobel test of the significance of the indirect effect (a×b) of the variable *INSIDE.DIR* on the firm performance (*ROA*) by R&D investment was satisfactory (z = 6.2273; p < 1%). The bootstrap confidence interval [0.0429; 0.1032] did not contain zero, thus it corresponds to the criterion of the significance of the mediator effect (Preacher & Hayes, 2004, 2008).

The Sobel test of Model 2 is also significant (z = 1.9230, p < 10%). This result is also confirmed by the bootstrap test with a confidence interval [0.1486; 1.6194] that did not contain zero. Still, we have indirect-only mediation for both models (performance measured by *ROA* and *MTB*). *H1* is thus validated by U.S. firms. R&D investment mediates the indirect impact of the dominance of inside directors on the economic and stock market performance of the firm. These results match those of Zouari and Zouari-Hadiji (2014b). An evaluation based on financial and accounting criteria in boards dominated by external directors leads managers to invest less in R&D projects, thus decreasing the firm performance.

Table 3. Regression results for mediator effects of R&D between inside directors' percentage and of U.S. firms' performance

Variables	Model 1			Model 2		
	β	SE	t	β	SE	t
Direct and total effects						
Effect of inside directors' percentage on R&D (a)	0.8784	0.0538	16.3354***			
Effect of the R&D on performance (ROA), controlling for inside directors' percentage (b)	0.0833	0.0123	6.7485***			
Effect of inside directors' percentage on performance (ROA) (c)	0.0020	0.0097	0.2058 n.s			
Effect of inside directors' percentage on performance (ROA), controlling for R&D (c′ = c − ab)	0.0751	0.0138	5.4304***			
Partial effect of firm size on ROA	-0.0011	0.0010	-1.0928			
Partial effect of activity sector on ROA	0.0965	0.0314	3.0685***			
	R^2 *(performance ROA) = 0.2606,*		*F = 3.5115****			
Effect of inside directors' percentage on R&D (a)				0.8784	0.0538	16.3354***
Effect of the R&D on performance (MTB), controlling for inside directors' percentage (b)				1.0064	0.5244	1.9192*
Effect of inside directors' percentage on performance (MTB) (c)				0.0706	0.3306	0.2135 n.s
Effect of inside directors' percentage on performance (MTB), controlling for R&D (c′ = c − ab)				0.8054	0.5621	1.4330 n.s
Partial effect of firm size on MTB				1.2910	2.1932	0.5886 n.s
Partial effect of activity sector on MTB				-1.8341	1.3363	-1.3725 n.s
	R^2 *(performance MTB) = 0.0590,*		*F = 1.5830 n.s*			
Indirect effects in cases of normal distribution (ab)						
Sobel	Value	SE	z			
Model 1	0.0731	0.0117	6.2273***			
Model 2	0.8840	0.4597	1.9230*			
Bootstrap results for indirect effects (ab)						
Effect	M	SE	LL 95% CI	UL 95 % CI	Types of mediation	
Model 1	0.0731	0.0154	0.0429	0.1032	Indirect-only mediation	
Model 2	0.8840	0.3752	0.1486	1.6194	Indirect-only mediation	

Notes: N = 172. The regression coefficients are standardized. The size of the bootstrap sample = 5000. LL = lower limit; UL = upper limit; CI = confidence interval; M = mean; SE = standard error. * p < 10% ; ** p < 5%; *** p < 1% ; n.s = non-significant.
Model 1: Inside directors' percentage as an independent variable, firm performance measured by ROA as a dependent variable and R&D investment as mediator.
Model 2: Inside directors' percentage as an independent variable, firm performance measured by MTB as a dependent variable and R&D investment as mediator.

4.1.2. Interpretation of results for Japanese firms

In Table 4, we present the results of the test of the mediator effect of R&D investment in the relationship between the *INSIDE.DIR* and both measurements of the Japanese firms' performance (*ROA* and *MTB*).

The *INSIDE.DIR* is positively and significantly linked to the R&D investment level (β = 0.7312, p < 1%). The latter also had a positive and significant impact on both firm performance indicators (for *ROA*: β = 0.0254, p < 10%, and for *MTB*: β = 0.0229, p < 5%), in conformity with the studies conducted by Jarrell et al. (1985), McConnell and Muscarella (1985), Chan et al. (1990), Godard (1996), Zouari and Zouari-Hadiji (2014a, 2014b, 2015). The *SECT* variable is positively and significantly associated with the stock market performance of Japanese firms (β = 0.2441, p < 5%).

The indirect effect (a×b) is significant for both measurements of the firm performance. The Sobel test confirms the significance of the indirect effect at a threshold of 10% for *ROA* (z = 1.6325) and 5% for *MTB* (z = 2.0716). Bootstrap confidence intervals [0.0010; 0.0465] and [0.0016; 0.0376] are significant at 95%, they do not have the zero value, thus corresponding to the criterion of the significance of the mediating effect (Preacher & Hayes, 2004, 2008). However, we have indirect-only mediation for both measurements of the performance (*ROA* and *MTB*).

Hence, *H1* is validated by Japanese firms. R&D investment acts as a positive mediator in the relationship between the *INSIDE.DIR* and the economic and stock market performance of Japanese firms in conformity with the studies conducted by Zouari and Zouari-Hadiji (2014b). The BD of Japanese firms with internal dominance practices a strategic control encouraging the managers to undertake investments in R&D, value creator for the firm.

