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Article

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Cogent Economics & Finance

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Suggested Citation: Slama, Ramzi Ben; Ajina, Aymen; Lakhal, Faten (2019) : Board gender diversity and firm financial performance in France: Empirical evidence using quantile difference-in-differences and dose-response models, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 7, Iss. 1, pp. 1-25, <https://doi.org/10.1080/23322039.2019.1626526>

This Version is available at:

<https://hdl.handle.net/10419/245254>

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To cite this article: Ramzi Ben Slama, Aymen Ajina & Faten Lakhal | (2019) Board gender diversity and firm financial performance in France: Empirical evidence using quantile difference-in-differences and dose-response models, Cogent Economics & Finance, 7:1, 1626526, DOI: [10.1080/23322039.2019.1626526](https://doi.org/10.1080/23322039.2019.1626526)

To link to this article: <https://doi.org/10.1080/23322039.2019.1626526>



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Received: 24 January 2019
Accepted: 28 May 2019
First Published: 02 June 2019

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Reviewing editor:
David McMillan, University of Stirling,
United Kingdom

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Board gender diversity and firm financial performance in France: Empirical evidence using quantile difference-in-differences and dose-response models

Ramzi Ben Slama^{1*}, Aymen Ajina² and Faten Lakhall²

Abstract: The purpose of this paper is to investigate the relationship between board gender diversity and firm performance under the enabling and voluntary institutional settings in France. We use a Quantile difference-in-differences and dose-response function estimations. The findings show that the comply-or-explain recommendation by the French code is likely to decrease performance for poorly performing firms. However, firm performance increases after the enabling date in high-performing firms. The results of the dose-response functions show that accounting performance reaches a threshold of 40% of women on boards, which coincides with the French law requirements in 2017.

Subjects: Economics; Finance; Business, Management and Accounting

Keywords: board gender diversity; firm performance; enabling approach; quantile difference-in-differences; dose response function

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PUBLIC INTEREST STATEMENT

The defense of women's rights, the promotion of gender equality and the fight against gender-based violence are one of the major priorities of France's external action in the area of promoting and protecting human rights. The purpose of this paper is to investigate the relationship between board gender diversity and firm performance in France. Applying a gender perspective in public policy: what it means and how we can do it better. It is the purpose of this paper. We investigate the relationship between board gender diversity and firm performance in France. The results suggest that complying with the 40% quota of women is likely to lead to more effective boards and then better firm performance. However, the appointment of women should be made gradually rather than rapidly to avoid negative investors' perceptions regarding the appointment of high proportions of women directors.

1. Introduction

The corporate governance literature has debated the role played by the board of directors. It is recognized that board composition affects firm performance (Carter, D'Souza, Simkins, & Simpson, 2010). One feature of board composition is gender diversity that has received a growing attention recently from academics and policymakers. The relation between gender diversity and firm performance is a substantial concern of board composition (Lückerath-Rovers, 2013; Mahadeo, Soobaroyen, & Hanuman, 2012; Parola, Ellis, & Golden, 2015). However, the extant research is far from providing conclusive results. Carter, Simkins, and Simpson (2003), Farrell and Hersch (2005) and Campbell and Mínguez-Vera (2008) show that board gender diversity is positively associated to financial performance. Adams and Ferreira (2009) find a positive relationship only for organizations with a weak governance structure. In Denmark, Rose (2007) finds no significant association between performance as measured by Tobin's Q and the presence of women directors. Haslam, Ryan, Kulich, Trojanowski, and Atkins (2010) find similar results in the U.K. Francoeur, Labelle, and Sinclair-Desgagné (2008) also find no significant association between gender diversity and firms' performance in Canada except for firms operating in complex environments. However, Ahern and Dittmar (2012) conclude that the imposition of a 40% quota for women on board by the Norwegian government had a negative effect on firm value. Moreover, Matsa & Miller (2013) compare financial data for publicly listed firms in Norway to a matched sample of unlisted firms in Norway and listed and unlisted firms in Scandinavia. The authors conclude that the quota system in Norway negatively influences firm performance by decreasing profits in the short run.

The relation between gender diversity on boards and firm performance is then ambiguous. The approach of women representation on the boardroom might be at the origin of the inconclusive results. Labelle, Francoeur, and Lakhali (2015) argue that several countries are currently adopting or considering the adoption of different approaches to promote gender diversity on corporate boards. According to these authors, there are three approaches regarding the representation of women on the board throughout the world. The first approach is coercive and consists in introducing affirmative legislation to ensure an appropriate level of female board participation, i.e. quotas. Under the second one, the enabling approach, companies are generally required by regulation to comply with given guidelines or explain why they do not. Under the third one, companies are left to market forces to decide whether to appoint women on boards, i.e. the voluntary approach. The market forces and the "soft" or "hard" law initiatives are all based on the fact that the presence of women is deemed to positively and significantly affect the quality of the firms' governance and strategic management, and hence their performance. This raises the question as to the relative effectiveness of these more or less coercive approaches.

French market authorities have adopted an enabling approach to promote gender diversity on corporate boards since 2010. The amended corporate governance code of AFEP/MEDEF in 2010 has indeed established a quota of 20% of women on boards within three years and 40% of women within six years. Besides, if board size is fewer than nine directors, the difference between genders must not be more than two, and if there are no women appointed on the boardroom upon publication, the board must nominate at least a woman by the second general meeting, either through replacement of a director or the appointment of a new director. Moreover, in 2011, the French legislator has adopted the Copé-Zimmerman law to constrain French-listed companies to appoint at least a quota of 40% of women on boards. The application of this coercive approach in France is set from the beginning of 2017.

According to Teigen (2011), regulatory initiatives in the form of corporate quotas can be seen as a direct measure to break the glass ceiling. Ford and Rohini (2011) consider the impact of direct policy legislations set out to increase the representation of women on corporate boards and argue that governments that are adopting laws for quotas are able to reach a gender balance on corporate boards. From a theoretical perspective, under the Bebchuk and Fried (2005) managerial power hypothesis, taking affirmative legal (imposing quotas) or regulatory (requiring firms to "comply or explain") actions to increase the participation of women on boards would enhance monitoring by the board by reducing the influence of the CEO and top management over its composition. Indeed, there is some empirical evidence that women are more likely than men to act similarly to independent directors (Adams & Ferreira, 2009), to better monitor CEOs decisions (Valenti, 2008), and to contribute

to good governance (Merridee & McConomy, 2010 and Rose, 2007). Contrary to the managerial power approach developed by Bebchuk and Fried (2005), traditional agency theory hypothesized that the current contracts of the firm are optimal and that regulation will affect this equilibrium. Boards are constituted to maximize value. Any exogenous change imposed to the board will lead to suboptimal boards and a decrease in firm performance. However, whether better board monitoring in an enabling or coercive approach translates into improved or less performance remains an open question.

The empirical Literature on the relation between board gender diversity and firm performance yielded many insights. However, to our knowledge, literally no one had taken this issue up and had risen the question about heterogeneous effects along the distribution of the performance variables ROA and Tobin Q. In addition, no one asked the question about the effect of the imposed quotas by the regulator.

The purpose of this paper is then to investigate the effect of the French soft law approach, i. e. the enabling initiative to promote board gender diversity on firm performance. First, this paper is to our knowledge the first to use a quantile difference-in-differences methodology to examine whether firm performance is affected by the type of approach used to promote women participation on the boardroom. Second, dose-response models allow to examine the distributional effects on firm performance of the 40% target quota of women participation on boards strongly recommended by the French code and now imposed by the French law since 2017. Our empirical strategy differs then from standard methodology adopted in the extant literature in terms of magnitude and significance and more importantly in terms of result's accuracy. Furthermore, our study is based on the adoption of an enabling approach in France (since 2010) relatively to the voluntary appointment of women on boards (before 2010). This allows to examine the effect of gender diversity on firm performance within the same country using different approaches.

The findings show that the comply-or-explain recommendation by the French code is likely to decrease performance for firms performing poorly. However, firm performance increases in highly performing firms suggesting that costs of appointing more women on the boardroom such as increased salary and recruiting costs could be high for non-performing firms subsequently to regulation requirements. Secondly, the results of the dose-response functions show that accounting performance reaches a highest level for the 40% level of women on boards which coincides with the comply-or-explain recommendation target and the French law requirements in 2017. This finding suggests that appointing more women is likely to lead to more effective boards and then better firm performance with an appropriate level of 40%. However, financial performance might decrease for high proportions of gender diversity in the board as investors react negatively to such proportions. The appointment of a quota of women on boards should then be made gradually than rapidly to avoid negative investors' perceptions.

