

The Mediating Effect of Corporate Innovation on the Relationship Between Gender Diversity and Firm Performance
L'effet médiateur de l'innovation dans la relation entre la diversité du genre et la performance de l'entreprise
El efecto mediador de la innovación empresarial en la relación entre diversidad de género y desempeño empresarial

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Résumé de l'article

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ABSTRACT

This study investigates the mediating effect of corporate innovation on the relationship between gender diversity in top management and firm performance. Using panel data from French firms listed in the SBF120 index (2013-2017), Generalized Method of Moments (GMM) regressions revealed that the presence of woman on the board and the executive committee positively and significantly influences both corporate innovation and firm performance, and innovation mediates the relationship between gender diversity and firm performance. We conclude that gender diversity in the strategic level improves the firm's decision-making process, facilitating the initiative to innovate.

Keywords: Top management gender diversity, corporate innovation, mediating effect, firm performance, GMM regression, panel data

Résumé

Cette étude examine l'effet médiateur de l'innovation dans la relation entre la diversité de genre et la performance de l'entreprise. Utilisant des données panel des firmes françaises de l'indice SBF120 (2013-2017), les régressions de la méthode des moments généralisés (GMM) révèlent que la présence de femmes au conseil d'administration et au comité exécutif influence positivement et significativement l'innovation et la performance de l'entreprise, et l'innovation joue un rôle médiateur entre la diversité de genre et la performance. Nous concluons que la diversité de genre aux niveaux stratégiques améliore le processus de prise de décision de l'entreprise, facilitant l'initiative d'innover.

Mots-Clés : diversité de genre, innovation, effet médiateur, performance de l'entreprise, régression GMM, données de panel

Resumen

Este estudio examina el efecto mediador de la innovación en la relación entre diversidad de género y desempeño empresarial. Utilizando un panel de firmas francesas del índice SBF120 (2013-2017), las regresiones del método generalizado de momentos revelan que la presencia de mujeres en el consejo de administración y en el comité ejecutivo influye positivamente en la innovación y el desempeño empresarial, y la innovación juega un papel mediador entre la diversidad de género y el desempeño. Concluimos que la diversidad de género a niveles estratégicos mejora el proceso de toma de decisiones de la empresa, facilitando la iniciativa de innovar.

Palabras Clave: diversidad de género, innovación, efecto mediador, desempeño de la empresa, regresión GMM, datos de panel



Gender diversity has become the subject of several studies over the past few decades. It emerged in the 1980s–90s in the US and was developed as a part of the managerial issue within the “management of diversity”. Presently, it represents financial and managerial challenges faced by firms. Additionally, this issue is of high interest for policy makers, firms, and investors. Several countries have implemented directives and regulations to ensure balanced representation of men and women in the decision-making structures due to the underrepresentation of women in governance and management positions in companies.

In 2020, the Global 500 Fortune firms¹ included only 14 firms (2.8%) headed by female CEO. Many countries such as France, Norway, North America, and Italy have opted for regulation by imposing gender quotas ranging from 40% to 50% representation of women in board of directors. Other countries such as Spain and the UK have adopted a flexible approach that recommends and encourages greater representation of women in corporate boards (Smith, 2014). According to the report entitled “Women, Business and the Law 2019: A Decade of Reform,” published in 2019 by the World Bank Group, 131 economies have adopted 274 legislative and legal reforms ensuring the improvement of equality between men and women along with the latter’s economic integration. The issue of women’s inclusion in management and governance structures embodies not only social and managerial challenges but also financial and managerial goals. It is also considered as one of the foundations of sustainable development and a major dimension of corporate social responsibility.

Numerous studies have investigated the impact of gender diversity on firm governance (Toé, 2012; Frye and Pham, 2018; Ye *et al.*, 2019), risk taking (Palvia *et al.*, 2015; Sila *et al.*, 2016; Bacha and Azouzi, 2019; Almenberg *et al.*, 2020), performance (Miller and Triana, 2009; Dezso and Ross, 2012; Toé, 2012, Toé, 2014; Post and Byron, 2015; Isidro and Sobral, 2015; Low *et al.*, 2015; Bauweraerts *et al.*, 2017; Chen *et al.*, 2018; Bibi *et al.*, 2018; Bennouri *et al.*, 2018; Aggarwal *et al.*, 2019; Toé and Bationo, 2019; Brahma *et al.*, 2020), and corporate social responsibility (Nekhili *et al.*, 2017; Liu, 2018; Francoeur *et al.*, 2019; Beji *et al.*, 2020). However, only a few studies have examined the impact of gender diversity on corporate innovation which is a key factor of competitiveness and a powerful determinant of firm development (Su *et al.*, 2019).

1. <https://fortune.com/global500/>

From a theoretical point of view, innovation is a major factor for economic growth and business development. Presently, companies are investing in it increasingly to improve their competitiveness. The surging investment in research and development (R&D) enables companies to obtain patents within well-defined periods and derive significant profits. Therefore, innovation is considered as an essential element of corporate strategy since it introduces more efficient means of production, preferable reputation with its customers, competitive advantage in the long term, and above all greater performance in the market (Gunday *et al.*, 2011). In this paper, we empirically analyze the direct effect of gender diversity in top management on performance and innovation. The results can be used by managers to understand the relationship between gender diversity, innovation, and performance. Specifically, we investigate whether gender diversity affects firm performance directly or through other channels. Thus, our study is significant because it hypothesizes the mediating effect of innovation on the above-mentioned relationship.

Previous studies have been inconclusive regarding the effect of gender diversity on firm performance. While some researches have observed that the presence of more women in management and decision-making structures improves firm performance, other scholars have highlighted the negative impact of gender diversity on firm performance. This discrepancy can be explained by two major reasons. First, the impact of female representation in top management on performance can be contextual (Klein and Harrison, 2007; Dezso and Ross, 2012). Dezso and Ross (2012) observed that gender diversity in top management positively affects firm performance, specifically in the context of innovation. Further, previous studies have assumed a direct impact of gender diversity on firm performance. However, the relationship between these variables can be mediated by other factors. We hypothesize that corporate innovation can be a moderating factor since gender diversity is particularly beneficial for firms with high innovation intensity (Dezso and Ross, 2012). This potential mediating effect of innovation can be also explained by a translational effect. While some studies report the positive impact of gender diversity on innovation, others consider innovation as a fundamental driving factor for firm performance. Thus, we believe that gender diversity affects innovation, which in turn affects performance.

