Board of Directors' Composition and Directors' Skill Sets:
It's All about Fit!

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Abstract

This paper contributes to the empirical literature addressing the relationship between boards of directors' composition and firm performance. It does so by introducing the new concept of board of directors' skill sets fit. This new dimension is further divided into internal and external fit, where internal fit represents the appropriate combination of a diverse range of directors' skill sets while maintaining a certain degree of complementarity, and external fit represents the appropriate inclusion of directors' skill sets to meet externally imposed challenges. Using a combination of econometric techniques to address endogeneity concerns that usually arise within the corporate governance literature, I find that firms showing both an internal and external fit dimension perform better than their peers.

I. Introduction

A firm's board of directors performs an oversight role within the firm by advising and monitoring top management on the firm's overall performance and risk profiles (Fama and Jensen ,1983). At the same time, the board of directors needs to take into consideration the external business environment, the political landscape, the firm's competition, and the overall risk environment. Given the delicacy and complexity of the task, the set of skills that the different directors contribute to the board must be carefully considered (e.g., Dass et al., 2013; Guner, Malmeinder and Tate, 2008; Faleye, Hoitash and Hoitash, 2018). These skills not only have to be internally consistent (complementary), but also need to be appropriate to deal with the external environment firms face. In fact, a board of directors should be able to monitor and complement top management's assessments and decisions while reducing internal conflicts and supporting the overall firm decision-making process.

In this paper, I examine the relationship between board of directors' skills composition and firm performance. However, unlike other papers analyzing similar research questions (e.g., Adams, Akyol and Verwijimeren, 2018; Kim and Stark, 2015), I introduce the concept of "Fit". According to the dictionary, the word fit indicates someone or something of a suitable quality or standard to meet the required purpose[1]. Therefore, I investigate the impact of boards of directors' skill sets internal and external suitability to perform their main tasks on firms' performance. Organizational science and strategy are not new to the concept of fit and its two dimensions, internal and external fit (e.g., Miller, 1992; Burns and Stalker, 1961; Thompson, 1967). According to Miller (1992), internal fit is the ability of a firm to "establish complementarities among aspects of structure and process", whereas external or environmental fit refers to the ability of a firm "to match their structures and processes to

[1] See https://dictionary.cambridge.org/dictionary/english/fit

their external setting". Hence, this study borrows the definitions of fit and its two dimensions from the organizational science literature to address the issue of board of directors' skills composition and firm performance. To my knowledge this is the first paper introducing the concept of board of directors' fit, thus, providing an important first step towards understanding the reason behind the numerous conflicting findings within the literature addressing the relationship between board composition and firms' corporate outcomes.

Exploiting the 2009 amendment to Regulation S-K, which requires US firms to disclose for each director and each nominee for director the skills, qualification and expertise that qualified that person to serve on the board, I create a dataset mapping each firm listed in the Standard and Poor's 500 (S&P 500) index to its board of director's skill sets. By using this dataset as my main source of information, I examine two board attributes: (1) whether boards of directors' skill sets have the right balance between skill diversity and complementarity [Internal Fit], and (2) whether boards of directors` skill sets are properly assembled to meet the external firm environment [External Fit].

In order to analyze the issue of internal fit, I first adopt a factor analysis approach by which I extract the main dimensions along which directors' skills cluster together. I find that there are three main groups of skills that characterize the firms in my sample: The Legal and Political cluster, the Leadership and Operational cluster, and the Strategy and Technology cluster. The factor analysis results support the idea that a board of directors should be both diverse in its skills composition and have the right combination of complementary skills at the same time. In fact, while the three categories of skills are very different from each other, each category embeds very complementary skills. As such, I conclude that there is an internal fit dimension when looking into board of directors' skills composition.

I next examine whether these skillsets are associated with firm performance, as measured by Tobin's Q and ROA. This study proposes that when boards of directors focus more on

these three skill categories, firms perform better than their peers. However, given the endogenous nature of board composition, it is particularly challenging to establish the causality of these results (Hermalin and Weisbach, 1998). To overcome this challenge, I propose a novel instrumental variable approach that builds on the work of Knyazeva, Knyazeva and Masulis (2013) which is particularly suitable for this study. My main instrumental variable exploits the pool of qualified prospective directors employed by peer firms. Specifically, I focus on directors employed by firms listed in the S&P 500 index as the main source of prospective qualified directors. The rationale behind this choice is that qualified directors are a scarce human resource. They face opportunity costs to join companies' boards, thus matching supply and demand, usually preferring firms that can offer more visibility and greater reputation benefits (Knyazeva, Knyazeva and Masulis, 2013). Therefore, I expect qualified directors already operating in one of the largest 500 US companies to be willing to join only companies of comparable status. Moreover, firms have better access to soft information about potential directors if these directors work on large and visible firms. Using the availability of qualified directors as an instrument in two-stage least squares (2SLS) regressions, I find strong and consistent support to the idea that greater board internal fit is associated with higher contemporaneous firm performance.

To test the external fit hypothesis, I exploit the findings of previous studies that show that firms strategically appoint directors with specialized skills to face specific situations. For example, technology/cyber experts (Klein, Manini and Shi ,2021), financial accounting experts (DeFond, Hann and Hu, 2005), and directors with foreign experience (Giannetti, Liao, Yu, 2015).

Using a difference-in-differences methodology, I show that boards of directors of firms operating in environmentally related sectors that have at least 3 ESG experts directors sitting on their boards after the Paris Climate Accord, experience higher performance when

compared to firms operating in the same sector which have less ESG experts sitting on their boards. This finding is consistent with the board effort to include specialized directors to better manage the challenges imposed by the Paris Agreement.

My study supports the view that achieving board of directors fit both in its internal and its external dimensions positively contributes to firm performance. The board of directors' internal fit represents the right combination of directors' skills' diversity and complementarity, whereas the board of directors' external fit is obtained when the firm carefully adds directors with specialized skills on the board to face external challenges. The better firms match their board of directors' skills composition with their internal and external environments, the higher the firm performance. Therefore, the larger the board of directors' fit, the higher the performance the firm achieves.

This study contributes to several lines of research. First, I introduce the concept of board of directors' fit, both in its internal and external dimensions. This new dimension of the board of directors complements previous studies examining whether board of directors' skills heterogeneity impact firm performance (Adams, Akyol and Verwijimeren 2018; and Kim and Stark 2016). My study differs from these papers in that I examine whether an appropriate combination of skills exists that maximizes firm performance rather than examining whether heterogeneity or diversity of skills per se affects firm performance.

Second, by introducing this new dimension of fit, I provide a possible explanation to the several contrasting results characterizing the literature that analyzes directors' skill composition and their contribution to performance (e.g., Dass et al 2013; Faleye et al 2018; Fich 2005). In fact, while these studies analyze whether one directors' skill can affect firm performance, I look at how each individual directors' skill fit into the board of directors as a multidimensional entity.

Finally, I provide further evidence that firms can use the board of directors' skill composition to face changes in the business and regulatory environment.

The rest of the paper proceeds as follows. Section II reviews the related literature and states the research hypotheses. Section III explains the sources of the data and how they are assembled. Section IV discusses and tests the board of directors' internal fit dimension. Section V discusses and tests the board of directors' external fit dimension. Section VI concludes and provides suggestions for future research.

II. Literature Review and Hypothesis

Boards of directors have always been under the spotlight of both the political and the academic worlds. The Sarbanes-Oxley Act of 2002 represents probably the greatest political intervention with respect to boards of directors' responsibilities and composition, but there are also more recent political interventions aimed at attaining greater social equality and advocating for boards of directors with a more extended set of skills, as an example, initiatives promoting gender diversity on boards fall within this spectrum.

The literature has inquired whether these external pressures add value to firms. For instance, Kim and Stark (2016) provide empirical evidence that having more women sitting on boards of directors provide unique skills, Billings, Klein and Shi, (2021) show that including women in the boardroom shapes the firm's culture and Dutchin, Matsusaka and Ozbas (2009) explain that directors' independence matters, and it is affected by the information environment.

At the same time, firms perform a cost/benefit analysis to meet their needs (Hermalin and Weisbach, 1998). This means that board composition and structure are endogenously determined. Many studies support this view with respect to the strategic inclusion of specialized directors in the board. For instance, DeFond, Hann and Hu (2005) find that the

market responds positively to the appointment of financial accounting experts on the audit committee. Huang, Jiang, Lie and Yang (2014) show that directors with investment banking experience impact the firm's acquisition attitude and Klein, Manini, and Shi (2021) provide evidence that firms tend to appoint cyber/tech expert directors on their boards to respond to a significant change in the cyber-risk environment.

Taken all together, these findings provide empirical evidence that firms compose their boards to meet their internal needs as well as to face externally imposed requirements. There are several reasons to believe this may be true. First, in general, boards of directors perform an oversight role within the firm by monitoring and advising top management on the firm's overall performance and risk profile (Fama and Jensen, 1983). Second, boards of directors are called to assess, amend, and approve major strategic decisions made by management (Coles, Daniels and Naveen, 2020). These tasks may require strictly internal assessments, but sometimes firms need to take a broader perspective which needs a thorough evaluation of the external environment. For example, decisions about the firm's compensation policy or its top management hiring process are mainly internal in their nature. Whereas how to respond to an industry specific regulatory shock, the public opinion questioning the firm's reputation, or a significant shift in the industry's competitive landscape are decisions requiring a sound assessment of the external environment.