One of the most important practical implications of this study is the support for the most recent attempt of the European Commission, the legislative body of the EU, to push the gender quota for females in corporate boards to 40% (The Guardian, 2017).

The paper is organized as follows. Section 2 presents a literature review and develops research hypotheses. Section 3 describes the data and the quantile difference in differences, the dose-response models and the related estimation techniques. This is followed by the results and discussion. Last section concludes the paper.

2. Theoretical development and hypotheses

Proponents of gender diversity prove that women bring new ideas, communicate better, and have lengthy discussion topics at meetings of the board (Julizaerma & Sori, 2012); Liu, Wei, & Xie, 2014). Hence, women have a cognitive style feeling that emphasizes the harmony and the ability to facilitate communication (Earley & Mosakowski, 2000), but also are serious since they have to face various challenges (Kenney, Lynch, Huntress, Haley, & Anderson, 2012). In addition, gender

diversity would lead to increasing creativity and innovation and subsequently to enhance firm performance levels (Galia & Zenou, 2012).

The linkage between gender diversity and financial performance has been addressed in a number of studies. Using Tobin's *q* as the measure of market-based performance, Carter et al. (2003) provide evidence that the US firms with a higher proportion of women on the board perform significantly better. Based on the return on assets' ratio as an accounting-based performance measure, a positive association is found between firm performance and board gender diversity (Krishnan & Park, 2005; Mahadeo et al., 2012). Erhardt, Werbel, and Shrader (2003) report similar results for a sample of 112 US companies, showing that board diversity is positively related to financial performance. Liu et al. (2014) confirm this result for China's listed firms from 1999 to 2011.

Using a sample of Canadian firms, Francoeur et al. (2008) show that a high percentage of women on Boards leads to positive and significant abnormal returns. Adler (2001), and more recently Ntim (2015) report that the benefits also involve the market performance, as their studies find that board gender diversity is positively associated with market valuations. In Europe, the evidence of a positive relationship between gender diversity and financial performance comes from 2,500 Danish firms (1993–2001) (Smith, Smith, & Verner, 2006) and 68 Spanish companies (1995–2000) (Campbell & Mínguez-Vera, 2008).

Marinova, Plantenga, and Remery (2016) suggest that on the evidence from the Netherlands and Denmark, there is no relation between board diversity and firm performance.

In the context of emerging markets, Kiliç and Kuzey (2016) provide evidence of a positive relationship for Turkish-listed firms.

Li and Chen (2018) used a panel data from A-share-listed non-financial firms in China to examine the relationship during the period of 2007–2012. They show that the gender diversity on the board has a positive impact on firm performance if and only if the value of firm size is less than some critical value.

The relationship between board gender diversity and firm performance is mixed and depends on the approach used to promote board gender diversity. In their multi-country study, Labelle et al. (2015) show that there is a positive relationship between women appointment on boards and firm performance only for the voluntary approach. In countries where the enabling approach exists, the relationship turns negative suggesting that women should be introduced on boards voluntarily rather than quickly and coercively to avoid sub-optimal board composition.

A legal or regulatory setting is one where board diversity enhancing measures such as quotas or codes are exogenously imposed on firms through law or regulation. Under the Bebchuk and Fried (2005) managerial power hypothesis, taking affirmative legal (ex. imposing quotas) or regulatory (ex.: requiring firms to “comply or explain”) actions to increase the participation of women on boards would enhance monitoring by the board by reducing the influence of the CEO and top management over its composition. This reduction in the power of management to perpetuate the “old boys club” mentality is compatible with the idea of women on boards being better “watch-dogs”. Indeed, there is some empirical evidence that women are more likely than men to act similarly to independent directors (Adams, 2008), to better monitor CEOs decisions (Valenti, 2008), and to contribute to good governance (Merridee et al. 2010 and Rose, 2007).

Contrary to the managerial power approach developed by Bebchuk and Fried (2005), traditional agency theory hypothesized that the current contracts of the firm are optimal and that regulation will affect this equilibrium. Boards are constituted to maximize value and any exogenous change imposed to the board will lead to suboptimal board and decrease in firm performance.

According to the agency theory framework, the optimal contract¹ should aim to entice managers into making all decisions that are in the shareholder's best interests and that any regulation will affect this equilibrium. This insight from contract theory provides a framework for understanding when governance regulations have the potential to improve welfare and firm performance.

This is the Coasian (Coase, 2013) perspective, insofar as we view governance arrangements as constrained-optimal contracts within the firm. Given this view, "reforms" are simply restrictions on these contracts imposed by an outside authority. Indeed, governance reforms are just a special case of contract regulation. Hermalin and Weisbach (2006) identify three conditions under which restrictions on contracts can be welfare improving. These are asymmetric information at the time of contracting, externalities on a third party, and access by the regulator (state) to penalties or other contractual provisions that are not available to private parties.

On the basis of this global perspective, any regulatory constraints hard or soft law, such as the coercive and enabling approaches, will alter contracts and destroy value (Nygaard, 2011). Duchin, Matsusaka, and Ozbas (2010) have shown that the impact on firm performance of the exogenous increase in outside directors generated by the US Sarbanes-Oxley Act (SOX) of 2002 depends on firm-specific information asymmetry. High information asymmetry firms constituted their board optimally. Therefore, the legislated increase in outside directors was harmful to these firms.

Scandinavian countries such as Norway have introduced legislation on requiring quotas for the number of female directors. This new quota-based law has become a critical consideration for corporate businesses, and its legally binding nature has made Norway's approach markedly different from that of other countries. Employers, both companies and employers' associations such as the Confederation of Norwegian Enterprise, strongly opposed the gender quota. From their perspective, quotas are likely to lead to more unqualified directors, an argument upheld by Rhode & Packer, (2014). Ahern and Dittmar (2012) argue that although the rules imposed by a gender quota are effective at reaching more gender diversity on boards, shareholders are likely to suffer if less competent women replace existing male directors.

Empirically, Bohren and Strom (2010) reported a significantly negative relationship between the proportion of women on the boards of Norwegian firms and Tobin's Q. Adams and Ferreira (2009) also suggested that female presence on corporate boards may lead to over monitoring for companies that already have strong governance in place, making it counterproductive for firm performance.

Casey, Skibnes, and Pringle (2011) compare policy strategies in Norway and New Zealand directed towards achieving gender equality in the governance of corporate institutions. A principal feature of the New Zealand strategy has been a soft regulation approach. For Norway, the use of legislation in the form of quotas and affirmative action programs has been the predominant strategy. Using empirical data collected in 2004–2005 on women's perceptions and experiences of corporate governance participation; results illustrate underline that, in a forced compliance situation, women may be seen as "quota-filling board members" who lack competence, affecting the way their contribution and motivation are perceived.

Moreover, Matsa & Miller (2013) examine the introduction of Norway's 2006 quota, comparing affected firms to other Scandinavian companies, public and private, that were unaffected by the rule. The authors find that firms affected by the quota undertook fewer workforce reductions than comparison firms, increasing relative labor costs and employment levels and reducing short-term profits.

The predictions of the agency theory and the optimal contracting hypothesis are similar and lead to the following hypothesis:

H₁: *Under the enabling approach, firm performance decreases relatively to voluntary appointment of women on boards.*

We then build on the critical mass theory as established by Moss Kanter (1977) to examine the effect of at least three women on the boardroom on firm performance. This theory examines which percentage of a minority has to be reached to have a significant influence on the team. According to Kramer, Konrad, Erkut, and Hooper (2006), majorities may exert more influence in a group than minorities because the latter are often marginalized. Similarly, women appointed in boardrooms are often considered as tokens (Terjesen, Sealy, & Singh, 2009). Hence, when firms include women among their board members, a qualitative change is deemed to take place in the nature of group interactions, and this is likely to positively influence performance (Powell, 1995). According to Moss Kanter (1977), when a threshold is reached (a critical mass), the impact of a subgroup becomes stronger. Kramer et al. (2006) support the fact that a board with three or more women is more likely to experience the positive effects, and contribute to firm performance and good governance.

