Board of directors : the role of networks

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Abstract

Board composition and role in corporate governance have been under close scrutiny both in the academic and "civil" worlds. Independence has been advocated as a way to reinforce the board's power over the managers. However, the empirical literature does not find convincing results to support this view. The first chapter of this dissertation offers a survey of these results and of two other strands of the literature that could be used to explain conflicting results. On the one hand, it presents findings on how social connections can affect corporate governance. On the other hand, it outlines the main results of information aggregation and conformity effects in committees. The object of this dissertation is to study how these play a part on boards and more specifically how they affect a CEO's election. Indeed, people commonly think that CEOs get appointed not only because of their talent or ability but also because of their social connections.

The second chapter explores this intuition from a theoretical perspective, using a static Bayesian game. Directors want to elect the best candidate but they also want to vote for the winner. In that context, results show that, when no candidate is part of the network, boards with a network perform better in electing the right candidate. On the other hand, it becomes detrimental for stockholders if one candidate is part of the network. The network has power over the results of the election and limits the power of the future CEO.

The third chapter explores the role of network in the election process from an empirical perspective using a unique database FIBEN of over 12000 firms, built at the

Banque de France, and *alumni* directories for the three most prestigious Grandes Ecoles in France (HEC, Polytechnique and ENA). Results show that indeed, *alumni* tend to favor their peers in the voting process but also that there is rivalry between the three Ecoles. This last finding is original and supports the idea of a network effect.

Keywords: Networks, corporate governance, voting

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Table of Contents

List of Figures

List of Tables

Chapter 1

Networks on boards: a survey of the literature

1.1 Introduction

In most large companies, investors and managers are distinct. This separation has long been a topic of interest for economists. Jensen and Meckling (1976) quote from Adam Smith's *Wealth of Nations*:

> The directors of such [joint-stock] companies, however, being the managers rather of other people's money than of their own, it cannot well be expected, that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own. Like the stewards of a rich man, they are apt to consider attention to small matters as not for their master's honour, and very easily give themselves a dispensation from having it. Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company.

The idea developed by Smith is at the heart of corporate governance issues. How can investors, who provide funds, ensure that they get an adequate return on investment? One answer to this question is that stockholders can supervise and create incentives for the managers to align both their interests. From this perspective, boards of directors appear as representatives of the stockholders and are in charge of guaranteeing that the decisions are profitable for the firm's owners. In publicly held companies, the role of board of directors is legally to represent the stockholders and their interests. Control over managers in these companies is split between the General meeting and the board of directors, elected by the General meeting. However, a board is composed of directors who have their own personal objectives. More specifically, they want to remain on the board. The stockholders elect directors but the CEO is not absent from the designation process. Therefore, the directors could develop their own strategies which might not best serve the interests of the stockholders.

The literature on the topic of boards is abundant and addresses this dichotomy. On the one hand, boards of directors appear to be a tool to supervise managers but on the other hand this tool suffers from shortcomings, mainly because of the designation process. Therefore, the literature has studied how the boards are composed and if their makeup could have an effect on the way they conduct their activity. Theory predicts that outside or independent directors would be better supervisors but empirical studies find conflicting results.

This could reflect the complexity of boards and the need to have as wide an approach as possible. Indeed, "independence", for example, can be a misleading word. It is conventionally defined as the absence of ties to the firms but this definition omits the social links that could exist between board members and managers. Using findings from the literature on networks and social ties could offer interesting perspectives on boards and corporate governance. Likewise, using literature on strategic voting in committees could provide a way to understand the mixed results.

In this paper, I explore the different strands of the literature to understand how networks and peer effects could be applied to the peculiar setting of boards of directors. My goal is not to provide a complete review of each strand but rather to see how they could be combined to provide different ways of exploring corporate governance. In section 1.2, I review some of the theoretical and empirical literature on boards, especially how their composition could affect their actions and their efficiency. In this section, I show that from these empirical results, there is not a clear evidence of such link. This could be explained by network and peer effects on the board. In section 1.3, I explore how those could affect boards. . Section 1.4 reviews some of the existing literature on information aggregation and voting theory applied to boards to explore how decisions are made on boards.

1.2 Boards' composition affects their actions

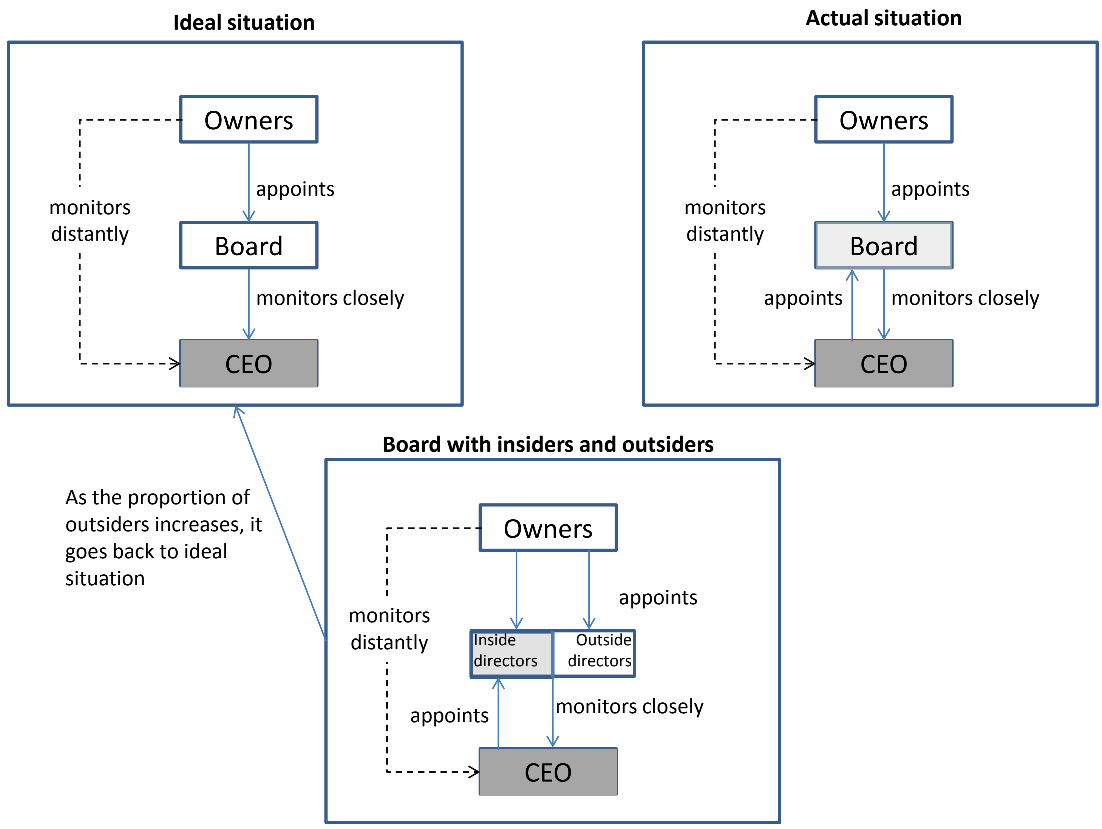
Separation of ownership and management seems, as appears already in Smith's words, to be a potential source of inefficiency and at the same time it is the most common organization of large companies. The main theory of Fama (1980) is that "separation of security ownership and control can be explained as an efficient form of economic organization within the set of contracts perspective". For these contracts to be enforced, supervision is needed which is carried out by the General meeting and the board, appointed by the General meeting. Boards are therefore at the heart of corporate governance which could explain why the literature has studied boards both theoretically and empirically abundantly.

1.2.1 An independent board is a better supervisor, a theoretical approach

Jensen and Meckling (1976) develop the topic of the separation of ownership and control. They show that managers, who do not own the firm, might undertake actions that are profitable to them, but not to the firm. They aggregate these concerns into the "agency theory". The agency theory aims at addressing problems that might occur when a "principal" needs to supervise an "agent" but does not have access to all information, for instance on the agent's efforts or ability. The principal then creates incentives for the agent to disclose his private type. Following this paper, Fama (1980) and in a more detailed approach Fama and Jensen (1983), show that a proper mechanism design might prevent inefficient behaviors. Indeed, proper incentives and compensation can lead the agent (the manager) to commit to guaranteeing the principal (the owner)'s interest. But, as noted by Jensen and Meckling (1976), in a publicly-held firm with a board, there are several agency problems. First, there is the agency problem outlined by Smith: between the manager and the shareholder. This is likely to occur because the decision maker (the manager) does not have a financial interest in the outcome of his decision. In this set up, the board supervises the manager. However, the CEO has power over the board. In particular, he plays a role in the nomination process. Directors' interests therefore do not align perfectly with shareholders'. This creates a second agency problem between directors and shareholders. Fama and Jensen (1983) show that reputation, in that set up, can function as incentives, in particular for outside directors.

Therefore, directors' independence is often seen as a way to limit the CEO's power over the board and to reinforce its ability to supervise. Independent boards are

Figure 1.1: Board of directors as seen in theory



seen as more likely to take actions in line with the owners' interests. Hermalin and Weisbach (1998) show that the board effectiveness is a function of its independence. In particular, they predict that more independent boards are more likely to fire poorly performing CEOs (a similar result is found by Laux (2008)). Schematically, the relation between independence and board efficiency can be read on figure 1.2.1.

Table 1.1: Main findings for relation between independence and performance

Article	Measure of performance used	Results
Fosberg (1989)	SG&A expenses, sales, number of employees, and return on equity	No influence
Hermalin and Weisbach (1991)	Tobin's Q	No influence
Bhagat and Black (2001)	Tobin's Q, return on assets, asset turnover and stock returns	No influence
Brickley, Coles and Terry (1994)	Stock market reaction to poison pill adoption	Positive
Anderson, Mansi and Reeb (2004)	Cost of debt, proxied by bond yield spreads	Inversly related (positive influence of independence)
Brown and Caylor (2004)	- Tobin's Q - Returns on equity, profit margins, dividend yields, stock repurchases	Negative Positive
MacAvoy, Cantor, Dana and Peck (1983)	Accounting measures	No influence
The following articles study the change in the composition		
Baysinger and Butler (1985)	Stock price	Positive
Rosenstein and Wyatt (1990)	Stock price	Positive

1.2.2 Not all empirical studies confirm that independent boards are better

The empirical literature aims to link board composition and firm performance. Again, the underlying theory is that, because they are sensitive to reputation incentives, outside directors will be better monitors, and boards with a larger proportion of outside directors will perform better. However, the link between independence and firm performance has not univocally been established. In their survey on the topic, Hermalin and Weisback (2003) conclude that "Overall, there is little to suggest that board composition has any cross-sectional relation with firm value". This result is similar to the findings of Bhagat and Black (2001). Likewise, Hermalin and Weisbach (1991) measure the effect of outside directors on the firm's performance, measured by Tobin's Q and find no significant relationship. Other studies that have focused on changes in the composition rather than on the proportion of outsiders, however, show that there is a positive reaction of the markets to the appointment of a new outside director. In particular, Rosenstein and Wyatt (1990) find a statistically significant 0.2 percent increase in stock prices after the announcement of an outside director nomination. However, this could be related to the change itself rather than to the "outsider" characteristic of the new director. In a follow up paper (Rosenstein and Wyatt (1997)), they provide evidence that adding an inside director could have a positive effect on stock prices, which could confirm the idea that markets react to change but not to the composition effect. Table 1.2.1 offers an overview of some empirical articles that try to find a relation between composition and firm performance. It is not exhaustive but offers a perspective of the different attempts. For a more complete review of the literature, see Hermalin and Weisback (2003).

Beyond performance, the empirical literature has also studied the effect of board composition on decisions taken by the board. Again results are contradictory. Weisbach (1988) explores the relation between outside directors and CEO replacements. The author uses resignations because it is the most common reason given for CEO replacement (138 instances out of 286 changes in the sample used). The hypothesis is that some of these resignations can be driven by the stockholders as a result of poor performance. Indeed, the paper finds a strong association between poor performance and CEO resignation, and shows that this relation is more probable for companies with boards dominated by outside directors. This confirms the theory. On the other hand, golden parachutes have been shown to be associated with larger proportions of outside directors (Singh and Harianto (1989) and Wade, O'Reilly III and Chandratat (1990)), contradicting the idea that outside directors protect the shareholders' interests better.

1.2.3 Diversity on boards: a proxy for independence

Research on board composition has also focused on diversity on boards. Diversity is often seen as a sign of independence. This, for instance, is the assumption made by Carter, Simkins and Simpson (2003): "a more diverse board is likely to be a more independent or activist board". The empirical literaure, however, is ambiguous. Adams and Ferreira (2004) explore gender diversity on boards. They find three results: diverse boards hold more meetings, they provide more pay-performance incentives and firms which have fewer women on boards are confronted to more variability in their stock return. It appears that diverse boards display peculiar characteristics, not only in the results they yield but also in their makeup or functioning. Carter et al. (2003) use a sample of Fortune 1000 firms to study the relationship between firm value measured by Tobin's Q and diversity, measured by the proportion of women or minorities on the board of directors. They find significant positive relationships between the fraction of women or minorities on the board and firm value. Likewise, Erhardt, Werbel and Shrader (2003) investigate the relationship between performance, measured by 1993 and 1998 return on asset and investment and diversity measured by the percentage of women and minorities on boards of directors for 127 large US companies. They find that diversity is positively associated with performance. On the other hand, Shrader, Blackburn and Iles (1997) analyze the 200 largest US firms and do not find any significantly positive relation between the percentage of female board members and firm performance measured by ROA and ROE. In some cases they find significantly negative relations. Kochan et al. (2003) also find no positive relations between gender diversity in management and firm performance for US companies.

Recent papers have used the introduction of gender quotas on corporate boards to study the impact of gender diversity on corporate decisions. Norway passed a law in 2006 that required all publicly listed companies to have at least 40% of women in their board of directors. Matsa and Miller (2012) compare financial data of publicly listed companies with a matched sample of private owned companies that do not have such obligations. They find that most corporate decisions are unaffected by the quota policy with the exception of employement decisions. Firms affected by quotas undertook fewer layoffs, lowering therefore the short-term profits of the firms. Their study shows however that the quotas, apart from gender diversity, did not affect the composition of the board with respect to characteristics such as seniority or age. The newly appointed women were younger than the average director but they replaced younger male directors. This view is challenged by Ahern and Dittmar (2012) who find that quotas led to younger and less experienced boards, increases in leverage and acquisitions, and deterioration in operating performance, consistent with less capable boards.

1.3 Networks and peers in the corporate world

The studies relating performance and independence or diversity often rely on the idea that boards supervise the CEO. However, the role of a board is complex and varies from one firm to another. Schwartz-Ziv and Weisbach (2011), exploring minutes of board meetings, study this variety. The authors distinguish between two main functions, managerial and supervisory. They show a high prevalence of the latter but the former is important as well. The characteristics that make for a board with high supervisory power might be different from those which make for a board with high adivisory power. The literature indicates that a friendly board can be better at advising the CEO. In particular managers might limit the amount of information disclosed to the board in the case of an unfriendly board. As shown by Adams and Ferreira (2007), a friendly board, one with a low monitoring intensity could increase the managers' incentive to share information, which, in turn, could increase the directors' efficiency. The authors conclude that, if the CEO's incentives meet some conditions, a friendly board can be an optimal governance structure. Westphal (1999) presents similar findings. Using an original survey data from 243 CEOs and 564 outside directors on behavioral processes and dynamics in management-board relationships, he shows that CEO-board friendship has no significant impact on monitoring but a positive impact on counseling. Likewise, demographic diversity has been linked to conflicts in the board that might limit the CEO's action (see Goodstein et al. (1994) or Kosnik (1990)). Peer effects have been shown to be a factor at play in the labor market in general and on boards in particular. Therefore, including such effects could provide some explanations to the conflicting results on the relation between make up and performance. Networks can have an influence on reputation outcomes as well as on performance outcomes of the firm which could dampen the importance of "independent" directors.

1.3.1 Social connections impact performance

Economic research has investigated how networks can affect performance of firms or individuals. These studies do not necessarily focus on corporate boards but they show how connections matter in some economic outcomes. For instance, Bertrand, Bombardini and Trebbi (2011) study lobbyists. The paper shows that lobbyists appear to choose their area of interest depending on whom they know. Interestingly, they appear to systematically switch topic as the politicians they are connected to switch committee assignments. The authors quote from McGrath (2006) :"There are three important things to know about lobbying: contacts, contacts, contacts." This should not come as a surprise that political connections play a part in lobbying. However, they are important for firms too. Faccio (2006) studies firms of 42 different countries, focusing on those whose controlling shareholders and top managers are members of national parliaments or governments. The findings show that these connections are relatively widespread (2.68 percent of the listed corporations and 7.76 percent of the world's market capitalization). Connections have an impact on the firms since they ensure easier access to financing.

Political connections are not the only connections which matter in the economic world. Mutual relations are important as well. In particular, they allow for better information flow. This feature has widely been studied in the finance industry. Cohen, Frazzini and Malloy (2008) document that the trades made by mutual fund portfolio managers who invest in companies run by people with whom they share an educational network outperform the other trades made by the same portfolio managers in firms with which such network does not exist. Connections can also be shown to have detrimental effects. Butler and Gurun (2012) report, using Execucomp data from 1992-2006 and hand-collected data on educational ties between firm executives and mutual fund managers, that for each percentage point of a firm‘s ownership that is connected through an educational network, total executive compensation is 2.5% higher.

1.3.2 Connections in the boardroom

This evidence demonstrates that social connections offer more power and opportunities and might affect the life of a board. In particular, the CEO’s connections inside and outside of the board must be taken into consideration. Connections inside the board might also lead to reassess the notion of independence since an "independent" director might be socially connected to the CEO. Hwang and Kim (2009) study this distinction. They use mutual alma mater, military service, regional origin, academic discipline, and industry as indications of an informal tie between a director and the CEO. Using the Fortune 100 firms from 1996 to 2005, they find that, under the conventional measure of independence, 87% of the boards are classified as independent (they have a majority of independent directors) but when they augment the conventional definition with the proposed social restrictions this percentage falls to 62%. The distinction has economic consequences on the firm since the authors find no significant difference in the CEO’s compensation when studying a conventionally independent board but reveal that the compensation is significantly lower, (on average, by $3.3 million) when there is a socially and conventionally independent board. Since the CEO has a part to play in the composition of the board, it is of interest to study whether social ties can have a role in the nomination process. Kramarz and Thesmar (2008) tackle this issue, using a dataset on executives and outside directors of corporations listed on the Paris stock exchange over the 1992-2003 period. The paper indicates that social networks strongly affect board composition. This, in some cases, proves detrimental to corporate governance and firm performance.