Considering how complex and diverse the role of the board is, it becomes important to analyze how directors' skills map to the board's monitoring and advising duties. Kim and Stark (2016) and Adams et al. (2018) tackle this research question by examining how boards of directors' heterogeneity of skills impact firm performance. Kim and Stark (2016) support the hypothesis that board of directors' heterogeneity of skills leads to greater advisory effectiveness. As a consequence, greater advisory effectiveness results into better decision making which in turn leads to greater firm performance. On the other hand, Adams et al

(2018) conclude that greater directors' skill diversity has a negative and significant impact on firm performance while they provide empirical evidence that directors' skill diversity is the main dimension along which boards of directors vary.

The corporate governance literature addressing the impact of directors' skills on firm performance does not always generate clear results. Indeed, when analyzing one directors' skill at a time, the literature is not unambiguous about which directors' skill adds value. For example, contrary to Dass et al. (2013) and Faleye et al (2018), who find that directors' industry experience is value-enhancing, Kang et al (2018) find that directors' industry experience is not always beneficial to the firm. Also, Fitch (2005) and Fahlenbrach, Low and Stulz (2010) disagree about the importance of directors' CEO experience. In fact, while the first argue that CEO experience adds value, the latter support the opposite view.

A reasonable explanation behind the inconsistency of these results lies in the context in which directors' skills are employed. Directors with different characteristics have different priors, so they have different views and priorities. For instance, a director with strong marketing foundations might see a very expensive advertising campaign as a great opportunity for the firm to enhance its brand image and expand its customer base. Therefore, this director would be in favor of financing the initiative. At the same time, another director sitting on the same board who has a strong experience in the financial arena may not be so keen in supporting the marketing expert's decision because a costly advertising campaign can affect the firm's budget and costs allocation.

According to this interpretation, Garlappi, Giammarino and Lazrak (2017) provide theoretical arguments that a collection of different points of view, which the authors define as heterogeneous beliefs, leads to inefficient corporate decision making. Also, some of the management literature shares this conclusion. For example, Pelled, Eisenhardt and Xin (1999) show that diversity shapes conflict and that conflict shapes performance. One of their findings

is that functional background diversity leads to task conflicts. Basically, both studies underpin the empirical findings of Adams et al. (2018) that lack of common priors and beliefs results in poor corporate decisions with negative effects on firm performance.

On the other hand, according to Janis (1971;1972), a high degree of homogeneity of backgrounds and ideologies could result in groupthink. Groupthink is a mechanism of thinking that rewards the desire of consensus over critical thinking and correct judgement. Janis (1972) goes beyond the definition of groupthink and identifies several situations that would favor groupthink. The most relevant to this study is probably the "structural faults" scenario, which refers to the homogeneity of backgrounds and ideologies among the group members as a reason behind groupthink. In practical terms, having a board of directors made of people with very similar expertise might lead to inefficient decision making because they would prioritize getting consensus among themselves rather than attaining the best outcome for the firm.

However, both homogeneity and diversity of backgrounds have a bright side. In fact, a certain degree of homogeneity of backgrounds seems to favor teamwork and efficient decision-making (Malenko, 2014). Other studies prize the importance of diversity of skills because it helps firms overcome challenges and attain higher levels of innovation. For example, Lazear (2005) develops a model showing that entrepreneurs need to be sufficiently skilled in several areas to be able to assemble a successful business. D'Acunto, Tate and Yang (2020) show that startups with founding teams that have a more diverse collective set of skills, grow faster than their competitors and adapt their strategies more successfully when facing uncertain environments.

Hence, my first hypothesis relates to the firm's ability to create a heterogeneously skilled board of directors that is also internally consistent. A combination of directors' skill sets that

provide a wide array of expertise while having a certain degree of complementarity among them.

I therefore state my first hypothesis as follows:

H1: It is possible to assenble a board of directors' skills composition [Internal Fit] that guarantees an efficient decision-making process while drawing information from a diverse pool of expertise.

Coles, Daniel and Naveen (2020), show that the nature and context in which the firm operates affect whether it will benefit from "directors overlap" or not. Hence, my second hypothesis relates to the firms' ability to quickly adapt to a constantly changing business environment while encouraging the firm's innovation. Given that many changes come from external forces such as regulators, the economy, and competitors, internal fit may not be enough: There might be the need for further specialized skills or a combination of them to face the external challenges.

Therefore, I present my second hypothesis as follows:

H2: Boards of directors should include specialized directors' skills to be better prepared to the external business environment [External Fit].

III. Sample Selection, Data Sources and Description of Data

I assemble a sample of U.S. public companies included in the S&P 500 Index at the end of 2019. After removing 131 firms that were not continuously listed in the S&P 500 throughout the period 2010 to 2019, I have an initial sample of 369 firms and 3,690 firm-year observations. As shown in Table 1 panel A, removing firms with missing ISS data (370 firm-year observations) and firms with missing COMPUSTAT data (145 firm-year observations) produces a final sample of 3,175 firm-year observations for my tests.

Table 1 panel B provides descriptive statistics of the sample. I use the ISS dataset as the main source of corporate governance data and COMPUSTAT as the main source of firms' fundamentals information. The typical firm in my sample (based on mean data) has 11 directors sitting on the board of which 19% are women and 83% are independent. The leverage ratio is 27% on average and the average return on assets (ROA) is 10%. I decided to analyze firms listed in the S&P 500 because it allows me to have access to all the relevant information as well as to have a benchmark corresponding to the largest US firms.

The core of my analysis revolves around the idea that the composition of skills of the board of directors has an impact on firm performance. Accordingly, I manually go through each firm's DEF14A form (proxy statements) and carefully read the description of each director's skills, experience, and qualifications included in the statement. According to the amendment to regulation S-K of 2010, "a company would be required to disclose for each director and any nominee for director the particular experience, qualifications, attributes or skills that qualified that person to serve as a director of the company, and as a member of any committee that the person serves on or is chosen to serve on, in light of the company's business".

I adopt a "hand collection" approach rather than an automated one for two main reasons. First, as Kim and Stark (2016) note, finding a clear textual pattern within any section of the

proxy statements is extremely complex, so the use of textual analysis techniques might lead to inexact results. Second, as Frankenreiter et al (2021) suggest, a thorough interpretation of corporate governance documents is paramount to be able to claim accurate results. In fact, these authors argue that corporate governance documents have become increasingly complex over time, so they need to be interpreted by expert professionals, lawyers in their specific case, to be able to extract relevant and correct data. They support this thesis by creating a corpus of corporate charters and using it to challenge some of the main results in empirical corporate governance research. They find that some of these seminal results in corporate governance show errors. For example, they show that the construction of the G-Index, the most appreciated proxy for "good governance" yields an error exceeding eighty percent. As a consequence, papers using this index as the main source for their empirical analysis are affected by this issue (e.g., Gompers, Ishii, and Metrick, 2003).

After reading through the disclosures, I identify ten specific directors' skills which are recurringly mentioned in the narrative of the DEF14A forms: Finance, Marketing, Technology, Science, Operations, Law, Public Policy, Leadership, Strategy and ESG (Environmental, Sustainability and Governance). Using the disclosures from the firms' filings, I can delineate each director's skill sets. For example, the following is an excerpt from Apple Inc's 2016 proxy statement disclosure[2]:

"**Al Gore** served as Chairman of Generation Investment Management, an investment management firm, since 2004, and as a partner of Kleiner Perkins Caufield & Byers, a venture capital firm, since 2007. Mr. Gore is also Chairman of The Climate Reality Project. Mr. Gore was elected to the US House of Representatives four times, to the US Senate two times, and served two terms as Vice-President of the United States. Among other qualifications, Mr. Gore brings to the board executive leadership experience, a valuable different perspective due to his extensive background in digital communication and technology policy, politics, and environmental rights, along with experience in asset management and venture capital."

[2] See https://www.sec.gov/Archives/edgar/data/0000320193/000119312516422528/d79474ddef14a.htm

Based on this disclosure, I attribute several skills to Al Gore; *Leadership* experience because of the relevant leadership positions he has occupied throughout his career (Partner, Chairman, and Vice-President); *Finance* given his career in the investment management and venture capital industries; *Public Policy*, because of his long and significant political career; ESG due to his being the chairman of The Climate Reality Project. My designations partially differ from Apple's DEF14A disclosure, which also attributes Technology expertise to Mr. Gore. However, since competence in Technology is not supported by any of Mr. Gore's disclosed qualifications and relevant professional experiences, for the purpose of this study, I do not include Technology as one of Mr. Gore's skills. Therefore, Al Gore is a Leadership, Finance, Public Policy and ESG expert.