These assumptions have different implications for the board of directors' research. Some studies enlighten that the main reason for the different effects of women directors on firm performance depends on the number of women appointed on boards (Torchia, Calabrò, & Huse, 2011). Moreover, a number of studies investigate the "magic number" to which critical mass corresponds could be. Specifically, Erkut, Kramer, and Konrad (2008) declare that the critical mass of women directors is reached once boards have at least three women. Konrad, Kramer, and Erkut (2008) confirm this finding.

Empirical studies mainly support this theoretical hypothesis. Joecks et al. (2013) examine the supervisory boards of 151 German stock exchange companies in the years 2000–2005. Their results indicate that gender diversity initially has negative effects on firm performance. Positive effects can only be observed after a critical mass. Hence, a U-shaped relationship is revealed, in which diverse teams negatively impact the return on equity (ROE) compared to uniform teams until a 10% proportion of women. At very low levels, gender diversity is associated with a decrease in firm performance. However, starting at a ratio of about 30%, diverse teams start to outperform uniform teams.²

Lückerath-Rovers (2013) examines a sample of 99 Dutch companies in the years 2005–2007. He shows that appointing at least three women on boards may lead to better decision making. With more women on boards, the board provides relevant information and viewpoints and increases the array of alternatives to examine for decision-making. As a consequence, firm performance improves.

Torchia et al. (2011) report similar results for a sample of 317 Norwegian companies between 2005 and 2006. They show that the board with more than three women is positively related to firm performance. Moreover, Arena et al. (2015) study the impact of board gender diversity on firm performance, by taking into account the critical mass of women directors. In a European multi-country context, the authors show that for a critical mass, women in the board of directors have a positive effect on firm performance.

Based on the contributions of the critical mass theory, the existence of three women at least on boards is likely to improve firm performance. Accordingly, our second hypothesis is as follows:

H₂: *The positive relationship between the presence of at least three women on boards and firm performance is stronger for the enabling approach than for the voluntary approach.*

3. Research design

3.1. Sample and data

As France moved to the enabling soft law approach in 2010, we choose 2008 and 2011 as the cut-off dates to compare the impact of board gender diversity and firm performance before and after the enabling approach. The enabling approach period means that a country is adopting regulations or codes of conducts in their corporate governance codes to convince managers to increase board gender diversity using a comply-or-explain recommendation. The voluntary approach period (before 2010) leaves it to market forces and companies to decide the appropriate level of representation on a voluntary basis.

Our sample includes French firms listed on the CAC All-Tradable.³ The CAC All-Tradable contains all the stocks of the Euronext Paris market that have an annual Free Float Velocity over 20%. We exclude financial companies because of their atypical behavior in financial reporting. We also remove missing data after matching the databases used in this study. Our final sample includes 89 companies over for years (2008–2011).

Data on board gender diversity and other board characteristics were retrieved from BoardEx Data Access Service. Data on corporate governance scores were collected from the SiRi Pro company database. Financial and accounting data were collected from the Compustat database.

3.2. Variable measurements

We rely on two measures for firm performance, the Tobin's Q and the ratio of return on assets (ROA).

Tobin's Q: It measures the market's expectations of future earnings and is a good proxy for a firm's competitive advantage (Montgomery & Wernerfelt, 1988). Firms with a Tobin's Q ratio greater than 1.0 are expected by investors to be able to create more value by using available resources efficiently. In addition, Tobin's Q accounts for risk and, unlike accounting measures such as return on assets, is not liable to reporting distortions due to tax laws and accounting conventions (Lindenberg & Ross, 1981). In particular, Accounting results are based on events that have already occurred, and thus offer a view of past performance, while Tobin's Q focuses on expectations of future performance (Demsetz & Villalonga, 2001).

ROA: is an accounting measure of firm performance. It is one of the most commonly used ratios in previous studies to proxy for firm performance (Vo & Nguyen, 2014). Return on assets is an indicator of how efficient is the management as using its assets to generate earning. It expresses the net income scaled by total assets of the company.

3.3. Descriptive statistics

Tables 1 and 2 provide, respectively, definitions and descriptive statistics for the variables used in this study. It shows that the Return on Assets ratio is, on average, positive and displays a level of 4.009. The approximation of Tobin's Q has a mean value of 0.793 considerably lower than the mean value reported by Demsetz and Villalonga (2001) for the U.S. market (1.1), by Hillier and McColgan (2001) for the U.K. market (1.96) and by López-Iturriaga and Rodríguez-Sanz (2001) for the Spanish market, 1.01, 1.44 and 1.23, for different years.

The mean percentage of women on French boards of directors is 12.44%. This is higher than the numbers reported for the U.S. market. For example, Carter et al. (2003) report a value of 9.6%, Farrell and Hersch (2005) a value of 6.9% and Catalyst (Joy, Carter, Wagner, & Narayanan, 2007) a value of 10.2%. The gap between France and the U.S. is bigger for the percentage of firms with at least one woman on the board. Indeed, 85% of French firms in our sample have one or more women on their board, while the comparative value for U.S. firms is 70% (Farrell & Hersch, 2005). Among MSCI ACWI⁴ Index constituents, 75.2% had at least one female director as of 26 September 2016, up from 72.3% in 2015.

With board size in our sample averaging 13.9, the critical percentage of about 23.6% women on the board translates into an absolute critical mass of on average three women. This percentage is

Table 1. Variables' definition

| Variable name | Description |
|------------------------------|--|
| Outcomes | |
| ROA | Return on assets or the ratio of net income to total assets. |
| Tobin's Q | Tobin's Q = (market value of equity + book value of debt)/book value of total assets |
| Treatment | |
| Women Dummy | A binary variable that equals to 1 if there was at least one female director on the board and to 0 otherwise. |
| Three Women | A binary variable coded as 1 if there are at least three women on the board and 0 otherwise. |
| Women percentage | The percentage of women on board measured by the number of women on board to the total number of members on board. |
| The set of covariates | |
| GovScore | A corporate governance quality index provided by SiRI. |
| Age | Average age of the directors on corporate boards. |
| Board qualifications | Average number of educational qualifications of board directors (undergraduate and above). |
| Board experience | Average number of boards on which firm directors have served |
| Board tenure | Average number of years on the board |
| BoardSize | The total number of directors in the boardroom. |
| FirmSize | Natural logarithm of total assets. |
| Leverage | The ratio of total long term debt to total assets. |
| Instruments | |
| Women Tenure | The average number of years women sit on a board |
| Women Qualification | The average number of diplomas |
| Women Experience | The average number of boards on which women directors have served |

lower to that reported in the study of Joecks, Pull, and Vetter (2013) which displays a level of 30%. However, out of 319 Japanese-domiciled constituents of the MSCI ACWI Index, only one (Lawson Inc.) had three women on the board as of 26 September 2016.

3.4. Empirical strategy

The purpose of this paper goes beyond examining the mere existence of a link between women participation on the boardroom and financial performance to investigate if the relationship depends on the approach used to promote women representation on the board of directors. As the political process is evolving through time, the French settings enable us to compare the enabling and voluntary approaches with a cut-off date of 2010. We then use the difference-in-differences (DiD, hereafter) and the dose-response function (DRF) methodologies.

3.4.1. The difference in differences (DiD) and the quantile DiD models

The DiD methodological framework is derived in part of individual-fixed and time effects models, used in panel data method. The general form of the model is as follows:

$$Y_{it} = \alpha D_{it} + \beta_i + \gamma_t + \varepsilon_{it}; \quad i = 1..N \text{ and } t = 1 \dots T \tag{1}$$

Where

Y_{it} : The outcome variable (ROA and Tobin's Q) for firm i at time t .

D_{it} : is the dummy treatment (Women Dummy, Three Women Plus) for firm i at time t .