Using a sample of US firms, Chen *et al.* (2018) observed that the positive translational effect only exists in innovation intensive industries where creativity

and innovation are pillars of corporate strategy. Miller and Triana (2009) studied the Fortune 500 firm sample and found that the relationship between gender diversity and corporate performance is mediated by innovation and reputation. Our paper extends the above-mentioned literature along two dimensions. First, the study is not restricted to the representation of women on the board but also in executive committees. In other words, our study is concerned with gender diversity in top management. In our sample, the main strategic decision-making structures of a company are both the board of directors and executive committee. Further, Miller and Triana's (2009) and Dezsó and Ross's (2012) finding are also extended by using patenting activity as a proxy to innovation productivity along with R&D expenditures. Second, the aforementioned studies have focused on the US (Dezsó and Ross, 2012; Chen *et al.*, 2018) and the Fortune 500 firms' context (Miller and Triana, 2009); our study highlights the French context. Consequently, we investigated a sample of listed French firms over the period 2013 to 2017, characterized by the adoption of legislative changes to improve gender diversity of the board of directors. We chose the French context for several reasons. Gender diversity in France constitutes a managerial, economic, and financial issue. In recent years, France has adopted the policy of feminization of boards of directors or supervisors to involve more women in management and decision-making structures. In 2011, the "Copé-Zimmermann" law was adopted. It mandated French companies to have 20% and 40% women members on their boards of directors² in 2014 and 2017, respectively. Consequently, this quota quickly accelerated from 23.2% in 2013 to 43.6% in 2018 for SBF120 companies. Thus, France is one of the first three European countries to achieve the objective of the feminization of boards of directors. Additionally, in the worldwide list of top50 companies that practice equality between men and women, 10 companies are French. Corporate innovation in this country is a major issue from both microeconomic and macroeconomic perspectives. According to OECD (Organization for Cooperation and Development), R&D expenditures constituted 2.191% of the French GDP in 2019. France invests in innovative activities more than the average of the other European Union countries that are members of OECD. This is corroborated by 15,812 patents and 99,054 trademarks

2. This law applies to listed firms and companies with more than 500 employees and a total balance sheet or a turnover exceeding 50 million euros.

in 2019³. In 2019, France was ranked second⁴ as a patent holder in Europe. The French government is also adopting several measures, such as the research tax credit (CIR) and industrial research training agreements (CIFRE), to stimulate innovation and encourage companies to invest in innovative activities.

The remainder of the paper is organized as follows. Section 2 includes a brief review of the literature and enlists the hypotheses for empirical investigation. Section 3 includes the details of the sample and variable measurements. The research methodology is presented in section 4. Section 5 reports the results and discussions, which is followed by the conclusion in section 6.

Literature Review and Hypotheses Development

Gender Diversity and Firm Performance

The issue of gender diversity in governance structure is no longer only a managerial and ethical concern, aiming to reduce the underrepresentation of women in strategic structures of companies. Currently, it represents a "business case" as the presence of more women directors represents potential value creation, better productivity, and greater performance (Miller and Triana, 2009; Dezsó and Ross, 2012; Toé, 2012; Liu *et al.*, 2014; Toé, 2014; Post and Byron, 2015; Low *et al.*, 2015; Bauweraerts *et al.*, 2017; Chen *et al.*, 2018; Bibi *et al.*, 2018; Toé and Bationo, 2019; Brahma *et al.*, 2020). Previous studies have reported mixed results on the relationship between gender diversity and firm performance. According to one perspective, increase in the proportion of women directors on the board can deteriorate firm performance (Ahern and Dittmar, 2012), deeming diversity as a factor of inefficiency. Board diversity may cause conflicts and internal problems between members. Kanter (1977) argued that heterogeneous teams do not adapt and cooperate easily because of the differences that exist between its members. Using a sample of listed French companies from 2009 to 2011, Boubaker *et al.* (2014) observed that female managers exert a negative impact on financial performance. Adams and Ferreira (2009) reported a negative relationship between gender diversity and performance due to over monitoring

3. Source: INPI (National Institute of Industrial Property).

4. Source: European Patent Office.

led by female presence on boards. Darmadi (2011) suggested that in the context of Indonesian firms, female representation on boards may be driven by familial relationship rather than skills and expertise. Rose (2007) and Marimuthu and Kolandaisamy (2009) illustrated that the presence of women on boards of directors does not affect the performance of Danish and Malaysian companies, respectively. Accordingly, Bauweraerts *et al.* (2017) found that the presence of women directors has no effect on the performance due to the curvilinear relationship while female executive directors influences negatively economic performance of Belgian companies. According to Toé *et al.* (2012), they suppose that the greater creativity and innovation induced by female presence in top management can be neutralized by the occurrence of internal conflict due to additional heterogeneity.

Nevertheless, several theories have claimed the economic value created by the presence of women in top management. First, the *human capital theory* assumes that each board member brings a set of skills and experience to an organization (Becker, 1967; Bruna and Chauvet, 2010) that can enlarge the range of knowledge, information, and perspectives. Consequently, gender diversity embodies greater access to human and capital resources that can improve firm performance (Miller and Triana, 2009; Low *et al.*, 2015). Hence, the presence of female directors improves the efficiency of decision-making of the board, enhancing firm performance (Kim and Starke, 2017). Second, the *resource dependency theory* assumes that firms are like open structures that depend on external organizations and economic conditions. This suggests that women on board help companies in optimizing access to critical resources by using their skills and knowledge that are different from those of male administrators (Hillman *et al.*, 2007). Carter *et al.* (2003) found that gender diverse boards have better decision-making capabilities associated with a finer understanding of the marketplace. Hence, women in top management are considered as complementary resources, that is, beneficial for firm performance. Third, the effect of gender diversity on firm performance can also be explained by the *agency theory*. According to this perspective, the presence of females improves board monitoring (Yi, 2011) and facilitates civilized behavior and better governance (Singh and Vinnicombe, 2004). Carter *et al.* (2003) confirmed that gender diversity might enhance board independence and reduce agency conflicts through effective monitoring and control. Fourth,

according to the *stewardship theory*, female managers are considered as transformational leaders since they tend to have aligned communal behavior (Eagly *et al.*, 2003). They pay more attention to collaboration, communication and networking (Claes, 1999) which can improve firm performance.