Table 4. Regression results for mediator effects of R&D between inside directors' percentage and of Japanese firms' performance

Variables	Model 1			Model 2		
	β	SE	t	β	SE	t
Direct and total effects						
Effect of inside directors' percentage on R&D (a)	0.7312	0.0673	10.8689***			
Effect of the R&D on performance (ROA), controlling for inside directors' percentage (b)	0.0254	0.0153	1.6582*			
Effect of inside directors' percentage on performance (ROA) (c)	0.0106	0.0136	0.7786 n.s			
Effect of inside directors' percentage on performance (ROA), controlling for R&D (c′ = c − ab)	-0.0080	0.0176	-0.4556 n.s			
Partial effect of firm size on ROA	-0.0008	0.0011	-0.7058 n.s			
Partial effect of activity sector on ROA	0.0059	0.1645	0.0360 n.s			
	R^2 (performance ROA) = 0.0681,		F = 4.0903***			
Effect of inside directors' percentage on R&D (a)				0.7312	0.0673	10.8689***
Effect of the R&D on performance (MTB), controlling for inside directors' percentage (b)				0.0229	0.0108	2.1192**
Effect of inside directors' percentage on performance (MTB) (c)				-0.0054	0.0096	-0.5650 n.s
Effect of inside directors' percentage on performance (MTB), controlling for R&D (c′ = c − ab)				-0.0222	0.0124	-1.7917*
Partial effect of firm size on MTB				0.0001	0.0008	0.1937 n.s
Partial effect of activity sector on MTB				0.2441	0.1159	2.1054**
	R^2 (performance MTB) = 0.0567,		F = 2.5681**			
Indirect effects in cases of normal distribution (ab)						
Sobel	Value	SE	z			
Model 1	0.0186	0.0114	1.6325*			
Model 2	0.0167	0.0081	2.0716**			
Bootstrap results for indirect effects (ab)						
Effect	M	SE	LL 95% CI	UL 95 % CI	Types of mediation	
Model 1	0.0186	0.0122	0.0010	0.0465	Indirect-only mediation	
Model 2	0.0167	0.0091	0.0016	0.0376	Indirect-only mediation	

*Notes: N = 176. The regression coefficients are standardized. The size of the bootstrap sample = 5000. LL = lower limit; UL = upper limit; CI = confidence interval; M = mean; SE = standard error. * p < 10% ; ** p < 5%; *** p < 1% ; n.s = non-significant.*
Model 1: Inside directors' percentage as an independent variable, firm performance measured by ROA as a dependent variable and R&D investment as mediator.
Model 2: Inside directors' percentage as an independent variable, firm performance measured by MTB as a dependent variable and R&D investment as mediator.

4.1.3. Interpretation of results for French firms

The results of Table 5 support complementary mediation for both models of regressions. Consequently, the R&D investment seems to mediate the relation between the *INSIDE.DIR* and the firm performance (apprehended by both measurements *ROA* and *MTB*).

The effect of the variable *INSIDE.DIR* on R&D investment, effect (a), is positive and statistically significant at the threshold of 1% ($β$ = 0.7406, p < 1%). The test of effect (b) reveals that R&D has a positive and significant impact at a threshold of 1% on the firm performance (for *ROA*: $β$ = 0.0534, and for *MTB*: $β$ = 0.0722), in accordance with the studies of Jarrell et al. (1985), McConnell and Muscarella (1985), Chan et al. (1990), Godard (1996), Zouari and Zouari-Hadiji (2014a, 2014b, 2015). The *SECT* variable is also positively and significantly associated with the firm performance at the threshold of 5% (for *ROA*: $β$ = 0.0899, and for *MTB*: $β$ = 0.0860).

The *INSIDE.DIR* has a direct effect (c) of 2.25% (significant at a threshold of 1% in Model 1) and an indirect effect (a×b) through R&D investment of 6.21% (significant at the threshold of 1% according to Sobel and bootstrap confidence interval [0.0104; 0.0685] is significant at 95%) on economic performance.

Similarly, R&D investment mediates the relationship between the *INSIDE.DIR* and the stock market firm performance. Indeed, the Sobel test confirms the significance of the indirect effect at a threshold of 1% and bootstrap confidence interval [0.0289; 0.0779] is significant at 95 %, it does not contain zero, thus corresponding to the criterion of the significance of the mediating effect (Preacher & Hayes, 2004, 2008).

H1 is therefore validated by French firms. These results are in accordance with those of Zouari and Zouari-Hadiji (2014a). The complementary mediation of *INSIDE.DIR* of the R&D investment can be interpreted as follows. Since the variable *INSIDE.DIR* is positively associated with R&D, we can say that our findings confirm the theory. More specifically, boards of externally-dominated French firms evaluate managers on the basis of financial and accounting criteria, increasing the intensity of managerial effort in favor of the maximization of short-term profit; hence; reducing the long-term firm performance.

Table 5. Regression results for mediator effects of R&D between inside directors' percentage and of French firms' performance

Variables	Model 1			Model 2		
	β	SE	t	β	SE	t
Direct and total effects						
Effect of inside directors' percentage on R&D (a)	0.7406	0.0322	22.9817***			
Effect of the R&D on performance (ROA), controlling for inside directors' percentage (b)	0.0534	0.0168	3.1793***			
Effect of inside directors' percentage on performance (ROA) (c)	0.0225	0.0073	3.0874***			
Effect of inside directors' percentage on performance (ROA), controlling for R&D (c′ = c − ab)	0.0621	0.0143	4.3328***			
Partial effect of firm size on ROA	0.0017	0.0022	0.7498 n.s			
Partial effect of activity sector on ROA	0.0899	0.0357	2.5198**			
	R² (performance ROA) = 0.1699,		*F = 8.7983****			
Effect of inside directors' percentage on R&D (a)				0.7406	0.0322	22.9817***
Effect of the R&D on performance (MTB), controlling for inside directors' percentage (b)				0.0722	0.0174	4.1469***
Effect of inside directors' percentage on performance (MTB) (c)				0.0175	0.0083	2.1179**
Effect of inside directors' percentage on performance (MTB), controlling for R&D (c′ = c − ab)				0.0725	0.0153	4.7265***
Partial effect of firm size on MTB				0.0004	0.0022	0.1786 n.s
Partial effect of activity sector on MTB				0.0860	0.0370	2.3255**
	R² (performance MTB) = 0.2131,		*F = 7.2443****			
Indirect effects in cases of normal distribution (ab)						
Sobel	Value	SE	z			
Model 1	0.0395	0.0126	3.1464***			
Model 2	0.0534	0.0136	3.9317***			
Bootstrap results for indirect effects (ab)						
Effect	M	SE	LL 95% CI	UL 95 % CI	Types of mediation	
Model 1	0.0395	0.0148	0.0104	0.0685	complementary mediation	
Model 2	0.0534	0.0125	0.0289	0.0779	complementary mediation	