Table 2. Firm and board of directors summary statistics

| | Mean | Median | Maximum | Minimum | Std. Dev. |
|----------------------|-------|------------------|----------------|---------|-----------|
| ROA | 4.009 | 3.818 | 18.29 | -8.861 | 3.867 |
| TobinQ | 0.793 | 0.519 | 7.487 | 0.041 | 0.799 |
| Women percentage | 12.44 | 11.11 | 37.50 | 0.000 | 8.483 |
| GovScore | 57.83 | 56.20 | 82.20 | 32.10 | 9.140 |
| Age | 58.64 | 59.17 | 67.50 | 42.27 | 3.762 |
| Board qualifications | 1.865 | 1.888 | 3.000 | 0.533 | 0.496 |
| Board experience | 4.711 | 4.666 | 9.687 | 1.000 | 1.791 |
| Board tenure | 6.260 | 6.022 | 16.74 | 0.400 | 2.966 |
| Board Size | 13.90 | 14.00 | 25.00 | 8.000 | 3.359 |
| FirmSize | 9.525 | 9.371 | 14.26 | 6.674 | 1.419 |
| Leverage | 62.37 | 62.40 | 96.38 | 25.88 | 15.36 |
| Women tenure | 3.835 | 2.65 | 0 | 22.5 | 3.953 |
| Women qualification | 1.861 | 1.5 | 0 | 7 | 1.298 |
| Women experience | 3.153 | 2.3 | 1 | 15 | 2.677 |
| | | Frequency | Percent | | |
| Women Dummy | 0 | 54 | 15 | | |
| | 1 | 302 | 85 | | |
| Three Women | 0 | 272 | 76.4 | | |
| | 1 | 84 | 23.6 | | |

$$D_{it} = \begin{cases} 1 & \text{if treated} \\ 0 & \text{if not} \end{cases}$$

α : is a parameter, which represents the effect of the treatment (here assumed to be constant)

β_i : is an individual-fixed effect.

γ_t : is a time effect common to all firms.

The terms, D_{it} , β_i and γ_t are potentially correlated, then ε_{it} is a random centered, homoscedastic, and uncorrelated to D_{it} , β_i and γ_t .

Here, there are two groups: One group of firms for treated (female participation in corporate boards: $D_{it} = 1$ from a time $t = \tau$, and a second control group for non-treated (no female participation in corporate boards: $D_{it} = 0$) at $t < \tau$. The outcomes are ROA and Tobin's Q, and the treatment variables are: "Women Dummy" and "Three Women".

The idea is to eliminate the fixed effects by first difference and time effects by a second difference:

$$\Delta Y_{it} = \alpha \Delta D_{it} + \Delta \gamma_t + \Delta \varepsilon_{it}; i = 1..N \text{ and } t = 1, \dots, T \quad (2)$$

Where

$$\Delta Y_{it} = Y_{it} - Y_{it-1}; \Delta \gamma_t = \gamma_t - \gamma_{t-1}; \quad \Delta \varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1} \quad (3)$$

Now if we put $t = \tau$ and $t - 1 = \tau - 1$ (or $t \geq \tau$ and $t - 1 \leq \tau - 1$)

If firm $i \in$ **Treatmentgroup**, then $\Delta D_{it} = 1$ which implies that $\Delta Y_{it}^{Tr} = \alpha + \Delta \gamma_t^{Tr} + \Delta \varepsilon_{it}^{Tr}$

If firm $i \in$ **Control** group, $\Delta D_{it} = 0$ which implies that $\Delta Y_{it}^C = \Delta \gamma_t^C + \Delta \varepsilon_{it}^C$.

The second difference eliminates common time effects.

$$\alpha = E(\Delta Y_{it}^{Tr}) - E(\Delta Y_{it}^C) \quad (4)$$

$$\text{Since, } \Delta \gamma_t^{Tr} = \Delta \gamma_t^C \text{ and } E(\Delta Y_{it}^{Tr}) = E(\Delta Y_{it}^C) = 0 \quad (5)$$

The DiD estimator is then given by:

$$\hat{\alpha} = \left(\overline{\Delta Y_{it}^{Tr}} \right) - \left(\overline{\Delta Y_{it}^C} \right) \quad (6)$$

$$\text{With } \left(\overline{\Delta Y_{it}^k} \right) = \frac{1}{N_k} \sum_{i=1}^{N_k} (Y_{it}^k - Y_{it-1}^k), k \in \{Tr, C\} \quad (7)$$

In a multiple regression model this becomes:

$$Y_{it} = \alpha D_{it} + \mu Z_{it} + \beta_i + \gamma_t + \varepsilon_{it}; i = 1..N \text{ and } t = 1 \dots, T \quad (8)$$

The estimator of the DiD is equivalent to the "within" estimator the projected pattern on the space orthogonal to the fixed effects and time.

$$WY = WX\beta + W\varepsilon \quad (9)$$

Where $X_{it} = [D_{it}, Z_{it}]$ and $\beta_{cov} = (\alpha, \mu')$. The estimator "within" of the parameter vector is given by:

$$\hat{\beta}_{cov} = (X'WX)^{-1}(X'WY) \quad (10)$$

$$V(\hat{\beta}_{cov}) = \sigma^2 (X'WX)^{-1} \tag{11}$$

The implementation of the *DiD* estimator requires the following assumptions:

H₁: The temporal effects are assumed to be common to both treatment groups and the control group $\gamma_t^{Tr} = \gamma_t^C$, at least $t = \tau$ and $t - 1 = \tau - 1$.

H₂: There can be no attrition or endogenous selection between $\tau - 1$ and τ .

H₃: The error terms are assumed not auto-correlated; otherwise, the standard deviation of the treatment effect is systematically underestimated (Bertrand, Duflou, and Mullainathan (2004)). In this case, the null hypothesis of no treatment effect $H_0 : \alpha = 0$ is rejected.

On the other hand, the estimation of the quantile-treatment effects in a difference-in-differences framework (QDiD) suggested by Abadie, Angrist, and Imbens (2002) and Athey and Imbens (2006) is important since it shows the effects of board gender diversity on the entire distribution rather than on averages only (MDiD).

The quantile-treatment effect is defined as the difference in the quantiles of Y^{Tr} and Y^C for the sub-population of “compliers”, namely those whose potential outcomes are independent of treatment status.

Specifically, the treatment indicator is:

$$D = (1 - W) D_0 + W D_1 \tag{12}$$

where D_1 and D_0 denote two latent binary indicators for two potential treatment states, corresponding respectively to applying or not applying the binary 0–1 instrument W . The “compliers” are those for whom $D_1 > D_0$ (those whose treatment status can be manipulated by the instrument).

QDiD ($q|D_1 > D_0$) denote the q^{th} -quantile of the observed outcome conditional on D for “compliers”. The key assumption is that $QDiD (q|D_1)D_0 = \alpha_q D + \beta_q X$ (13)

Thus, the quantile-treatment effect is defined as the difference

$$QDiD(q) = Q_1(q|D_1 > D_0) - Q_0(q|D_1 > D_0) = \alpha_q \tag{14}$$

When the subpopulation of “compliers” is identified, the estimator of (α_q, β_q) may be obtained by standard asymmetric least absolute deviation (LAD) estimator. Although the “compliers” are not identifiable, a consistent and asymptotically normal estimator of (α_q, β_q) may be obtained by a weighted asymmetric LAD estimator, with weights to be estimated in a preliminary step.

3.4.2. Dose-response functions frame

The dose-response approach allows to focus on the functional form of the Average Treatment Effect (ATE) over all possible treatment levels, here the percentage of women in the boardroom and to study the distribution of the treatment effects regarding changes in treatment levels. We think that policymakers and even companies concerned by this regulatory measure and their shareholders would be increasingly interested in distributional effects of the 40% target threshold of women participation strongly recommended by the French code and now imposed by the French law. Indeed, we are interested in estimating the causal effect of the regulation policy (the enabling approach) to promote gender diversity on corporate boards (continuous treatment variable t : the Percentage of Women in the boardroom) on firms’ performance (outcome variables y : ROA and Tobin Q). We assume that treated and untreated firms may respond differently both to

specific observable confounders (Covariates denoted by X : governance score, board qualifications, board experience, board tenure, board size, firm size, and leverage).

Joining Hirano and Imbens (2004), we estimate a dose-response function of y on t either when the treatment is assumed to be exogenous when selection to-into-treatment depends only on observables or endogenous when selection-into-treatment depends both on observables and unobservable variables (IV: Women Tenure, Women Qualification, Women Experience). Hirano and Imbens (2004) proposed a model with no full normality assumption and it fits well when many units have a zero-level of treatment. Besides, this model may consider instrumental variables (IV) estimations to take into account the treatment “endogeneity”.