Several empirical studies have confirmed the positive relationship between gender diversity and firm performance in accordance with these theories. Toé (2012) studied the determinants for integrating women into the board and analyzed the expected impact of female participation in top management on economic and financial performance and on corporate governance. Considering French firms listed on the SBF120 index, from 2004 to 2009, results report positive impact of gender diversity on ROA and ROE. This impact becomes negative on Tobin's Q ratio. It appears also that integrating women into the board affects positively the quality of governance and the market value of the company. The relationship between female representation in top management and the financial market reaction was also studied by Toé and Bationo (2019) proving a positive effect. Chakrabarty and Bass (2014) focused on micro-financial institutions and illustrated that women are better at reducing operating costs and improving financial performance (Strom *et al.*, 2014). Indeed, the female board representation influences not only the average performance of companies, but also the dispersion of their performance (Conyona and He, 2017). Post and Byron (2015) conducted a meta-analysis of 140 studies and concluded that diversity within the boards of directors is positively linked to accounting returns, especially in countries where shareholder protection is reinforced. Similarly, Bibi *et al.* (2018) found that the presence of women on the board is positively associated with the performance of microfinance institutions. Bennouri *et al.* (2018) demonstrated that the reputation of women directors is positively associated with firm performance. Recently, Tsou and Yang (2019) illustrated that highly educated women improve Chinese firm performance. Considering the FTSE100 firms in the UK, Brahma *et al.* (2020) found that the positive relationship between gender diversity and firm performance became highly significant in the case of the appointment of three or more females to the boards compared to the appointment of two or less females. Therefore, based on these studies, our first hypothesis is as follows:

H1: There is a positive direct effect of gender diversity on firm performance.

Gender Diversity and Innovation

Most studies on gender diversity have focused on the effect of women directors on firm value, governance, risk-taking, and corporate social responsibility. However, few studies have investigated the effect of gender diversity on corporate innovation, even though it is a determining factor of the competitiveness of companies and countries (Wojnicka-Sycz and Sycz, 2016). Innovation is of interest to a large number of stakeholders such as business leaders, employees, and investors (Fang *et al.*, 2014). It is widely regarded as a major catalyst for economic growth and industrial evolution. Investing in innovative activities and devoting various human and financial resources to it, are some of the most important decisions that a company can take.

An emergent strand of literature has investigated the effect of gender diversity on a firm's innovation, but the results remain inconclusive. Few studies have shown that gender diversity does not affect innovation or can have a negative impact on it. Assessing a sample of 25 banks, Iren and Tee (2018) found that the presence of women managers does not significantly affect bank innovativeness. Likewise, Bianchi *et al.* (2012) found that for Italian companies, gender diversity does not influence investment in innovation. Investing in innovative activities is very risky for a company and requires significant financial resources. In most cases, the manager follows the rooting theory; meaning, irrespective of their gender, they do not prefer to invest in innovative projects that can be unprofitable and lead to dismissal in the case of loss.

Contrarily, other works have concluded that gender diversity has a positive impact on innovation (Teruel *et al.*, 2015). This positive impact is explained by the *behavioral theory* of the firm (Cyert and March, 1963). Accordingly, gender diversity produces a wider range of ideas, information, and perspectives producing high quality decisions (Joshi and Roh, 2009). Thus, it generates greater creativity and innovative decisions through cognitive conflicts (Chen *et al.*, 2005; Østergaard *et al.*, 2011; Garcia Martinez *et al.*, 2017). Managers can benefit from these different contributions and encourage their companies to create new products by investing in innovation and developing an innovative strategy. According to Chen *et al.* (2018), women are more productive in terms of innovation, as they spend more on R&D and acquire more patents. Horbach and Jacob (2018) reported that a large representation of highly qualified women and mixed-gender board positively correlate

with activities of innovation in the environmental sector. Roh and Koo (2019) illustrated that companies with a more diverse team of researchers demonstrate a better capacity for innovation due to various experience and knowledge (Faems and Subramanian, 2013). Díaz-García *et al.* (2013) revealed that gender diversity within R&D teams enhances radical rather than incremental innovation. Na and Shin (2019) suggested that female representation in top management positively affects innovation for two reasons. First, top female managers use a style of leadership that facilitates information exchange and communication and promotes more collaboration and creativity (Zuraik and Kelly 2019). Second, they are less likely to give or receive bribes than male managers, which affects available funds for innovation (Jha and Sarangi, 2018). According to the *agency theory*, women in top management are associated to less agency related problems. Women leaders have greater capacity to monitor and follow-up, which enables them to solve agency problems linked to innovation (Chen *et al.*, 2018). However, this female monitoring should not be excessive to prevent managerial myopia causing less innovation investments (Becker-Blease, 2011). Empirically, we propose to test the following hypothesis:

H2: There is a positive effect of gender diversity on innovation.

The Mediating Effect Of Innovation

As mentioned above, previous literature provides mixed results regarding the effect of gender diversity on firm performance. Kochan *et al.* (2003) highlighted that to understand the relationship between gender diversity and performance, it should be relevant to examine when and how gender diversity can improve performance. Two main reasons can explain the divergent results and examine the context (when) and ways (how) through which gender diversity affects firm performance. First, the impact of female representation in top management on performance can be contextual. Dezsó and Ross (2012) proposed a model to explain how the impact of female representation in top management is moderated by strategically relevant organizational contexts. Specially, they believed that gender diversity positively affects firm performance and this effect is not general but context specific (Klein and Harrison, 2007). The authors' theoretical model explains how female representation in top management positively affects firm performance by improving managerial task performance. The authors argue that it is due to the informational and social diversity benefits associated with

female representation in top management team that the behaviors exhibited by managers throughout the firm are enriched, and middle management women are motivated. Women in middle management are expected to be more motivated and engaged in the case of a greater female presence on the top management, particularly, in the presence of an interactive and participative leadership style encouraged by gender diversity (Rosener, 1995). Testing their model using data from the S&P500, Dezsó and Ross (2012) found that gender diversity in top management positively affects firm performance, specifically in the context of innovation. Moreover, Van Knippenberg *et al.* (2004) observed that tasks demanding creative solutions are more valuable because these require divergent views and detailed information processing headed by female representation in top management. Creativity is facilitated by gender diversity (Stahl *et al.*, 2009) which is particularly relevant to managerial activities and beneficial for innovative firms (Dezsó and Ross, 2012). Motivation and commitment are important to engage with an effective innovation strategy.