The effect of social ties between the CEO and the directors is even more important if one considers interlocking. Hallock (1997) report that, in his sample of America's 700 largest companies, about 8% of CEOs are reciprocally interlocked with another CEO; that is the current CEO of firm 1 sits on the board of firm 2 whose CEO sits on the board of firm 1. The authors find that CEOs who lead interlocked firms earn significantly higher compensation. They measure return to interlock can be as high as 17%.

Ties between boards do not come only from CEO interlocking. Directors hold a large number of seats in different companies. Fich and Shivdasani (2006), from a sample of firms that appear in the 1992 Forbes 500 list of largest corporations during the 7-year period from 1989 to 1995, record that directors hold an average of 3.11 seats in publicly held companies. The authors find that in their sample, 52% of directors are "busy", ie. hold three or more seats. Perry and Peyer (2005) report a similar proportion. Fich and Shivdasani (2006) show that firms with boards in which a majority of outside directors are "busy" display weak corporate governance and CEO turnover-performance sensitivities indistinguishable from those with boards dominated by inside directors. Core, Holthausen and Larcker (1999) find similar results. Busy outside directors are associated with excessive compensation packages for the CEO and therefore poor firm performance; however the number of seats held by a director can be a sign of performance of that director. Indeed, it is used as a proxy for reputation by Shivdasani (1993) and Vafeas (1999). Following this intuition, we could have expected busy directors to enhance firm performance.

Connections of directors could usefully be included when studying board composition and its effect on performance. Indeed, Westphal and Milton (2000) show that minority directors are more influential if they have ties to majority directors. Therefore, studying a board where directors who represent a demographic minority but who are well-connected and a board where the minority directors do not have social connections should yield different results. This, in turn, could explain the contrasted results reported in section 1.2.

1.4 Information aggregation and voting in committees

The above analysis on networks and how they can affect boards shows that dynamics among directors should be explored. In particular, the specificity of the voting process in a board is that it occurs in a small committee and is usually transparent. Therefore, to determine best practices in terms of composition, it is of interest to explore theories about information aggregation and strategic voting. This can open perspectives on how the different characteristic of the directors could have a part in the final decisions. The scope of this paper is not to be exhaustive on the literature on decision-making in committees but rather to offer a perspective as to which findings could be useful in studying boards. An interested reader could find a complete survey in Gerling, Grüner, Kiel and Schulte (2005).

1.4.1 Information aggregation and herding

Voting in committees has been extensively studied in theory, starting as early as 1785 in Condorcet's *Essay on the Application of Analysis to the Probability of Majority Decisions*. In his Jury Theorem, Condorcet describes a committee as a mechanism to aggregate information efficiently. He shows that the majority is more likely than individuals to make the right choice between two options. The proofs of this theorem rely on the assumption that voters vote "sincerely". Condorcet's model also relies on individual obtaining their signal at no cost and having the same objective (to make the right decision). Finally, the model does not involve cheap talk or any information exchange before the vote.

All these assumptions have been challenged or refined by subsequent models on voting in committees. On sincere voting, Austen-Smith and Banks (1996) find that sincere voting does not constitute a Nash equilibrium, even if voters have identical preferences. However, strategic voting is not necessarily the source of inefficiency. Feddersen and Pesendorfer (1997), for instance, show that large numbers of voters who vote strategically can aggregate information perfectly under a voting rule that is expressed as a fraction of the number of voters (for instance majority).

In these papers, however, models assume that the voters' objective is to make the right decision and they do not study conformity effects. Literature on "herding" has provided evidence that previous decisions can influence directors or managers especially when agents want to appear competent. Scharfstein and Stein (1990) show that managers, under certain circumstances, prefer to ignore their private signal and follow other managers' investment strategies. This is of even greater importance as they are uncertain about their own ability. Building upon the model by Scharfstein and Stein (1990), Avery and Chevalier (1999) add a possibility for managers to have private information about their ability. The authors confirm that when managers have no private information about their ability, they will more readily "herd". However, as they acquire private information, "promising" (ie. smart) managers herd less. In these papers, decision making is sequential. This is not the case on a board where the votes are cast simultaneously. Nonetheless, herding could happen on a board.

1.4.2 Decision-making on boards

Levy (2007b) provides a voting model that can be applied to boards in which she studies the impact of career concerns on voting in committees. In the model, the author assumes that the decision makers want to accumulate reputation through their votes. They want to show that they have private information about the topic on which they vote. In that set up, when the vote is transparent, directors want to signal their types, which leads to "anti-herding". The same holds true when the vote is secret but to a lesser extent. This has consequence for board decisions since votes are transparent inside the board, but usually secret for the General meeting. This paper is not specifically designed to model boards of directors and it therefore omits some features of decision making in the board. In particular, it does not take into consideration the cost of dissent. Directors know that their activity can be monitored by the CEO who has a power in the nomination process of the board. The cost of dissent may be high.

Warther (1998) studies how directors vote in decisions to fire or retain a top manager. The analysis is based on management's power in the composition of the board members. It focuses on the effect of this power on the probability of dissent from one board member. He shows that in the case of a two-member board, a director is reluctant to vote against the CEO even if his private information about him is negative. Chemmanur and Fedaseyeu (2012) develop a similar idea but with an arbitrary number of directors. Their model is constructed as follows. The directors have shares in the firm. In the long run, the market learns the CEO's ability so directors have an incentive to fire bad CEOs. However, if a director votes to fire the CEO but fails, the cost of dissent is high. The authors show that when the cost of dissent is zero, directors vote informatively. However, when the cost of dissent is not null, then the board becomes sub-optimally passive. Malenko (2010) shows that the cost of dissent can lead directors to engage in communication before the vote, even if communicating is costly. In her paper, she considers that dissent can be understood both vis-a-vis the CEO but also vis-a-vis the other board members. This last aspect is related to the desire for conformity that has been developed in the "herding" literature.

Conformity appears therefore to be a strong feature of boards. Dissent may arise for reputational concerns (as in Levy (2007b)) but it is limited by the power the CEO has over the board. Noe and Rebello (1997) report indeed that disagreements in the boardroom are rare. Drawing from section 1.3, it seems important to underline that fear of dissent or desire for conformity is all the more crucial as directors can have ties that go deeper than professional connections. Ravanel (2013) studies theoretically such impacts. The model considers directors who are career concerned but also want to please the future CEO by voting for him. Voting is transparent inside the board but secret for the General Meeting. Some, amongst the directors, are socially connected. The paper shows that, when no candidate is connected to the other board members, such ties can be optimal as they limit the power of the elected CEO over the board.

1.5 Conclusion

This review indicates that boards are central in corporate governance. They are a scheme through which contracts between managers and stockholders can be enforced. Their role as a monitor of the CEO is therefore at the heart of most research although others studies also report on the role of the board as advisor.

The literature shows that, both empirically and theoretically, the power of the CEO over the board, mainly through the role he or she has in the nomination process, leads to endogeneity in the composition which makes the boards so difficult to explore. This led the literature to study independent directors and boards as a way to avoid this endogeneity. However, the results of this strand of the literature show that it is very difficult to observe a link between the ability of the board (measured by the performance of the firm) and its composition. The same holds true when taking diversity as a proxy for independence. The literature on network, social connections and peer effects offers one explanation for these mixed results. Independence is usually measured as a lack of formal link to the firm. However, that measure does not take into account social ties. Nonetheless, these ties have been shown to have important effects on economic outcomes, especially on corporate governance issues. Another possible explanation is suggested by the literature on information aggregation and more particularly on voting. Herding and desire for conformity is a common feature in these studies and it is shown to be very important in boards, because of the CEO's power. The two explanations do not contradict one another. On the contrary since the desire to conform is more vivid when the ties are not only professional but also social, both explanations can be combined. It must here be noted that studies that link board diversity to firm performance more often (though not always) get significant positive relationship than those using conventional measures of independence. One of the possible reasons is that a more diverse board is more likely to be socially independent.

Chapter 2

Voting in committee : firm value vs. backscratching

2.1 Introduction

In his *History of the Peloponnesian War*, Thucydides recounts the preparation of the Sicilian campaign. He pictures the opposition between Nicias, the older, prudent man and Alcibiades, the young and imprudent one. The citizens need to elect a general but what they are really voting for is a strategic choice : peace with Nicias or war with Alcibiades. Both men make a speech defending their points of view but it appears quickly that Alcibiades makes a bigger impression than Nicias and the citizens elect him, by a show of hand (as was customary in Athens). Interestingly enough, Thucydides reports : "With this enthusiasm of the majority, the few that liked it not, feared to appear unpatriotic by holding up their hands against it, and so kept quiet". Alcibiades gets elected for three reasons: many citizens liked the idea of going to war, he was more brilliant than Nicias and few people wished to utter their opposition in the context where it appeared he would win the election.
The election of the Chairman of a board or a CEO bears similarities with that of Alcibiades. Candidates are more or less talented and they present strategic options for the firms. Board members have their own opinions as to what the strategy should be, they are looking for a talented leader but also, none of them wants to be a "black sheep" who voted against the elected Chairman. In this context, ties between board members could be important. Indeed, if a subgroup of them shares the same opinion

on the right strategy and the right candidate, it has an impact on the election. This is the hypothesis I study in this paper. Using a static Bayesian game borrowed from Levy (2007a), I explore how ties between some board members affect every director's vote. The results show that, if directors are not biased towards the winner, then directors who are not part of the network are not affected by the existence of such network. But if we consider that directors are indeed biased towards the winner, then all directors are affected by the network.

In the case of Athens, the election of Alcibiades was a disaster since the Sicilian expedition led to a military defeat, a renewed war with Sparta and eventually the oligarchic coup of 411 BC. In the corporate boards, the effect on the firm's owners is not as obviously detrimental. The bias towards the winner is always detrimental but a network among some board members can produce desirable effects. In particular, when no candidate is part of that network, the existence of ties between some board members can limit the bias to vote for the winner and lead all directors to express their opinions. On the other hand, when one candidate is part of the network, then, it is detrimental to the firm's owners. These effects on the firm's value show that ties between board members have an effect. This could lead to reassessing the effect of directors' independence or at least to broaden the definition of "independence".

To analyze this question, after a quick literature review (**section 2.2**), I set up a model where directors are biased towards the winner but in which they are not tied to one another (**section 2.3**). I call this the "benchmark case" and show in (**section 2.4**) that the bias distorts votes compared to the case where directors are only concerned about voting for the best candidate. After that, I introduce ties between two board members out of three. This is the network. All directors are biased towards the winner. The candidates can be out of the network (**section 2.5**) of part of it (**section 2.6**). I then estimate the "welfare" of the firm's owners in all these situations (**section 2.7**).

2.2 Literature review

Interest for corporate governance has surged over the last decades. In many corporate scandals, the role of the board has been pointed out as critical. Consequently, guidelines regarding board composition have been issued by policy makers or by firms themselves. As a consequence, the proportion of independent directors has increased. Despite this attempt, the financial crisis and its aftermath has further brought suspicion onto boards and their regulatory powers, in particular regarding their control over compensations. Consequently, some advocate passing laws to limit such compensations or golden parachutes. Academic research on corporate boards has preceded and accompanied this movement of public interest.

The role of a board is to hire and fire top management, supervise it and set the strategy of the firm. Academic research has focused widely on the supervision, although hiring and firing of top management enter in these models. Theory papers mainly rely on agency theory. They advocate for the separation between the control and the management authorities (see Fama and Jensen (1983)). Dividing both authorities leads to ask the question of the board's independence. The theory predicts that firms with independent boards will better protect the interests of the owners. Empirical studies show conflicting results on this point: Westphal (1999) shows that indeed a more independent board fires more easily a poorly performing CEO but Boyd (1994) shows that an increased ratio of outside directors can be positively correlated with compensation. In these papers, independence is defined as a lack of formal link with the firm other than directorship. However, this definition is oblivious of two forms of dependence that might affect the votes: de facto dependence towards the Chairman and interdependence of board members. González (2006) looked into herding as a possible candidate for the contradictory results regarding the effect of outside directors.

To study further the hypothesis that directors' interdependence can affect the election process, I borrow a model from Levy (2007a) and Levy (2007b). This model studies voting behaviors in committees, with transparent voting. In these papers, Levy studies directors who are concerned about how they are going to be perceived by stockholders. I do not keep these reputation concerns in my model. However, I add a concern similar to a reputation concern: directors are concerned about how the future CEO is going to assess them. Very simply, the CEO judges positively a director who voted for him. In this set up, following Levy, I study the impact of correlation between board members. But I assume that only 2 out of 3 directors are correlated.

2.3 Benchmark case : a bias towards the winner but no network

This paper aims at studying the effect of networks in a board where directors have a dual concern: they want to vote for the winner and they want to elect the candidate they believe will make most out of the firm.

I assume that all candidates are directors and I only consider CEOs serving also as Chairmen. This could be relaxed but would make the model more complex and less tractable. I assume also that votes inside a board are transparent. This ensures that the elected CEO knows who voted for him and who did not with certainty, justifying that board members want to vote for the winner.

Directors also want to elect the best candidate. Each director, in his own field of interest, assesses a candidate by the yardstick of the strategy suggested by the candidate. Each director has his own opinion about which strategy is best. It is assumed that the composition of the board is optimal, i.e. aggregating the ideal strategy of each director would yield the best possible outcome. This hypothesis that directors choose a new CEO according to the strategy he will implement is consistent with results of empirical studies on boards, in particular Westphal and Fredrickson (2001).

2.3.1 The set up

I now describe the election process in a board. Consider a 5 member committee. Two members are candidates and vote for themselves. I am analyzing the votes of the three other members. This is the smallest possible board for my study because I want to introduce a network between some but not all members who are not candidates. I study how increasing the number of members affects the results in section 2.8 (it reinforces the results but does not alter them).

Each non candidate member i, $i \in \{1, 2, 3\}$ is assigned a random variable $w_i \in \{A, B\}$ that he does not observe directly. This w_i represents the candidate who is most in line with director i 's strategy in director i's field of interest. Without loss of generality, the probability that $w_i = B$ is $q > 1/2$. The prior is the same for all directors and is common knowledge.

Directors do not have a perfect knowledge of the candidate therefore they cannot have full information on w_i. They only receive a signal s_i on w_i.

Depending on their talent/ work as directors, this signal will be more or less accurate. Each expert receives the signal $s_i \in \{A, B\}$ such that $Pr(s_i = w_i) = t_i$ and t_i is uniformly distributed on $[0.5, 1]$. s_i and t_i are private information. The more talented directors are, the more they learn about the candidates, and the more they are able to assess which is best.

Directors know their own t_i so they can retrieve their own w_i from s_i with Bayesian updating.

$$v(q, s_i, t_i) \equiv Pr(w_i = A|q, s_i, t_i) = \begin{cases} \frac{(1-q)(1-t_i)}{qt_i+(1-q)(1-t_i)} & \text{if } s_i = B \\ \frac{(1-q)t_i}{q(1-t_i)+(1-q)t_i} & \text{if } s_i = A \end{cases} \tag{2.1}$$

Members A and B who are candidates, get respectively $w_A = A$ and $w_B = B$ and all board members observe that. The intuition of this is obvious: it is common knowledge that each candidate thinks he is the best suited for the job. Likewise, the candidates do not have the same utility function as the other members: they vote for themselves since their utility is obviously higher if they are elected than if their competition is.
All members simultaneously cast their vote $m_i \in \{A, B\}$. The decision of the committee is $D \in \{A, B\}$. The voting rule is a simple majority so $D = A$ if and only if $\{\#i|m_i = A\} > 2$ The board members are interested in who will be Chariman as he will lead the firm in one or the other direction. Their utility function is as follows:

$$u_i(D|w_i) \begin{cases} 1 & \text{if } D = w_i \\ 0 & \text{otherwise} \end{cases} \tag{2.2}$$

This corresponds to the idea that directors have an intrinsic individual "best" candidate.
But the directors are also concerned about voting for the Chariman who wins. The CEO holds a large power over directors, especially when he acts as Chairman as shown by Adams, Almeida and Ferreira (2005). He decides over the composition of committees, plays a key role in the election of new members and can lead an elected member not to be reelected. Directors, whether independent or not, are reluctant to challenge the CEO. Mace (1971) found that those who challenge the CEO can be asked to resign. I assume a bias towards the winner in the following information

function:

$$z_i(m_i|D) = \begin{cases} 1 & \text{if } m_i = D \\ 0 & \text{otherwise} \end{cases} \tag{2.3}$$

The value function of the director is a convex combination of the two functions: $(1-G)u_i(D|w_i) + Gz_i(m_i|D)$. G can be seen as the importance the directors assign to the fact of voting for the winner. Since I normalize the payoffs of both functions u and z to 1 and 0, the only variation comes from G. When $G = 0$, directors care only about the decision and therefore vote efficiently. The timing of the game goes as follows:

1. The states of the world w_i are realized and each i learns s_i and t_i
2. Each board member casts simultaneously her vote m_i including the two candidates who vote for themselves. Each board member observe the others' votes
3. The decision of the committee is $D = A$ if $\{\#i|m_i = A\} > 2$, D=B otherwise
4. The values $u_i(D|w_i)$ and $z_i(m_i|D)$ are realized
5. The firm is dismissed

2.4 Analysis of the benchmark case : bias, no network

The case we want first to consider is one in which all directors are independent. The w_i's are not correlated. One cannot learn anything on his own w from the other's or anything on the others' w's from his own.