Table 1 panel C shows descriptive statistics for the set of expertise for the boards of directors in my sample. Based on mean statistics, the four most represented skills are: Leadership (10.03), Finance (3.02), Operations (1.92) and Public Policy (1.01). The rest of the skills are on average less represented on the boards of directors with the rarest qualifications being ESG and Science. These two qualifications are the rarest because they depend significantly on the firm's external business environment, hence these are the type of skills that firms might want to consider when building their board of director's external fit. To illustrate similarities and differences in directors' skill sets, Table 2 panel A presents descriptive statistics of board of directors' skill sets for the entire sample, the manufacturing industry (two-digit SIC codes 20, 36 and 37) and the energy industry (two-digit SIC codes 13 and 49). I choose these sectors because they are clear examples of industries operating in two very different business environments. Data show that all three samples share very similar numbers (based on mean) in terms of Leadership, Finance, Operations and Public Policy expertise. However, if we look at the ESG specialists' representation among the three samples, the typical firm (based on mean) operating in the energy sector shows a much more

significant presence of ESG qualified directors sitting on the board (0.39) than the typical company in the overall sample (0.16), and in the manufacturing sector (0.05). A t-test (shown in the bottom row of the panel) for the difference in percentages yields p-values less than 0.01. These results corroborate my approach of looking at the ideal board of directors' composition of skills both from an internal and from an external perspective.

As another example, Table 2 panel B compares descriptive statistics for directors' skill sets in the complete sample, the computer-programming sector (two-digit SIC code 73) and the chemicals and pharmaceuticals sector (two-digit SIC code 28). Once again, statistics show that all three samples share very similar mean numbers in terms of Leadership, Finance and Operations expertise. On the other hand, the Technology and Science specializations show very different mean numbers depending on the sector in which the firms operate. Specifically, firms operating in the pharmaceutical sector have a more important representation of scientific knowledge in their boards (1.28) than the typical company in the overall sample (0.30) and the typical company operating in the computer programming sector (0.13). Firms operating in the computer area give more weight to technology expertise (1.08) compared to firms representing the overall sample (0.47) and the pharmaceutical sector (0.28). T-tests (bottom row) for differences in percentages yield p-values less than 0.01.

I take several approaches in creating variables which represent boards of directors' skill sets composition. First, following Adams et al (2018), I create the variable Skillsum that represents the total number of unique skills that compose a board of directors. Each skill is measured with a dummy variable taking the value of one if there is at least one director providing that skill and zero otherwise.

Second, following several corporate governance studies that analyze topics such as boards of directors' composition and CEO characteristics (e.g., Adams et al, 2018; Custodio, Ferreira and Matos, 2013; Kaplan and Sorensen, 2021), I employ a factor analysis approach to extract

the main dimensions along which boards vary with respect to directors' skills and qualifications. Table 3 panel A shows the results of factor analysis based on the ten directors' skills identified for this work. There are four factors representing four different categories of directors' skill sets. Factor I is defined by *Law*, *Public Policy* and *ESG*; Factor II by *Operations*, *Leadership* and *Marketing*; Factor III by *Strategy*, *Technology* and *Finance*; Factor IV is mainly made of *Science.*

The economic magnitude of the factor coefficients identified in the previous analysis may be difficult to interpret. Moreover, it might be difficult to discuss and claim instrumental validity when the endogenous variable of interest is a factor. Therefore, I create three variables to replace Factors I, II and III. Notice that I do not include factor IV in my analysis because I am interested in directors' skills combinations and Factor IV is defined mostly by *Science*. Each variable is the sum of the two most relevant skills defining each factor[3]. Therefore, the *Law_exp* variable is the sum of *Law* and *Public Policy* experts sitting on the board, *Mgt_exp* is the sum of *Operations* and *Leadership* expert directors, and finally *Strategy_exp* is the sum of *Strategy* and *Technology* qualified directors sitting on the board.

Table 3 panel B presents the correlation coefficients among the factors generated through the factor analysis approach and the directors' skill sets variables I create. The results show a highly significant correlation among the variables. Factor I is highly correlated (79%) with *Law_exp*. Factor II is 92% correlated with *Mgt_exp* and Factor III is 91% correlated with *Strategy_exp.* These results support the approach I am taking generating more intuitive variables to replace the factor coefficients and to make further tests to address endogeneity that are easier to interpret.

[3] Each skill chosen to represent a skill category yields a factor score of a t least 60%

IV. Board of Directors' Internal Fit and Firm Performance

Hypothesis 1 (H1) examines if it exists an internal fit dimension of the board of directors' skills composition that favors efficient decision making while drawing information from a broad array of skills.

According to the organizational research literature, diversity should be an asset to efficient decision making because it brings more perspectives and resources to problem solving (Milinken and Martins, 1996; O'Reilly and Williams, 1998). On the other hand, diversity can also become a liability because different approaches and interpretations of a problem might lead to misunderstandings, hence a slower and less efficient decision-making process (Garlappi et al., 2017). Therefore, the first step of my analysis will be to address if it is possible to assemble a diverse board of directors that guarantees a wide array of tools for decision making and efficiency during the decision-making process.

The first step of my analysis will be to understand how boards of directors could generate this internal fit. The results of the factor analysis in Table 3 indicate that there are four dimensions through which boards of directors' skills vary, three of which are a relatively balanced combination of several skills. Looking at the first two skills generating Factors I, II and III, I notice the following combinations of skills: *Law* and *Public Policy*, *Operations* and *Leadership* and *Strategy* and *Technology*. While each factor is very different from the others based on the skills that constitute it, each skill composing each factor belongs to the same dimension of expertise. For example, *Law* and *Public Policy* are very much interconnected because the public policy arena is constantly engaged with regulations, public speaking, and legal matters in general. *Leadership* and *Operations* are at the base of the management science dealing with top level decision making and its optimal implementation. Lastly, *Technology* and *Strategy* are all about innovation and seeing the bigger picture. Hence, given the complementarity of the skills constituting each factor and the fact that each one of these

bundles of directors' skills is related to different spheres of the decision-making process, factor analysis seems to support the idea that this internal fit dimension exists.

However, intuitively, whether a firm's board of directors implement an efficient decision-making process should be reflected in the firm's performance. Therefore, to assess whether this directors' skill sets internal fit dimension is associated to efficient decision making and consequently to higher firm performance, I estimate the following regression:

$$Performance_{j,t} = \beta_0 + \beta_1 Factor_{j,t} + \sum Controls_{j,t} + TimeFE + FirmFE + \varepsilon_{j,t} \quad (1)$$

Where $Performance_{j,t}$ is firm's j performance measured as Tobin's Q or ROA at time t, and $Factor_{j,t}$ is Factors I, II and III respectively for firm j at time t. The regression controls for various variables that might be correlated with firm performance: capital expenditures (CAPEX), firm size, total number of directors sitting on the board, the percentage of independent directors sitting on the board as well as the percentage of women representing the firm's board of directors. All regression models are estimated with heteroskedasticity-robust standard errors to reduce any concern related to the homogeneity of the variances of the residuals. See Appendix A for variable definitions.

Table 4 presents summary statistics from these regressions. I find significantly positive coefficients on Factor I and Factor II (Columns 1, 2, 4, 5, 6 and 8) both when performance is proxied with Tobin's Q and when it is proxied with ROA. Thus, I show evidence that boards of directors that combine clusters of skills including mainly *Law*, *Public Policy*, *Operations* and *Leadership* perform better than their peers. Factor III, the one incorporating mainly *Strategy* and *Technology* related skills, gives a negative and insignificant coefficient when performance is measured through Tobin's Q and a negative significant coefficient when performance is proxied through ROA.

Next, I re-estimate equation (1) using more intuitive directors' skill variables instead of the factors. These variables besides being more intuitive, they provide robustness to the results obtained in Table 4. As mentioned in Section III, each one of these variables is the sum of the main two skills making up the factor they substitute in the empirical analysis. Therefore, Factor I is replaced by *Law_exp*, Factor II by *Mgt_exp* and Factor III by *Strategy_exp*. See Appendix A for more details on the variables' descriptions. Table 5 provides results consistent with Table 4. Specifically, *Law_exp* and *Mgt_exp* are significantly positively correlated with both performance measures whereas *Strategy_exp* is negative and insignificant when correlated with Tobin's Q and negative and significant when correlated with ROA.

These results along with the correlation coefficients presented in Table 3 panel B justify the use of *Law_exp, Mgt_exp* and *Startegy_exp* as substitutes for Factors I, II and III. To show that my analysis does not simply capture the concept of board of directors' heterogeneity of skills, I follow Adams et al. (2018) approach and I create a variable, *Skillsum*, which is the sum of all the different skills represented in the board of directors. I estimate again equation (1) using *Skillsum* as my main independent variable of interest and I obtain positive, but insignificant results both when the dependent variable is Tobin's Q and when it is ROA. This result is particularly interesting because it shows that it is not enough to have a large sum of different skills on the board to obtain better performance, but a firm rather needs a board with a combination of diverse and complementary skills. Boards need to be internally fit.