This contextual effect of gender diversity on performance leads us to the second reason explaining the divergent results. Previous studies have assumed that the relationship between female representations in top management on firm performance is direct. However, the link between gender diversity and firm performance can be mediated by other factors, for example, corporate innovation, since gender diversity is particularly beneficial for firms with high innovation intensity (Dezsó and Ross, 2012). The mediating effect of innovation on financial performance can be explained by a translational effect.

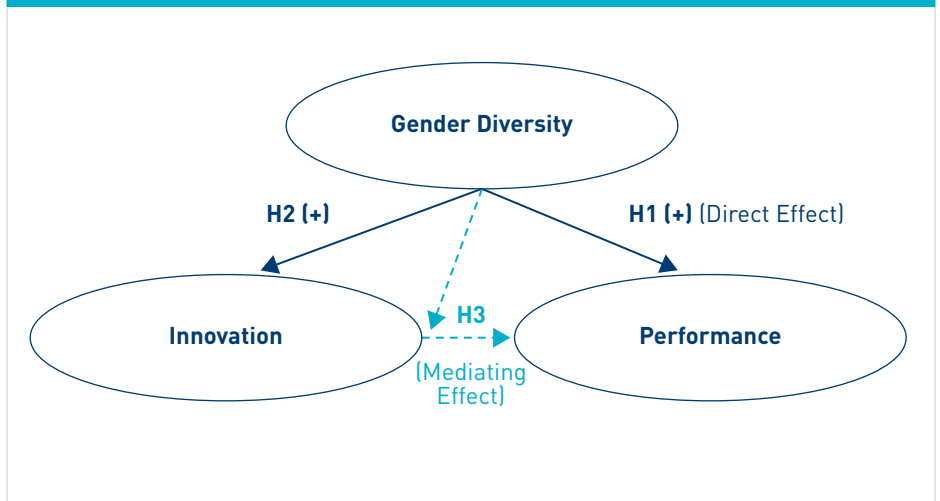
Female representation in top management plays a particularly important role in corporate decision-making, especially in innovative industries (Dezsó and Ross, 2012). It influences the choice of strategic decisions such as investment in innovation. Ruiz-Jimenez *et al.* (2016) revealed that gender diversity plays a positive moderating role in the relationship between knowledge combination capability and innovation. It improves creativity, external collaboration (Joshi and Jackson, 2003), and generation of new ideas, which positively affect innovation (Lu and Wang, 2018). It also provides greater cognitive ability and is considered a valuable strategy to pursue to improve incremental and radical innovation performance (Garcia Martinez *et al.*, 2017). Morris (2018) illustrated that companies that increase spending on R&D and create innovative products, achieve

improved productivity and generate higher profits than companies that do not innovate. Innovative companies can gain a competitive advantage in the market, facilitating their improvement in terms of increased profitability. Griffin *et al.* (2019) highlighted that gender diversity is beneficial for innovative performance due to three mechanisms: failure-tolerant and long-term oriented managerial incentives schemes, corporate culture, and inventor diversity. The authors suggest that gender diverse boards positively affect corporate innovative efficiency because female managers avoid investing in projects that are unlikely to succeed. Therefore, we hypothesize that gender diversity affects innovation, which in turn influences firm performance. We postulate an indirect effect of gender diversity on firm performance through corporate innovation (Fig. 1).

Empirically, this induces the following hypothesis:

H3: Innovation mediates the relationship between gender diversity and firm performance.

FIGURE 1
The mediating effect of innovation



Data and Variable Measurements

Our study assesses a sample of French companies listed in the SBF120 index from 2013 to 2017. We excluded financial firms from the sample to obtain homogenous data. The final panel included 95 companies (475 observations). Data was collected from various sources. For example, data on gender diversity was extracted from the Ethics & Boards survey which is the main corporate governance observatory for listed companies related to the composition of boards. Financial data was obtained from Datastream. Rest of the data were collected manually from reference documents and annual reports published by companies on their official websites.

Considering our research question, the following three variables are considered: gender diversity in top management, innovation, and firm performance. To measure *gender diversity in top management*, we employ two proxies. First, we consider the percentage of women on the board of directors (Female board representation or FB). This measure has been frequently used in previous studies (Dang and Nguyen, 2016; Chen *et al.*, 2018; Ye *et al.*, 2019) to signify female representation at a firm's strategic level. The second variable measures the proportion of women in the executive committee (Female executive representation or FE). The executive committee implements the strategic orientations defined by the board and controls its performance. It represents a relevant committee to corporate development. In the French context, the board of directors and executive committee are the main strategic decision-making structures of a company.

Then, we measure *mediator variable innovation* by employing two proxies focusing essentially on product innovation as output innovation. The first proxy, measuring innovation input, is defined as the natural logarithm of R&D expenditures, calculated as follows: . The second proxy, measuring product innovation output, is based on the natural logarithm of patent number, defined as . According to Hsu *et al.* (2014) and Chen *et al.* (2018), R&D represents the first step in the investment in an innovation strategy. Markovic and Bagherzadeh (2018) believed that investment in R&D is a proxy for an innovation that indicates companies' initiative to innovate. In addition, R&D is an essential and primordial component of innovation, indicating the intensity with which companies explore new products. The natural logarithm of patent number available to a company (Lu and Wang, 2018; Sheikh, 2018) represents a formal method of protecting the intellectual property rights associated with an invention. Atanassov (2013) confirmed that

R&D expenditures do not constitute the effective results of the innovation process. Hence, several authors have considered the patent measure as complementary to R&D expenditures, indicating the efficiency and productivity through which the company uses its inputs. This measure cannot be used alone to quantify innovation because innovations are not completely patented within a company. It differs from one firm to another, for example, there are countries where property rights are sparse, so companies have to file fewer patents (Wadho and Chaudhry, 2018).