2.4.1 The efficient director – no bias and no network

In this case, directors' sole concern is to elect the candidate who is more in line with their interests ($G = 0$). They vote as if they were pivotal. Indeed, if they are not pivotal, their vote has no consequence on their utility. In that case, they vote efficiently.

Proposition 2.4.1 *When they are not concerned about voting for the winner, there exist a unique cut-off equilibrium* $(s^* = A, t^* = q)$ *in which directors are efficient and vote for* A *if and only if* $s = A$ *and* $t > q$

Proof of proposition 2.4.1. All proofs are in the appendix. ■

The proof of proposition 2.4.1 is detailed in the appendix. Notice however that the key equality is:

$$v(q,s,t)u(A|w = A)+(1-v(q,s,t))(u(A|w = B)) = v(q,s,t)u(B|w = A)+(1-v(q,s,t))u(B|w = B) \tag{2.4}$$

This equates the payoffs when a director votes for A (left hand side) with payoffs when he votes for B (right hand side). Equality shows that the director is indifferent and this provides the cutoff value.

This proposition shows that the directors, when concerned about electing their best candidate, follow their signal to contradict the prior only if they consider that their ability is high enough to do so. The limit case is when $s = A$ and $t = 1$, in which case the signal provides perfect information. It is then efficient for the director to contradict the prior since he knows, for sure, that the best candidate is indeed A. In the case where $s = A$ and $t = 0.5$, the signal provides no information, it is therefore efficient for the director to choose the candidate favored by the prior and vote for B. The cut-off $t^*_{eff} = q$ makes sense. Indeed, if $t > q$ and $s = A$, then it means that the probability that $w = A$ is greater than the probability that $w = B$ by definition of q and t. It is thus efficient for a director to vote for A in that case and in that case only.

2.4.2 Introducing the bias to vote for the winner

When I introduce a bias towards the winner ($G \neq 0$), a director's vote affects his utility whether he is pivotal or not through function $z(.)$. Indeed, even when he is not pivotal, the future Chairman observes individual votes. A director therefore has to estimate his probability of being pivotal. He always votes for the winner when he is pivotal (by definition). On the other hand, when he is not, his vote does not have any effect on the result of the election, so he is only concerned in electing the winner.

Lemma 2.4.1 *There exists a unique cut-off value $v^*(q, s, t)$, corresponding to a unique pair (t^*, s^*) such that the director votes for A if $v(q, s, t) > v^*(q, s, t)$ and B otherwise.*

Let $P_i[piv]$ is the probability of director i being pivotal, $P_i[D|npiv]$ is the probability of D being elected given that director i is not pivotal (I drop the subscript for simplicity reasons).

Lemma 2.4.2 *If $s^* = A$, then $(1-P[Piv])(P[A|nonpiv]) < (1-P[Piv])P[B|nonpiv])$*

Lemma 2.4.3 *The only possible cut-off equilibrium admits $s^* = A$*

The lemma is intuitive in this case. The directors want to elect the candidate who is both the best and the most likely to being elected. Since the prior favors B, the a priori most likely one to be elected is B. When a director thinks he is pivotal, he acts efficiently and contradicts the prior only if his signal contradicts the prior and he is talented enough to follow that signal. If a director thinks he is pivotal and gets a signal B, he never contradicts his signal. If he does not think he is pivotal, a director looks at the prior to evaluate who is most likely to being elected (in this case B). So there is no reason why a director with signal B should vote for A when ws are not correlated.

Proposition 2.4.2 *When directors are concerned about voting for the winner, there exists a unique cut-off point equilibrium characterized by a pair* $(s^* = A, t^*)$ *such that if* $s = A$ *and* $t > t_0^*(q)$*, the director votes for* A *and* B *otherwise.* $t > t_0^*(q) > q$ *but bounded away from 1. This equilibrium exists for* G *low enough. When* G *is too high,* $G > \bar{G}_0$*, the only possible equilibrium is one in which all directors vote for* B*.*

(Notice that I use the subscript eff for the efficient case and 0 for the benchmark case)

An efficient director (no bias, $G = 0$) director goes against the prior only if he is talented enough. In the benchmark case (bias, no network), this still holds for the case in which the director votes as pivotal. With the probability that he is not pivotal, his own signal, even if it is perfectly accurate, does not inform him on the outcome of the election since the w_is are note correlated. Therefore, he relies only on the prior. This leads to more herding.

Notice that, as long as the probability of being pivotal is not too low, the cut-off equilibrium exists. If this probability is very low, then, unanimity occurs. The upper bound comes from this feature. Indeed, if the ability required to vote for A is too high, if only the extremely able vote for A, the probability of being pivotal decreases sharply as well as the probability of A being elected. Therefore, even the extremely able directors with a signal A would choose B, leading to unanimity for the candidate favored by the prior and making the cut-off equilibrium unsustainable. This might also occur if q is very high (leading to a high t^*).

If the concern to vote for the winner (G) is very high, this leads to unanimity for the candidate who is favored by the prior.

So, if the election is extremely biased towards one candidate (for whatever reasons) or if the directors care too much about voting for the winner, then a director who observes a signal different from the prior, even if he is extremely competent, fears to express his opinion and herds. This might be very detrimental to a firm since it limits the emergence of opposition in a board. Notice also that, as the board gets larger, the probability of being pivotal decreases. I will study this more in depth in section 2.8 below.

This analysis is made in the case in which all directors are independent from one another. But this is seldom the case. In boards, there is evidence of some links between members. Those ties can affect the vote as well.

2.5 Introducing the network effect

It is possible to expect that directors have ties between one another and that those ties do not come from the firm itself. Therefore, independent directors can still have ties with the other board members. I will loosely call this interdependence "network". The mere fact of sitting on the same board creates interconnection. This can create group dynamics and desire to conform (see on this Malenko (2010)), leading to herding. Herding is a well-studied phenomenon (see in particular Banerjee (1992) and Scharfstein and Stein (1990)). Groups of peers or networks could have an influence in how the board behaves beyond herd behavior. The literature on "old boys club" informs us that these ties indeed influence decisions such as hiring, colluding or forming groups (see Balan and Dix (2009), Byrne (1971),Rivera (2012)). In this section, I study how networks or clubs could affect the results of the election process. To study networks, I consider that, out of the three board members who are not candidates, two are from the same network N. I do not consider that any of the two candidates is part of the network for the moment.

To understand how networks might enter in the framework, we need to go back to w_i and its interpretation. The state of the world represents who the expert is more inclined to see as the best candidate, which candidate defends, in the director's field of interest, the strategy that the director would favor. The aggregation of all states of the world represents the overall strategy advocated by each candidate. To characterize the network, I assume that experts who attended the same higher education institution, come from the same family, belong to the same groups in some other way are more likely to have the same state of the world w. This means that, with some probability, they share the same interests and value the same strategy in that field. This assumption can be justified by different things:

- They received the same education so might give a similar weigh to similar aspects;
- they had similar careers;
- they have converging interests (work in the same field, hope for the same strategy for the firm).

In my model, directors from the same network will share the same state of the world with some probability λ. The parameter $\lambda \in [0;1]$ is common knowledge. It is drawn before the w_is. $\lambda \equiv P[w_i = w_N]\ \forall\ i \in \{N\}$ where N is a specific network. With probability λ, a common w is drawn for the two members of the network, and with probability $1-\lambda$, there are two separate draws as in the benchmark case. Then talent t and signal s remain personal and private information. The third member draws his own w.

Following the assumption that the board is optimally composed in the benchmark case, when there is a network, with probability λ, some information is lost. The candidates are evaluated in one less dimension. This is important when studying the output for the firm's owners.

Introducing a subgroup of two out of three non candidate voters creates heterogeneity among the directors. I need to study separately the directors who are part of the network and the one who is not.
Some further notations are needed. Subscript x will denote that the variable is that of the director who is not part of the network, n will refer to one of the directors in the network. Since there is symmetry between the two directors in the network, I will not use n, i and n, j. Finally, the capital letters X refers to a situation in which each director draws his own w and N to the situation in which the directors from the network share a common w.

2.5.1 The director out of the network

The "outside" director's private information on his w_i does not inform him on the others' w. However, he knows that the other two have the same w with some probability λ. Therefore the probabilities of A or B being elected are altered as well as the probability of being pivotal.
The indifferent director who is not in the network faces the following problem :

Lemma 2.5.1 *The indifference equation for a director who is not in the network simplifies to:*

$$v_x^*(q, s, t) = \frac{1}{2} + \frac{G}{2(1-G)} \frac{P_x[B \cap npiv] - P_x[A \cap npiv]}{P_x[Piv]} \tag{2.5}$$

where :

$$P_x[B \cap npiv] = \lambda P[B \cap npiv|N] + (1-\lambda)P[B \cap npiv|X] \equiv \lambda B_N(t_n^*, t_n^*) + (1-\lambda)B(t_n^*, t_n^*)$$

$$P_x[A \cap npiv] = \lambda P[A \cap npiv|N] + (1-\lambda)P[A \cap npiv|X] \equiv \lambda A_N(t_n^*, t_n^*) + (1-\lambda)A(t_n^*, t_n^*)$$

$$P_x[Piv] = \lambda P[Piv|N] + (1-\lambda)P[Piv|X] \equiv \lambda I_N(t_n^*, t_n^*) + (1-\lambda)I(t_n^*, t_n^*)$$

Compared to the benchmark case, a director who is not part of the network observes a different probability of being pivotal and assesses differently the probability that B is elected. This, in turn, changes his vote. The network affects all the board members, including the director who is not part of it.

2.5.2 A director in the network

A director who is part of the network can get information on his own state of the world from the other member's vote. Indeed, with some probability, they share the same w. Therefore, there is information to gain from the other's vote.

Lemma 2.5.2 *The indifference equation for a director who is in the network simplifies to:*

$$(1-\lambda)v_n^*(q,s,t)+\lambda V_n^*(q,s,t)=\frac{1}{2}+\frac{G}{2(1-G)}\frac{P[B\cap npiv]-P[A\cap npiv]}{P[piv]} \tag{2.6}$$

Let $P[B\cap npiv]\equiv B(t_n^*,t_x^*)$, $P[A\cap npiv]\equiv A(t_n^*,t_x^*)$ and $P[piv]\equiv I(t_n^*,t_x^*)$ Compared to the benchmark case, the director who is part of the network has access to more information on his w. This alters his voting strategy.

2.5.3 Cut-off equilibrium in the network case

Solving the equilibrium here is slightly more involved than in the benchmark case since the directors are not symmetric anymore. Notice however that in the case in which $\lambda = 0$, we are back in the benchmark case and the only solution is that $t_x^* = t_n^* = t_0^*$ (where t_x^* is the cut-off for the director who is not part of the network and t_n^* that of the directors who are part of the network.

Lemma 2.5.3 *In equilibrium $t_n^*\leq t_x^*$, with equality when $\lambda=0$ or when unanimity arises.*

Proposition 2.5.1 *In the case of a network, there exists one cut-off equilibrium where* $s_n^* = s_n^* = A$*,* $t_n^*(q, G)$*,* $t_n^* \leq t_x^* \leq t_0^*$*.* t_x^**,* t_n^* *and* t_x^* *are bounded away from 1. There exists another equilibrium in which every director votes for B when G is high enough.*

We can divide the intuition into two parts.
The director who is not part of the network is less likely to be pivotal since the other two have correlated states of the world. Therefore, the bias towards the winner has a stronger role. If the two other directors had the same strategy as a benchmark director (the same cut-off), this would lead the director out of the network to vote for the candidate favored by the prior more often than in the benchmark case (and have a higher cut-off point). But this is not the case because directors from the network have a lower cut-off than in the benchmark case. Therefore, B is still more likely to be elected than A, but less so than in the benchmark case. The director who is out of the network and who is more biased towards the winner tends to vote more often for A than in the benchmark case (but less often than an efficient director). Notice that when $G = 0$, the director is efficient and the network has no effect on his vote.
When a director is part of the network, the cut-off decreases as well, even when there is no bias towards the winner. Indeed, when $G = 0$, the cut-off is lower than q. A director i who is part of a network votes for A more often when he has a signal A than an efficient director. This reflects the loss of efficiency coming from the lost information. Indeed, since information is now correlated, a director in the network with a signal A can retrieve information on his network co-member's vote. If he believes he is pivotal, this means that out of the two other directors, one voted for A. It is more likely that the director who voted for A is the one from the network since the cut-off point is lower. If that director voted for A, it means that he had a signal A and was sufficiently

able to trust it. Therefore, if the other director from the network has a signal A and if states of the world are correlated ($\lambda > 0$), he can give it higher credit. The updated probability that his $w = A$ is higher with the same t.

This result shows that, when there is a subgroup in a committee, this group gains power to vote for its best candidate. Indeed, the members of the network vote for A only if $s = A$, that is, only if they believe A to be their best candidate. But if that is so, they trust their signal more than a benchmark director. Moreover, in a context in which there is a network, the director who is not part of that network will vote for A more often than in the benchmark case, leading to a higher probability that A is elected, when he is the best candidate of the network members. Notice that this voting behavior from the director who is not part of the network arises only to conform to the others, because it does not happen when $G = 0$.

2.5.4 Unanimity in the network case

By increasing the probability that A is elected, introducing a network limits the cases in which there is unanimity if no candidate is part of the network.

Proposition 2.5.2 *The $\bar{G}_N$ that leads to a unanimous vote for B is higher than in the benchmark case ($\bar{G}_N > \bar{G}_0$). This means that unanimity arises for a smaller set of parameters when there is a network and no candidate is part of that network.*

This feature comes from the extra power gained by the members of the network: they express their opinion more often and lead the director who is not part of the network to vote for A more often, hoping to vote like the members of the network. This result comes in part from the behavior of the member who is not part of the network. This director has a lower probability of being pivotal than in the benchmark case. Therefore he cares for voting for the winner more. This could lead to a tendency to vote for the candidate favored by the prior. But, on the other hand, the directors who are from the network vote for A more often than in the benchmark case. There is a less clear cut as to which candidate is going to be elected, reducing the expected gain of voting like the prior.

2.6 One candidate is part of the network

In the previous section, I have studied the bias caused by the existence of a network among the voting directors, assuming neither candidate is part of the network. Another important question is to understand what happens when one candidate is part of the network (and not the other). This is of interest to us because it is close to the idea that network members can favor their peer, a behavior which is often associated with networks in the public opinion. We expect to see it at work at the time of the election of the CEO.

In this framework, when a candidate is part of the network, it means that with probability λ, all members of the network will have the w of the candidate (more information is lost). That is, if the candidate in the network is A, all the network members will have $w = A$ with probability λ and this is common knowledge since the w of the candidates are common knowledge.

The case of B candidate of the network is the most obvious since B is already favored by the prior. Compared to the previous case (no candidate from the network), B is more likely to win and unanimity arises for a larger set of parameters.

Proposition 2.6.1 *If B is part of the network, $t^*_{n,B} > t^*_{x,B} > t^*_0 > q$ and $\bar{G}_{N,B} < \bar{G}_0$.*

On the other hand, when A is candidate, the prior goes against the network candidate. The question is therefore whether the network can be stronger than the prior, i.e., will all directors bend their votes against the prior.

Proposition 2.6.2 *When A is the candidate of the network, there is a unique equilibrium which varies, depending on λ and G: $s_n^* = s_x^* = A$ and $t_n^* < t_x^* < t_0^*$ (for lower values of λ). As λ increases, the equilibrium shifts towards one with $s_n^* = B$ and $s_x^* = B$ and $t_x^* < t_0^*$. Recall that in this equilibrium, a director from the network votes for A if he has signal A or if he has signal B and a $t < t_{n,A}^*$. For G or λ high enough, there is unanimity for A*

This shows that when the ties of the network are strong (high λ) there exists an equilibrium where every director votes for A, going against the prior. This is very interesting because it shows that the network, in a context of directors concerned about voting for the winner, can bias the votes not only towards more herding around the "natural" candidate but even more around the challenger. This also shows that network can play an important part in being elected Chairman and can, in some cases, supplement ability. That could be very detrimental to stockholders.

2.7 Optimum comparisons

It is interesting to study how the different cases affect the “welfare" of the stockholders. As in Levy (2007b), a “natural" criterion for efficiency of the board is the probability that the decision is correct on all dimensions. Efficiency can be measured as the probability that every director votes correctly, votes as his w_i suggested. In other words, I study the probability that $m_i = w_i$ for every i.

When all directors are symetric, it suffices to compute this probability for one director. Here, unlike in Levy, all directors are not symmetric ex ante in all cases, so I need to study each case separately. Let $W(t_i, t_j, t_k) \equiv ((1-q)m_a(t_i) + q(1-m_b(t_i)))((1-q)m_a(t_j) + q(1-m_b(t_j)))((1-q)m_a(t_k) + q(1-m_b(t_k)))$ where m_a, the probability to vote for A when $w = A$, is $m_a(t) = 1 - t^2$ and m_b, the probability to vote for A when $w = B$, is $m_b(t) = (1 - t)^2$.When $W(.)$ is minimized, the probability of error is minimized, welfare is maximized.

2.7.1 From efficient to benchmark case - effect of introducing the bias to vote for the winner

In the efficient case, the directors maximize the value of the firm; therefore, there should not be a gain from deviating.

Proposition 2.7.1 $W(t^*_{eff}) > W(t^*_0)$ *where* $W(t^*_{eff})$ *is the welfare associated with the cut-off strategy adopted from efficient directors (cut-off point* t^*_{eff}*) and* $W(t^*_0)$ *is the welfare associated with the cut-off strategy adopted by directors in the benchmark case (cut-off point* t^*_0*)*

This fact is not surprising and it shows that, when deviating from the goal of value-maximizing, the directors decrease the welfare of the stockholders. Again, by definition of efficient, this is an expected result.

2.7.2 No preference for the winner, with and without network - effect of introducing network

To study the welfare in the network case, I consider that the correct w_i of each director is the one drawn in the absence of correlation, the one drawn with probability $1 - \lambda$. This comes from my definition of w and the assumption that, in the absence of network, the aggregation of the three ws reflects perfectly all available information on the candidates. Therefore, what enhances the welfare of the firm's owners is that each director votes like this w, allowing for the best information aggregation. When the network is introduced, with probability λ, some information is lost since only two ws then become observable or retrievable instead of three. This assumption leads to consider that introducing a network leads to a loss of welfare (by assumption since I consider that aggregating the three ws leads to a perfect information on the candidates).