We note y_{1i} and y_{2i} the outcome of the firm i when she is treated ($t > 0$) and when she is untreated ($t = 0$), respectively. We define $w_i = 1$ for treated firms and 0 for untreated.

$X_i = (x_{1i}, x_{2i}, \dots, x_{ki})$ a row vector of confounders for $i = 1, 2, \dots, N$.

We define $g_1(X_i)$ and $g_0(X_i)$ two distinct response functions to the vector of confounders when the firm is treated and untreated, respectively.

In what follows, we will get rid of the subscript i in order to simplify notations.

$$\begin{cases} w = 1 : y_1 = \mu_1 + g_1(X_i) + h(t) + u_1 \\ w = 0 : y_0 = \mu_0 + g_0(X_i) + u_0 \end{cases} \quad (1)$$

We assume the function g linear in parameters, and takes the following form:

$$\begin{cases} g_0(X) = X\delta_0 \\ g_1(X) = X\delta_1 \end{cases} \quad (2)$$

The Average Treatment Effect (ATE) conditional on X and t is:

$$ATE(X, t, w) = w[\mu + X\delta + h(t)] + (1 - w)[\mu + X\delta] \quad (3)$$

where $\mu = (\mu_1 - \mu_0)$ and $\delta = (\delta_1 - \delta_0)$

$$ATE = p(w = 1)[\mu + \bar{X}_{t>0}\delta + \bar{h}_{t>0}] + p(w = 0)[\mu + \bar{X}_{t=0}\delta] \quad (4)$$

where $p(\cdot)$ is a probability and $\bar{h}_{t>0}$ the average of the response function taken over $t > 0$.

We obtain from equation (4):

$$\begin{cases} ATE = p(w = 1)[\mu + \bar{X}_{t>0}\delta + \bar{h}_{t>0}] + p(w = 0)[\mu + \bar{X}_{t=0}\delta] \\ ATE_T = \mu + \bar{X}_{t>0}\delta + \bar{h}_{t>0} \\ ATE_{NT} = \mu + \bar{X}_{t=0}\delta \end{cases} \quad (5)$$

where the dose-response function is given by averaging $ATE(X, t)$ over X :

$$ATE(t) = \begin{cases} ATE_T + [h(t) - \bar{h}_{t>0}] \text{ if } t > 0 \\ ATE_{NT} \text{ if } t = 0 \end{cases} \quad (6)$$

That is a function of treatment intensity. The estimation of equation (6) under different hypotheses and whether the treatment is considered exogenous or endogenous is the main purpose.

4. Results and discussion

4.1. The quantile did results and discussion

The mean DiD and the quantile DiD methods allow estimation based on first step estimation of the propensity score. The propensity score method is implemented non-parametrically using

Epanichnikov kernel function. Propensity scores are used to re-weight the observations. Probit regression for the propensity to receive the treatment is reported in Table A1 in the Appendix A. Implementing the balancing test as in Becker and Ichino (2002) shows that the balancing property is satisfied for our data. There are no statistical differences between the mean of the propensity score in the treatment and control group. Results of the balancing test (Table B1) and the propensity score balance plot are presented in the Appendix B.

Before the adoption of the enabling approach, the treatment variable indicates whether the observations belong to one of the four groups: treated before enabling (before 2010), untreated before enabling (before 2010), treated after enabling (after 2010) and untreated after enabling (after 2010). Treatment variables are Women dummy and three women, and the covariates are: governance score, board qualifications, board experience, board tenure, board size, firm size, and leverage.

The point estimate for each of the 0.25th, 0.50th, 0.75th and 0.90th-quantiles (QDiD) are somewhat smaller/bigger than the MDiD indicating that the gain from female participation to boardroom after the enabling was either not similar across quantiles or slightly at lower/higher ROA and Tobin's Q parts of the distribution that at higher/lower ROA and Tobin'Q of the distribution.

Table 2 shows the results of the mean and quantile DiD estimations. The mean DiD shows that in the pre-enabling period, the treated group, i.e. firms with women in their boards perform less than firms without board gender diversity (control group). After the implementation of the enabling approach, the difference between the treated and untreated groups is stronger. This means that the soft regulation to promote board gender diversity does not enhance firm performance compared to boards where there are no women as board directors. However, the difference in the difference between the two periods is not significant.

We now focus on the quantile DiD results to examine if the difference between the two periods regarding the effect of board gender diversity on firm performance is statistically significant according to low and high levels of firm performance (by quantile). Table 3 shows that for a low level of firm performance (the 0.25th quantile), firms with gender diversity after the enabling have an average ROA ratio of 1.80 compared to 5.30 for the control group. The difference between the two groups is significant at the 5% level. Besides, the difference between treated and untreated groups before and after the enabling date is statistically significant at the 10% level. This finding suggests that the enabling approach has decreased firm performance between treated and untreated groups compared to the pre-enabling period only for less performed firms. Hence, when firm performance is at its lowest levels, the appointment of more women on boards as strongly recommended by the enabling approach does not enhance firm performance. Our first hypothesis is then confirmed only partially for the 0.25th quantile. Firm performance decreases after the adoption of the comply-or-explain recommendation to promote gender diversity for less performing firms. This finding is similar to those of Matsa & Miller (2013) who find a drop in firm performance after the adoption and implementation of the quota system in Norway. This decrease in performance could be explained by high implementation costs of appointing more women in the boardroom such as increased salary and recruiting costs, particularly, for firms with low performance (0.25 quantile in our study) who are not able to bear such costs.

However, for the 0.90th-quantile expressing high levels of firm performance, board gender diversity group performs better than the control group for the 2008–2011 period. Table 3 shows that before the enabling 2010 date, firms without women in their boards were performing better than those with at least one women on the boardroom. Indeed, the mean ROA ratio for the 0.90 quantile is 11.83 for the treatment group and 16.78 for the control group. After the enabling date, the treatment group records a higher level of ROA ratio of 14.45 compared with 10.93 for the control group. The difference between the two groups is not significant. However, the difference between the two groups (before and after the enabling date) is statistically significant. Thus, the difference in difference for these high performing firms is positive and significant suggesting that

Table 3. MDiD and QDiD estimates for enabling to increase female representation in corporate boards

| Treatment: Women Dummy Outcome: ROA | Before enabling | | | After enabling | | | DiD $D_2 - D_1$ |
|---|------------------|------------------|-----------------------------------|------------------|------------------|------------------------------------|----------------------------------|
| | Control C_0 | Treated T_0 | Difference $D_1 = (T_0 - C_0)$ | Control C_1 | Treated T_1 | Difference $D_2 = (T_1 - C_1)$ | |
| MDiDcov-Kernel- based PS matching | 3.052 | 3.185 | 0.133 (0.21) | 5.425 | 3.962 | -1.463 (-1.54) | -1.596 (-1.18) |
| MDiDcov | 23.373 | 23.118 | -0.255 (-0.28) | 24.873 | 23.626 | -1.247 (-0.85) | -0.991 (-0.65) |
| MDiD no cov | 4.533 | 3.185 | -1.348** (-1.99) | 6.498 | 3.962 | -2.536** (-2.07) | -1.18 (-0.85) |
| QDiDcov-Kernel-based PS matching | | | | | | | |
| QDiD [0.25] | 1.930 | 1.350 | -0.580 (-0.65) | 5.300 | 1.840 | -3.460*** (-2.74) | -2.880* (-1.69) |
| QDiD [0.5] | 4.400 | 3.380 | -1.020 (-1.06) | 6.900 | 3.650 | -3.250*** (-2.68) | -2.230 (-1.37) |
| QDiD [0.75] | 8.390 | 5.350 | -3.040** (-2.51) | 8.870 | 6.230 | -2.640* (-1.81) | 0.400 (0.20) |
| QDiD [0.90] | 16.780 | 11.830 | -4.950* (-1.69) | 10.950 | 14.450 | 3.500 (1.14) | 8.450* (1.85) |

Notes: This table provides estimates of the Mean difference-in-Differences: MDiD and the Quantile difference-in-Differences: QDiD for $q = (0.25, 0.5, 0.75, 0.9)$ using a Kernel Propensity Score (PS) matching method on the observational dataset. The columns labeled “difference” provide the difference between the control group and the treated group before and after enabling. The set of covariates (cov): governance score, age, board qualifications, board experience, board tenure, board size, firm size, and leverage). No cov: no covariates). The MDiD model and the QDiD model use Kernel propensity score re-weighting techniques based on the covariate set. Standard errors are produced using 50 bootstrap iterations. T-statistics are between parentheses. ***, **, * are the significance level at 1%, 5% and 10%, respectively.

high performing firms record better firm performance after complying with the French recommendation. These findings suggest that board gender diversity is likely to positively influence firm performance for well-performed firms. This is in line with the recent study findings of Conyon and He (2017) who investigate the relation between firm performance and board gender diversity using quantile regression methods for US firms. The authors find that women directors have a stronger positive impact in high-performing firms relative to low-performing firms and that the gender effect is not homogenous.