Third, to measure performance we focus on financial performance, using a marked based measure, that is, the Market-to-Book (MB) ratio (Barber and Lyon, 1997; Adams and Ferreira, 2009; Bennouri *et al.*, 2018). To ensure robustness, we also employ accounting measures such as the return on assets (ROA) and return on equity (ROE) (Mefteh-Wali and Rigobert, 2018). Accounting measures generally reflect previous profits and short-term performance. The Market-to-book ratio values all the activities of a company and considers the current and future cash flow. More importantly, it provides a measure to evaluate intangible factors such as innovation.

Finally, based on previous literature, we include control variables that may affect innovation and firm performance. In our analysis, we retain board independence (BINDP), duality of the manager function (DUAL), institutional ownership (INSTOWN), block shareholders (MAJSHARE), firm size (SIZE), leverage (debt ratio [LEVERAGE]). Moreover, we include the following two sector variables: information and communication technologies sector (ICTSECT) and industrial sector (INDSECT). We explain this choice based on the CIS⁵ survey. Accordingly, the ICT and industrial sectors remain the most innovative sectors between 2014 and 2016. Table 1 summarized all the variables.

Research Methodology

The main objective of our research is to explore the mediating effect of innovation on the relationship between gender diversity and firm performance. The mediating effect, also known as the indirect effect, determines the impact of an independent variable on a dependent variable (Edwards and Lambert, 2007). A mediator acts

5. CIS is the Capacity to Innovate and Strategy survey conducted by the French national institute for statistical and economic studies.

TABLE 1
Description of Variables

Symbol	Variables	Measure
Gender diversity		
FB	Female board representation	Percentage of women on the board.
FE	Female executive representation	Percentage of women on the executive committee.
Innovation		
LN(1+R&D)	Innovation input	The natural logarithm of one plus a firm's research and development expenditure.
LN(1+PATENT)	Product Innovation output	The natural logarithm of one plus a firm's total number of patents.
Performance		
ROA	Return on assets	Net income divided by total assets.
ROE	Return on equity	Net income divided by total equity.
MB	The Market-to-Book ratio	Market value divided by the book value of the firm.
Control variables		
SIZE	Firm size	The logarithm of total assets.
BINDEP	Board independence	Number of independent directors to the total number of directors.
MAJSHARE	The first majority shareholder	Percentage of capital held by the majority shareholder.
DUAL	Duality	Dummy variable = 1, if the manager is the board chairman and 0 otherwise.
INSTOWN	Institutional ownership	Percentage of capital held by institutional shareholder.
LEVERAGE	The debt ratio	Ratio of debts by total assets
ICTSECT	Information and communication technologies sector	Dummy variable =1, if a company operates in the information and communication technologies sector and 0 otherwise.
INDSECT	Industrial sector	Dummy variable =1, if a company operates in the industrial sector and 0 otherwise.

as a tool explaining the mechanism through which one variable affects another. In other words, the mediating effect explains the influence of an independent variable upon a mediating variable, which then influences a dependent variable. Therefore, the mediating variable is perceived as a bridge between the independent and dependent variables (Musairah, 2015).

We used Baron and Kenny's (1986) approach, to test whether innovation mediates the relationship between gender diversity and firm performance. This approach includes three steps: **(1)** prove that the independent variable is correlated with

the dependent variable; **(2)** prove that the independent variable is correlated with the mediating variable; and **(3)** regress the dependent variable on both the independent and mediator variables. This allows us to detect the indirect effect of gender diversity on firm performance through innovation and compare it with the direct effect. Therefore, we begin by investigating the direct effect of gender diversity on firm performance (*H1*), using the following Model 1.

$$Perf_{i,t} = \alpha_0 + \alpha_1 Perf_{i,t-1} + \alpha_2 FB_{i,t} + \alpha_3 FE_{i,t} + \sum_{k=1}^9 \beta_k X_{k,i,t} + a_i + \mu_{i,t} \quad (1)$$

Here, index (*i*) refers to the company, index (*t*) indicates the year of *Perf* study. denotes the performance measures assessed by the following three proxies: *ROA*, *ROE*, and *MB*. and denote gender diversity measures: Female board representation and Female executive committee representation, respectively. X_k where $K = 1, \dots, 9$, denotes the control variables mentioned above. The fixed effect over a period is indicated by α_i and $\mu_{i,t}$ is the idiosyncratic term that denotes error.

To test the effect of gender diversity on corporate innovation [H2], we utilize Model 2.

$$\begin{aligned} Innovation_{i,t} = & \sigma_0 + \sigma_1 Innovation_{i,t-1} + \sigma_2 FB_{i,t} \\ & + \sigma_3 FE_{i,t} + \sum_{k=1}^9 \gamma_k X_{k,i,t} + \alpha'_i + \epsilon_{i,t} \end{aligned} \quad (2)$$

Here, denotes both the proxies of innovation: innovation input and innovation output (Table 1). Fixed effect over time is indicated by α'_i and $\epsilon_{i,t}$ is the idiosyncratic term that denotes error.

Finally, we study the mediating effect by regressing firm performance on both gender diversity and innovation [H3] using the following model.

$$\begin{aligned} Perf_{i,t} = & \psi_0 + \psi_1 Perf_{i,t-1} + \psi_2 FB_{i,t} + \psi_3 FE_{i,t} + \psi_4 LN(1 + R\&D)_{i,t} \\ & + \psi_5 LN(1 + PATENT)_{i,t} + \sum_{k=1}^9 \beta_k X_{k,i,t} + \alpha''_i + \pi_{i,t} \end{aligned} \quad (3)$$

Here, denotes three proxies of performance: *ROA*, *ROE*, and *MB*. Fixed effect over time is indicated by α''_i and $\pi_{i,t}$ is the idiosyncratic term that denotes error.