Proposition 2.7.2 $W(t^*_{eff}) > W(t^*_{N,eff})$ *where* $W(t^*_{eff})$ *is the welfare associated with the cut-off strategy adopted from efficient directors (cut-off point* t^*_{eff}*) and* $W(t^*_{N,eff})$ *is the welfare associated with the cut-off strategy adopted by directors in a board in which there is network but no bias to vote for the winner (cut-off point* t^*_0*).*

This distortion from the efficient case by introducing the network comes from the assumption that the board composition is optimal. Of course, when there is network and a bias to vote for the winner, there is also a loss of welfare compared to the efficient case.
What is of interest is the comparison between the benchmark and the network case.

2.7.3 From benchmark to network - no candidate is part of the network

Proposition 2.7.3 *When* G *is greater than some value* $\tilde{G}(q)$*,* $W(t^*_N) > W(t^*_0)$ *where* $W(t^*_N)$ *is the welfare associated with the cut-off strategy adopted from directors in a board where there is a network., In particular,* $W(t^*_N) > W(uB)$ *where* $W(uB)$ *is the welfare associated with a unanimous vote for* B

This proposition comes from the intuition I developed earlier. Let us consider only the case in which $G > \tilde{G}(q)$, that is when there is a substantial deviation from the efficient strategy in the benchmark case.
When there is a network in a board, the directors from the network "make" the election. They have more power than a director in the benchmark case in the sense

that it is more likely that, by voting for their "best" candidate they also vote for the winner: they are more likely to be pivotal and there is a possibility that, when they are not pivotal, the pivotal voter shares the same best candidate and votes accordingly. In that set up, the directors who are part of the network have a "best" candidate determined by the prior. Of course there is a loss of efficiency when there is network since some information is lost. But the deviation from the efficiency is smaller (for G high enough, that is, when the deviation in the benchmark case is important). This result comes from the power of the network and its ability to trust its signal more. This in turn leads the director who is out of the network (and who therefore has less power than in the benchmark case) to behave more efficiently because B is less likely to be elected. Therefore, the expected gain from herding with the prior is dampened and leads this director to follow her signal more often as well. As we have seen, unanimity arises faster in the benchmark case than in the case in which there is a network inside the board, but no candidate is part of the network. Unanimity is detrimental for the firm because even when q is high, there is always a chance $(1-q)^2$ that A is the best candidate for the firm. Unanimity prevents the election of A in any case (even with very able directors).

2.7.4 B IS A CANDIDATE IN THE NETWORK

Proposition 2.7.4 $W(t^*_{N,B}) < W(t^*_0)$ *where* $W(t^*_{N,B})$ *is the welfare associated with the voting strategy of a board with a network and* B *part of that network*

The intuition still comes from the power the network has. The network decides who is going to be elected (broadly speaking). Therefore, when no candidate is part of the network, this is good for the stockholders because the network acts close to what the states of the world dictates. But as soon as one candidate is part of the network, their interest is to elect that candidate (with probability λ he is their best candidate). Information loss is more important since two dimensions of evaluation disappear with probability λ. This becomes detrimental for the firm because B is the best candidate with probability q^2. But when there is a network and when B is part of that network, he becomes the candidate perceived as best with probability $(1-\lambda)q^2+\lambda$, which is higher. The interests of the stockholders and that of the directors inside the network diverge. The extra power that the directors gain from the network becomes detrimental.

2.7.5 A is a candidate in the network

Proposition 2.7.5 $W(t^*_{N,A}) < W(t^*_0)$ *where* $W(t^*_{N,A})$ *is the welfare associated with the voting strategy of a board with a network and* A *part of that network*

The analysis is the same as above except now the interest diverges even further. For the firm A is the best candidate with probability $(1-q)^2$. But when there is a network and when B is part of that network, he becomes the candidate perceived as best with probability $(1-\lambda)((1-q)^2)+\lambda$. The difference is even greater than in the case where B is the candidate from the network.

2.7.6 Summary of optima comparisons

There are situations in which the network can be good for the stockholders. This is the case when directors are not efficient and worry about electing the winner. To that respect, the network can give them more power to elect who they think is best rather than just trying to conform to the others and herd around the candidate favored by the prior. However, this power can prove detrimental if the interests of the directors do not align with that of the stockholders and more specifically if one candidate is part of the network. In that case, the existence of a network inside the board becomes detrimental. The question that now arises is whether it is credible to think that, in a board where there is a network among directors, no candidate is going to come from that network. I have assumed that candidates are exogenous and that G is exogenous as well. It could be argued that there is a first stage where board members decide to run for the job of CEO. In that setting, it is possible to think that at least one candidate will be from the network and in that sense, having a network inside a board would always be detrimental for the firm. It is not the scope of this paper to study this, but it would certainly be of interest. t is interesting to study how the different cases affect the "welfare" of the stockholders. An intuitive measure of welfare would be to look at the probability that the board makes a mistake, i.e. elects the candidate that had a minority of w. The intuition comes from the assumption that by aggregating the w_i (when they are not correlated), the board members would get a perfectly accurate opinion on the candidates. Therefore, the candidate that has a majority of w_is, who is the best candidate of a majority of board members is also the best candidate for the firm. In other words, the board is composed in an efficient way so that if board members could observe perfectly their private interests (apart from voting for the winner) and expressed them truthfully, that would lead to the optimal decision for the firm. Again, this is an assumption, it comes from the definition of the w.

2.7.7 From efficient to benchmark case - effect of introducing the bias to vote for the winner

In the efficient case, the directors maximize the value of the firm, therefore, there should not be a gain from deviating.

Proposition 2.7.6 $W(t^*_{eff}) > W(t^*_0)$ *where* $W(t^*_{eff})$ *is the welfare associated with the cut-off strategy adopted from efficient directors (cut-off point* t^*_{eff}*) and* $W(t^*_0)$ *is the welfare associated with the cut-off strategy adopted by directors in the benchmark case (cut-off point* t^*_0*)*

This fact is not surprising and it shows that, when deviating from the goal of value-maximizing, the directors decrease the welfare of the stockholders. Again, by definition of efficient, this is an expected result.

2.7.8 From efficient to network with no bias to vote for the winner - effect of introducing network

To study the welfare in the network case, I consider that the w_i of each director that is optimal for the firm is the one he observes in the absence of correlation, the one he observes with probability $1 - \lambda$. This comes from my definition of w and the assumption that, in the absence of network, the aggregation of the three w_is reflect perfectly all available information on the candidates. Therefore, what enhances the welfare of the firm's owners is that each director votes like his w_i, allowing the election of the best candidate for the firm. When the network is introduced, with probability λ, some information is lost since only two ws then become observable or retrievable. This assumption leads to consider that introducing a network leads to a loss of welfare (by assumption since I consider that aggregating the three ws leads to perfect information on the candidates and that this does not happen with network).

Proposition 2.7.7 $W(t^*_{eff}) > W(t^*_{N,eff})$ *where* $W(t^*_{eff})$ *is the welfare associated with the cut-off strategy adopted from efficient directors (cut-off point* t^*_{eff}*) and* $W(t^*_{N,eff})$ *is the welfare associated with the cut-off strategy adopted by directors in a* *board in which there is network but no bias to vote for the winner (cut-off point t_0^*). This proposition is contained in the assumption on w.*

This distortion from the efficient case by introducing the network comes from the definition of w and the assumption of perfect aggregation of information in the case in which the ws are not correlated. The loss of welfare appears in the graph .I do not care to focus on it too long. What is of interest is the comparison between the benchmark and the network case.

2.7.9 Unanimity

It is interesting to study how introducing networks can affect the welfare of stockholders.
In the first place, I will compare the benchmark case and the case of a unanimous vote for B. Indeed, as shown in the previous section, unanimity arises more often (for a lower G) in the case of a network than in the benchmark case. The legitimate question is therefore to know whether this is detrimental to the firm.

Proposition 2.7.8 $W(t_0^*) > W(1)$ *where* $W(1)$ *is the welfare associated with unanimity for B (the cut-off is* $t = 1$*, leading to unanimity).*

This proposition comes from the fact that $t = q$ is efficient. Any distortion from that cut-off creates a welfare loss. Therefore, as long as the benchmark case does not create unanimity, there is a welfare loss. This is consistent with the intuition. Indeed, unanimity, even for the best candidate in probability, limits the possibility of A being elected even if he is the best candidate in fact. As long as the cut-off in the benchmark case allows for the possibility of A being elected, even very small, that creates more welfare for the firm. The case in which A is part of the network and for which there is unanimity for A is even more detrimental for the firm. Not only there is no possibility for the candidate B to be elected even if he is best in fact but B is very likely to be best in fact since $q > 0.5$.

Proposition 2.7.9 *$W(t_0^*) > W(0)$ and $W(1) > W(0)$ where $W(0)$ is the welfare associated with unanimity for A (the cut-off is $t = 0$, leading to unanimity).*

2.7.10 From the benchmark case to the network case with no unanimity

To compare these two situations is not easy because t_n^* cannot be solved for in closed form. There is no obvious intuition as to what will be more detrimental to the welfare since $t_x^* > t_0^*$ but $t_n^* < t_0^*$. In other words, the director who is out of the network is mistaken more often than the director in the benchmark case but nothing can be said a priori from the director in the network. Besides, unlike when all directors are symmetric, it is not sufficient to compare individually the cut-offs. Indeed, if we assess the probability that the board collectively takes the "right decision", it must be taken into account that a director from the network will more likely be pivotal. Therefore if he is mistaken, this leads to more welfare loss in probability than when a director who is not part of the network commits a mistake. Since nothing can be said a priori, I will study some cases to see how the parameters can affect the welfare of the stockholders.

2.8 Extensions

2.8.1 Increasing the number of board members

Increasing the number of board members distorts the votes even in the benchmark case when $G \neq 0$. We can take a very simple example of that. Imagine a board in which there is no election but rather they randomly draw which director chooses the result of the election. In a case of a three-member board, the probability of being pivotal is $\frac{1}{3}$, in a case of a five-member board, the probability falls to $\frac{1}{5}$. In our case, the probability of being pivotal is less obvious to compute but the idea is similar. Therefore, if the number of people on a board increases, the directors will put more weight on voting for the winner. This is equivalent to increasing G. It appears therefore that very large boards might be less efficient when choosing their CEO/ Chairman.

Proposition 2.8.1 *When the number of board member increases, directors tend to vote more for B. There exists a $\bar{J}(q)$ for which, directors vote for B for any signal and any ability when $G > 0$*

The proposition comes from the fact that, as the number of board member increases, the probability of being pivotal decreases. This limits the responsibility of each director in the final decision but it makes each more eager to vote for the winner, because comparatively this is how he can best increase his expected payoff.

2.8.2 Endogenizing G

In the model as I present it, G is exogenous and the same for all board members. One could argue that the premium for voting for the winner depends on the number of people who voted for him or whether the director who voted for him is from the same network.

If the election is close, the winner will value each vote more. If that is so, G should vary with the number of votes.

Remark 2.8.1 *If G is a function of the number of final votes, the results do not change substantially, they just correspond to a rescaling of G.*

This result is true in the particular set up of the model because, in this model, directors worry about G only if they are not pivotal. Therefore, they will get $G(3votes)$ or nothing at all. If I consider that $G(2votes) > G(3votes)$, endogenizing G comes back to an exogenous G but lower than in the general model. However, if they were more than 3 directors whose vote counted, this particular result could be altered.

2.9 Concluding remarks

In this paper, I have shown that, if we assume that directors are concerned not only about the value of the firm but also about the favors they could get from the Chairman, they will not vote efficiently. This is likely the case since indeed the Chairman has power to provide favors or retaliate against board members. This effect combined with networks inside the board affects every director's vote. The results show that having a network inside a board is beneficial for stockholders as long as members of that network are not candidates to become CEO. In that case, the existence of a network gives power to its members which balances that of the future CEO. It therefore limits the incentive of voting for the future winner and reinforces the incentive to vote for the best candidate.

This result contradicts common intuition that networks are detrimental in general. Here, I show that it can provide power to directors who are part of this network and decrease the power of the CEO over every member of the board, including directors who are not part of the network. This, in turn, allows them to vote efficiently. In this paper, I study only the CEO's election process. However, it is likely that the extra power directors have when part of a network could affect other decisions on a board (strategy, compensation, dividends). However, as the results show, if one member of the network is candidate to become CEO, the existence of a network becomes detrimental. In the paper, I assume that candidacy is exogenous but it is very likely not the case. If so, one could suppose that in a board with a powerful network, at least one candidate will be from that network.

Chapter 3

Networks matter at the top : an empirical analysis of French boardrooms

3.1 Introduction

In the past decades, debates on corporate finance have been very active.Directors' independence has been under a close scrutiny since it is a common belief that independent directors provide more accurate control and lead to better governance (following the theoretical finiding of Fama (1980)). France is no exception in that debate. The proportion of independent directors now enters the guidelines of the AFEP-MEDEF (the representative of the firms) ethics code, for firms in France. And the number of independent directors has surged along with the number of firms disclosing that information. Firms communicate more and more on the number of independent directors and proportion of independent directors has (also) become one tool of corporate communication.

However, independence is defined with respect to the firm. The relationships between board members are seldom studied. Nonetheless, one could think that interdependence between board members would increase herding behaviour and limit board effectiveness (see González (2006)) . In France, this could be particularly true as the education system could appear to favour the emergence of "clubs". In particular, the three main *"Grandes Ecoles"*, Ecole polytechnique, HEC and l'ENA, are thought to have powerful *alumni* networks and provide top managers both in the public and

Table 3.1: Education of the CAC40 CEOs

	ENA	HEC	X	1 school	1 Grand corps
Out of 40 CEOs	28%	13%	23%	53%	33%
Out of 30 CEOs	37%	17%	30%	70%	43%

"1 school" refers to the proportion of CEOs that graduated from at least one of the three; "1 Grand Corps" is the proportion of CEOs issued from either the Finance inspection, the Mines or the Bridges "corps"

private sectors. For instance, 53% of CAC40 CEOs are *alumni* of at least one of these three schools. The proportion climbs to 70% if we exclude foreigners and CEOs who inherited their firms (see table 3.1).

In this paper, using a multinomial logit model at the firm level and a logit model at the individual level, I choose to study how board behavior varies depending on the proportion of *alumni* from HEC, Polytechnique or ENA in each board. More specifically, I focus on the election of a new Chairman of the board or CEO. If networks have an impact on how boards behave, we should observe a link between the board members' *alma mater* and the CEO's. Unlike Kramarz and Thesmar (2008), I do not study how the CEO's *alma Mater* affects the composition of the board, but rather how the composition of the board influences the choice of CEO. Both papers are complementary. Also, I extend my study beyond the CAC40, and use over 12 000 French firms. I not only get the expected result that *alumni* from one school elect more often one of their peers but also that there is rivalry between Ecoles. This supports even further the idea of network effects.

3.2 Literature review

The literature on corporate governance has widely studied directors' independence and its effect on various outcomes such as CEO compensation, golden parachutes, firm performance or other corporate related issues. The theory, mainly following agency problems *à la* Fama (1980), advocates for independent directors since it would ensure separation between control and management. In such setting, a more independent board would lead to efficient behaviors such as a board firing a poorly performing CEO (Hermalin and Weisbach (1988), Laux (2008)). Westphal (1999) finds results consistent with such prediction. However, not all studies find similar results. A larger proportion of outside directors can be associated with a higher probability of the CEO getting a golden parachute (e.g. Singh and Harianto (1989), Wade et al. (1990), Cochran, Wood and Jones (1985)). Likewise, an increased ratio of outside directors can be positively correlated with compensation (e.g. Boyd (1994)).

Social networks and educational networks can explain these contradictory results. Literature on "old boys club" inform us on the importance of networks in labor market processes such as hiring, colluding or forming groups (see Balan and Dix (2009), Byrne (1971),Rivera (2012)). On boards, specifically, networks have been studied to predict board composition (see Kramarz and Thesmar (2008), Hillman, Shropshire and Cannella (2007)). But social networks also affect the CEO. For instance, Belliveau, O'Reilly and Wade (1996) show that social capital of the CEO relative to that of the chair of the compensation committee can increase the CEO's compensation. Similarly, Butler and Gurun (2012) outline the importance of educational networks in the process of voting the CEO's compensation. To my knowledge, no paper has studied the effect of social networks on the hiring process of the CEO. Westphal and

Fredrickson (2001) show how a board can be important in choosing a new CEO. Therefore, I study the effect of networks in that process.

3.3 The data

3.3.1 *Alumni* directories for the top 3 schools

Schematically, after high-school, for students who wish to pursue a higher education, the French education system offers two parallel choices: joining a University or preparing competitive exams to enter a Grande Ecole. These Grande Ecole are usually small (around 1200 students each, 300 per batch), the total population of students being around 50,000 a year. Their *alumni* tend to find better jobs and to achieve better careers both in the private and in the public sectors. This system is a heritage of the Revolution period. It was aimed at that time to generate a new elite based on their merits rather than family. Not all Grande Ecole enjoy the same prestige. I will make the assumption that the best ranked schools also have the most powerful networks. This paper aims at exploring network effects. My purpose is to focus on the networks that are thought to be the most powerful. Indentifying the most prestigious schools is straightforward. Every year, newspapers and magazines (le Figaro, le Point, l'Etudiant, ...) publish a ranking of the best engineering and the best business schools. Each year and in each source, since the rankings started, l'Ecole Polytechnique (X from now on) and l'Ecole des Hautes Etudes Commerciales (HEC from now on) are ranked best engineering and business school respectively. [1] In addition to those two schools, I add l'Ecole Nationale d'Administration (ENA) that was designed to recruit

[1] It is also significant that a student accepted to both Polytechnique and another engineering school, usually choose Polytechnique. It is difficult to have actual numbers but it is rumored that only 1 to 4 students accepted to l'X each year choose to go to the second best school. It is the same for HEC, to the point that the school does not have a waiting list, considering it useless since no student admitted would resign to choose another school.

top civil servants, politicians but also leads to top positions in business. I confirm this choice by studying the education of top French CEOs. The Ecole des Mines publishes each year an international ranking of schools and universities based on the education of the Forbes 500 CEOs. The first three French schools in this ranking are : HEC (rank 4), Polytechnique (7) and ENA (9).