However, given the endogenous nature of boards of directors' composition (Hermalin and Weisbach, 1998; Adams et al., 2010), it is complicated to give a causal relationship to the results in Table 4. For this reason, I will adopt an instrumental variable approach to circumvent the endogeneity issues that might affect the previous estimations. To do that, I need to have skill sets variables that lend themselves to the necessary arguments needed for

instrumental validity and factor coefficients are not the best candidates for that (Adams et al., 2018). For this reason, I will use Table 5 as the basis for the IV analysis since it lends itself to a more intuitive discussion of the validity conditions. I rely on an instrumental variable (IV) based on an argument similar in spirit to that in (Knyazeva, Knyazeva and Masulis, 2013). The authors show that the firms' ability to attract talented directors is highly influenced by the local supply of talented directors. Their argument relies on the idea that locating qualified directors can be costly both for firms and directors, besides, qualified directors face also opportunity costs when deciding whether to join a new board of directors, usually preferring appointments at larger and more prestigious firms.

All firms in my sample belong to the S&P 500 Index, so it will be unlikely for a highly skilled director to find better appointment opportunities outside of the S&P 500 realm. Therefore, I rely on the supply of qualified directors within the firms listed in the S&P 500 index to construct the instrumental variables needed for the tests. Moreover, to avoid any possible concern of conflict of interests related to the possibility of directors of direct competitors joining the firm, I exclude firms in the same two-digit code industry. Therefore, my instrument is the availability (based on the category of skills) of particularly skilled directors in the pool of the directors already appointed in any of the S&P 500 firms available in my sample.

Notably, this instrument satisfies both the relevance condition because the availability of specialized directors is correlated with the possibility of a firm to hire specialized directors and the exclusion restriction. In fact, there is no reason to expect any possible correlation between firms' performance and the availability of specialized directors among firms of similar size operating in different industries.

Table 1 panel D provides descriptive statistics for the variables used to create the instruments needed for the IV regressions. Based on mean statistics, in my sample, there are

over 7,775 directors that belong to the *Law_exp* group (*Total_pool_law*), 58,188 who belong to the *Mgt_exp* group (*Total_pool_mgt*) and 5,911 who belong to the *Strategy_exp* group (*Total_pool_strategy*). Each industry represented in the sample counts an average of 24.44 *Law_exp* (*Pool_law_exp*), 182.40 *Mgt_exp* (*Pool_Mgt_exp)* and 15.30 *Strategy_exp* (*Pool_strategy_exp*) directors. Finally, each firm in the sample could rely on a pool of (based on mean statistics) 7,750 *Law_exp* (*IV_Law*), 58,005 *Mgt_exp* and 5,892 *Strategy_exp* (*IV_Strategy*) potential directors. Table 6 shows the results of the second stage of the IV regressions. The coefficients on the first stage regressions have the expected signs and are statistically significant[4]. Moreover, the traditional F-statistics pass the weak instrument tests (see first row of the block of regression statistics of Table 6). Therefore, the instruments used seem to be (empirically) relevant. In the second stage IV regression (2SLS), the coefficients on *Law_exp* and *Mgt_exp* are all positive and significant both when performance is measured with Tobin's Q and when it is measured using ROA.

The results in Table 6 are consistent with the OLS estimations presented in Table 5 and suggest a positive (causal) effect from boards of directors' internal fit to firm performance. With respect to *Strategy_exp* the results on the 2SLS regression differ from the OLS specification. In fact, when performance is represented by Tobin's Q, the coefficient on *Strategy_exp* becomes positive and significant showing that once the endogeneity concerns are addressed, after controlling for other factors, the combination of Strategy and Technology skill sets yields positive performance outcomes in terms of the firm's growth opportunities as proxied by Tobin's Q. When the dependent variable of interest is ROA the coefficient on *Strategy_exp* becomes positive but insignificant, suggesting that the combination of the two skills does not have any tangible effect on operational performance, which is consistent with

[4] The full first stage regressions table is available upon request

the view that Strategy and Technology skills have a more long-term impact on the firm's outcomes.

V. Board of directors' External Fit and Firm performance

Hypothesis 2 (H2) states that the board of directors should include specialized skills to meet the firm's external business environment's needs and challenges. To test this hypothesis, I first need to identify a possible challenge brought to the firm by the external environment and then test whether firms can adjust their board of directors' skill sets composition by adding specialized skills to meet the external challenge. Basically, I need to test whether firms can generate an external fit dimension using the appropriate combination of directors' skills. To do that I identified a relevant external challenge that is supposed to impact firms' performance.

Following other empirical studies exploiting regulatory shocks to test their hypotheses (e.g., Giannetti, Liao, Yu, 2015), I exploit a particular regulatory shock to show that the strategic inclusion of directors with specific expertise can contribute to the creation of a board of directors' external fit dimension, hence improve firm performance. Specifically, I exploit the Paris Climate Accord of 2015 as a regulatory shock.

According to the official website of the United Nations for Climate Change (www.unfccc.int), the Paris Agreement is "*a legally binding international treaty on climate change".* On December 12, 2015, at COP (the UN climate change conference) 21 in Paris 196 Parties joined this initiative. The Agreement entered into force on November 4, 2016, and its main goal is to reduce global warming and to disincentivize the emissions of greenhouse gas to finally achieve a climate neutral world. It is an ambitious step towards a more ESG (Environmental, Sustainability and Governance) oriented economy and society.

Given the nature of the regulation, which puts substantial emphasis on environmental change and actions, it is expected that firms operating in the energy sector to be the most affected by the initiative. To test whether this intuition is correct, I perform a difference-in-differences regression comparing two groups of firms, namely the firms which are likely to be the most affected by the new regulation (Treatment group) and the firms which are relatively unaffected by the new regulation (Control group).

I use as a treatment group those firms whose business is particularly associated with climate change. Thus, I would expect these firms to bear the highest burden of compliance with the new environmental requirements. These firms are those operating in the oil and gas drilling and field exploitation services, the natural gas transmission and distribution (two-digit SIC code 13) and in the waste management industry (two-digit SIC code 49). Notice that the firms in the treatment group belong to a subfield of the energy sector as defined by the SEC. The control group, by default, consists of all firms operating in all other industries.

I employ the following regression:

$$Performance_{j,t} = \beta_0 + \beta_1 Treated_j + \beta_2 Post + \beta_3 (Treated_j \times Post) + \sum Controls_{j,t} + FirmFE + \varepsilon_{j,t} \quad (2)$$

Where *Treated* is equal to one for all firms belonging to the oil and gas drilling exploitation services, the natural gas transmission and distribution services and the waste management services (two digits sic codes 13 and 49) and zero for all firms not operating in these industries. *Post* is a dummy equal to one in the post Paris Agreement period (from 2015 onwards) and zero otherwise.

Figure 1 presents parallel trends analyses from 2010 to 2019. Parallel trends assume that any difference in the output variable in the post-period is not due to a divergence

starting in the pre-period. Figures 1.a and 1.b present the performance trends in terms of Tobin's Q and ROA respectively of the firms in the Treatment and Control groups. Both figures show very similar trends in performance between treated and non-treated firms. However, in 2015, when the Paris Agreement was subscribed, it is possible to observe a decrease in performance for the treated firms. This drop in performance is particularly evident when performance is measured with ROA. Thus, this analysis shows evidence consistent with parallel trends before the shock.

Table 7 contains summary statistics for regression (2). I focus on the interactive term *Treated* × *Post.* A significantly negative coefficient is consistent with firms operating in the treated group having to bear higher costs of regulatory compliance when compared with firms operating in the control group. As results show, firms in the treated group experience a significant drop in performance in comparison to firms in the control group.

The results in Table 7 substantiate the intuition that firms operating in environmentally related sectors are more heavily affected by the Paris Agreement. The next step is to exploit this situation to test whether and how firms operating in the treated industries can use their directors' skill sets composition to address this regulatory challenge. According to the existing literature, firms strategically appoint specialized directors to face specific challenges (e.g, Field and Mkrtchyan, 2017; Huang et al, 2014). Thus, H2 argues that to face challenges brought by the external environment, firms could add an appropriate number of specialized directors to tailor their board of directors' skills composition and generate an external fit dimension.

Given the nature of the regulatory shock levied by the Paris Agreement, I argue that a possible way to tailor the board of directors' skill set composition to obtain an external fit dimension is by adding an appropriate number of ESG experts on the board. ESG experts are individuals specialized in environmental, sustainability and governance issues.

Therefore, having a significant representation of such professionals on the board should lead to greater monitoring and advising activities in relation to issues pertaining to the environmental protection. Firms operating in the treated industries identified in the previous analysis are expected to benefit from a board of directors that is skilled in understanding and addressing ESG related topics. Therefore, I estimate another difference-in-differences regression of the same form of equation (2), but with the following differences: the sample is limited to those firms belonging to the oil and gas drilling exploitation services, the natural gas transmission and distribution services and the waste management services (two-digit SIC codes 13 and 49), and the *Treated* variable is equal to one if the firm has more than one ESG expert director sitting on its board and zero otherwise. Notice that I use numbers greater than one to assign firms to the treated group to avoid any concern of a possible "tokenism approach" to board composition (Billings, Klein, Shi, 2021; Adams and Ferreira, 2009).