Table 4 shows the results of the mean and quantile DiD when using the treatment variable at least three women in the board to test our second hypothesis that in presence of at least three women on the board, firm performance after the enabling is likely to increase. The results show that there is, in general, no significant difference between the treated group and the control group over the two tested periods before and after the adoption of the enabling approach suggesting that firms with three or more women on boards do not perform better after the enabling date. These results do not support the critical mass theory perspective that a threshold of three women might enhance the effectiveness of board decisions and lead to better firm performance. We then reject our second hypothesis.

Using the Tobin's Q to measure firm performance, the results of Tables 5 and 6 are slightly similar to those reported in Tables 3 and 4 for the ROA accounting measure.

4.2. The estimated dose-response function

Figure 1 shows the kernel estimation of the distribution of $ATET(x,t)$, $ATE(x,t)$ and $ATENT(x,t)$ and the plots of the dose-response function with 95% confidence intervals. We clearly notice that the ROA and the Tobin's Q measures for the firm performance show that in each graph there is a tightly clustered distribution for $ATET(x,t)$ compared with $ATE(x,t)$ and $ATENT(x,t)$. Moreover, $ATET(x,t)$ appears to be much more concentrated on higher values suggesting that the effect on firm performance of treated firms seems stronger than for the untreated firms. This means that board gender diversity is likely to be positively correlated with firm performance based on the OLS models (Graphs 1 and 5) or addressing the endogeneity of board gender diversity using instruments for board gender diversity such as women tenure, qualifications and experience (Graphs 2–4 for the ROA proxy and 6–8 for the Tobin's Q measure). The results here do not support the contracting and managerial power perspectives that the voluntary appointment of women will lead to sub-optimal boards and then to a decrease in firm performance. These findings concur with the ones reported by the DiD estimations for well-performing firms suggesting that the French soft law could enhance firm performance compared to firms with no women on their boards.

More interestingly is the pattern of the dose-response functions (DRF). For the ROA ratio plots, we notice that the DRF has a cubic spline with positive slopes before and after the inflection point. Indeed, the plot of the DRF shows that the relation between gender diversity and firm performance is first weakly increasing and then strongly increasing around a dose level of 40% and is significant at 5% level. This means that firm performance measured by the ROA ratio reaches its highest level when the proportion of women on the boardroom is 40%. This is in line with the recommendation target of the corporate governance code issued by French authorities in 2010. It is also similar with legislators' expectations and constraints imposed through the cope-Zimmerman law in France. Indeed, the quotas imposed by policymakers around the world to promote equality between genders in the board is 40%. Appointing more women is then likely to lead to more effective boards and then better firm performance as in Carter et al. (3003). Accordingly, even if existing studies (Ahern and Ditmar, 2012) do not conclude for a positive relationship between gender diversity and firm performance in a regulated institutional setting as is the case in Norway, we might expect that the long-term effect of women quotas will lead to high levels of firm performance. This confirms the intuition by Labelle et al. (2015) that a rapid increase in women appointment onto boards can create a shortage of women as directors in a short time frame.

Table 4. MDiD and QDiD estimates for enabling to increase female representation in corporate boards

| Treatment: Three Women Outcome: ROA | Before enabling | | | After enabling | | | |
|---|------------------------|------------------------|---|------------------------|------------------------|---|------------------------------------|
| | Control C ₀ | Treated T ₀ | Difference D ₁ = (T ₀ -C ₀) | Control C ₁ | Treated T ₁ | Difference D ₂ = (T ₁ -C ₁) | DiD D ₂ -D ₁ |
| MDiDcov-Kernel-based PS matching | 3.285 | 3.486 | 0.201 (0.21) | 4.186 | 3.612 | -0.574 (-0.89) | -0.775 (-0.67) |
| MDiDcov | 23.807 | 24.316 | 0.509 (0.85) | 24.581 | 24.076 | -0.505 (-1.37) | -1.014 (-1.52) |
| MDiD no cov | 3.464 | 3.511 | 0.047 (0.06) | 4.383 | 3.615 | -0.768 (-1.27) | -0.815 (-0.79) |
| QDiDcov-Kernel-based PS matching | | | | | | | |
| QDiD [0.25] | 1.430 | 1.600 | 0.170 (0.19) | 2.120 | 1.480 | -0.640 (-1.01) | -0.810 (-0.74) |
| QDiD [0.5] | 3.500 | 3.770 | 0.270 (0.39) | 3.860 | 3.650 | -0.210 (-0.28) | -0.480 (-0.51) |
| QDiD [0.75] | 5.470 | 6.580 | 1.110 (0.95) | 6.440 | 5.680 | -0.760 (-0.88) | -1.870 (-1.30) |
| QDiD [0.90] | 8.950 | 7.150 | -1.800* (-1.83) | 7.570 | 7.600 | 0.030 (0.02) | 1.830 (1.19) |

Notes: This table provides estimates of the Mean difference-in-Differences: MDiD and the Quantile difference-in-Differences: QDiD for $q = (0.25, 0.5, 0.75, 0.9)$ using a Kernel Propensity Score (PS) matching method on the observational dataset. The columns labeled “difference” provide the difference between the control group and the treated group before and after enabling. The set of covariates (cov: governance score, age, board qualifications, board experience, board tenure, board size, firm size, and leverage). No cov: no covariates). The MDiD model and the QDiD model use Kernel propensity score re-weighting techniques based on the covariate set. Standard errors are produced using 50 bootstrap iterations. T-statistics are between parentheses. ***, **, * are the significance level at 1%, 5% and 10%, respectively.

Table 5. MDiD and QDiD estimates for enabling to increase female representation in corporate boards

| Treatment: Women Dummy Outcome: Tobin Q | Before enabling | | | After enabling | | | |
|---|---------------------------|---------------------------|---|---------------------------|---------------------------|---|--|
| | Control C ₀ | Treated T ₀ | Difference D ₁ = (T ₀ - C ₀) | Control C ₁ | Treated T ₁ | Difference D ₂ = (T ₁ - C ₁) | DiD D ₂ - D ₁ |
| MDiDcov-Kernel-based | 0.970 | 1.011 | 0.041 (0.19) | 1.150 | 0.846 | -0.304 (-1.21) | -0.345 (-1.17) |
| PS matching | | | | | | | |
| MDiDcov | 5.707 | 5.793 | 0.088 (0.49) | 5.969 | 5.671 | -0.297 (-1.28) | -0.386 (-1.42) |
| MDiD no cov | 1.059 | 0.775 | -0.284* (-1.87) | 1.435 | 0.711 | -0.724** (-2.53) | -0.440 (-1.36) |
| QDiDcov-Kernel-based PS matching | | | | | | | |
| QDiD [0.25] | 0.540 | 0.410 | -0.130 (-1.50) | 0.880 | 0.360 | -0.520* (-1.68) | -0.390 (-1.23) |
| QDiD [0.5] | 0.980 | 0.700 | -0.280 (-1.29) | 1.100 | 0.590 | -0.510 (-1.41) | -0.230 (-0.55) |
| QDiD [0.75] | 1.320 | 1.190 | -0.130 (-0.47) | 1.720 | 1.030 | -0.690 (-1.48) | -0.560 (-1.01) |
| QDiD [0.90] | 2.180 | 7.490 | 5.310*** (3.06) | 2.040 | 4.530 | 2.490*** (3.58) | -2.820 (-1.44) |

Notes: This table provides estimates of the Mean difference-in-Differences: MDiD and the Quantile difference-in-Differences: QDiD for $q = (0.25, 0.5, 0.75, 0.9)$ using a Kernel Propensity Score (PS) matching method on the observational dataset. The columns labeled “difference” provide the difference between the control group and the treated group before and after enabling. The set of covariates (cov: governance score, age, board qualifications, board experience, board tenure, board size, firm size, and leverage). No cov: no covariates). The MDiD model and the QDiD model use Kernel propensity score re-weighting techniques based on the covariate set. Standard errors are produced using 50 bootstrap iterations. T-statistics are between parentheses. ***, **, * are the significance level at 1%, 5% and 10%, respectively.