For each of these three schools, we establish a list of *alumni*. For l'ENA, I only keep those who have at least one occupation in the private sector. For Polytechnique, I use the complete *alumni* directory, provided by the School. Finally, for HEC, I use the *alumni* that are present in the Who's Who in France. This is obviously not exhaustive, and it certainly leaves out many *alumni* that work in smaller firms.

3.3.2 The firms

The data for the firms and their boards come from FIBEN, a dataset constructed by the Banque de France. FIBEN is an individual company dataset. It includes about 200 000 companies for which it provides data on capital, revenue, past revenue (2 year lag), employees, and exports, value added, dividends and other financial data. However, it does not provide stock prices, and not all companies are listed on the stock market. In addition to financial data, the dataset also contains information of ownership and on board composition over the years. Its main purpose is to allow the Banque de France to rate the firms. This, in turn, provides information on the risk exposure of the banks. FIBEN is sold to the banks that need more information on firms before they give loans. Because it is sold to the banks, FIBEN does not include the banking and financial sector in the firms. Indeed, that would constitute a breach of competition if banks could access their competitors' balance sheet. The 200,000 firms are rated by size (A,B,C,D,...). I only keep the largest ones (up to D) which gives a sample of over 12 000 firm. It is very probable that the others will not have boards, but I do not have access to these data to verify it. For all these firms, the data provides the composition of their board (if they have one), the legal form of incorporation, the CEO. There is no information however on the executives. FIBEN is a unique dataset since it includes very various data on a large number of firms. In particular, the board composition is kept over the years as well as the ownership data. Therefore, for each firm, one can reconstruct the structure of the board since the birth of the firm as well as the structure of ownership. Some databases are similar but do not cover the same range as FIBEN. In particular, Corporate Affiliation^{TM} has lots of similarities with FIBEN. It gives detailed financial data, group structures, board composition, competitors and also executives and former executives for over 1 000 000 companies in the US and abroad. It also provides biographical information for 1 600 000 executives or directors. However, its scope is limited at parent companies with an annual revenue of $ 1,000,000. FIBEN provides information on smaller firms as well.

3.3.3 Description of the data used in the econometrics

In France, there is a legal obligation to elect the Chairman among the board members. This obligation applies for firms incorporated in certain legal ways. Along with this duty, those firms need to have at least three board members. Therefore, I restrict the sample to firms with at least three active board members at the moment of the election of the CEO or Chairman. I also exclude firms with extreme revenue growth. Indeed, in the whole sample, I have firms whose revenues grow by 55000% in 2009. As a reference, Fannie Mae, which was the fastest growing listed company in the US in 2009 (reference year), grew by 429% (Source: Fortune). It is therefore a fair assumption that the reports of the firms with extreme revenue growth are mistaken or misleading. Therefore, I do not keep the firms with a revenue growth of more than

700%, which is already high but more plausible, especially for smaller or younger firms. From 12 482 firms, the sample shrinks to 6,664 firms. Figure B.1 shows how capital, revenue and number of employees change with the restriction of the sample. Higher volatility in financial data can be explained by the fact that firms with no board are excluded from the sample. These firms are usually founded, owned and run by the same person and are homogeneous financially speaking. After reducing the sample, the proportion of Grandes Ecoles *alumni* increases and that the volatility is reduced: they are more present in bigger firms, or at least, they are less likely to create and run a small firm. When I restrict the sample, it also leads to a reduction of the number of directors I observe. In the whole database, there are 92,107 unique directors. After the reduction, 34,625 are left. The proportion of *alumni* of each school among those directors increases slightly compared with the initial sample, comforting the previous observation (see table 3.2). In table 3.3 , I compare the characteristics of the directors in the sample, to those who are *alumni* from the various schools. *Alumni* hold a larger number of mandates on average and are more often CEO, except for ENA *alumni*. This cancan be explained by the fact that ENA *alumni* are often civil servants, since the school is designed to educate civil servants. When they sit on boards, it can be *inuitu personae* or as representant of the State if the firm is partly owned by the State. When they act as representant of the State, board members cannot be elected Chairman of the Board.

Finally, there is no evidence of a financial difference between firms run by *alumni* of Grandes Ecoles and the others. In table 3.4, I report the t-tests comparing the mean of each group to the reference group (i.e. not an *alumnus* CEO) on different financial data. It is interesting to see that there is no statistical difference on average. This would need refinement but it is not the object of this paper. However, as a first approach, it is interesting in that in limits the argument according to which *alumni* of Grandes Ecoles are better CEOs and therefore get elected more frequently based on their abilities.

To have a visual approach of networks in French firms, I create some figures (see figure B.6 to B.10). In B.6 and B.7, the nodes are the firms. The color of the node depends of the CEO (red if she is an *alumnus* for one of the three *Grandes Ecoles*, blue if not). The edges represent a director who sits on the board of both firms he links. The color of the edges represent the *alumnus* status of the said director. Each firm is then connected to a number of other firms through its directors. The size of the node depends on the number of connections. The layout is constructed by an algorithm depending on connections and weights of the nodes.A node which is in the center of the graph is well connected to other nodes which are in turn well-connected. This node has greater influence in the network. In these figures, it appears that, not only do firms with a *alumnus* CEO are well connected but more over that connections are mainly due to *alumni*, reflecting the fact that they hold on average more seats. In figure B.8 to B.9, the nodes are the directors themselves and the edges are created if two directors sit on the same board. Again, the size of the node depends on the number of connections. *Alumni* clearly appear to be better connected and in the center of the network of all directors, giving them extra powers. This in turn should increase their probability of being elected.

Table 3.2: Proportion of alumni among directors

	Total	In the final sample
Proportion of ENA alumn.	1.0%	1.3%
Proportion of X alumn.	1.1%	1.5%
Proportion of HEC alumn.	0.8%	1.1%

Table 3.3: Comparison of directors' characteristics

	Total	ENA alumn	X alumn.	HEC alumn
CEO at least in one firm	21.40%	18.7%	28.7%	29.4%
Average number of mandates	1.30	1.77	1.77	1.78

Table 3.4: P-values in mean comparison tests (Ha: the two groups have different means)

	EBITDA	Dividends	VA/employee
HEC	0.17	0.08	0.08
X	0.06	0.05	0.32
ENA	0.26	0.29	0.52

The table reports the p-value for a mean comparison test between groups of firms whose CEOs who attended HEC, ENA, X and none of these schools

Reading the table: the p-value for EBITDA and HEC is 0.17 >0.05. We can reject the hypothesis that companies run by an HEC CEO, on average, have a different EBITDA

3.4 Economic model

There is evidence to suspect that the proportion of *alumni* on a board increases the probability that one of them will be elected CEO/ Chairman. I aim at capturing the role of networks in reaching the top position (CEO or Chairman) from a high responsibility position. The purpose of this section is to give an outline of an economic model that would explain why there would be a network effect. A more detailed model can be approached theoretically by looking at a strategic voting game in committee (see Ravanel (2013)) . This is not my purpose here.

Recall that although we do not observe them directly, the variable that would be of interest to us is the individual votes of each board member. I make a number of assumptions to keep the model as simple as possible: a candidate is elected if he obtains a majority of votes. Let B be the candidate. Board members vote to maximize their utility. Assume that the board members have a reservation utility $\bar{u}$. They vote for B if the utility they gain from this vote is greater than $\bar{u}$. The utility they get from voting for B depends on whether they are part of the same network as he is. If a director is not part of any network, she gets utility from the value the firm gets if B is elected: $u(B)$. This function depends on the characteristics of the firm and of B (we assume $u(B)$ increases with B's talent as a Chairman). If the director is form the same network as B, with probability λ, she gets, on top of the firm's value $u(B)$, a premium P if B is elected and with probability $(1 - \lambda)$, she gets the same utility as the board members who are not part of the network ($u(B)$). Finally, if the director is from a competing network, with probability γ_k, she gets, on top of the firm's value $u(B)$, a discount/premium D if B is elected and with probability $1 - \gamma_k$, they get the same utility as the board members who are not from any network (*i.e.* $u(B)$).

As a summary, we can write:

$$u_{B,i} = u(B) \text{ if } i \text{ is not part of any network} \tag{3.1}$$

$$u_{B,j} = \lambda(u(B) + P) + (1 - \lambda)u(B) \text{ if } j \text{ in the same network as B} \tag{3.2}$$

$$u_{B,k} = \gamma_k(D + u(B)) + (1 - \gamma_k)u(B) \text{ if } k \text{ in the part of network k} \tag{3.3}$$

Let m_i be the vote of i. We define $m_i = 1$ if i votes for B and 0 otherwise.

$$m_i = 1 if u_{B,i} > \bar{u} \quad \forall i \tag{3.4}$$

However, since we do not observe the individual votes, we need to aggregate at the firm level. Let M be the election result. We define $M = 1$ if B is elected by the board and 0 otherwise. We can write:

$$M = 1 \text{ if } \sum_{i=1}^{J} m_i > J/2$$

where J is the total number of the board members. Let furthermore assume that the reservation utility is distributed on a standard uniform distribution and let $Prop_k$ be the proportion of board members that are part of network k. We can rewrite:

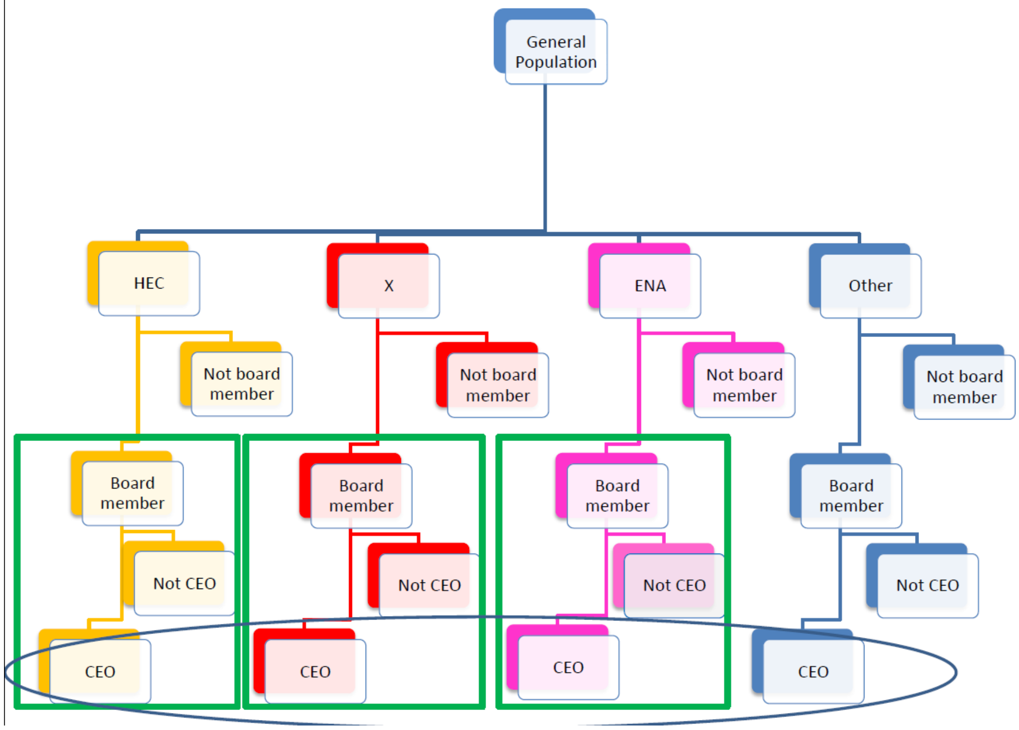
$$M = 1 \text{ if } Prop_{kB}\lambda P + \sum_{k \neq kB} Prop_k \gamma D + u(B) > 1/2 \tag{3.5}$$

where kB is the network of the candidate B. This is the equation I will estimate.

3.5 Estimation strategy

The object of the paper is to identify whether network connections have a part in becoming a CEO once a director. There are two possible ways to estimate this. Figure **??** provides a schematic view of these strategies. At the firm level (blue ellipse), one can study the probability of the CEO being an *alumnus*, given the proportion of *alumni* on the board. At the individual level (green rectangles), on can compare the

Figure 3.1: Estimation strategies



probability of one director, *alumnus* from school k, to become CEO compared with his fellow *alumni* directors who are not CEOs.

3.5.1 By firm

Going back to equation 3.5, at the firm level, what is of interest to us is the higher education received by the CEO. Is he from Polytechnique, HEC, ENA (or a mix of these) or not? It therefore appears clearly that it is a categorical variable. Therefore, I create the variable $CEOpart$ where

$$CEOpart_j = \begin{cases} 1 & \text{if CEO of firm } j \text{ is X } \textit{alumnus} \\ 2 & \text{if CEO of firm } j \text{ is ENA } \textit{alumnus} \\ 3 & \text{if CEO of firm } j \text{ is HEC } \textit{alumnus} \\ 0 & \text{otherwise} \end{cases}$$

Then the question we ask is whether a high proportion of *alumni* of the same school, present on the board at the moment of the vote, will affect the result of the election.

$$CEOpart_j = \alpha + \sum_k \nu_k PROP(k)_j + \beta Controls \tag{3.6}$$

Comparing with equation 3.5 we see that the controls are equivalent to $u(B)$. They are meant to capture what the board members would have decided in the absence of network effect (B is actually a suitable candidate). Unfortunately, we have little information on the individuals apart from their education, the number of board member positions and the amount of their participation in the firm. We mainly control therefore for characteristics of the firm. Another difference is that in the estimation, I do not distinguish between λ (or γ) and P (or D). In practice $\nu = \lambda P$ (or $\nu = \gamma D$). This is not necessarily problematic because ν captures both effect of the network: people vote for their peer (λ) because they expect them to give them more in return (P). In the case of a competing network, the sign we expect of ν is not obvious. There are two possible contradictory effects. Either people who went to HEC, X and ENA believe they are part of a larger, broader network of *alumni* of Grandes Ecoles, in which case ν should be positive but smaller than the one for the school of the candidate. Or, networks compete. In which case, someone from ENA will not want to favor someone from another school and will want to avoid his election. This can come from the *alumnus* does not want other schools to benefit from the good "image" of having many CEOs or because he fears that an *alumnus* from another school might give him less than a neutral Chairman ($D < 0$). In any case, the sign of ν for competing networks is of interest to us. To be able to understand the ν correctly, I correct the proportion for the weight of one person on a board. That is $Prop = \frac{\#ofboardmembersfromschoolk}{\#boardmembers} - \frac{1}{\#boardmembers}$. In doing so, I correct for the automatic increase in the probability of a CEO being from HEC as the proportion of HEC increases. Roughly, by doing so, I control for the 45 degree line. If a coefficient is positive, that means that the probability of the CEO being from HEC is greater than what would be expected from the mere number of HEC alumni should there have been a random draw. A positive coefficient shows a direct network effect.

3.5.2 By individual

If we study the database by individual director instead of looking at it at the firm aggregated level, we can form subgroups by *alumni* status. Inside each group, assuming some sort of homogeneity of skills, we can look at who is elected and in which type of firms. It is much easier to control for the firm peculiarities since in the data, there are many variables that characterize the firm. It is possible to create an average of the firms' characteristics for the group (all firms in which there are some *alumni* of network k) and compare the average to the specific features of the firms in which one of them is elected. Another way to go would be to construct the average at each individual's level, for those who sit on more than one board. We can then run a logit model for each group. The specification would be:

$$CEO_{i,k} = \nu NetProp_{i,k} + \theta Netcontrol_{i,k} \tag{3.7}$$

$NetProp$ is the net proportion of *alumni* from k on the board of the firm where individual i from network k is the CEO minus the average proportion of *alumni* from

k over the boards in which at least one *alumnus* sits. The same goes for the controls. The problem with this specification is that the interpretation is very narrow. If ν is positive, it will show that, among board members from network k, the probability of being elected is greater if the proportion of k *alumni* is greater.

3.6 Results

Here is an outline of the main results.

3.6.1 By Firm

The multinomial regression described in the previous section is run on the firms in the sample described in section 3.3.3 for which the election is not a mere reelection. This allows us to control for composition effect of the board. More precisely, we can think that a Chairman will have an influence on the composition of the board during his term. At the end of his term, he is more likely to be reelected since he nominated many of the board members. Also, I exclude from the sample the CEOs that went to more than one of the three schools. That allows to have a clearer vision of the cross effects of networks.

Specification 1 is the multinomial logit with all controls, specification 2 is the multinomial logit without the previous CEO type (ENA,X,HEC), 3 is same as 2 but with no control for being located in the Paris area, 4,5,6 are LP regression on each type of CEO. I report the marginal effects.

It appears from the table 3.5 that the pure network effect exists and is positive. This is what we expected to see. In all the specifications, the coefficients are significant. For the cross effects, the results are as follows. It appears that in the specification with fewer controls, the coefficients are not significant at the 5% level or at the 10%

level whereas when controlling for the status of the previous CEO, the significance is enhanced. The only coefficient that is not significant at the 10% level is the proportion of X *alumni* on the election of an ENA CEO. Apart from this one, the other coefficients are all negative (less than 1 in the relative risk ratio approach). We observe the same in the OLS regression. This is very interesting: it means that there is some sort of competition among schools. Notice that I excluded from the sample the CEOs that went to more than one school. When including them, we get slightly different results on cross effects (loss of significancy) since a CEO who graduated from two schools gets the votes of *alumni* from those two schools. Therefore, the coefficients catch the pure effect, not the cross effect. This competition across networks is interesting for two aspects: it reveals a strong sense of the networks' interest and a strong belief in network effects when it comes to favoring your peers. Indeed, as explained in the previous section, there are two reasons why a board member part of network k would vote less for someone who is part of network k' than for someone who is part of no network. First of all, he might think that being elected CEO gives the network a higher importance. The more Chairmen, the more powerful a network becomes being the underlying assumption. If that is true, and given that there are a finite number of Chairman position, it is more useful for a network to attribute the seat to someone who is not part of any network than to give it to another network so that the relative power of someone's own network is not diminished. The other possible explanation is that that board member believes that the elected Chairman will not treat him as well if he is part of a competing network than if he is not part of any network. Again, two reasons can sustain this belief. Either the Chairman from another network will favor in priority his own peer (because there is network effect, because he believes they are better at their jobs or for any other reason) or a Chairman who does not come from any network will favor whoever is better at their job. In this case, someone from a Grande Ecole who is usually considered as being competent, will be in a good position compared to board members who did not go to these schools. The board member from network k will compete with those from network k' on an equal basis (compared with the situation in which a CEO from network k' is elected). Again, what matters is the relative power of the network compared to others. The existence of these cross effects is therefore a very strong indication of the existence of network effect.