*Notes: N = 184. The regression coefficients are standardized. The size of the bootstrap sample = 5000. LL = lower limit; UL = upper limit; CI = confidence interval; M = mean; SE = standard error. * p < 10% ; ** p < 5%; *** p < 1% ; n.s = non-significant.*
Model 1: Inside directors' percentage as an independent variable, firm performance measured by ROA as a dependent variable and R&D investment as mediator.
Model 2: Inside directors' percentage as an independent variable, firm performance measured by MTB as a dependent variable and R&D investment as mediator.

4.2. Assessing the hypotheses of the model "dual structure/R&D investment/firm performance"

The purpose of this hypothesis is to test the mediating role of the R&D investment level variable (R&D) in the relationship between the dual structure (*DUAL*) and the firm performance (*ROA* and *MTB*). In order to test our hypothesis of indirect effect (a×b), we have estimated separate regression models for each of the measurements of the firm performance by the bootstrap method (Preacher & Hayes, 2004, 2008) allied to the Sobel test (Sobel, 1982, 1986).

4.2.1. Interpretation of results for U.S. firms

According to Table 6, Model 1 (which tests the relationship between the variable *DUAL* and the *ROA*) has an interesting explanatory power (R^2 = 25.74%). The overall quality of the model is significantly acceptable (F = 14.4678, p < 1%). It is likely that at least one of the explanatory variables brings a significant contribution amidst the overall fluctuations in the profitability of the assets. Moreover, once the performance is measured by *MTB*, Model 2 turns out to have a weak explanatory power (R^2 = 4.57%) and a significant Fisher test (F = 1.9974; p < 10%).

For both models, the Student's tests reveal that the variable *DUAL* is negatively and significantly associated with R&D investment (β = -0.8432, p < 1%). The combination of functions is thus associated with low levels of R&D investment (Kor,

2006; Zouari-Hadiji & Zouari, 2010a). On the other hand, the R&D investment level has a positive and significant impact on both indicators of the firm performance (for *ROA*: β = 0.0815, p < 1%; and for *MTB*: β = 1.0897, p < 5%). R&D investments then contribute to improving the firm's economic and stock market performance, in conformity with the studies conducted by Jarrell et al. (1985), McConnell and Muscarella (1985), Chan et al. (1990), Godard (1996), Zouari and Zouari-Hadiji (2014a, 2014b, 2015). The *SECT* variable is also positively and significantly associated with the performance of a U.S. firms' ROA (β = 0.1030, p < 1%).

Employing regression analyses according to the model of Preacher and Hayes (2004), the findings point to an indirect-only mediating effect via R&D investment in the relationship between dual structure and the performance of the firm (*ROA* and *MTB*). The Sobel test is significant (for *ROA*: z = -6.0847, p < 1% and for *MTB*: z = -2.0536, p < 5%) and bootstrap confidence interval did not contain zero (For *ROA*, IC = [-0.0991, -0.0384], and for *MTB*, IC = [-1.6686, -0.1692]).

Hypothesis 2 (*H2)* is thus validated by U.S. firms. R&D investment acts as a negative mediator in the relationship between the *DUAL* and the economic and stock market performance of U.S. firms, these findings are similar to those of Zouari and Zouari-Hadiji (2014b). In fact, the accumulation of functions offers the possibility for American managers to more easily defend their own interests to the detriment of R&D investments, which negatively affects the firm performance.

Table 6. Regression results for mediator effects of R&D between dual structure and
of U.S. firms' performance

Variables	Model 1			Model 2		
	β	*SE*	*t*	*β*	*SE*	*t*
Direct and total effects						
Effect of dual structure on R&D (a)	-0.8432	0.0494	-17.0618***			
Effect of the R&D on performance (ROA), controlling for dual structure (b)	0.0815	0.0125	6.5241***			
Effect of dual structure on performance (ROA) (c)	0.0021	0.0089	0.2375 n.s			
Effect of dual structure on performance (ROA), controlling for R&D (c′ = c − ab)	0.0709	0.0132	5.3555***			
Partial effect of firm size on ROA	-0.0092	0.0138	-0.6711 n.s			
Partial effect of activity sector on ROA	0.1030	0.0315	3.2743***			
	R^2 (performance ROA) = 0.2574,		F = 14.4678***			
Effect of dual structure on R&D (a)				-0.8432	0.0494	-17.0618***
Effect of the R&D on performance (MTB), controlling for dual structure (b)				1.0897	0.5259	2.0722**
Effect of dual structure on performance (MTB) (c)				0.1712	0.3402	0.5031 n.s
Effect of dual structure on performance (MTB), controlling for R&D (c′ = c − ab)				-0.7478	0.5569	-1.3427 n.s
Partial effect of firm size on MTB				-0.8082	0.5792	-1.3953 n.s
Partial effect of activity sector on MTB				-1.7473	1.3239	-1.3198 n.s
	R^2 (performance MTB) = 0.0457,		F = 1.9974*			
Indirect effects in cases of normal distribution (ab)						
Sobel	*Value*	*SE*	*z*			
Model 1	-0.0688	0.0113	-6.0847***			
Model 2	-0.9189	0.4475	-2.0536 **			
Bootstrap results for indirect effects (ab)						
Effect	*M*	*SE*	*LL 95 % CI*	*UL 95 % CI*	*Types of mediation*	
Model 1	-0.0688	0.0155	-0.0991	-0.0384	Indirect-only mediation	
Model 2	-0.9189	0.3825	-1.6686	-0.1692	Indirect-only mediation	