Table 6. MDiD and QDiD estimates for enabling to increase female representation in corporate boards

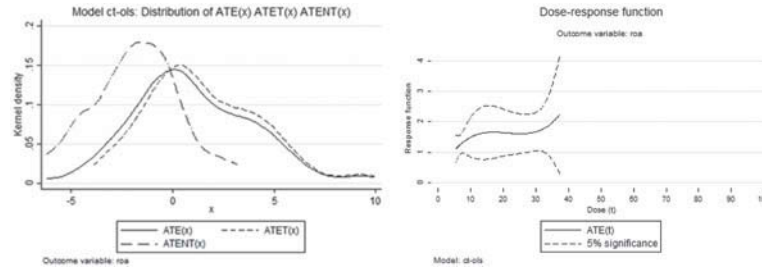
| Treatment: Three Women Outcome: Tobin Q | Before enabling | | | After enabling | | | |
|---|------------------------|------------------------|--|------------------------|------------------------|--|-------------------------------------|
| | Control C ₀ | Treated T ₀ | Difference D ₁ = (T ₀ - C ₀) | Control C ₁ | Treated T ₁ | Difference D ₂ = (T ₁ - C ₁) | DiD D ₂ - D ₁ |
| MDiDcov-Kernel-based PS matching | 0.791 | 0.790 | -0.001 (0.00) | 0.772 | 0.636 | -0.135 (-1.10) | -0.135 (-0.63) |
| MDiDcov | 5.780 | 5.831 | 0.051 (0.37) | 5.728 | 5.631 | -0.097 (-1.18) | -0.148 (-0.91) |
| MDiD no cov | 0.843 | 0.781 | -0.061 (-0.33) | 0.817 | 0.638 | -0.180 (-1.35) | -0.118 (-0.52) |
| QDiDcov-Kernel-based PS matching | | | | | | | |
| QDiD [0.25] | 0.320 | 0.450 | -0.130* (-1.91) | 0.300 | 0.300 | 0.00 (0.00) | -0.130 (-1.45) |
| QDiD [0.5] | 0.500 | 0.620 | 0.120 (0.77) | 0.550 | 0.480 | 0.070 (-0.72) | -0.190 (-0.98) |
| QDiD [0.75] | 1.110 | 0.970 | -0.140 (-0.50) | 0.970 | 0.740 | -0.230* (-1.88) | -0.090 (-0.29) |
| QDiD [0.90] | 5.670 | 1.990 | -3.680* (-1.70) | 4.530 | 2.420 | -2.110*** (-2.76) | 1.570 (0.72) |

Notes: This table provides estimates of the Mean difference-in-Differences: MDiD and the Quantile difference-in-Differences: QDiD for $q = (0.25, 0.5, 0.75, 0.9)$ using a Kernel Propensity Score (PS) matching method on the observational dataset. The columns labeled "difference" provide the difference between the control group and the treated group before and after enabling. The set of covariates (cov: governance score, age, board qualifications, board experience, board tenure, board size, firm size, and leverage). No cov: no covariates). The MDiD model and the QDiD model use Kernel propensity score re-weighting techniques based on the covariate set. Standard errors are produced using 50 bootstrap iterations. T-statistics are between parentheses. ***, **, * are the significance level at 1%, 5% and 10%, respectively.

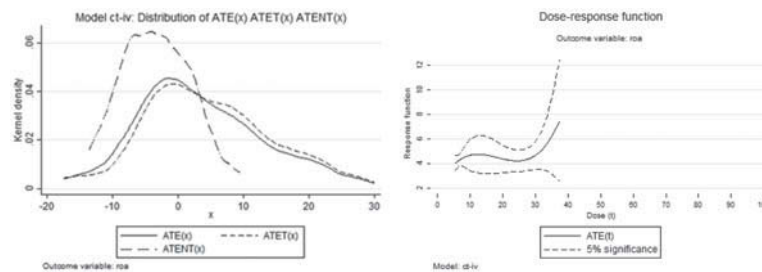
However, for the second firm performance measure the Tobin's Q, the DRF has negative slopes and shows that the relation is first weakly decreasing and then strongly decreasing with a maximum around a dose level of 40%. The relation is quite strongly significant at a 5% level. This financial measure of firm performance may be capturing the market's reaction to a high level of women on the boardroom, i.e. 40% rather than the change in board performance. Hence, the signaling hypothesis could be used to explain the relationship between firm

Figure 1. Distribution of ATE(x,t), ATET(x,t) and ATENT(x,t) and DRF with CI.

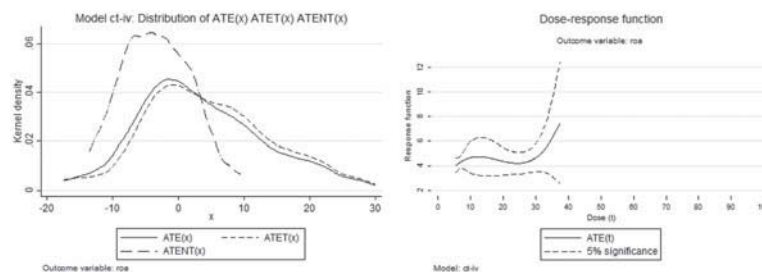
Graph 1. Outcome : ROA - Treatment : women Dummy - Continuous treatment : Women percentage - Model : OLS



Graph 2. Outcome : ROA - Treatment : women Dummy - Continuous treatment : Women percentage - Model : IV (women tenure)



Graph 3. Outcome : ROA - Treatment : women Dummy - Continuous treatment : Women percentage - Model : IV (women qualification)



Graph4. Outcome : ROA - Treatment : women Dummy - Continuous treatment : Women percentage - Model : IV (women experience)

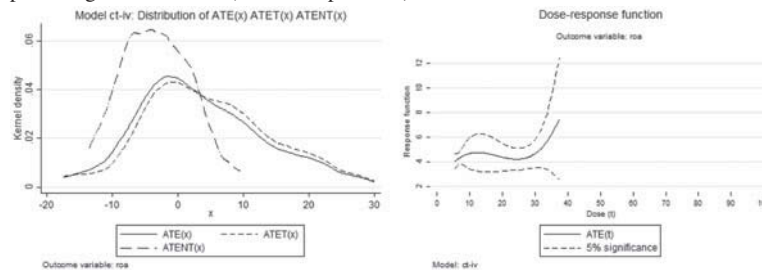
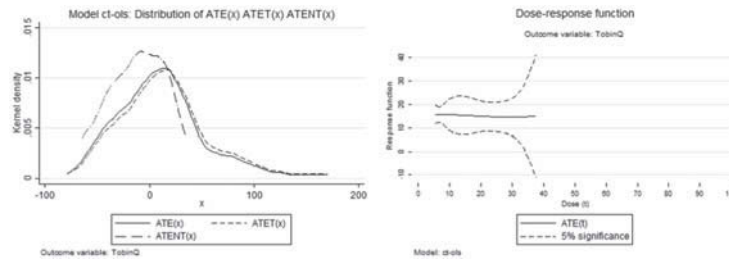
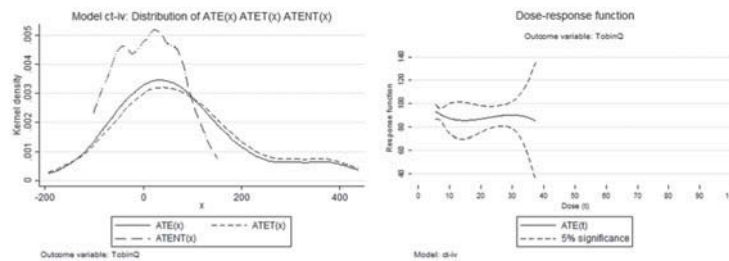


Figure 1. Continued.