The other coefficients that are of high interest are those relative to the *alumnus* status of the previous CEO. It appears that, for each network, the coefficient of the previous CEO being from the same network is significant at the 5% level and that it is negative. It appears that, when they do not reelect the previous CEO, board members tend to choose someone that does not come from the same network or does not come from any network. This is very interesting because it is not conform to the intuition. In particular, there is evidence to believe that a CEO from a specific network will appoint board members from the same network (see Kramarz and Thesmar). Therefore, if the previous CEO is from k, there is a chance that the proportion of *alumni* of k on the board is greater than the average. We would expect to see a new CEO from the same network being reelected. But from the estimation, it appears that a former CEO who is an *alumnus* of k decreases the probability of a new *alumnus* of k to be elected. Recall here that I do not include in the sample firms who reelect their CEOs. This feature is anticipated in Zajac and Westphal (1996) who predict that "more powerful boards are more likely to change CEO characteristics in the direction of their own demographic profile. Outside successors are also typically demographically different from their CEO predecessors but demographically similar to the boards.". What it points out to is that the board members believe the value of the firm will suffer from electing another CEO from k and that this belief is high enough to overcome the network effect. This does not mean that *alumni* from *Grandes Ecoles* are less efficient CEO (we are not considering the ones that get reelected).

3.6.2 By Individual

The results (shown in table 3.6 for the marginal effects) show more or less the same effects. The probability of being elected CEO when *alumnus* of one of the three schools increases when the proportion of *alumni* is larger than the average proportion in firms where there is at least one *alumnus*. That is true for all three schools and is significant. The largest effect appears to be between HEC *alumni*. this can be explained by the fact that for ENA *alumni* in particular, and Polytechnique *alumni* to a lesser extent some other network might play a part (especially political connections) leading to dampened results. Cross effects are less clear than in the firm level specifications. However, they are negative (except for X on ENA) but not always significant. Another feature from those regressions is the effect of the status of the former CEO, which is similar to that of the "firm level" strategy.
The econometric model is run on subsets of directors, those who went to one of the three Grande Ecole. Therefore, there is no unobservable linked to an ability coming from the status of *alumnus*. This limits the problem of endogeneity. Sample selection remains but if we look at the subgroup of *alumni*, we can conclude that a larger proportion of *alumni* on one board favors the election of one *alumnus* compared to situation in which the *alumnus* is more isolated.

3.6.3 Limits

There exist limits to the strategies I use above. The main ones are on the sample selection and the endogeneity problem.
On the sample selection, the problem is that I am looking at board members only

Table 3.5: Marginal effects for the firm level specifications

	1	2	3	4	5	6
	CEO is X					
Prop. Of X alumn.	0.67	0.58	0.57	1.74	.	.
	0.03	*0.03*	*0.03*	*0.04*	.	.
Prop. Of HEC alumn.	-0.12	-0.07	-0.07	-0.49	.	.
	0.07	*0.06*	*0.06*	*0.06*	.	.
Prop. Of ENA alumn.	-0.19	-0.19	-0.19	-0.95	.	.
	0.07	*0.06*	*0.06*	*0.07*	.	.
Previous CEO is ENA	-0.02	.	.	0.09	.	.
	0.03	.	.	*0.03*	.	.
Previous CEO is X	-0.12	.	.	-0.32	.	.
	0.01	.	.	*0.02*	.	.
Previous CEO is HEC	0.03	.	.	0.11	.	.
	0.02	.	.	*0.03*	.	.
	CEO is ENA					
Prop. Of X alumn.	0	0.01	0.01	.	-0.12	.
	0.01	*0.01*	*0.01*	.	*0.02*	.
Prop. Of HEC alumn.	-0.1	-0.09	-0.09	.	-0.53	.
	0.02	*0.02*	*0.02*	.	*0.03*	.
Prop. Of ENA alumn.	0.19	0.17	0.17	.	0.78	.
	0.02	*0.02*	*0.02*	.	*0.03*	.
Previous CEO is ENA	-0.02	.	.	.	-0.1	.
	0.01	.	.	.	*0.01*	.
Previous CEO is X	0.01	.	.	.	0.04	.
	0	.	.	.	*0.01*	.
Previous CEO is HEC	0	.	.	.	0.1	.
	0.01	.	.	.	*0.01*	.
	CEO is HEC					
Prop. Of X alumn.	-0.06	-0.06	-0.06	.	.	-0.18
	0.02	*0.02*	*0.02*	.	.	*0.02*
Prop. Of HEC alumn.	0.36	0.37	0.37	.	.	1.39
	0.04	*0.04*	*0.04*	.	.	*0.04*
Prop. Of ENA alumn.	-0.05	-0.03	-0.03	.	.	-0.99
	0.03	*0.03*	*0.03*	.	.	*0.04*
Previous CEO is ENA	0	.	.	.	.	0.2
	0.01	.	.	.	.	*0.02*
Previous CEO is X	0	.	.	.	.	0.03
	0.01	.	.	.	.	*0.01*
Previous CEO is HEC	-0.03	.	.	.	.	-0.24
	0.01	.	.	.	.	*0.02*

Table 3.6: Individual approach:marginal effects

ENA			
	LP	Logit	Probit
Proportion of ENA alumni*	*0.621**	*0.643***	*0.650***
	[0.335]	[0.312]	[0.317]
Proportion of HEC alumni*	*-0.891***	*-0.957***	*-0.953***
	[0.387]	[0.404]	[0.381]
Proportion of X alumni*	*0.204*	*0.114*	*0.0925*
	[0.213]	[0.199]	[0.200]
Previous CEO	*-0.224****	*-0.204***	*-0.201***
	[0.0832]	[0.0861]	[0.0826]

X			
	LP	Logit	Probit
Proportion of ENA alumni*	*-0.821****	*-0.820****	*-0.818****
	[0.209]	[0.209]	[0.208]
Proportion of HEC alumni*	*-0.179*	*-0.133*	*-0.151*
	[0.305]	[0.292]	[0.289]
Proportion of X alumni*	*0.565****	*0.561****	*0.553****
	[0.127]	[0.122]	[0.121]
Previous CEO	*-0.288****	*-0.278****	*-0.278****
	[0.0429]	[0.0404]	[0.0402]
Age		*-0.00647****	*-0.00675****
		[0.00150]	[0.00149]

HEC			
	LP	Logit	Probit
Proportion of ENA alumni*	*-0.359*	*-0.313*	*-0.363*
	[0.386]	[0.389]	[0.385]
Proportion of HEC alumni*	*1.688****	*1.722****	*1.711****
	[0.318]	[0.290]	[0.289]
Proportion of X alumni*	*-0.449*	*-0.437*	*-0.429*
	[0.309]	[0.293]	[0.292]
Previous CEO	*-0.0311*	*-0.0149*	*-0.00999*
	[0.128]	[0.137]	[0.136]

Standard errors in brackets *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specification (3) is used to calculate ME and not globally at the population. This indeed creates a selection problem since, obviously, board members have been selected and are not representative of the total population. Looking only at gender or age should make that obvious (there are more older males than in the total population). The board members are not exactly independent from one another, compared to the global population. This appears as a problem but reveals strength. Indeed, it is not my point to take the global population as a starting point. My object of interest is what extra qualities matter at the top. How does one become Chairman from being a board member? The intuition is that personal qualities as a professional are not enough because, to that respect, all board members are similar.

The other selection problem is all the more important because I am studying networks. There is a suspicion that the network of the CEO will affect the composition of the board (see Kramarz and Thesmar). Indeed, when looking at the sample, it appears that the average proportion of each network is much higher when the former CEO was from that network. However, the assertion is less powerful when I compare with the firms in which the proportion is not 0, that is in firms in which there is at least 1 *alumnus*. In that case, it appears that the difference between firms whose former CEO was from the network or not is not significant. The conclusion is that there is selection but it happens more through cooptation than only from the power of the CEO. However, in order to control for this aspect, I include a dummy for the *alumnus* status of the previous CEO. As for the cooptation possibility, this is network effect that will be reflected in the election of a Chairman from the network, so it reinforces the main point. To make it short, the idea is that, if there is a network effect, it will lead to cooptation which results in high concentration of *alumni* on boards. This high concentration added to the network effect favors the election of a CEO from the network. Notice that if there was no network effect but high concentration of *alumni* on boards (for exogeneous reasons), there would be no reason to see Chairmen being elected more often among *alumni*. Therefore, *per se*, concentration is not a problem. Endogeneity is a concern as well. The idea is that, since the *alumni* we are looking at went to the best schools and since those schools select students, there is a suspicion that they are better professional and therefore are more often elected CEO or Chairman because of that. This idea cannot be disregarded and since there is no obvious instrument to correct for this, Hausman test cannot be run to test our results. However, many factors can somewhat dampen the problem. First of all, as I said earlier, I am only looking at board members. If someone got elected to that position, it can be imagined that she has the assets that could make her eligible for the job of Chairman. Indeed, it is not very easy to become a board member: competition is fierce and it requires some skills (both on the professional level and on the personal level) that will prove useful to be elected Chairman as well. Therefore, *alumni*, even if they differ from the other board members in other ways than just belonging to a network (if they are on average "better" at their jobs), differ less from other board members than from the global population. From that point of view, endogeneity concern is less vivid. On top of that, there are other remarks that have to be made to reinforce the conviction that endogeneity is not as big a concern as it could be. First, those *alumni* attended *Grandes Ecoles* at age 20. The system that selected them, chose them at age 16 or 17. The Chairmen are usually much older than this (50 or 60 in the biggest firms). Besides, they were selected on very precise skills: namely, being good at taking competitive exams, math oriented for X and HEC, more diverse for l'ENA. At no point did the exams measure the ability to be a good manager. Therefore, it can be dubious to say that, compared with the other board members, they have exceptional skills that make them apart. Finally, some descriptive aspects sustain this view that endogeneity is not as big a concern as it may seem. At X and ENA, students are ranked at the end of their school years based on their grades. Depending on their ranking, they choose their "corps" (body)[2]. There is a clear hierarchy in those "corps". For l'ENA, there are three " grands corps": the Inspection of Finance, the Conseil d'Etat (Supreme court equivalent) and the Cour des Comptes (GAO in the US). For Polytechnique, it is les Mines or les Ponts. In the data, it can be observed that, in a board with X *alumni* whose majority did not enter the "Ponts" but went to the Telecoms one, a Pont *alumnus* is less likely to be elected CEO than a Telecom one although, from an educational attainment point of view, he should be regarded as better. The same is true for l'ENA. This points out to a pure network effect, with no judgment made on skills. In our data, we have too little information to test this hypothesis more formally.

Despite all these descriptive evidence, endogeneity cannote completely be ruled out. In an ideal world, a difference in difference regression would offer evidence of network effects without the suspicion of endogeneity because it would provide individual fixed effects. However, in this case, this is not an option because the reference group (those who are not part of any network) would be affected by an increase in the proportion of *alumni*. Indeed if the dependent variable is the probability of becoming CEO, it is clear that the sum of the probabilities by group should equal to 1. Therefore, if there is indeed a network effect (the higher the proportion of *alumni* the higher the probability that one is elected), then it clearly affects the test group. However, the estimation run at the individual level can be seen as having some similarities with the difference in difference specification, as it compares each *alumnus* to the average of his peers. Another endogeneity concern is that some schools might be more able at providing certain skills that have higher returns in certain firms. Simply put, Poly-

[2]those can be the jobs students will get when they get out of the school (in ENA) or the last year of their training, during which they specialize.

technique might be a better place to learn engineering and a Polytechnique alumnus will in turn have better return as a director on the board of a car making firm than an HEC alumnus. Likewise, a Polytechnique alumnus will make a better CEO of a car making firm. The correlation between proportion of alumni and probability of becoming the CEO might not reflect network effects but simply better matching. To properly control for that effect, a panel regression would be needed in that it could include some firm fixed effects. Unfortunately, it is not an option due to the data. However, the estimation strategies I use might limit this concern without correcting it entirely. Indeed, I control for many firm related specificities, in particular sector, size, part of the revenue from exportations, location. Endogeneity concern remains, but it would be linked to skills specifically related to a firm and not to a type of firm. In other words, it would reflect that Polytechnique is better at providing skills specifically linked to Peugeot but not Renault. It is possible, in particular if many alumni work at Peugeot and then teach classes about the firm's specificities. However, if this is so, it is difficult to draw a line between skills and network. Network is not necessarily only about favouring your peers as such but also about providing insider's information and knowledge.

3.7 Concluding remarks

From the evidence presented above, there seems to be some network effect at stake when electing a Chairman or CEO. More interestingly, networks seem to have a higher predictive power than the variables used as proxy for ability. This could be a problem as it points out that the board does not play its main role: choosing the most competent Chairman. This can come from many factors. First of all, the boards are rather large (the average is more than 6 board members). Therefore, it is possible that individually, board members see their probability of being pivotal as small. This might lead them to vote for the person who is more likely to give them more favors in the future, leaving the firm's value preoccupation to others. Also, it might reflect that candidates are similar in terms of ability and therefore votes are motivated by other objectives. It does not seem however that this behavior is necessarily detrimental to the firm since there is no difference in the average performances of firms run by *alumni* of X, ENA or HEC and the others.

If the existence of network effects is not, on average, detrimental to the firms, it still leaves some interrogations. If there are network effects at the moment of the election of the Chairman, it might be believed that these effects still have a part to play for everyday decisions. This could lower the monitoring power of the board. The other possible issue is on the board representativeness. For a long time (until the mid 70s) women were not allowed to take the X or HEC exam. Therefore, women from that generation do not benefit from these networks. Even now, the proportion of women entering Polytechnique or l'ENA is low. More broadly, and even if it is now a well known concern, there is a gender and social bias in the exams. This is not due to the Ecoles themselves but rather to the scholar system in general. Although it is supposedly a meritocratic system, flaws exist and diversity is not completely achieved. In turn, this would lead to fewer diversity at the Chairman level, which could indicate that the candidates are not selected amongst the largest possible pool of able candidates but rather among a restricted club which could have adverse effects.

Appendices A

Appendix of Chapter 2

A.0.1 Preliminaries

Lemma A.0.1 *$\partial\beta(t,t) > 0$on the range of G that makes the equlibrium sustainable (i.e. for $0 \leq G \leq \bar{G}$)*

Proof of Lemma A.0.1.

Let $\beta(t,t) \equiv v(q,s,t) - \frac{G}{2(1-G)} r(t,t)$ where $r(t,t) \equiv \frac{B(t,t)-A(t,t)}{I(t,t)}$. We have $\frac{\partial v(q,s,t)}{\partial t} > 0$ and $\frac{\partial r(t,t)}{\partial t} > 0$. Therefore it must be that at $G = 0$, $\frac{\partial \beta(t,t)}{\partial t} > 0$ and that at $G = 1, \frac{\partial \beta(t,t)}{\partial t} < 0$. Besides, $\frac{\partial \beta(t,t)}{\partial G} < 0$. By continuity, there exists a $\tilde{G}$ such that $\frac{\partial \beta(t,t)}{\partial t} = 0$. The claim is that $\tilde{G} > \bar{G}$, leading to $\frac{\partial \beta(t,t)}{\partial t} > 0$ for $0 \leq G \leq \bar{G}$.

Suppose this is not the case and $\tilde{G} < \bar{G}$ In equilibrium (for $G < \bar{G}$), $v(q,s,t^*) = 1/2 + \frac{G}{2(1-G))} r(t^*,t^*)$, therefore, $\frac{\partial v(q,s,t^*)}{\partial t^*} = \frac{G}{2(1-G)} \frac{\partial r(t^*,t^*)}{\partial t^*}$, for all G, including a G such that $\tilde{G} < G < \bar{G}$. Therefore it must be that $\frac{G}{2(1-G)} \frac{\partial r(t^*,t^*)}{\partial t^*} - \frac{\tilde{G}+\epsilon}{2(1-\tilde{G}+\epsilon)} \frac{\partial r(t^*,t^*)}{\partial t^*} < 0$ (with $\epsilon > 0$) which leads to $\tilde{G} > G > \bar{G}$, which contradicts the supposition. Therefore, it must be that $\tilde{G} > \bar{G}$. ∎

Proof of Lemma 2.5.3.