*Notes: N = 172. The regression coefficients are standardized. The size of the bootstrap sample = 5000. LL = lower limit; UL = upper limit; CI = confidence interval; M = mean; SE = standard error. * p < 10% ; ** p < 5%; *** p < 1% ; n.s = non-significant.*
Model 1: Dual structure as an independent variable, firm performance measured by ROA as a dependent variable and R&D investment as mediator.
Model 2: Dual structure as an independent variable, firm performance measured by MTB as a dependent variable and R&D investment as mediator.

4.2.2. Interpretation of results for Japanese firms

The findings in Table 7 show that the explanatory power of the firm performance (measured by *ROA* and *MTB*) by the *DUAL* variable is moderately low (R^2 = 3.47% and R^2 = 5.94%, respectively). The overall quality of both models is statistically acceptable (F = 2.0581, p < 10%, F = 2.6987, p < 5%, respectively). It is should be forwarded that at least one of the explanatory variables brings a significant contribution to the Japanese firms' performance.

In order to test effect (a), Student values show that the *DUAL* variable is negatively and significantly associated with the R&D of Japanese firms at a threshold of 1% (*β* = -0.748, p < 1%). Conversely, the effect (b) of R&D on the firm performance is positive and significant (for *ROA*: *β* = 0.0262, p < 10%, and for *MTB*: *β* = 0.0228, p < 5%), according to the studies of Jarrell et al. (1985), McConnell and Muscarella (1985), Chan et al. (1990), Godard (1996), Zouari and Zouari-Hadiji (2014a, 2014b, 2015). The *SECT* variable is also positively and significantly associated with the firm's stock market performance at a threshold of 5% (*β* = 0.2408).

The *DUAL* variable does not have any direct effect (c) on both regression models, whereas it has

an indirect effect (a×b) through R&D investment of about 2%. Sobel's test confirms the significance of this indirect effect at a threshold of 10% for *ROA* (z = -1.6425) and 5% for *MTB* (z = -2.0779). Bootstrap confidence intervals [-0.0219; -0.0172] and [-0.0310; -0.0031] are significant at 95%, they do not have the zero value, thus corresponding to the significance criterion of the mediating effect (Preacher & Hayes, 2004, 2008). However, we have an indirect-only mediation for both measurements of performance (*ROA* and *MTB*).

H2 is validated by Japanese firms. The relationship between the dual structure, on the one hand, and the firm's economic and stock market performance, on the other hand, seems to be mediated by R&D investment, according to the theory. Through its effect on the firm's R&D activities, the accumulation of functions helps to considerably diminish the firm performance. In fact, a dual structure weakens the monitoring ability of the board to fulfil its control function, to direct the managers' decisions towards the choice of short-term investments, and, consequently, to reduce the firm performance (Zouari & Zouari-Hadiji, 2014b).

Table 7. Regression results for mediator effects of R&D between dual structure and
of Japanese firms' performance

Variables	Model 1			Model 2		
	β	SE	t	β	SE	t
Direct and total effects						
Effect of dual structure on R&D (a)	-0.7482	0.0627	-11.9242***			
Effect of the R&D on performance (ROA), controlling for dual structure (b)	0.0262	0.0158	1.6641*			
Effect of dual structure on performance (ROA) (c)	0.0087	0.0130	0.6685n.s			
Effect of dual structure on performance (ROA), controlling for R&D (c′ = c − ab)	-0.0109	0.0175	-0.6223n.s			
Partial effect of firm size on ROA	-0.0118	0.0192	-0.6135n.s			
Partial effect of activity sector on ROA	0.0071	0.1643	0.0434 n.s			
	R^2 (performance ROA) = 0.0347,		F = 2.0581*			
Effect of dual structure on R&D (a)				-0.7482	0.0627	-11.9242***
Effect of the R&D on performance (MTB), controlling for dual structure (b)				0.0228	0.0108	2.1202**
Effect of dual structure on performance (MTB) (c)				-0.0042	0.0092	-0.4515 n.s
Effect of dual structure on performance (MTB), controlling for R&D ((c′ = c − ab)				-0.0212	0.0122	-1.7440*
Partial effect of firm size on MTB				-0.0099	0.0135	-0.7282 n.s
Partial effect of activity sector on MTB				0.2408	0.1158	2.0800**
	R^2 (performance MTB) = 0.0594,		F = 2.6987**			
Indirect effects in cases of normal distribution (ab)						
Sobel	Value	SE	z			
Model 1	-0.0196	0.0120	-1.6425*			
Model 2	-0.0171	0.0082	-2.0779**			
Bootstrap results for indirect effects (ab)						
Effect	M	SE	LL 95% CI	UL 95 % CI	Types of mediation	
Model 1	-0.0196	0.0012	-0.0219	-0.0172	Indirect-only mediation	
Model 2	-0.0171	0.0071	-0.0310	-0.0031	Indirect-only mediation	

*Notes: N = 176. The regression coefficients are standardized. The size of the bootstrap sample = 5000. LL = lower limit; UL = upper limit; CI = confidence interval; M = mean; SE = standard error. * p < 10% ; ** p < 5%; *** p < 1% ; n.s = non-significant.*
Model 1: Dual structure as an independent variable, firm performance measured by ROA as a dependent variable and R&D investment as mediator.
Model 2: Dual structure as an independent variable, firm performance measured by MTB as a dependent variable and R&D investment as mediator.