We used the Generalized Method of Moments [Blundell and Bond, 1998] to estimate the model above and avoid several statistical problems. It tackles the bias of reverse causality and omitted variables, as well as endogeneity. In addition, it assures the simultaneous control of specific temporal and individual effects of the variables, specifically in case of the existence of more than one lags at the level of the dependent variable. We employ the dynamic panel system GMM estimator, which favors estimation efficiency and includes fixed effects to gauge unobservable heterogeneity among companies. To ensure the relevance of GMM

estimators, we tested the validity of two statistical tests. First, the Sargan-Hansen test, which examined the validity of the model instruments based on the assumption that error terms and exogenous variables are not correlated. Second, the Arellano and Bond test that examines the autocorrelation of errors.

Results

Table 2 incorporates the descriptive statistics. It depicts that on an average, SBF120 companies have 33.2% female board member, with a maximum proportion of 63%—exceeding the 40% quota imposed by the Copé-Zimmermann law. Further, French companies have an average of 12.4% woman in the executive committee. Figure 2 demonstrates the temporal evolution of the number of firms with female representation exceeding 30% and 50% on board (FB) and on executive committee (FE), respectively. It appears that French firms continue to make efforts to increase women's representativeness on boards. However, executive committees remain underrepresented by women.

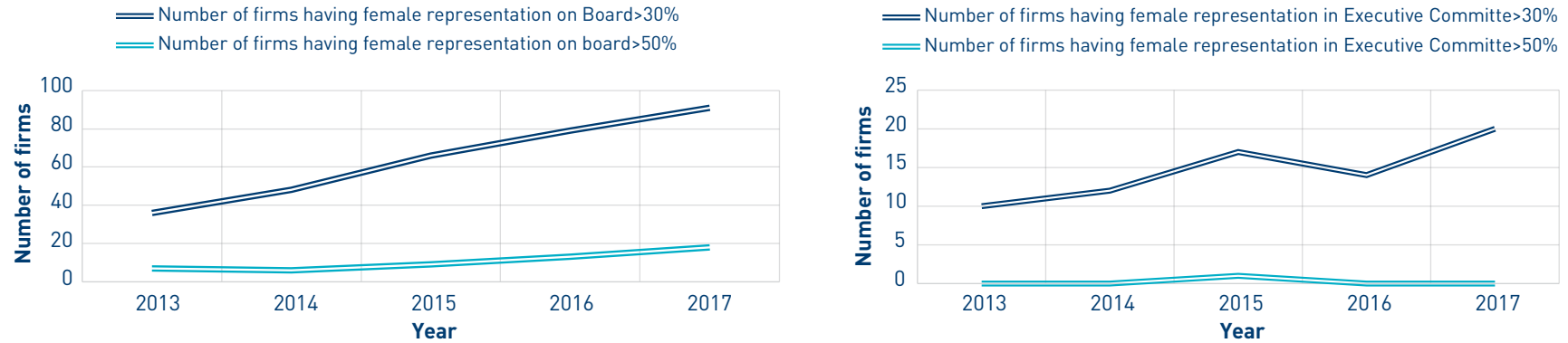
In terms of innovation variables, R&D expenditures and patent numbers correspond with an average of 363 Million Euros and 230, respectively. The ICT and industrial sectors spend 366 Million Euros in R&D and register 232 patents annually, which confirms the innovative potential of these sectors.

Regarding financial performance, French companies obtained an average MB, ROA, and ROE of 0.316, 0.227, and 0.964, respectively. Additionally, Table 2 depicts 52.8% as the mean of independent directors with a dispersion of 18.7%. This indicates that independence of directors is important in French firms, which is consistent with the corporate governance code. The SBF120 companies are characterized by concentrated shareholding capital. On an average, the major shareholder procures 44.5% of the entire capital. Further, institutional investors maintain an average of 52.5% of the capital shares. Besides, 62.26% of French companies have duality. Debt ratio represents an average of 29.4% with a 21.9% spread rate. Finally, the sector variables indicate that 10.11% and 26.32% of the companies operate in the ICT and industrial sector, respectively.

Table 3 reports the correlation matrix of all the variables utilized in our statistical analyses. The variance inflation factor (VIF) was also calculated to ensure the multicollinearity of the variables. The correlation matrix and VIF confirm the absence of a multicollinearity bias.

FIGURE 2

Female representation on board and executive committee between 2013 and 2017



This graph reports the annual evolution of the number of firms having female representation higher than 30% (=) and 50% (=) on board and executive committee, respectively. Total Number of firms = 95.

TABLE 2
Descriptive Statistics

Variables	Frequency	Mean	Standard-deviation	Minimum	Maximum
Dependent variables					
R&D (Millions Euro)	-	363.128	726.439	0.713	5472
PATENT	-	230.053	888.245	0	8780
MB	-	0.316	0.325	-0.95	0.947
ROA	-	0.227	0.499	-3.345	5.126
ROE	-	0.964	0.941	0.001	7.395
Independent variables					
FB	-	0.332	0.107	0	0.63
FC	-	0.124	0.111	0	0.666
Control variables					
INSTOWN	-	0.525	0.268	0	0.997
MAJSHARE	-	0.445	2.992	0	63.97
DUAL	0.622	-	-	-	-
BINDEP	-	0.528	0.187	0.077	1
LEVERAGE	-	0.294	0.219	0	2.377
SIZE	-	8.878	2.213	0	13.395
ICTSECT	0.101	-	-	-	-
INDSECT	0.263	-	-	-	-

TABLE 3
Correlation matrix and Variance inflation factor (VIF)

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	VIF
(1)	FB	1.000										1.060
(2)	FC	0.166	1.000									1.101
(3)	INSTOWN	-0.003	0.126	1.000								1.209
(4)	MAJSHARE	0.032	-0.054	-0.098	1.000							1.043
(5)	DUAL	-0.032	-0.018	-0.015	-0.060	1.000						1.068
(6)	BINDP	0.095	-0.020	0.339	-0.047	-0.014	1.000					1.167
(7)	LEVERAGE	-0.052	-0.083	0.074	-0.059	0.019	0.059	1.000				1.072
(8)	SIZE	0.093	0.148	0.144	-0.031	0.212	0.120	-0.075	1.000			1.181
(9)	ICTSECT	0.070	-0.101	-0.121	0.160	0.009	0.023	-0.166	-0.138	1.000		1.129
(10)	INDSECT	0.032	-0.077	0.138	-0.040	-0.021	0.079	0.088	0.159	0.082	1.000	1.089

This table provides the correlation between variables. The description of each variable is summarized in Table 1.