Substracting (2.5) from (2.6), we get:

$$v(q,s^*,t_n^*) - v(q,s^*,t_0^*) + \lambda(V(q,s^*,t_n^*,t_x^*) - v(q,s^*,t-n^*)) =$$
$$\frac{G}{2(1-G)} (\frac{B(t_n^*,t_x^*) - A(t_n^*,t_x^*)}{I(t_n^*,t_x^*)} - \frac{B(t_n^*,t_n^*) - A(t_n^*,t_n^*)}{I(t_n^*,t_n^*) + \lambda(I(t_n^*,t_n^*) - I_X(t_n^*,t_n^*))}$$

Suppose $t_n^* > t_x^*$, then :

$$\lambda((V(q,s^*,t_n^*,t_x^*) - v(q,s^*,t-n^*))+$$
$$(B(t_n^*,t_x^*) - A(t_n^*,t_x^*))\frac{G}{2(1-G)}\frac{(I_X(t_n^*,t_n^*) - I(t_n^*,t_n^*))}{I(t_n^*,t_x^*) * (I(t_n^*,t_n^*) + \lambda(I_X(t_n^*,t_n^*) - I(t_n^*,t_n^*)))} <$$
$$\frac{G}{2(1-G)}((B(t_n^*,t_x^*) - A(t_n^*,t_x^*))I(t_n^*,t_n^*) - (B(t_n^*,t_n^*) - A(t_n^*,t_n^*))I(t_n^*,t_x^*)$$

The right hand side is always positive but the left hand side is positive if and only if $t_x^* > t_n^*$. Which contradicts our supposition. Therefore, it must be that $t_n^* \geq t_x^*$ with equality when $\lambda = 0$ ■

A.0.2 The benchmark case

Proof of proposition 2.4.1. Let $v_i(q,t,s) \equiv Pr(w_i = a|q,s_i,t_i)$. In this case, an indifferent director between voting for A and voting for B will face (I drop the subscripts) :

$$v(q,s,t)(u(A|w=A))+(1-v(q,s,t)(u(A|w=B)) = v(q,s,t)(u(B|w=A))+(1-v(q,s,t))(u(B|w=B)) \tag{A.1}$$

The left hand side is the utility from voting for A and the right hand side is the utility from voting for B. I have $u(A|w=A) = u(B|w=B) = 1$ and $u(A|w=B) = u(B|w=A) = 0$. Rearranging the equation above, we get:

$$v(q,s,t) = 1/2$$

If $s = B$, the left hand side is always smaller than $1/2$ (for all $q > 0.5$). This means that a director with a signal B always votes for B. The equilibrium has to admit $s^* = A$. If $s^* = A$, the equation holds for $t_{eff}^* = q$. If $t > t_{eff}^* = q$, $v(q,s,t)$ is greater than $1/2$ and the director votes for A. ■

Proof of Lemma 2.4.1. If G is small enough, some types vote for A and some for B. Therefore, there must exist a type (s,t) who is indifferent between the two votes. For this (s,t), the following must hold:

$$\begin{aligned} P[piv](V(q,s,t)((1-G))+(1-P[piv])P[A|npiv]G= \\ P[piv]((1-V(q,s,t))(1-G))+(1-P[piv])P[B|npiv]G \end{aligned} \tag{A.2}$$

where $P[piv]$ is the probability of being pivotal, $P[D|npiv]$ is the probability of D being elected knowing that the director is not pivotal $V(q,s,t) = \frac{P[piv|w=a]v(q,s,t)}{P[piv|w=a]v(q,s,t)+P[piv|w=b](1-v(q,s,t))}$. Notice that in the case where there is no correlation between the w of the directors $V(q,s,t) = v(q,s,t)$ or, rearranging:

$$v(q,s,t) = \frac{1}{2} + \frac{G}{2((1-G))}\frac{P[B \cap npiv] - P[A \cap npiv]}{P[piv]} \tag{A.3}$$

The right hand side is fixed for (s,t) since it depends only on the other members of the board, their types and their strategy. The other members cannot condition their strategies on s,t since they do not know them. The left hand side changes with (s,t) and $v(q,A,t)$ is strictly increasing in t and $v(q,b,t)$ is strictly decreasing in t. They are equal for $t=\frac{1}{2}$, so there can be only one (s^*,t^*) that satisfies the equation. ∎

Proof of Lemma 2.4.2. Conjecture an equilibrium with a cut-off point t^* and $s^* = A$ such that a director votes for A if and only if $s = A$ and $v > v^*$. Denote m_w the probability that a director with w votes for A, we get : $m_A = \int_{t^*}^{1} 2tdt = 1 - t^{*2}$ and $m_b = \int_{t^*}^{1} 2(1-t)dt = (1-t^*)^2$.

Now, we can write:

$$\frac{(1-P[Piv])P[A|nonpiv]}{1-P[Piv]} = P[A \cap nonpiv] \text{ and } \frac{(1-P[Piv])P[B|nonpiv]}{1-P[Piv]} = P[B \cap nonpiv]$$

$$<=> (1-P[Piv])P[A|nonpiv] - (1-P[Piv])P[B|nonpiv] = 1 + 4q(-1+t^*)t - 2t^{*2} < 0$$

$\forall \quad 0.5 \leq t^* \leq 1$ and $0.5 < q \leq 1$

■

Proof of Lemma 2.4.3. The cut-off strategy implies that a director votes for A is $v(q,s,t) > v^*(q,s,t)$.

CASE 1 : $s^* = B$. First, conjecture a cut-off equilibrium in which $s^* = B$. If that is true, every director with $s = A$ votes for A (for all t) since $v(q,A,t) > v(q,B,t^*) \forall t$ and some directors with a signal $s = B$ vote for A (for values of t lower than some t^*) since $v(q,B,t) > v(q,B,t^*)$ if $t < t^*$. In turn, the two following inequalities are necessary conditions for the existence of a cut-off equilibrium in which $s^* = B$:

$$v(q,A,t) > \frac{1}{2} + \frac{G}{2(1-G)} \frac{P[B \cap npiv] - P[A \cap npiv]}{P[piv]} \quad \forall t \text{ and } 0 \leq G < \bar{G}_0$$

$$v(q,B,t) > \frac{1}{2} + \frac{G}{2(1-G)} \frac{P[B \cap npiv] - P[A \cap npiv]}{P[piv]} \quad \text{for some } t$$

where $\bar{G}_0$ is the upper bound on G above which unanimity always occur. This first inequality does not hold for all t. (For instance, if $G = 0$ it does not hold for $t = 0.5$). A cut-off equilibrium cannot admit $s^* = B$ *CASE 2 :* $s^* = A$. Conjecture $s^* = A$, this means that a director that observes $s = B$ votes always for B since $v(q,B,t) < v(q,A,t^*)$ for all t. A director who observes $s = A$ votes for A when since $v(q,A,t) > v(q,A,t^*)$, $t > t^*$.Therefore, the two necessary conditions are:

$$v(q,A,t) > \frac{1}{2} + \frac{G}{2(1-G)} \frac{P[B \cap npiv] - P[A \cap npiv]}{P[piv]} \quad \text{for some } t$$

$$v(q,B,t) < \frac{1}{2} + \frac{G}{2(1-G)} \frac{P[B \cap npiv] - P[A \cap npiv]}{P[piv]} \quad \forall t \text{ and } 0 \leq G < \bar{G}_0$$

There exists at least a $t(G)$ such that the first inequality holds. For instance, for $G = 0$, we are back in the "efficient" case and the inequality holds for every t greater than q. The second inequality holds. The right hand side is greater than $\frac{1}{2}$ since it is increasing in G because of lemma 2.4.2.The left hand side is always lower than 1/2 for $q > 1/2$.

Therefore, it has to be that $s^* = A$ in equilibrium. ■

Proof of proposition 2.4.2.

Following 2.4.1, the equilibrium solves:

$$v^*(q,s,t) = \frac{1}{2} + \frac{G}{2((1-G))} \frac{P^*[B \cap npiv] - P^*[A \cap npiv]}{P^*[piv]} \tag{A.4}$$

which is the equation when all directors use the optimal strategy and the probabilities are calculated using the equilibrium cut-off point.

Step 1:

The existence of a cut-off equilibrium $(s^* = A, t^*)$ follows from lemmas 2.4.1 and 2.4.3.

Step2:

For the fixed point equation to hold, we need the right hand side to be less than 1 since $v(q,s,t)$ is at most 1. However, the right hand side is not bounded. It is a monotone (increasing) function of t for $0.5 \leq t \leq 1$ [1] and $lim_{t->1} rhs = \infty$. Therefore there must exist a $\bar{t} < 1$ such that for $t > \bar{t}$ the right hand side is greater than 1.It must be that $t_0^* < \bar{t}$.

Step 3 :

For the fixed point equation to hold, we need the right hand side to be less than

---

[1] $\frac{\partial rhs}{\partial t} = \frac{G}{2(1-G)} \frac{\frac{\partial(P[B\cap npiv]-P[A\cap npiv])}{\partial t} P[Piv] - \frac{\partial(P[Piv])}{\partial t}(P[B\cap npiv]-P[A\cap npiv])}{P[piv]^2}$, we have: $\frac{\partial(P[Piv])}{\partial t} < 0$,$(P[B \cap npiv] - P[A \cap npiv]) > 0$ and $\frac{\partial(P[B\cap npiv]-P[A\cap npiv])}{\partial t} > 0$ so $\frac{\partial rhs}{\partial t} > 0$

1 since $v(q,s,t)$ is at most 1. However, the right hand side is not bounded. It is a monotone (increasing) function of G [2] and $lim_{G->1} rhs = \infty$. There exists a $\bar{G}_0$ such that, if $G > \bar{G}_0$, $rhs > 1$. In this case, no director votes for A and a cut-off equilibrium is not sustainable.

■

A.0.3 The network case

Proof of Lemma 2.5.1. The full length indifference equation is:

$$(1-\lambda)(P[piv|X]V_x(q,s,t,X)(1-G)+(1-P[piv|X])P[A|npiv,X]G)$$
$$+\lambda(P[piv|N]V_x(q,s,t,N)(1-G)+(1-P[piv|N])P[A|npiv,N]G)=$$
$$(1-\lambda)(P[piv|X](1-V_x(q,s,t,X))(1-G)+(1-P[piv|X])P[B|npiv,X]G)$$
$$+\lambda(P[piv|N](1-V_x(q,s,t,N))(1-G)+(1-P[piv|N])P[B|npiv,N]G)=$$

where:

$$V_x(q,s,t,Z) \equiv \frac{v_x(q,s,t)P[Piv|Z,w=a]}{v_x(q,s,t)P[Piv|Z,w=a]+(1-v_x(q,s,t))P[Piv|Z,w=b]}$$

with $Z = \{X, N\}$.

Since the director who is not part of the network cannot learn anything on the other directors' w from his own, he has $V(q,t,s,\lambda) = v(q,s,t)$. We can simplify the equation to get:

$$v_x(q,s,t) = \frac{1}{2}+\frac{G}{2(1-G)}\frac{(1-\lambda)(P[B\cap npiv|X]-P[A\cap npiv|X])+\lambda(P[B\cap npiv|N]-P[A\cap npiv|N])}{(1-\lambda)P[piv|X]+\lambda P[piv|N]}$$

---

[2] $\frac{\partial rhs}{\partial G} = \frac{1}{2(1-G)^2}\frac{(P[B\cap npiv]-P[A\cap npiv])}{P[Piv]} > 0$

Denote the probability that B is elected when the director who is not part of the network is not pivotal $P_x[B \cap npiv] = \lambda P[B \cap npiv|N] + (1-\lambda)P[B \cap npiv|X]$. Likewise $P_x[A \cap npiv] = \lambda P[A \cap npiv|N] + (1-\lambda)P[A \cap npiv|X]$ and $P_x[Piv] = \lambda P[Piv|N] + (1-\lambda)P[Piv|X]$

We get (2.5):

$$v_x(q,s,t) = \frac{1}{2} + \frac{G}{2(1-G)} \frac{P_x[B \cap npiv] - P_x[A \cap npiv]}{P_x[Piv]}$$

■

Proof of Lemma 2.5.2. The full length indifference equation is:

$$(1-\lambda)(P[piv|X]V(q,s,t,X)(1-G) + (1-P[piv|X])P[A|npiv,X]G)$$
$$+\lambda(P[piv|N]V(q,s,t,N)(1-G) + (1-P[piv|N])P[A|npiv,N]G) =$$
$$(1-\lambda)(P[piv|X](1-V(q,s,t,X))(1-G) + (1-P[piv|X])P[B|npiv,X]G)$$
$$+\lambda(P[piv|N](1-V(q,s,t,N))(1-G) + (1-P[piv|N])P[B|npiv,N]G) =$$

The difference with the director who is not part of the network is that $V(q,s,t,N) \neq v(q,s,t)$ since his w is correlated with that of the other member of the network. Therefore he can update his information on his w given his beliefs on the other director's vote. On the other hand, $P[piv|X] = P[piv|N]$ and $P[D|npiv,X] = P[D|npiv,N]$. Indeed, the two remaining directors are not part of the same network (one is in the network and one is not), therefore, their w_i are not correlated. This can be rewritten as (2.6):

$$(1-\lambda)v^*(q,s,t) + \lambda V(q,s,t) = \frac{1}{2} + \frac{G}{2((1-G))} \frac{P^*[B \cap npiv] - P^*[A \cap npiv]}{P^*[piv]} \quad \text{(A.5)}$$

■

Proof of proposition 2.5.1.

Step1: Existence and uniqueness

For existence, we can follow lemma 2.4.1. The indifference equations are now:

$$v_x(q,s,t) = \frac{1}{2} + \frac{G}{2(1-G)} \frac{P_x[B \cap npiv] - P_x[A \cap npiv]}{P_x[Piv]} \tag{A.6}$$

$$(1-\lambda)v^*(q,s,t) + \lambda V(q,s,t) = \frac{1}{2} + \frac{G}{2(u(A|A) - u(A|B))} \frac{P^*[B \cap npiv] - P^*[A \cap npiv]}{P^*[piv]} \tag{A.7}$$

The rest of the proof of lemma 2.4.1 can be applied.

Step 2:$s_x^* = s_n^* = A$

Just as in the benchmark case, an equilibrium with $s^* = B$ cannot be sustained. If $s_x^* = s_n^* = B$, then we would need:

$$v_x(q,A,t) > \frac{1}{2} + \frac{G}{2(1-G)} \frac{P_x[B \cap npiv] - P_x[A \cap npiv]}{P[piv]} \quad \forall t, \lambda \text{ and } 0 \leq G < \bar{G}_0$$
$$(1-\lambda)v_n(q,A,t) + \lambda V_n(q,A,t) > \frac{1}{2} + \frac{G}{2(1-G)} \frac{P[B \cap npiv] - P[A \cap npiv]}{P[piv]} \quad \forall t, \lambda \text{ and } 0 \leq G < \bar{G}_0$$

We know that neither equation holds (for $\lambda = 0$, for instance). Therefore, the equilibrium cannot admit $s_n^* = s_x^* = B$.

The equilibrium has to admit $s^* = A$ for the directors part of the network or not.

Step 3: Determining the bound

Just as in the benchmark case, for the equilibrium to hold, we need both right hand sides to be less than 1 and both sides tend to infinity as t_n^* goes to 1. Therefore, it must be that there exists a $\bar{t}_{n,x}$ that makes the right hand side of equation (A.6) equal to 1 and $\bar{t}_{n,n}$ that makes the right hand side of (A.7) equal to 1. Notice that the two right hand side depend only on t_n^* since t_x is a function of t_n. The lowest of $\bar{t}_{n,x}$ and $\bar{t}_{n,n}$ is the upper bound $\bar{t}_n$ on t_n^*. In turn that gives an upper bound to t_x where $\bar{t}_x^* = f(\bar{t}_n^*)$

Step 4 : deriving the cut-off points

Let us substract (A.4) and (2.5), we obtain:

$$v(t_0^*)-v(t_x^*) = \frac{G}{2(1-G)}(\frac{B(t_0^*,t_0^*)-A(t_0^*,t_0^*)}{I(t_0^*,t_0^*} - \frac{B(t_n^*,t_n^*)-A(t_n^*,t_n^*)}{I(t_n^*,t_n^*)} - \lambda\frac{I(t_n^*,t_n^*)-I_N(t_n^*,t_n^*)}{I(t_n^*,t_n^*)+\lambda(I_N(t_n^*,t_n^*)-I(t_n^*,t_n^*))} \quad (A.8)$$

We have $\frac{I(t_n^*,t_n^*)-I_N(t_n^*,t_n^*)}{I(t_n^*,t_n^*)+\lambda(I_N(t_n^*,t_n^*)-I(t_n^*,t_n^*))} < 0$ for all t_n.
Therefore (if $r(t_0,t_0) \equiv \frac{G}{2(1-G)}\frac{I(t_n^*,t_n^*)-I_N(t_n^*,t_n^*)}{I(t_n^*,t_n^*)+\lambda(I_N(t_n^*,t_n^*)-I(t_n^*,t_n^*))}$)

$$v(t_0^*) - v(t_x^*) \geq r(t_0^*) - r(t_n^*)$$

$$<=> v(t_0^*) - v(t_n^*) \geq r(t_0^*) - r(t_n^*)$$

since $t_n^* < t_x^*$ by lemma 2.5.3

$$<=> r(t_0^*) - v(t_0^*) \leq r(t_n^*, t_x^*) - v(t_n^*)$$

Let $\beta(t_0^*,t_0^*) \equiv r(t_0^*,t_0^*) - v(t_0^*)$. By lemma A.0.1 , we know that $\frac{\partial\beta(x,x)}{\partial x} > 0$ for $G < \bar{G}$. Therefore, when a cut-off equilibrium is sustainable $t_0^* > t_n^*$. But we have $v(t_0^*) - v(t_x^*) \geq r(t_0^*) - r(t_n^*)$ and $r'(t) > 0$ so $v(t_0^*) - v(t_x^*) \geq 0$ $=>t_0 \geq t_x^*$) with equality when $G = 0$ or $\lambda = 0$ ■

Proof of proposition 2.5.2. We define $\bar{G}$ as the G for which a cut-off equilibrium is no longer sustainable. All cut-offs increase continously with G but, for all values of G $t_0^* > t_x^*$ and $t_0^* > t_n^*$. It must be that, for $\bar{G}_0$ such that $t_0^* = 1$, $t_x^* < 1$ and $t_n^* < 1$.
In turn, it must be that the $\bar{G}_X$ and $\bar{G}_N$ such that T_x^* and t_n^* are greater than 1 are greater than $\bar{G}_0$. ■

Proof of proposition 2.6.1. When B is part of the network, the indifference equation for the director who is part of the network becomes:

$$(1-\lambda)v^*(q,s,t) = \frac{1}{2} + \frac{G}{2(u(A|A)-u(A|B))}\frac{P^*[B\cap npiv]-P^*[A\cap npiv]}{P^*[piv]} \tag{A.9}$$

We have $\frac{\partial t^*_{n,B}}{\lambda} > 0$. In turn, we have $\frac{\partial t^*_{x,B}}{\lambda} > 0$. Both cut-off points are higher than in the benchmark case. ■

Proof of proposition 2.6.2. It is not necessary that $s^* = A$ however the cut-off equilibrium is unique (either $s^* = A$ or $s^* = B$ for each type of director) from lemma 2.4.1. I will separate between the directors from the network and the director out of the network.