4.2.3. Interpretation of results for French firms

Table 8 shows the mediating effect coefficients of R&D investment within the relationship between the dual structure and the firm performance. The test of the relationship between the *DUAL* variable and the firm performance (measured by *ROA* and *MTB*) has a satisfactory explanatory power (R^2 =0.2132 and R^2 = 0.1671, respectively) and significantly acceptable at a threshold of 1% (F = 7.2470 and F = 8.6298). It is likely that at least one of the explanatory variables makes a significant contribution to the performance of French firms.

The effect of the *DUAL* variable on R&D investment, effect (a), is negative and statistically significant at a threshold of 1% (β = -0.7825, p < 1%). On the other hand, the test of effect (b) reveals that R&D has a positive as well as a significant impact at a threshold of 1% on the firm performance (for *ROA*: β = 0.0716, and for *MTB*: β = 0.0518), according to the studies of Jarrell et al. (1985), McConnell and Muscarella (1985), Chan et al. (1990), Godard (1996), Zouari and Zouari-Hadiji (2014a, 2014b, 2015).

The variable *SIZE* is also positively and significantly associated with the firm performance (for *ROA*: β = 0.0867, p < 5%, and for *MTB*: β = 0.0926, p < 1%).

Employing regression analyses according to Preacher and Hayes' model (2004), the results highlight a complimentary mediation effect via R&D investment within the relationship between the dual structure and the firm performance. The Sobel test is significant at a threshold of 1% (for *ROA*: z = -4.0475, and for *MTB*: z = -2.9340) and the bootstrap confidence interval did not contain zero (for *ROA*, IC = [-0.0812; -0.0307], and for *MTB*, IC = [-0.0677; -0.0074]).

H2 is therefore validated by French firms. R&D investment mediates the indirect impact of the dual structure on the economic and stock market performance of French firms. These results join those of Zouari and Zouari-Hadiji (2014a). Indeed, a dual structure within the board of directors of French firms releases the managers of any potential control. It, thus, incites them to favor diversification strategies whose efficiency is short-term; this contributes to reducing the value of the firm.

Table 8. Regression results for mediator effects of R&D between dual structure and
of French firms' performance

Variables	Model 1			Model 2		
	β	SE	t	β	SE	t
Direct and total effects						
Effect of dual structure on R&D (a)	-0.7825	0.0384	-20.3618***			
Effect of the R&D on performance (ROA), controlling for dual structure (b)	0.0716	0.0173	4.1349***			
Effect of dual structure on performance (ROA) (c)	0.0167	0.0074	2.2557**			
Effect of dual structure on performance (ROA), controlling for R&D (c′ = c − ab)	0.0728	0.0152	4.7822***			
Partial effect of firm size on ROA	0.0867	0.0370	2.3425**			
Partial effect of activity sector on ROA	-0.0026	0.0131	-0.2010 n.s			
*R² (performance ROA) = 0.2132, F = 7.2470****						
Effect of dual structure on R&D (a)				-0.7825	0.0384	-20.3618***
Effect of the R&D on performance (MTB), controlling for dual structure (b)				0.0518	0.0167	3.1036***
Effect of dual structure on performance (MTB) (c)				0.0237	0.0066	3.6069***
Effect of dual structure on performance (MTB), controlling for R&D (c′ = c − ab)				0.0633	0.0143	4.4342***
Partial effect of firm size on MTB				0.0926	0.0356	2.6049***
Partial effect of activity sector on MTB				-0.0003	0.0120	-0.0283n.s
*R² (performance MTB) = 0.1671, F = 8.6298****						
Indirect effects in cases of normal distribution (ab)						
Sobel	*Value*	*SE*	*z*			
Model 1	-0.0560	0.0138	-4.0475***			
Model 2	-0.0376	0.0128	-2.9340***			
Bootstrap results for indirect effects (ab)						
Effect	*M*	*SE*	*LL 95% CI*	*UL 95 % CI*	*Types of mediation*	
Model 1	-0.0560	0.0129	-0.0812	-0.0307	Complementary mediation	
Model 2	-0.0376	0.0154	-0.0677	-0.0074	Complementary mediation	

Notes: N = 184. The regression coefficients are standardized. The size of the bootstrap sample = 5000. LL = lower limit; UL = upper limit; CI = confidence interval; M = mean; SE = standard error. * p < 10% ; ** p < 5%; *** p < 1% ; n.s = non-significant.
Model 1: Dual structure as an independent variable, firm performance measured by ROA as a dependent variable and R&D investment as mediator.
Model 2 Dual structure as an independent variable, firm performance measured by MTB as a dependent variable and R&D investment as mediator.

In general, the results of this study have important implications for theory as well as for practice. On the one hand, our research widens current knowledge by suggesting an integrative model allowing us to measure the mediating effect of R&D investment between the BD characteristics and the firm performance. Mediating-variable modelling regarding the current corporate governance research has not yet been developed. Nevertheless, this study provides an initial early-stage response to both conceptual and methodological levels.