Table 4 reports the results of the GMM regression examining the direct effect of gender diversity on firm performance (*Hypothesis 1*). The results indicate that the presence of women on the board of directors is positively associated with firm performance at 1% significance level. These results correspond with Toé (2012), Strom *et al.* (2014), Conyona and He (2017), and Bibi *et al.* (2018). This positive effect can be explained by the agency theory and human capital theory. Gender diversity collates different viewpoints in management structures, improving strategic decision-making. In addition, a gender diversified board ensures better and effective supervision and control that can reduce information asymmetry and avoid agency related conflicts between different directors, promoting firm performance (Ahmadi *et al.*, 2017).

Moreover, the results prove that the presence of women in the executive committee positively and significantly influences firm performance. Women

executive directors contribute to the improvement of firm performance (Smith *et al.*, 2006; Brahma *et al.*, 2020). In this regard, Nekhili and Gatfaoui (2013) argued that, in the French context, several demographic attributes such as age, education level, and experience enable women in top management positions to improve firm performance. This is contradiction to Bauweraerts *et al.* (2017) in the Belgian context and to Boubaker *et al.* (2014) who found that gender diversity negatively affects French companies' performance. These studies were conducted before the adoption of the "Copé-Zimmermann" law, which possibly explains this negative effect.

Table 4 suggests that the governance variables significantly influence firm performance. Governance mechanisms are relevant determinants of firm performance (Kiradoo, 2019). Additionally, the debt ratio positively affects firm performance, and firm size and sector variables significantly influence firm performance.

TABLE 4
Model 1—The direct effect of gender diversity on firm performance

	ROE	ROA	MB
Lag ROE	0.141*** (0.000)		
Lag ROA		0.114*** (0.003)	
Lag MB			0.506*** (0.000)
FB	0.624*** (0.000)	0.504*** (0.000)	1.813*** (0.000)
FE	0.327*** (0.004)	0.295*** (0.002)	0.883*** (0.000)
INSTOWN	-1.310*** (0.000)	-0.307** (0.017)	0.380 (0.255)
MAJSHARE	-0.227** (0.010)	-0.559*** (0.000)	0.006 (0.279)
DUAL	0.060 (0.339)	0.139*** (0.000)	0.788*** (0.000)
BINDEP	0.265*** (0.000)	0.208*** (0.006)	-2.662*** (0.000)
LEVERAGE	0.152* (0.050)	0.103*** (0.004)	0.003 (0.987)
SIZE	0.154*** (0.000)	-0.056*** (0.000)	-0.329*** (0.000)
ICTSECT	0.148*** (0.000)	0.046 (0.173)	0.699*** (0.000)
INDSECT	0.287*** (0.005)	-0.260*** (0.000)	-0.145 (0.312)
Constant	-1.074*** (0.000)	0.750*** (0.000)	3.521*** (0.000)
Arellano-Bond test for AR(1)	0.002	0.000	0.007
Arellano-Bond test for AR(2)	0.113	0.203	0.643
Sargan test	0.000	0.002	0.000
Hansen test	0.406	0.391	0.543

Table 4 summarizes the two-step Dynamic Panel System GMM regression results, examining the direct effect of gender diversity on firm performance. The dependent variable is firm performance measured by the return on assets (ROA), return on equity (ROE), and market-to-book ratio (MB). Lag ROA, Lag ROE, Lag MB are the lagged values of our dependent variable. The independent variable is gender diversity, which includes two measures: FB and FE. We control the effect of governance (by using INSTOWN, MAJSHARE, DUAL, and BINDEP), debt ratio (LEVERAGE), firm size (SIZE), information and communication technologies sector (ICTSECT), and industrial sector (INDSECT). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Values in the parentheses represent p-values.

TABLE 5
Model 2—Impact of gender diversity on corporate innovation

	LN (1+R&D)	LN (1+PATENT)
Lag LN (1+R&D)	0.829*** (0.000)	
Lag LN (1+PATENT)		0.923*** (0.000)
FB	0.525*** (0.000)	0.057* (0.061)
FE	0.508*** (0.000)	0.175** (0.014)
INSTOWN	-0.520*** (0.000)	0.180*** (0.003)
MAJSHARE	0.005 (0.131)	-0.030*** (0.000)
DUAL	-0.158*** (0.004)	-0.058 (0.189)
BINDEP	-0.146 (0.182)	-0.294*** (0.000)
LEVERAGE	-0.241** (0.021)	0.231*** (0.002)
SIZE	0.078*** (0.000)	0.048*** (0.000)
ICTSECT	0.235*** (0.000)	0.568*** (0.000)
INDSECT	-0.649*** (0.000)	-0.223*** (0.003)
Constant	0.540*** (0.000)	-0.256** (0.013)
Arellano-Bond test for AR(1)	0.046	0.049
Arellano-Bond test for AR(2)	0.508	0.939
Sargan test	0.042	0.030
Hansen test	0.605	0.696

Table 5 summarizes the two-step Dynamic Panel System GMM regression results, examining the effect of gender diversity on innovation. The dependent variable is innovation which is measured by its input LN (1+R&D) and output LN (1+PATENT). Lag LN (1+R&D) and Lag LN (1+PATENT) are the lagged values of our dependent variable. The independent variable is gender diversity, which includes FB and FE. We control the effect of governance (by using INSTOWN, MAJSHARE, DUAL, and BINDEP), debt ratio (LEVERAGE), firm size (SIZE), market-to-book ratio (MB), information and communication technologies sector (ICTSECT), and industrial sector (INDSECT). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Values in the parentheses represent p-values.