Figure 2 shows the parallel trends analysis from 2010 to 2019. Specifically, Figures 2.a and 2.b present the trends in performance of both treated and control firms. As the figures show, in terms of Tobin's Q (Figure 2.a), both groups of firms seem to maintain very similar trends, even if in the period around 2015 seems that treated firms have a less sharp drop in performance with respect to control firms. In terms of ROA (Figure 2.b) instead, the difference in patterns between firms belonging to the treated group and their counterpart in the control group is much more evident, with firms having one or less ESG expert sitting on the board (control group) suffering a much more acute drop in performance than firms with two or more ESG specialists sitting on their boards.

Table 8 presents the coefficient estimates. As Figure 2.a seemed to suggest, our main variable of interest (*Treated* × *Post*) is positive, but not statistically significant when performance is measured through Tobin's Q. On the other hand, when we focus on

operational performance (ROA), the coefficient on the interactive term is positive and highly significant. These results seem to corroborate the hypothesis that a board of directors' skill sets composition can be tailored towards facing challenges imposed by the external environment such as a regulatory shock, as in this case.

In summary, the empirical analysis presented in section V is consistent with the existence of a board of directors' external fit of skills composition, which is achieved by strategically appointing an appropriate number of directors with specialized skills on the board to face externally imposed challenges.

VI. Additional Tests

This section presents some additional tests to corroborate the main findings of this study. First, I re-estimate equation one replacing the main variables of interest corresponding to the clusters of skills contributing to the board of directors Internal Fit with the sum of the clusters. Specifically, I generate the variable *Global_exp* which is equal to the sum of *Law_exp, Mgt_exp* and *Strategy_exp.* Table 9 presents summary statistics for these regressions. Once again, the coefficient on *Global_exp* is positive and significant both when performance is measured with Tobin's Q and when it is measured with ROA. Moreover, the coefficient on the variable *Skillsum* that represents the number of different skills present on the board is negative, but insignificant (Columns 1 and 2).

These results support the idea that diversity of skills per se is not necessarily a good thing for the firms' board of directors, but it is better to rather have a group of clusters of diverse expertise that have a certain degree of complementarity among them.

Also in this case, it is key to address the issue of endogeneity that underpins the main research question behind the paper. To do so, I exploit the same IV strategy proposed in Section IV. Once again, the coefficients on the first stage regression have the expected signs

and are statistically significant. Besides, the F-statistics pass the weak instrument tests. The results of the 2SLS regression are positive and significant for the instrumented *Global_exp* variable both when performance is measured through Tobin's Q and ROA. Interestingly, when the endogeneity issue is addressed, the coefficient on *Skillsum* becomes negative and significant as in Adams et al (2018) (Columns 3 and 4).

VII. Summary and Suggestions for Future Research

This paper examines how board of directors' skills can be combined to generate both an internal and an external fit dimension that leads to higher firm performance. I find that there are three main categories of expertise that allow a board of directors to have both a wide array of expertise from where to seek advice and an efficient decision-making process. Empirical tests show that the combination of these three categories of skills has a positive relationship with firm performance.

Specifically, I find that by combining these three clusters of expertise within the board of directors' firms achieve higher Tobin's Q and ROA performance. These results hold both unconditionally and in an instrumental variable framework. I also provide evidence that boards of directors can further tailor their fit to meet externally imposed challenges by strategically adding specialized directors in their boards. These results hold within a difference-in-differences setting where I exploit the Paris Agreement on Climate Change as a regulatory shock to firms operating in very specific industries.

The relationship between boards of directors' composition and firm performance is a relevant theme in corporate governance research and many academics tried to figure out what is the best possible board of directors' composition which can maximize firms' performance. More related to this paper, several empirical studies sought to understand which directors' skills or combination of skills are the most desirable to obtain higher performance.

Due to the broad nature of the research question and its related endogeneity concerns, most studies about board of directors' skills composition and firm performance tend to find contrasting results among them. Through this paper, I provide a possible explanation to these discrepancies by introducing the concept of board of directors' fit, which has both an internal and an external perspective. In fact, both fit dimensions go beyond the idea of directors' skill sets diversity, which is important to generate fit, but diverse directors' skills need to be properly balanced in their complementarity to have internal fit and they need to be strengthened by an oculate inclusion of specialized directors' skills to face external challenges to be externally fit. This is just a step forward towards understanding the importance of directors' skill sets composition and its relation to firms' outcomes. In fact, future research might exploit this new dimension of fit to test its relationship to other key dimensions of the firm such as transparency, risk exposure and resiliency. Furthermore, this new dimension of fit can be further refined by understanding its implications in broader settings that go beyond the large companies included in the S&P 500 index. For instance, whether firms operating in different countries or of smaller size need different board of directors' fit dimensions.

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Figures 1. and 2. Parallel Trend Analyses for the Difference-in-Difference Tests Around the Paris Climate Agreement on Firms' Performance

Figure 1.a Firms' Tobin's Q Trend for Non- Energy Vs Energy

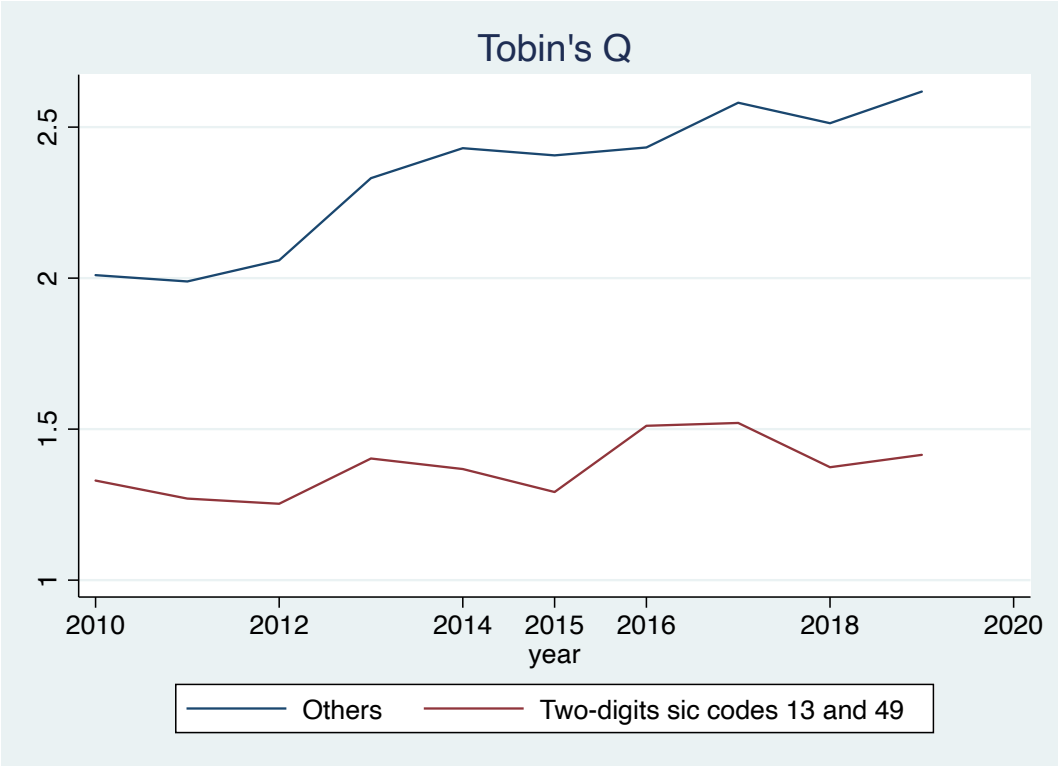

Figure 1.b Firms' ROA Trend for Non-Energy Vs Energy

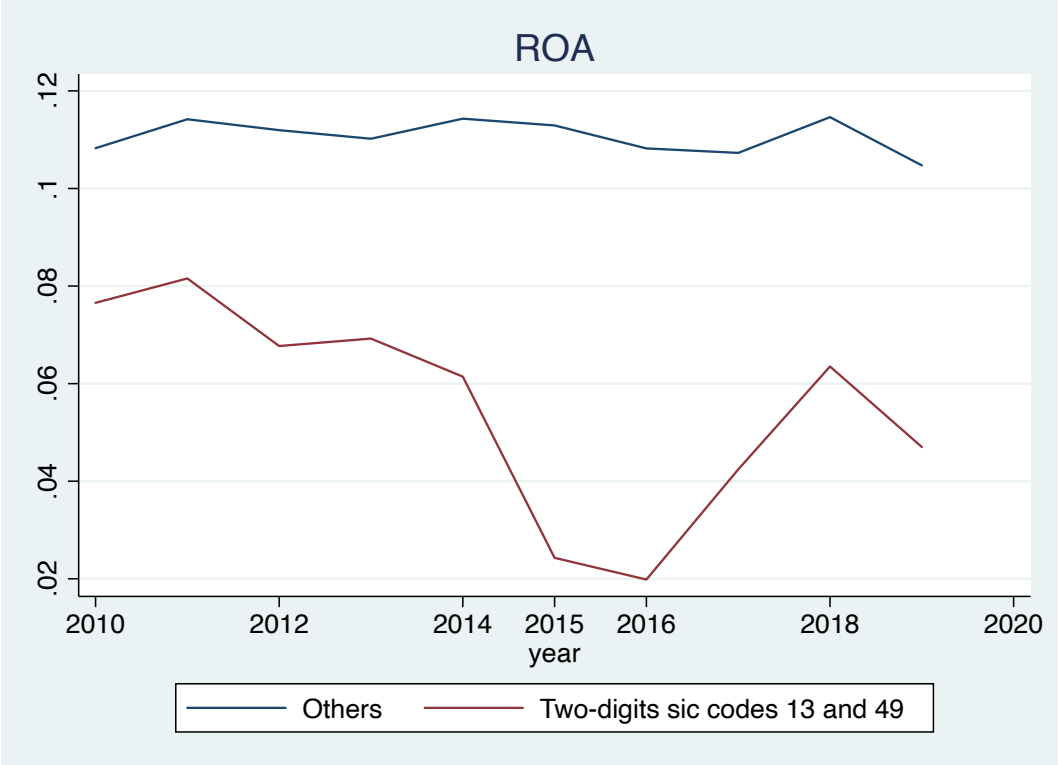

Figure 2.a Firms' Tobin's Q Trend for Firms with less than 2 ESG experts directors Vs Firms with more than one ESG expert directors sitting on the board