On the other hand, our results demonstrate that American, Japanese, and French firms prove to have interesting motives and benefits leading them to invest in R&D activities, encouraged by the desire to significantly increase their performance. Moreover, if one is to focus on the individual effects of governance mechanisms, our results suggest that these firms would benefit from giving great importance to the inside directors and the non-dual structure. In fact, two variables seem to be positively and significantly associated with the firm performance through the R&D investment level. The importance of the mediating effect of R&D concerning these variables has been demonstrated. Indeed, the introduction of the mediation effect of R&D in the complete model allows increasing in a significant way explanatory power. At this level, it should be underlined that, following these results, the weak explanatory power of the traditional governance model could be explained by the quasi-absence of analysis relevant to the mediating effect of intermediary variables decisive in the relationship of causality between corporate governance mechanisms and the firm performance.

5. CONCLUSION

In the theoretical framework of corporate governance, this article studies the efficiency of the board's control over managers in order to favor R&D investment, creator of value. This efficiency is sensitive to national systems of governance. The modeling of the relationships between the three concepts, namely BD, R&D investment and performance could be summarized as follows. Since R&D investment could act as a mediating variable for a particular variable of the BD characteristics and not for another one, the assessment of such a mediating effect was carried out by the development of both models in accordance with the number of BD variables used in this study.

Several empirical studies showed that the BD is more or less related to the firm performance (Hill & Snell, 1988; Baysinger et al., 1991; Lee & O'Neill, 2003; Hosono et al., 2004; Lee, 2005; Zouari-Hadiji & Zouari, 2010a, 2010b). However, a common feature of these studies lies in the fact that most of them tend to focus on the direct association between BD and the firm performance while overlooking other intermediary factors that may prove to be relevant to understanding the pertinent causal relationship. A successful research perspective, therefore, is to

adopt a model with a mediating-variable, namely the R&D investment level. It is probable that the last variable exerts a mediating effect in the relationship between the BD and the firm performance. As a result, the indirect effect could be demonstrated by verifying the potential mediating effect of R&D investment.

In this respect, our results indicate that all exogenous variables dominance of inside directors in the BD and the dual structure is relevant to determining the mediating effect according to the approach of Preacher and Hayes (2004, 2008). It follows that the mediation of the R&D variable between the variables related to the BD characteristics and the performance of American, Japanese, and French firms is either complementary or only indirect. It thus seems that the variable dominance of inside directors in BD favors R&D investment strategies, thus improving the firm performance. The non-significance of the direct effect of the dominance of inside directors variable in the BD on American and Japanese firm performance (measured by *the ROA and MTB*) is a particularly important finding. In this case, it seems that R&D investment mediates only indirectly the dominance of inside directors in the BD on the economic and stock market performance of American and Japanese firms.

Whereas for French firms, the relationship between the variable inside directors' dominance in the BD and the firm performance appears to be mediated in a complementary way by R&D investment. It follows that the impact of the variable dominance of inside directors in the BD on the firm performance is both direct and indirect. Hence, the more the firms have boards composed mostly of inside directors the more they engage in R&D activities and the more they show high performance.

In addition, mediation analyzes prove the mediating role of the R&D variable in the relationship between the dual structure and firm performance (ROA and MTB). For American and Japanese firms, the Sobel tests and bootstrap confidence intervals confirm that R&D investment mediates the indirect impact of the dual structure on economic and stock market performance. Meanwhile, this mediation is only indirect. On the other hand, the accumulation of functions offers the possibility for French managers to defend more easily their own interests, which directly and indirectly affects the firm performance. The impact is indirect through the mediation of the R&D variable.

The findings also reveal the importance of adding the R&D mediating variable in the improvement of the explanatory power of the complete model. This shows that this variable is a reliable predictor of the dependent variable, namely the firm performance.

If this research offers contributions to the understanding of the firm performance determinants through R&D investment, it has, however, some limitations and presents some new opportunities for future studies. In addition to the role of the BD, which we studied, the model should incorporate financing decisions and other mechanisms of internal and external governance (for example, ownership structure, financial market, labor market, goods, and services market, etc.) allowing to represent more complete reality. These mechanisms have an impact on managerial latitude and hence the choice of R&D investment, creator of value. It would also be interesting to extend the theoretical framework to the contributions of cognitive and behavioral governance. Future studies may seek to use another method like structural equation modeling or decision tree.

REFERENCES

1. Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychology research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182. https://doi.apa.org/doi/10.1037/0022-3514.51.6.1173
2. Baysinger, B. D., Kosnik, R. D., & Turk, T. A. (1991). Effects of board and ownership structure on corporate R&D strategy. *The Academy of Management Journal, 34*(1), 205-214. Retrieved from https://www.jstor.org/stable/256308
3. Chan, S. H., Martin, J. D., & Kensinger, J. W. (1990). Corporate research and development expenditures and share value. *Journal of Financial Economics, 26*(2), 255-276. https://doi.org/10.1016/0304-405X(90)90005-K
4. Charreaux, G. (1997a). Modes de contrôle des dirigeants et performance des firmes/The managers' system of control and the performance of the firm. In G. Charreaux (Ed.), *Le gouvernement des entreprises: Corporate Governance Théorie et Faits* (pp. 17-54). Retrieved from https://cutt.ly/sxtWbqC
5. Charreaux, G. (1997b). Vers une théorie du gouvernement des entreprises. In G. Charreaux (Ed.), *Le gouvernement des entreprises: Corporate Governance Théorie et Faits* (pp. 421-469). Retrieved from https://www.researchgate.net/publication/4799182_Vers_une_theorie_du_gouvernement_des_entreprises
6. Chen H.-L., Ho, M. H.-C., & Hsu, W.-T. (2013). Does board social capital influence chief executive officers' investment decisions in research and development? *R&D Management, 43*(4), 381-393. https://doi.org/10.1111/radm.12025
7. Daily, C. M., & Dalton, D. R. (1994). Bankruptcy and corporate governance: The impact of board composition and structure. *The Academy of Management Journal, 37*(6), 1603-1617. https://doi.org/10.2307/256801
8. Edwards, J. R., & Lambert, L. S. (2007). Methods for integrating moderation and mediation: A general analytical framework using moderated path analysis. *Psychological Methods, 12*(1), 1-22. https://doi.apa.org/doi/10.1037/1082-989X.12.1.1
9. Ellstrand, A. E., Tihanyi, L., & Johnson, J. L. (2002). Board structure and international political risk. *The Academy of Management Journal, 45*(4), 769-777. https://doi.org/10.2307/3069310
10. Fama, E. F. (1980). Agency problems and the theory of the firm. *Journal of Political Economy, 88*(2), 288-307. https://doi.org/10.1086/260866
11. Fama, E. F., & Jensen, M. C. (1983a). Agency problems and residual claims. *Journal of Law and Economics, 26*(2), 327-350. https://doi.org/10.1086/467038
12. Fama, E. F., & Jensen, M. C. (1983b). Separation of ownership and control. *Journal of Law and Economics, 26*(2), 301-326. https://doi.org/10.1086/467037