Table 5 summarizes the results of the effect of gender diversity on corporate innovation (*Hypothesis 2*). It is indicated that the presence of women on the board of directors has a significant and positive impact on R&D expenditures and patents. Meaning, the presence of women on the board of directors improves the decision-making process, facilitating the initiative to innovate and generate more patents. In addition, the presence of women in the executive committee positively and significantly affects innovation input and output. These results are explained by the fact that women directors have a specific leadership style characterized by empathy, creativity, and collaboration that promotes innovation performance (Horbach and Jacob, 2018). In fact, a gender diverse team facilitates the promotion of innovation investment and its performance (Garcia Martinez *et al.*, 2016; Díaz-García *et al.*, 2013). Our results are consistent with Ruiz-Jiménez *et al.* (2016) who observed that gender diversity in top management teams enhances the association between knowledge capability and corporate innovation.

Table 5 indicates that majority ownership has a positive and significant impact on R&D investment. Majority shareholders are more interested to invest in long term R&D projects that yield firm value. In addition, manager duality has a negative impact on innovation input and output. In fact, it increases conflicts between the board and management, due to which the president refuses to engage in long-term strategic and investment decisions such as innovation projects. Furthermore, the presence of independent directors negatively influences corporate innovation. Independent directors as consultants cannot disseminate adequate information that enables the amelioration of the firm's

innovation performance and effectiveness. Also, firm size has a significant and positive effect on corporate innovation. It is considered as one of the primary determinants and generators of corporate innovation since large companies possess the resources and skills necessary to facilitate innovations.

Table 6 reports the mediating effect of corporate innovation on the relationship between gender diversity and firm performance (*Hypothesis 3*). The results indicate that innovation significantly mediates the relationship between gender diversity and firm performance. Correlation coefficients of the indirect effect of innovation on gender diversity and firm performance are lower than the direct effect. Consequently, based on Baron and Kenny's (1986) method, the results confirmed that corporate innovation mediates the relationship between gender diversity and firm performance.

Considering the culture and specificity of the French business environment, gender diversity improves the decision-making process, increasing the initiative to innovate and generate more patents. In fact, as a member of the board of directors, women have the right to vote and actively participate in formulating strategic decisions. Moreover, as executive directors, they participate in the decision-making process, policy direction, and oversight. Accordingly, the presence of women at the strategic levels ameliorates firm performance, specifically in the innovative fields (Dezso and Ross, 2012). In conclusion, adopting an innovative strategy promotes the positive influence of the presence of women in top management positions on firm performance.

TABLE 6

Model 3—The mediating effect of innovation on the relationship between gender diversity and firm performance

	ROE	ROA	MB
Lag ROE	0.110*** (0.000)		
Lag ROA		0.090*** (0.000)	
Lag MB			0.841*** (0.000)
FC	0.291*** (0.000)	0.356*** (0.000)	0.232*** (0.006)
FE	0.219*** (0.000)	0.121** (0.018)	0.574*** (0.000)
LN(1+R&D)	0.112*** (0.000)	0.074*** (0.000)	0.017** (0.041)
LN(1+PATENT)	-0.020*** (0.000)	0.034*** (0.000)	0.021*** (0.001)
INSTOWN	-0.566*** (0.000)	0.230*** (0.002)	0.024 (0.801)
MAJSHARE	0.129** (0.039)	0.327*** (0.000)	0.012*** (0.000)
DUAL	-0.040 (0.129)	0.036*** (0.003)	0.074** (0.047)
BINDEP	0.424*** (0.000)	-0.171** (0.026)	-0.332*** (0.002)
LEVERAGE	-0.083*** (0.000)	0.018 (0.534)	0.203** (0.037)
SIZE	0.003 (0.608)	-0.052*** (0.000)	-0.073*** (0.000)
ICTSECT	0.122*** (0.004)	0.093** (0.028)	0.469*** (0.000)
INDSECT	-0.065 (0.247)	-0.311*** (0.000)	-0.182** (0.016)
Constant	-0.326*** (0.000)	0.118 (0.352)	0.644*** (0.000)
Arellano-Bond test for AR(1)	0.004	0.001	0.004
Arellano-Bond test for AR(2)	0.094	0.207	0.384
Sargan test	0.000	0.000	0.000
Hansen test	0.325	0.527	0.536

This table summarizes the two-step Dynamic Panel System GMM regression results, examining the impact of gender diversity and corporate innovation on firm performance. The dependent variable is firm performance measured by the return on assets (ROA), return on equity (ROE) and market-to-book ratio (MB). Lag ROA, Lag ROE, Lag MB are the lagged values of our dependent variable. The independent variables are innovation input and output measured by LN (1+R&D) and LN (1+PATENT) and gender diversity, which includes FB and FE. We control the effect of governance (by using INSTOWN, MAJSHARE, DUAL, and BINDEP), debt ratio (LEVERAGE), firm size (SIZE), information and communication technologies sector (ICTSECT), and industrial sector (INDSECT). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Values in the parentheses represent p-values.

Conclusion

The paper aimed to investigate the mediating effect of innovation on the relationship between gender diversity and firm performance. We began by testing the direct effect of gender diversity on firm performance. Then, we explored the effect of gender diversity on innovation. For this, we used two complementary innovation measures: R&D expenditures as innovation input, and patents number as innovation output. Finally, we examined the mediating effect of innovation on the relationship between gender diversity and firm performance.

Our results confirm that the presence of women on the board of directors and in the executive committee positively and significantly affects firm performance. This implies that gender diversity in the strategic decision-making process improves a company's financial performance.

In addition, we highlight that gender diversity significantly and positively influences innovation when women are board' and executive' directors. Furthermore, corporate innovation significantly mediates the relationship between gender diversity and firm performance. Based on these results and the imposition of gender quota law in France since 2011, we observe an increasing engagement of women at the strategic levels of a firm. In fact, the presence of women on the board of directors and executive committees improves the decision-making process, and positively influences corporate innovation and financial performance.

However, our study has a limitation, as we focus only on product innovation. Future research should consider different forms of innovation such as process innovation, organizational innovation, or marketing innovation.

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