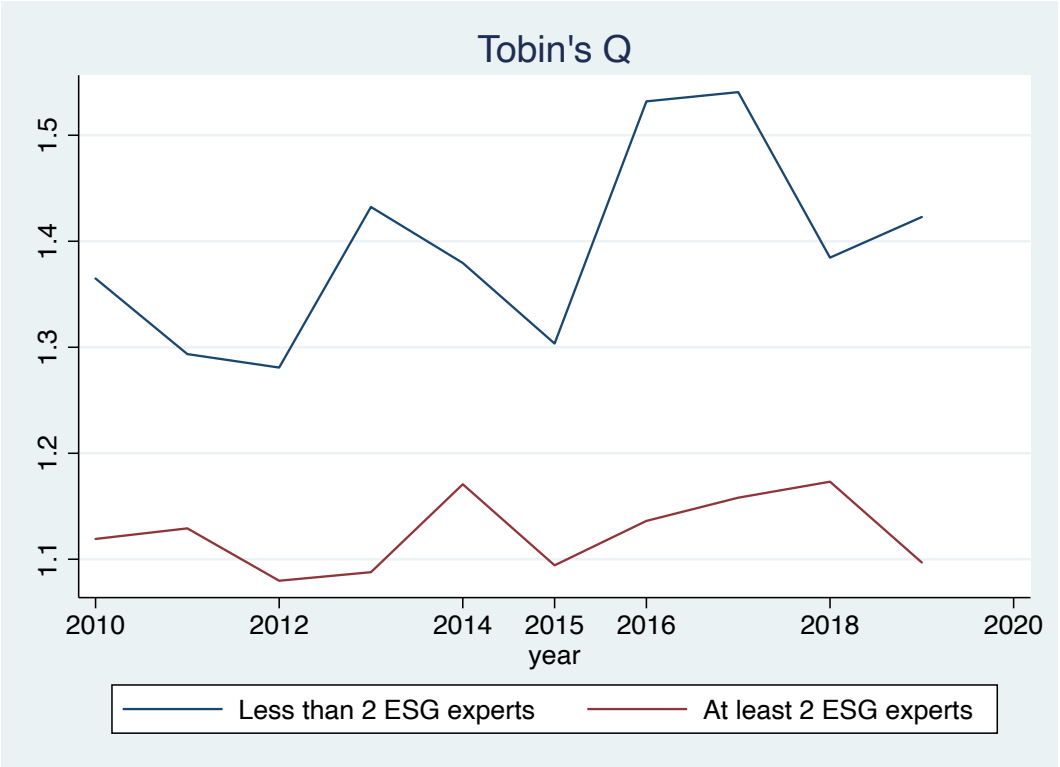

Figure 2.b Firms' ROA Trend for Firms with less than 2 ESG experts directors Vs Firms with more than one ESG expert directors sitting on the board

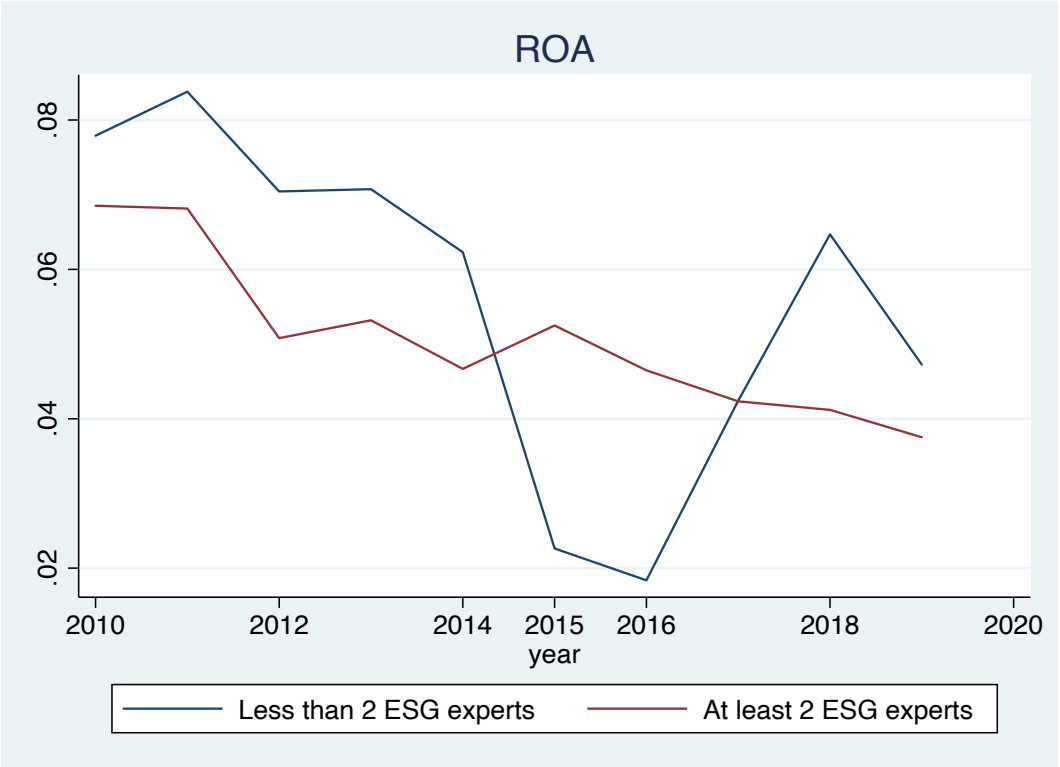

Table 1. Sample and Summary Statistics

Panel A. Sample Selection

Note	Number of Observations
Number of firms in the hand collected dataset at year ended 2019	3690
Less: Missing observations after merging with the ISS database	370
Less: Missing observations after merging with the COMPUSTAT database	145
Number of firms year observations for the cross-sectional tests	3175

Panel B. Descriptive Statistics of the Sample

Variable	Observations	Mean	Std. Dev.	Min	Max
Tobin's Q	3175	2.23	1.50	0.95	8.97
ROA	3175	0.10	0.08	-0.04	0.35
CAPEX	3175	0.04	0.04	0.00	0.20
Leverage	3175	0.27	0.17	0.00	0.79
Size	3175	9.85	1.37	6.94	13.54
BoD Size	3175	10.59	1.95	7.00	16.00
Perc_Independent	3175	0.83	0.09	0.55	0.93
Perc_Women	3175	0.19	0.10	0.00	0.45

Panel C. Descriptive Statistics of Board of Directors' Individual Skill Sets

Variable	Observations	Mean	Std. Dev.	Min	Max
Finance	3175	3.02	1.73	0.00	12.00
Marketing	3175	0.70	0.98	0.00	6.00
Technology	3175	0.47	0.77	0.00	6.00
Science	3175	0.30	0.74	0.00	6.00
Operations	3175	1.92	1.35	0.00	7.00
Law	3175	0.65	0.86	0.00	6.00
Public Policy	3175	1.01	1.23	0.00	7.00
Leadership	3175	10.04	2.10	4.00	20.00
Strategy	3175	0.65	0.88	0.00	6.00
ESG	3175	0.16	0.43	0.00	3.00

Panel D. Descriptive Statistics of the Variables Used to Create the IVs

Variable	Observations	Mean	St. Dev.	Min	Max
Pool_law_exp	3175	24.44	15.08	0	61
Pool_Strategy_exp	3175	18.43	15.30	0	70
Pool_Mgt_exp	3175	182.40	102.11	6	360
Total_pool_law	3175	7775.42	353.04	6885	8172
Total_pool_Mgt	3175	58188.18	5828.94	46689	66528
Total_pool_Strategy	3175	5911.029	1275.69	3888	7960
IV_Law	3175	7750.979	353.17	6830	8172
IV_Mgt	3175	58005.79	5819.69	46418	66520
IV_Strategy	3175	5892.599	1272.57	3846	7960