13. Godard, L. (1996). *Conseil d'Administration, stratégie et performance financière* (Doctoral thesis, IAE Dijon, Université de Bourgogne). Retrieved from http://www.theses.fr/1996DIJOE004
14. Godard, L., & Schatt, A. (2005). Caractéristiques et fonctionnement des conseils d'administration français: Un état des lieux. *Revue Française de Gestion, 31*(158), 69-87. https://doi.org/10.3166/rfg.158.69-88
15. Goold, M., & Quinn, J. J. (1990). The paradox of strategic controls. *Strategic Management Journal, 11*(1), 43-57. https://doi.org/10.1002/smj.4250110104
16. Hill, C. W. L., & Snell, S. A. (1988). External control, corporate strategy and firm performance in research intensive industries. *Strategic Management Journal, 9*(6), 577-590. https://doi.org/10.1002/smj.4250090605
17. Holmbeck, G. N. (2002). Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *Journal of Pediatric Psychology, 27*(1), 87-96. https://doi.org/10.1093/jpepsy/27.1.87
18. Hoskisson, R. E., & Hitt, M. A. (1988). Strategic control systems and relative R&D investment in large multiproduct firms. *Strategic Management Journal, 9*(6), 605-621. https://doi.org/10.1002/smj.4250090607
19. Hosono, K., Tomiyama, M., & Miyagawa, T. (2004). Corporate governance and research and development: Evidence from Japan. *Economics of Innovation and New Technology, 13*(2), 141-164. https://doi.org/10.1080/10438590410001628125
20. Iacobucci, D. (2008). *Mediation analysis.* https://doi.org/10.4135/9781412984966
21. Jarrell, G. A., Lehn, K., & Marr, W. (1985). Institutional ownership, tender offers, and long-term investments. Retrieved from https://docecity.com/institutional-ownership-tender-offers-and-long-term.html
22. Kenny, D. A. (2008). Reflections on mediation. *Organizational Research Methods, 11*(2), 353-358. https://doi.org/10.1177/1094428107308978
23. Kor, Y. Y. (2006). Direct and interaction effects of top management team and boards compositions on R&D investment strategy. *Strategic Management Journal, 27*(11), 1081-1099. https://doi.org/10.1002/smj.554
24. Krivogorsky, V. (2006). Ownership, board structure, and performance in continental Europe. *The International Journal of Accounting, 41*(2), 176-197. https://doi.org/10.1016/j.intacc.2006.04.002
25. Kuo, H.-C., Wang, L.-H., & Yeh, L.-J. (2018). The role of education of directors in influencing firm R&D investment. *Asia Pacific Management Review, 23*(2), 108-120. https://doi.org/10.1016/j.apmrv.2017.05.002
26. Lee, P. M. (2005). A comparison of ownership structures and innovations of US and Japanese firms. *Managerial and Decision Economics, 26*(1), 39-50. https://doi.org/10.1002/mde.1188
27. Lee, P. M., & O'Neill, H. M. (2003). Ownership structures and R&D investments of US and Japanese Firms: Agency and stewardship perspectives. *The Academy of Management Journal, 46*(2), 212-225. https://doi.org/10.2307/30040615
28. Lev, B., & Sougiannis, T. (1996). The capitalization, amortization, and value-relevance of R&D. *Journal of Accounting and Economics, 21*(1), 107-138. https://doi.org/10.1016/0165-4101(95)00410-6
29. Lev, B., & Zarowin, P. (1998). *The market valuation of R&D expenditures* (New York Stern University Working Paper). Retrieved from https://ssrn.com/abstract=142122
30. Liao, L., Luo, L., & Tang, Q. (2015). Gender diversity, board independence, environmental committee and greenhouse gas disclosure. *The British Accounting Review, 47*(4), 409-424. https://doi.org/10.1016/j.bar.2014.01.002
31. Lin, B.-W., & Chen, J.-S. (2005). Corporate technology portfolios and R&D performance measures: A study of technology intensive firms. *R&D Management, 35*(2), 157-170. https://doi.org/10.1111/j.1467-9310.2005.00380.x
32. MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7*(1), 83-104. https://doi.apa.org/doi/10.1037/1082-989X.7.1.83
33. Mansfield, E. (1969). *Industrial research and technological innovation: An Econometric Analysis.* New York, NY: W. W. Norton & Company.
34. Matoussi, H., & Khemakhem-Jardak, M. (2012). International corporate governance and finance: Legal, cultural and political explanations. *The International Journal of Accounting, 47*(1), 1-43. https://doi.org/10.1016/j.intacc.2011.12.001
35. McConnell, J. J., & Muscarella, C. J. (1985). Corporate capital expenditure decisions and the market value of the firm. *Journal of Financial Economics, 14*(3), 399-422. https://doi.org/10.1016/0304-405X(85)90006-6
36. Pandit, S., Wasley, C. E., & Zach, T. (2011). The effect of Research and Development (R&D) inputs and outputs on the relation between the uncertainty of future operating performance and R&D expenditures. *Journal of Accounting, Auditing and Finance, 26*(1), 121-144. https://doi.org/10.1177/0148558X11400583
37. Pearce, J. A., II, & Zahra, S. A. (1992). Board composition from a strategic contingency perspective. *Journal of Management Studies, 29*(4), 411-438. https://doi.org/10.1111/j.1467-6486.1992.tb00672.x
38. Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36,* 717-731. https://doi.org/10.3758/BF03206553
39. Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879-891. https://doi.org/10.3758/BRM.40.3.879
40. Sallemi, N., Zouari-Hadiji, R., & Zouari, G. (2021). Governance mechanisms and the Takaful insurance performance: The moderating role of the leader's seniority. *Journal of Islamic Accounting and Business Research, 12*(2), 149-168. https://doi.org/10.1108/JIABR-09-2019-0185
41. Scherer, F. M. (1984). *Innovation and growth: Schumpeterian perspectives.* Cambridge, MA: The MIT Press.
42. Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equations models. *Sociological Methodology, 13,* 290-312. https://doi.org/10.2307/270723
43. Sobel, M. E. (1986). Some new results on indirect effects and their standard errors in covariance structure models. *Sociological Methodology, 16,* 159-186. https://doi.org/10.2307/270922
44. Wang, H., Liang, P., Li, H., & Yang, R. (2016). Financing sources, R&D investment and enterprise risk. *Procedia Computer Science, 91,* 122-130. https://doi.org/10.1016/j.procs.2016.07.049
45. Xie, X., O'Neill, H., & Cardinal, L. (2003). Boards as agents of innovation: How board characteristics affect R&D intensity and R&D performance in research intensive firms. Paper presented at *Academy of Management Annual Meeting*, Seattle, WA.
46. Xu, M., & Zhang, C. (2004). The explanatory power of R&D for the cross-section of stock returns: Japan 1985-2000. *Pacific-Basin Finance Journal, 12*(3), 245-269. https://doi.org/10.1016/j.pacfin.2003.09.001