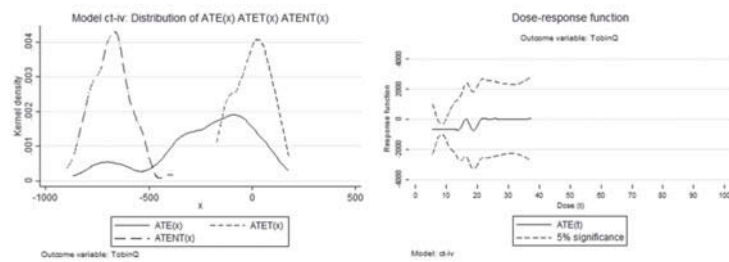
Graph 5. Outcome : Tobin's Q - Treatment : women Dummy - Continuous treatment : Women percentage - Model : OLS



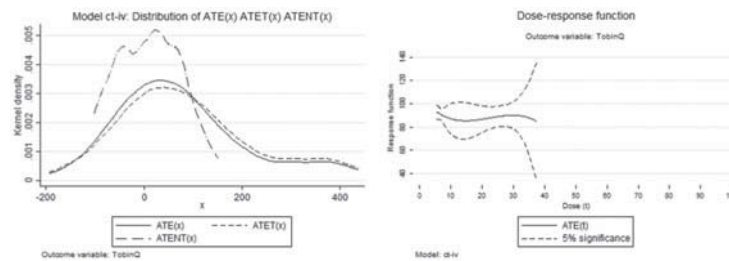
Graph 6. Outcome : Tobin's Q - Treatment : women Dummy - Continuous treatment : Women percentage - Model : IV (women tenure)



Graph 7. Outcome : Tobin's Q - Treatment : women Dummy - Continuous treatment : Women percentage - Model : IV (women qualification)



Graph 8. Outcome : Tobin's Q - Treatment : women Dummy - Continuous treatment : Women percentage - Model : IV (women experience)



financial performance and women's presence on corporate boards. Under the signaling hypothesis (Ross, 1973), firms voluntarily choose to appoint women on their boards to signal quality. Thereby, they convey a positive signal to their shareholders about the quality of their governance (Rose, 2007; Fondas, 2000; Broome, 2007; Adams & Ferreira, 2009). It seems that under a more coercive and regulated approach, investors react negatively to quotas.

5. Conclusion

The purpose of this paper is to investigate the effect of a more regulated institutional setting regarding the promotion of more women on boards comparatively to the voluntary appointment of women. France has adopted in 2010 the enabling approach by introducing in the corporate governance code a comply-or-explain recommendation as far as board gender diversity is concerned. Our research aims to study the relation between gender diversity and firm performance before and after the implementation of the enabling approach by French authorities. Based on a quantile difference-in-differences methodology and dose-response functions, we firstly find that regulation is likely to decrease firm performance for less performing firms. However, firm performance increase for a more diversified board in highly performing firms suggesting that costs of appointing more women in the boardroom such as increased salary and recruiting costs subsequently to regulation could be high for low performing firms. Secondly, the results of the dose-response functions show that accounting performance reaches the highest level for the 40% level of women on boards, which coincide with the recommendation and the French law expectations. However, financial performance might decrease for high proportions of gender diversity in the board as investors could react negatively to such proportions.

One of the most important practical implications of this study is the support for the most recent attempt of the European Commission, the legislative body of the EU, to push the gender quota for females in corporate boards to 40% (The Guardian, 2017).

In fact, by 2017, French-listed firms are compelled to have a quota of 40% of women as board directors. We may say that the appointment of women first through regulation (recommendation) then the application of the Cope-Zimmerman law have enabled firms to introduce women in their boards gradually rather than rapidly to not alter board optimality. Future research could examine the effect of the French law on firm performance in the coming years.

Now, how does public opinion affect firms' profitability? What is the role of the media and other interest groups in this process? Clearly, these are all important questions that we do not know much about. Research into the process by which public opinion affects gender diversity potentially will aid research into other consequences of public opinion on economic activities.

Funding

The authors received no direct funding for this research.

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Citation information

Cite this article as: Board gender diversity and firm financial performance in France: Empirical evidence using quantile difference-in-differences and dose-response models, Ramzi Ben Slama, Aymen Ajina & Faten Lakhel, *Cogent Economics & Finance* (2019), 7: 1626526.

Notes

1. Bebchuk, Fried, and Walker (2002) define an "optimal contract" as "one that minimizes agency costs (that is, the sum of contracting costs, monitoring costs, other costs incurred in achieving a certain level of compliance with the principal's interest) and the costs of the residual divergence."

2. Uniform groups are groups in which all members share the same (visible) characteristic. That is, with respect to gender, all members of the group are either male or female.
3. SBF 250 Index became CAC All-Tradable Index as of 2011/03/21.
4. MSCI ACWI Indexes offer a modern, seamless, and fully integrated approach to measuring the full equity opportunity set with no gaps or overlaps. MSCI ACWI represents the Modern Index Strategy and captures all sources of equity returns in 23 developed and 24 emerging markets.

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Appendix A. Propensity Score Estimation

Table A1. Probit regression for the propensity score

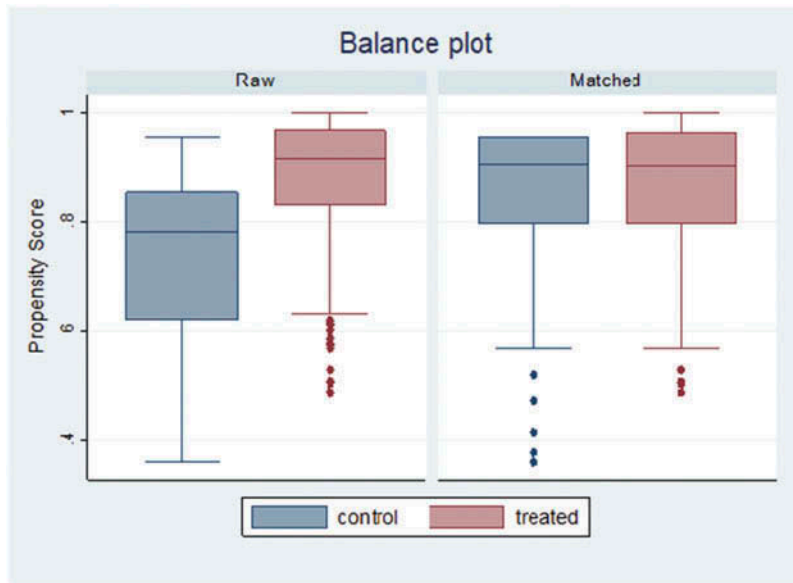
| Treatment Variable | | |
|----------------------|---------------------|---------------------|
| Covariates | Women Dummy | Three Women |
| GovScore | 0.015 (0.019) | -0.004 (0.019) |
| Age | -0.008 (.038) | -0.025 (0.049) |
| Board qualifications | 0.515 (0.336) | -0.142 (0.360) |
| Board experience | -0.253** -0.117 | (0.110) (0.115) |
| Board tenure | 0.010 (0.052) | 0.148** (0.058) |
| Board Size | 0.015*** (0.047) | 0.126*** (0.048) |
| FirmSize | 0.431*** (0.140) | 0.138 (0.207) |
| Leverage | 0.014* (0.008) | -0.006 (0.420) |
| Fixed effects | Yes | Yes |

Notes: standard errors in parentheses; ***, **, * are the significance level at 1%, 5% and 10%, respectively.

Table B1. Balancing test (test on common support)

| Covariates (Weighted variables) | Mean in Matched Sample | | T-test | |
|---------------------------------|------------------------|-----------|--------------|---------|
| | Control | Treatment | T-Statistics | P-value |
| GovScore | 54.457 | 54.655 | 0.16 | 0.8709 |
| Age | 59.114 | 59.515 | 0.56 | 0.5738 |
| Board qualifications | 1.669 | 1.585 | 0.81 | 0.4202 |
| Board experience | 4.839 | 4.435 | 1.30 | 0.1940 |
| Board tenure | 7.506 | 7.775 | 0.46 | 0.6468 |
| Board Size | 16.090 | 15.650 | 0.76 | 0.4489 |
| FirmSize | 9.799 | 9.814 | 0.07 | 0.9461 |
| Leverage | 62.696 | 61.473 | 0.52 | 0.6045 |

Notes: ***, **, * are the significance level at 1%, 5% and 10%, respectively. Means and test are estimated by linear regression



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