Table 2. Directors' Skill sets Comparison

Panel A. Overall Vs Manufacturing Vs Energy

Overall						**Manufacturing**					**Energy**				
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Observations**	**Mean**	**Std. Dev**	**Min**	**Max**
Leadership	3175	10.04	2.10	4.00	20.00	351	10.35	2.20	0.50	16.00	370	10.62	2.03	6.00	20.00
Finance	3175	3.02	1.73	0.00	12.00	351	2.79	1.79	0.00	7.00	370	2.89	1.43	0.00	6.00
Operations	3175	1.92	1.35	0.00	7.00	351	2.10	1.27	0.00	6.00	370	1.96	1.19	0.00	7.00
Public Policy	3175	1.01	1.23	0.00	7.00	351	1.09	1.19	0.00	5.00	370	1.39	1.46	0.00	7.00
Marketing	3175	0.70	0.98	0.00	6.00	351	0.88	1.10	0.00	5.00	370	0.22	0.58	0.00	3.00
Law	3175	0.65	0.86	0.00	6.00	351	0.79	0.91	0.00	3.00	370	0.79	0.91	0.00	3.00
Strategy	3175	0.65	0.88	0.00	6.00	351	0.63	0.64	0.00	3.00	370	0.56	0.79	0.00	3.00
Technology	3175	0.47	0.77	0.00	6.00	351	0.76	0.92	0.00	4.00	370	0.28	0.46	0.00	2.00
Science	3175	0.30	0.74	0.00	6.00	351	0.37	0.70	0.00	3.00	370	0.24	0.50	0.00	2.00
ESG	3175	0.16	0.43	0.00	3.00	351	0.05	0.64	0.00	1.00	370	0.35	0.64	0.00	3.00

Variable	**Manufacturing**	**Energy**	**T-test of the mean (a)-(b)**
ESG	0.05	0.35	-0.30**

Panel B. Overall Vs Computer Vs Pharmaceuticals

Overall						**Computer**					**Pharmaceuticals**				
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Observations**	**Mean**	**Std. Dev**	**Min**	**Max**
Leadership	3175	10.04	2.10	4.00	20.00	290	9.26	1.94	4.00	15.00	230	10.21	2.03	5.00	16.00
Finance	3175	3.02	1.73	0.00	12.00	290	2.95	1.66	0.00	9.00	230	3.41	1.68	0.00	7.00
Operations	3175	1.92	1.35	0.00	7.00	290	1.75	1.19	0.00	5.00	230	2.08	1.41	0.00	6.00
Public Policy	3175	1.01	1.23	0.00	7.00	290	0.77	1.06	0.00	5.00	230	0.95	1.50	0.00	7.00
Marketing	3175	0.70	0.98	0.00	6.00	290	0.92	1.10	0.00	4.00	230	1.13	1.43	0.00	6.00
Law	3175	0.65	0.86	0.00	6.00	290	0.54	0.72	0.00	2.00	230	0.32	0.55	0.00	3.00
Strategy	3175	0.65	0.88	0.00	6.00	290	0.82	0.89	0.00	3.00	230	0.85	1.02	0.00	4.00
Technology	3175	0.47	0.77	0.00	6.00	290	1.08	1.13	0.00	6.00	230	0.28	0.56	0.00	2.00
Science	3175	0.30	0.74	0.00	6.00	290	0.13	0.34	0.00	1.00	230	1.28	1.75	0.00	6.00
ESG	3175	0.16	0.43	0.00	3.00	290	0.10	0.30	0.00	1.00	230	0.15	0.36	0.00	1.00

Variable	**Computer**	**Pharmaceuticals**	**T-test of the mean (a)-(b)**
Technology	1.08	0.28	0.80***
Science	0.13	1.28	-1.15***

Table 3. Factor Analysis and Correlation Table

Panel A. Factor Analysis

This table presents the results of a factor analysis based on 10 expertise categories. I present rotated factor loadings for the first four factors using the principal component analysis approach.

Variable	Factor I	Factor II	Factor III	Factor IV
Marketing	0.34	**0.33**	0.31	-0.13
Leadership	0.37	**0.72**	0.14	0.03
Finance	0.34	0.19	**0.43**	-0.12
Technology	-0.12	-0.10	**0.66**	-0.08
Science	-0.02	0.01	0.01	**0.91**
Operations	-0.14	**0.81**	-0.11	0.00
Law	**0.64**	-0.04	-0.06	-0.38
Public Policy	**0.61**	0.24	0.02	0.09
Strategy	0.04	0.02	**0.72**	0.11
ESG	**0.54**	-0.07	-0.01	0.19

Panel B. Correlation Table

This table presents the correlation coefficients between Factors I, II and III and the variables constructed on the basis of the number of experts' count.

Variable	Law_exp	Strategy_exp	Mgt_exp
Law_exp	1.00		
Strategy_exp	-0.00	1.00	
Mgt_exp	0.21	0.04	1.00
Factor I	0.79	-0.05	0.21
Factor II	0.16	-0.04	0.92
Factor III	-0.02	0.91	0.05

Table 4

This table presents the results of Tobin's Q and ROA regressions on Factors I, II and III. The dependent variables are Tobin's Q or ROA. All variables are defined in Appendix A. I control for year fixed effects as well as firm fixed effects. T-statistics are reported in parentheses below coefficient estimates and are based on heteroskedasticity corrected standard errors. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Tobin's Q					**ROA**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Factor I	0.064*			0.104***	0.004*			0.005**
	(2.11)			(3.41)	(0.23)			(3.07)
Factor II		0.127***		0.157***		0.005**		0.006**
		(3.53)		(4.05)		(2.94)		(3.11)
Factor III			-0.019	0.009			-0.006**	-0.005**
			(-0.44)	(0.20)			(-3.24)	(-2.59)
CAPEX	6.451***	6.393***	6.436***	6.408***	0.568***	0.565***	0.567***	0.566***
	(5.17)	(5.11)	(5.16)	(5.13)	(7.52)	(7.51)	(7.56)	(7.57)
Leverage	0.644	0.556	0.623	0.587	-0.060***	-0.064***	-0.059***	-0.060***
	(1.93)	(1.68)	(1.87)	(1.76)	(-4.31)	(-4.65)	(-4.31)	(-4.35)
Size	-0.665***	-0.662***	-0.664***	-0.663***	-0.026***	-0.026***	-0.003***	-0.026***
	(-8.26)	(-8.25)	(-8.24)	(-8.29)	(-7.22)	(-7.18)	(-7.22)	(-7.25)
BoD_Size	0.011	-0.017	0.023	-0.043*	0.001	-0.001	0.002*	-0.001
	(0.88)	(-0.95)	(1.85)	(-2.07)	(0.83)	(-0.62)	(2.51)	(-1.19)
Perc_Independent	-0.13	-0.09	-0.123	-0.085	0.021	0.023	0.024	0.026
	(-0.42)	(-0.29)	(-0.40)	(-0.27)	(1.50)	(1.61)	(1.72)	(1.83)
Perc_Women	0.600*	0.645*	0.623*	0.616*	-0.001	-0.005	-0.005	-0.006*
	(2.31)	(2.49)	(2.40)	(2.38)	(-0.58)	(-0.40)	(-0.43)	(-0.47)
R-Squared	0.83	0.83	0.83	0.83	0.84	0.84	0.85	0.85
Observations	3175	3175	3175	3175	3175	3175	3175	3175
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5