47. Yoshimori, M. (1998). La gouvernance des entreprises au Japon: Les causes de son dysfonctionnement. *Revue Finance Contrôle Stratégie, 1*(4), 137-165. Retrieved from https://crego.u-bourgogne.fr/images/stories/rev/014199.pdf

48. Yoo, T., & Sung, T. (2015). How outside directors facilitate corporate R&D investment? Evidence from large Korean firms. *Journal of Business Research, 68*(6), 1251-1260. https://doi.org/10.1016/j.jbusres.2014.11.005

49. Zahra, S. A. (1991). Predictors and financial outcomes of corporate entrepreneurship and financial performance. *Journal of Business Venturing, 6*(4), 259-285. https://doi.org/10.1016/0883-9026(91)90019-A

50. Zahra, S. A. (1996). Governance, ownership and corporate entrepreneurship: The moderating impact of industry technological opportunities. *Academy of Management Journal, 39*(6), 1713-1735. https://doi.org/10.5465/257076

51. Zahra, S. A., & Pearce, J. A., II. (1989). Boards of directors and corporate financial performance: A review and integrative model. *Journal of Management, 15*(2), 291-334. https://doi.org/10.1177/014920638901500208

52. Zhao, X., Lynch, J. G., Jr., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research, 37*(2), 197-206. https://doi.org/10.1086/651257

53. Zouari, G., & Abdelmalek, I. (2020). Financial innovation, risk management, and bank performance. *Copernican Journal of Finance & Accounting, 9*(1), 77-100. https://doi.org/10.12775/CJFA.2020.004

54. Zouari, G., & Zouari-Hadiji, R. (2014a). Directors' board, R&D investment and the firm's performance: Evidence from the French case. *Corporate Board: Role, Duties & Composition, 10*(2), 85-101. https://doi.org/10.22495/cbv10i2art7

55. Zouari, G., & Zouari-Hadiji, R. (2014b). The indirect impact of the board of directors' composition on the firm's performance: An international comparison. *Asian Journal of Empirical Research, 4*(10), 468-487. Retrieved from https://www.researchgate.net/publication/315743939_The_indirect_impact_of_the_board_of_directors'_composition_on_the_firm's_performance_An_international_comparison

56. Zouari, G., & Zouari-Hadiji, R. (2015). Ownership structure, innovation and firm performance: Evidence from Tunisia. *Journal of Global Academic Institute Business & Economics, 1*(1), 132-154. Retrieved from https://www.researchgate.net/publication/315815653_Ownership_Structure_Innovation_and_Firm_Performance_Evidence_From_Tunisia

57. Zouari-Hadiji, R. (2021). Financial innovation characteristics and banking performance: The mediating effect of risk management. *International Journal of Finance and Economics.* Advance Online Publication. https://doi.org/10.1002/ijfe.2471

58. Zouari-Hadiji, R., & Zouari, G. (2010a). Internal governance systems and R&D investment: An international comparison. *Corporate Board: Role, Duties & Composition, 6*(1), 39-56. https://doi.org/10.22495/cbv6i1art3

59. Zouari-Hadiji, R., & Zouari, G. (2010b). Institutional investors and R&D investment: An international comparison. *Corporate Ownership & Control, 7*(3), 44-56. https://doi.org/10.22495/cocv7i3p4