This table presents the results of Tobin's Q and ROA regressions on the categories of skills. The dependent variables are Tobin's Q or ROA. All variables are defined in Appendix A. I control for year fixed effects as well as firm fixed effects. T-statistics are reported in parentheses below coefficient estimates and are based on heteroskedasticity corrected standard errors. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Tobin's Q						**ROA**				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Skillsum	0.020					0.000				
	(0.99)					(0.23)				
Strategy_exp		-0.008			-0.001		-0.003*			-0.003
		(-0.20)			(-0.03)		(-1.98)			(-1.77)
Law_exp			0.088***		0.086***			0.005***		0.004***
			(4.90)		(4.83)			(4.98)		(4.75)
Mgt_exp				0.451**	0.043**				0.002*	0.002*
				(3.16)	(3.05)				(2.12)	(2.09)
CAPEX	6.474***	6.440***	6.421***	6.413***	6.394***	0.553***	0.552***	0.551***	0.551***	0.550***
	(5.17)	(5.13)	(5.15)	(5.10)	(5.12)	(7.39)	(7.45)	(7.46)	(7.41)	(7.48)
Leverage	0.616	0.617	0.646	0.568	0.603	-0.055***	-0.053***	-0.053***	-0.057***	-0.053
	(1.85)	(1.86)	(1.95)	(1.71)	(1.81)	(-4.03)	(3.91)	(-3.92)	(-4.15)	(-3.93)
Size	-0.663***	-0.664***	-0.670***	-0.663***	-0.669***	-0.026***	-0.026***	-0.026***	-0.026***	-0.026***
	(-8.24)	(-8.24)	(-8.35)	(-8.26)	(-8.37)	(-7.32)	(-7.33)	(-7.49)	(-7.33)	(-7.49)
BoD_Size	0.019	0.022	0.006	-0.026	-0.040	0.001	-0.001	-0.000	-0.000	-0.002
	(1.52)	(1.80)	(0.46)	(-1.23)	(-1.87)	(1.34)	(-1.64)	(-0.10)	(-0.84)	(-1.46)
Perc_Independent	-0.140	-0.128	-0.117	-0.113	-0.096	0.019	0.022	0.020	0.020	0.023
	(-0.45)	(-0.41)	(-0.37)	(-0.36)	(-0.31)	(1.39)	(1.54)	(1.46)	(1.45)	(1.63)
Perc_Women	0.593*	0.622*	0.530*	0.658*	0.566*	-0.012	-0.012	-0.017	-0.010	-0.015
	(2.25)	(2.39)	(2.03)	(2.54)	(2.17)	(-0.96)	(-0.93)	(1.33)	(-0.84)	(-1.20)
R-Squared	0.83	0.83	0.83	0.83	0.83	0.85	0.85	0.85	0.85	0.85
Observations	3175	3175	3175	3175	3175	3175	3175	3175	3175	3175
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6
This table presents the results of firm performance regressions on the instrumented skills categories using the two-stage-least-square method (2SLS). The dependent variables are Tobin's Q and ROA. All variables are defined in Appendix A. I control for year fixed effects as well as firm fixed effects. T-statistics are reported in parentheses below coefficient estimates and are based on heteroskedasticity corrected standard errors. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Tobin's Q				**ROA**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
IV_Strategy	0.641***			0.004		
	(3.49)			(0.62)		
IV_Law		0.290***			0.016***	
		(3.72)			(4.19)	
IV_Mgt			1.192**			0.022*
			(3.15)			(2.01)
CAPEX	6.513***	6.350***	5.676***	0.553***	0.549***	0.538***
	(5.16)	(5.45)	(3.08)	(7.83)	(7.97)	(7.24)
Leverage	0.235	0.733*	-0.566	-0.057***	-0.049***	-0.077***
	(0.67)	(2.32)	(-1.01)	(-4.33)	(-3.75)	(-4.41)
Size	-0.667***	-0.684***	-0.618***	-0.026***	-0.027***	-0.025***
	(-8.48)	(-9.05)	(-5.75)	(-7.78)	(-8.43)	(-6.94)
BoD_Size	-0.008	-0.031	-1.237**	0.000	-0.002*	-0.023
	(-0.50)	(-1.75)	(-3.08)	(1.05)	(-2.21)	(-1.92)
Perc_Independent	-0.600	-0.082	0.423	0.017	0.022	0.030
	(-1.81)	(-0.27)	(0.79)	(1.25)	(1.68)	(1.80)
Perc_Women	0.594*	0.308	1.558**	-0.012	-0.029	0.006
	(2.21)	(1.33)	(2.70)	(-1.02)	(2.27)	(0.37)
KP F-Stat	79.98	129.23	11.53	80.00	126.86	11.45
Observations	3175	3175	3175	3175	3175	3175
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7
This table uses a difference-in-difference analysis to examine whether companies' performance measured as Tobin's Q and ROA changes after the passage of the Paris Agreement on climate change. I identify the firms in the oil and gas drilling and field exploitation services, the natural gas transmission and distribution and the waste management sectors as the treated group. The output variable Post is a dummy variable equal to one for the years after the Paris agreement approval (2015 on) and zero otherwise. The Treated variable is a dummy equal to one when the sample firm belongs to the sector according to their two digits sic code and their SEC industry classification. The Treated × Post variable is the primary variable of interest, and it represents the interaction between the Post and Treated variables. I control for firm fixed effects. T-statistics are reported in parenthesis below coefficient estimates and are based on heteroskedasticity corrected standard errors. ***, **, * indicate statistical significance at the 1%, 5% and 10% level respectively

	Tobin's Q	**ROA**
Post	0.341*** (11.24)	0.007*** (5.21)
Treated	-1.816*** (-10.58)	-0.085*** (-10.88)
Treated × Post	-0.285*** (-6.80)	-0.029*** (-7.37)
CAPEX	6.078*** (4.76)	0.540*** (7.28)
Leverage	0.814* (2.44)	-0.059*** (-4.26)
Size	-0.504*** (-6.56)	-0.026*** (-7.72)
BoD_Size	0.015 (1.23)	0.001 (1.60)
Perc_Independent	0.137 (0.42)	0.024 (1.71)
Perc_Women	1.373*** (5.48)	0.015 (1.27)
Observations	3175	3175
R-Squared	0.83	0.84
Firm FE	Yes	Yes

Table 8
A difference-in-difference analysis to examine whether firms' performance measured as Tobin's Q and ROA changes after the passage of the Paris agreement on climate change. This test uses only the companies in the oil and gas drilling and field exploitation services, the natural gas transmission and distribution and the waste management sectors within the sample. The output variable Post is a dummy variable equal to one for the years after the Paris Agreement approval (2015 on) and zero otherwise. The Treated variable is a dummy equal to one when the sample firm has more than one ESG director sitting on its board of directors. The Treated × Post variable is the primary variable of interest, and it represents the interaction between the Post and Treated variables. I control for firm fixed effects. T-statistics are reported in parenthesis below coefficient estimates and are based on heteroskedasticity corrected standard errors. ***, **, * indicate statistical significance at the 1%, 5% and 10% level respectively.

	Tobin's Q	**ROA**
Post	0.080** (2.75)	-0.017*** (-3.46)
Treated	-0.151** (-2.92)	-0.019 (-1.15)
Treated × Post	0.031 (0.54)	0.029** (3.21)
CAPEX	0.447 (0.69)	0.453*** (4.24)
Leverage	0.060 (0.13)	-0.318*** (-5.35)
Size	-0.253** (-3.24)	-0.017*** (-1.43)
BoD_Size	0.008 (0.65)	0.004 (1.93)
Perc_Independent	0.075 (0.21)	0.027 (0.64)
Perc_Women	1.325 (1.33)	0.114** (3.19)
Observations	370	370
R-Squared	0.67	0.50
Firm FE	Yes	Yes

Table 9
This table presents the results of Tobin's Q and ROA regressions on *Global_exp*. The dependent variables are either Tobin's Q or ROA. Columns 1 and 2 present results of classical panel data regressions, while columns 3 and 4 show the results of 2sls regressions where the variable Global_exp is instrumented. All variables are defined in Appendix A I control for firm fixed effects. T-statistics are reported in parenthesis below coefficient estimates and are based on heteroskedasticity corrected standard errors. ***, **, * indicate statistical significance at the 1%, 5% and 10% level respectively.

	OLS		2SLS	
	Tobin's Q	ROA	Tobin's Q	ROA
	(1)	(2)	(3)	(4)
Global_exp	0.055***	0.002***	0.800***	0.019*
	(4.33)	(3.60)	(3.75)	(2.47)
Skillsum	-0.023	-0.001	-0.609***	-0.014*
	(-0.93)	(-1.34)	(-3.53)	(-2.34)
CAPEX	6.351***	0.562***	4.685**	0.526***
	(5.10)	(7.45)	(2.99)	(6.99)
Leverage	0.549	-0.065***	-0.355	-0.084***
	(1.66)	(-4.69)	(-0.80)	(-5.12)
Size	-0.667***	-0.026***	-0.717***	-0.027***
	(-8.36)	(-7.27)	(-7.62)	(-7.68)
BoD_Size	-0.046*	-0.002	-0.923***	-0.021*
	(-8.36)	(-1.64)	(-3.64)	(-2.33)
Perc_Independent	-0.132	0.021	-0.014	0.024
	(-0.42)	(1.51)	(-0.03)	(1.58)
Perc_Women	0.632*	-0.005	1.159**	0.007
	(2.41)	(-0.39)	(2.59)	(0.45)
Observations	3175	3175	3175	3175
R-Squared	0.83	0.84		
KP F-Stat			19.62	19.62
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Appendix A. Variables Definition

Variable	Definition
Skillsum	The sum of unique skills represented on the board
Law_exp	The total number of Law and Public Policy experts sitting on the board
Mgt_exp	The total number of Leadership and Operations experts sitting on the board
Strategy_exp	The total number of Strategy and Technology experts sitting on the board
Global_exp	The sum of Law_exp, Mgt_exp and Strategy_exp sitting on the board
CAPEX	Capital expenditures over total assets
Leverage	Total liabilities divided by total assets
Size	The natural log of total assets
BoD_Size	The total number of directors sitting on the board
Perc_Independent	The percentage of independent directors sitting on the board
Perc_Women	The percentage of women sitting on the board
Pool_Law_exp	The total number of Law and Public Policy expert directors in each industry
Pool_Strategy_exp	The total number of Strategy and Technology expert directors in each industry
Pool_Mgt_exp	The total number of Leadership and Operations expert directors in each industry
Pool_Global_exp	The total number of Law_exp, Mgt_exp and Strategy_exp directors in each industry
Total_pool_law	The total number of Law and Public Policy expert directors
Total_pool_Strategy	The total number of Strategy and Technology expert directors
Total_pool_Mgt	The total number of Leadership and Operations expert directors
Total_Pool_Global	The total numbers of Law_exp, Mgt_exp and Strategy_exp
IV_Law	The difference between Total_pool_law and Pool_law_exp
IV_Strategy	The difference between Total_pool_Strategy and Pool_Strategy_exp
IV_Mgt	The difference between Total_pool_Mgt and Pool_Mgt_exp
ROA	Operating income before depreciation divided by total assets
Tobin's Q	The sum of total assets and market value of equity less book equity divided by total assets