Directors in the network

For such an equilibrium with $s^*_n = A$ to hold we need:

$$(1-\lambda)v(q,a,t)+\lambda = \frac{1}{2} + \frac{G}{2(1-G)}\frac{P_n[B\cap npiv]-P_n[A\cap npiv]}{P_n[Piv]}[forsome]t$$

$$(1-\lambda)v(q,b,t)+\lambda < \frac{1}{2} + \frac{G}{2(1-G)}\frac{P_n[B\cap npiv]-P_n[A\cap npiv]}{P_n[Piv]}[forall]t$$

The equilibrium holds for $\lambda = 0$, so there are cases in which $s^*_n = A$ but as λ increases, the left hand side of the second equation increases and can become greater for some t than the left hand side (depending on the value of$G$). It mus be that there is a t such that both sides are equal. [3]. Since $v(q,a,t) > v(q,b,t)$ for all t and all $0.5 < q < 1$, when this is the case, it must be that $(1-\lambda)v(q,a,t)+\lambda > \frac{1}{2} + \frac{G}{2(1-G)}\frac{P_x[B\cap npiv]-P_x[A\cap npiv]}{P_x[Piv]}[forall]t$. So we have the following equations:

$$(1-\lambda)v(q,a,t)+\lambda > \frac{1}{2} + \frac{G}{2(1-G)}\frac{P_n[B\cap npiv]-P_n[A\cap npiv]}{P_n[Piv]}[forall]t$$

$$(1-\lambda)v(q,b,t)+\lambda = \frac{1}{2} + \frac{G}{2(1-G)}\frac{P_n[B\cap npiv]-P_n[A\cap npiv]}{P_n[Piv]}[forsome]t$$

[3]The limit case is $\lambda = 1$ and $G = 0$, in which case, it does not depend on t and only a vote for A is an equilibrium

Those are the conditions for an equilibrium with $s_n^* = B$. Therefore, there must be a $\lambda_n\bar(G)$ such that if $\lambda < \lambda_n\bar(G)$, $s_n^* = A$ and if $\lambda > \lambda_n\bar(G)$ $s_n^* = B$.

Directors in the network

For $s_x^* = A$ to be a possible equilibrium, the following conditions must hold:

$$v(q,a,t) = \frac{1}{2} + \frac{G}{2(1-G)} \frac{P_x[B \cap npiv] - P_x[A \cap npiv]}{P_x[Piv]}[forsome]t$$
$$v(q,b,t) < \frac{1}{2} + \frac{G}{2(1-G)} \frac{P_x[B \cap npiv] - P_x[A \cap npiv]}{P_x[Piv]}[forall]t$$

When A is candidate,$P_x[B \cap npiv] - P_x[A \cap npiv] = (1-\lambda)(P_0[B \cap npiv] - P_0[A \cap npiv]) + \lambda(2t_n^{*2} - 1) = (1-\lambda)(2t_n^*(2q(1-t_n^*) + t_n^*) + \lambda(2t_n^{*2} - 1)$. Since $(2t_n^*(2q(1-t_n^*) + t_n^*) > (2t_n^{*2} - 1)$, the right hand side decreases with λ. Moreover, for $t_n^* < \sqrt{\frac{1}{2}}$, $2t_n^{*2} - 1 < 1$, therefore, there must be a $\lambda_x\bar(G)$ such that the first condition does not hold. Following the same reasoning as for the director in the network, in that case, the equilibrium has to admit $s_x^* = B$
In both cases, when $s^* = A$ the cut-off points are lower than in the benchmark case since both are negative functions ofλ. Moreover, when both $s^* = B$, there exists a G such that the conditions do not hold and unanimity for A arises. ■

A.0.4 Optimum comparison

Over the section, I assume that the firm is better off when $W(t) \equiv ((1-q)m_a(t) + q(1-m_b(t)))^3$ is maximized, that is the probability that the three directors make the right decision. Recall that $m_a(t) = 1 - t^2$ and $m_b(t) = (1-t)^2$.

Proof of proposition 2.7.6. Since in the efficient case and in the benchmark case all directors are symmetric, it is sufficient to show that $(1-q)m_a(q) + q(1 - m_b(q)) > (1-q)m_a(t_0^*) + q(1 - m_b(t_0^*))$. It is easy to show that $t = q$ maximizes

$(1-q)(1-t^2)+q(2t-t^2)$.

Therefore, $(1-q)m_a(q)+q(1-m_b(q)) > (1-q)m_a(t_0^*)+q(1-m_b(t_0^*))$ holds for all t_0^*. ■

Proof of proposition 2.7.7. Since in the efficient case directors are symmetric and that in the network case, directors from the network are symmetric, it is sufficient to show that $(1-q)m_a(q)+q(1-m_b(q)) \geq (1-q)m_a(t_x^*)+q(1-m_b(t_x^*))$ and $(1-q)m_a(q)+q(1-m_b(q)) \geq (1-q)m_a(t_n^*)+q(1-m_b(t_n^*))$ with at least one inequality being strict. In the case with a network but with $G=0$, $t_x^*=q$ and $t_n^*<q$ for $\lambda>0$, therefore $(1-q)m_a(q)+q(1-m_b(q)) = (1-q)m_a(t_x^*)+q(1-m_b(t_x^*))$. Besides, $t=q$ maximizes $(1-q)(1-t^2)+q(2t-t^2)$, so $(1-q)m_a(q)+q(1-m_b(q)) > (1-q)m_a(t_n^*)+q(1-m_b(t_n^*))$ ■

Proof of proposition 2.7.3. $t=q$ maximizes $(1-q)(1-t^2)+q(2t-t^2)$, therefore, the welfare of the stockholders is maximized for the closest distance of the cut-offs to q. Therefore, to show that $W(t_N^*) > W(t_0^*)$, it is sufficient to show that $(t_n^*-q)^2(t_n^*-q)^2(t_x^*-q)^2 < ((t_0^*-q)^2)^3$. Indeed,

$$W(t_N^*) =((1-q)(1-(t_n^{*2})+q(2(t_n^*-(t_n^{*2}))^2(1-q)(1-t^2)+q(2(t_x^*-(t_x^{*2})$$

$$t_n^* = q+(t_n^*-q) \quad t_x^* = q+(t_x^*-q)$$

$$=> W(t_N^*) = -(t_x^*-q)^2(-(t_n^*-q)^2)^2$$

$$W(t_0^*) =((1-q)(1-(t_0^{*2})+q(2(t_0^*-(t_0^{*2}))^3$$

$$t_0^* =q+(t_0^*-q)$$

$$=> W(t_0^*) =(-(t_0^*-q)^2)^3$$

$$=> W(t_N^*) > W(t_0^*) <=> ((t_0^*-q)^2)^3 > (t_x^*-q)^2((t_n^*-q)^2)^2$$

When $G=0$ $t_n^*<q$ but as G increases, $t_n^*->1>q$. Therefore, there must be a $\underline{G}(q)$ such that for all $G>\underline{G}(q)$, $tn_q>q$ (and $t_n^*<t_0^*$ and $q<t_x^*<t_0^*$).

Case 1 :$G > \underline{G}$: In that case,, we have $q < t_n^* < t_0^* => (t_0^* - q)^2) > (t_n^* - q)^2)$ and $q < t_x^* < t_0^* => (t_0^* - q)^2) > (t_x^* - q)^2)$. Therefore, it must be that $((t_0^* - q)^2)^3 > (t_x^* - q)^2((t_n^* - q)^2)^2$ and $W(t_N^*) > W(t_0^*)$

Case2 : :$G < \underline{G}$: In that case, for $W(t_N^*) > W(t_0^*)$ to hold. Either $t_n^* > 2q - t_0^*$, that is, the distance between q and t_n^* is smaller than that between q and t_0^*. Both cut-offs increase in G and in q. When $G = 0$ and $G < \underline{G}(q)$, $t_0^* = q$, $t_n^* < 2q - t_0^*$ but when $G = \underline{G}(q)$, $t_n^* = q$, $t_n^* > 2q - t_0^*$ Therefore, there must be a $\tilde{G}(q)$ such that $t_n^* = 2q - t_0^*$ and $\tilde{G}(q) < \underline{G}$. When $G > \tilde{G}(q)$, $W(t_N^*) > W(t_0^*)$

If $\bar{G}_0 > \tilde{G}(q)$, then $W(t_N^*) > W(uB)$ ■

Proof of proposition 2.7.4. to show that $W(t_{N,B}^*) < W(t_0^*)$, it is sufficient to show that $(t_n^* - q)^2(t_n^* - q)^2(t_x^* - q)^2 > ((t_0^* - q)^2)^3$

When B is from the network, then $t_n^* > t_0^* \geq q => (t_n^* - q)^2 > ((t_0^* - q)^2)^2$ and $t_x^* \geq t_0^* \geq q => (t_x^* - q) > ((t_0^* - q)^2)$ so it must be that $W(t_{N,B}^*) < W(t_0^*)$ ■

Proof of proposition 2.7.5. $W(t_{N,A}^*) < W(t_0^*)$ When there is unanimity in both cases, B is the elected candidate in the benchmark case and A in the case where A is a candidate from the network. In that case, the equation holds because it is like having $t_0^* = 1$ and $t_n^* = t^*x = 0$. Since $q > .5$, the distance is farther from q in the network case. When $\lambda = 1$, we have unanimity in the network case (if $G > 0$, otherwise, the directors from the network vote for A and the director who is not randomizes). This too leads to $W(t_{N,A}^*) < W(t_0^*)$ ■

A.0.5 Extensions

Proof of proposition 2.8.1. Going back to (A.3), it is clear that when you go from 3 to 5 votes, the probability of being pivotal decreases as well as the probability of A being elected when the indifferent director is not pivotal while the probability of B being elected increases. Therefore, we have:

$$\frac{P[B \cap npiv|J=5] - P[A \cap npiv|J=5])}{P[piv|J=5]}$$
$$> \frac{P[B \cap npiv|J=3] - P[A \cap npiv|J=3])}{P[piv|J=3]}$$

So, $t_5^* > t_3^*$.

The same goes by increasing the number of board members from 5 to 7 and so on and so forth. More generally, it is easy to see that $\lim_{J->\infty} P[piv] = 0$, $\lim_{J->\infty} P[A] = 0$ and $\lim_{J->\infty} P[B] = 1$. Therefore, $\lim_{J->\infty} rhs = \infty$. As long as $G > 0$, this leads to a vote of every director for B. It must be that, since the right hand side is increasing in J there is a $\bar{J}$ such that no cut-off equilibrium is sustainable. This $\bar{J}$ solves$\frac{1}{2} + \frac{G}{2(u(A|A)-u(A|B))} \frac{P^*[B \cap npiv|J]-P^*[A \cap npiv|J]}{P^*[piv|J]} = \frac{1}{2}$ for all $G > 0$ ■

Proof of Remark 2.8.1. Let G become a function of the votes for the winner $G(\#of votes)$. In that case, the indifference equation becomes:

$$P[piv](v(q,s,t)((1-G(2))+G(2))+(1-v(q,s,t))G(2))+(1-P[piv])P[A|npiv]G(3) =$$
$$P[piv]((1-v(q,s,t))(1-G(2))+v(q,s,t)G(2))+(1-P[piv])P[B|npiv]G(3)$$

In the case in which the director is pivotal, he always votes for the winner so the concern cancels out ($G(2)$) and the equlibrium condition becomes:

$$v^*(q,s,t) = \frac{1}{2} + \frac{G(3)}{2((1-G(2)))}\frac{P^*[B\cap npiv] - P^*[A\cap npiv]}{P^*[piv]}$$

So endogenizing G leads to a decrease in the $G/(1-G)$ ratio and unanimity is reached less rapidly. However, it does not change the results in that the ratio is the same in all cases and only alters the intensity of the results. ■

Appendices B

Appendix of Chapter 3

Figure B.1: Financial data on the whole dataset and in the final sample

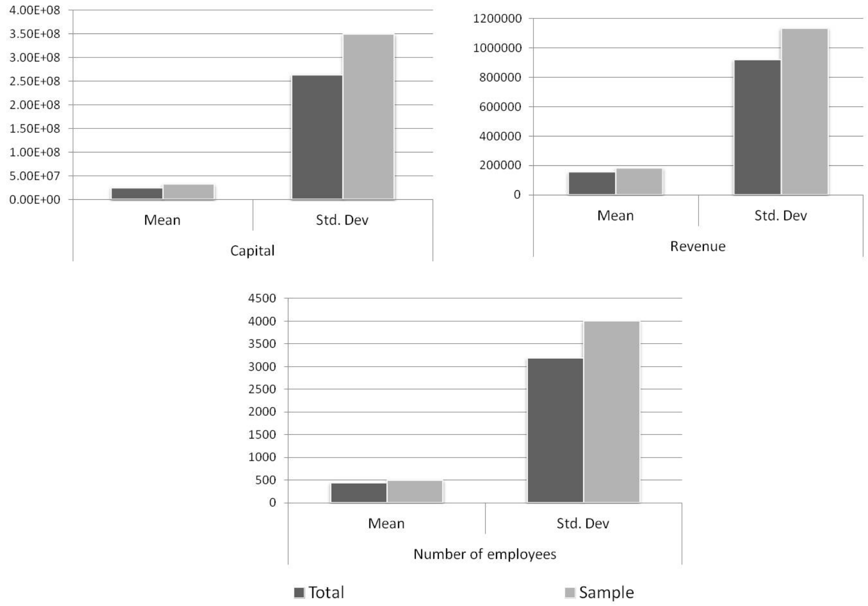


Figure B.2: Proportion of alumni on the whole dataset and in the final sample

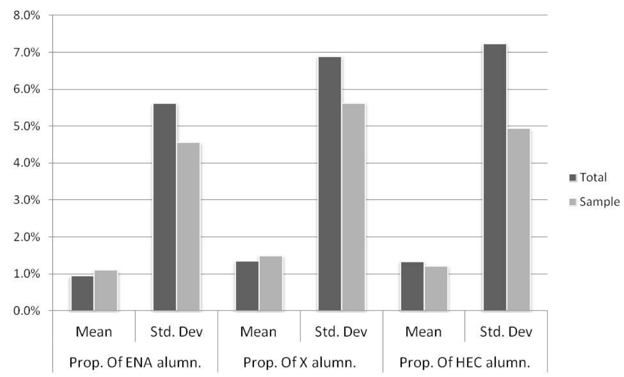


Figure B.3: Financial data when the CEO is an alumnus

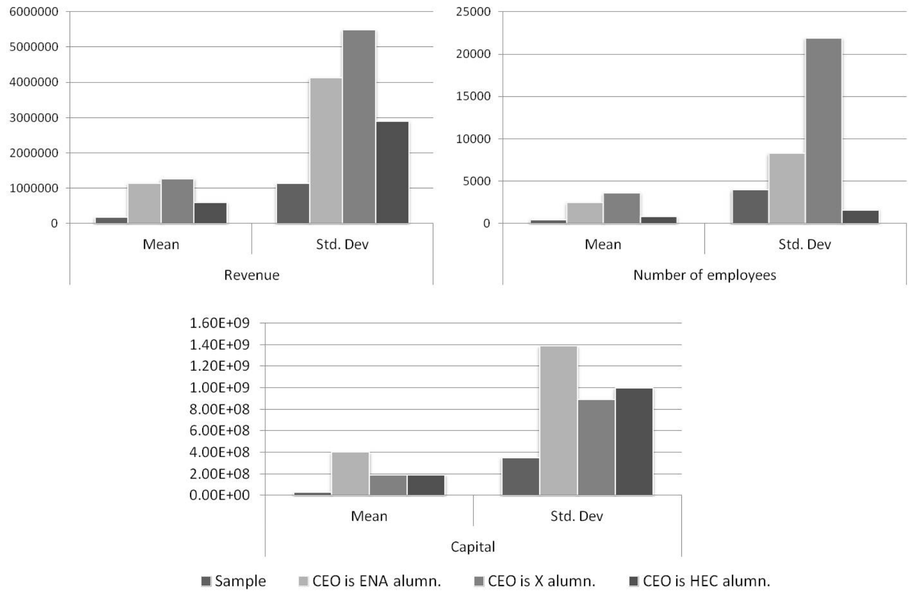


Figure B.4: Proportion when the CEO is an alumnus

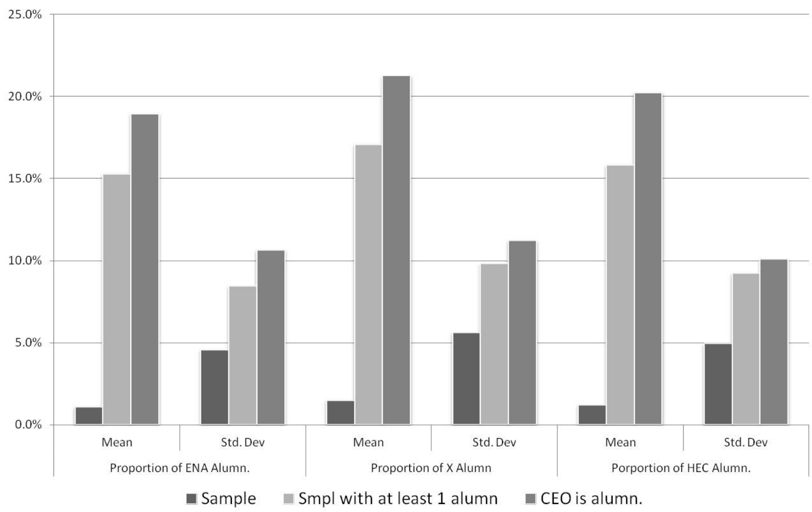
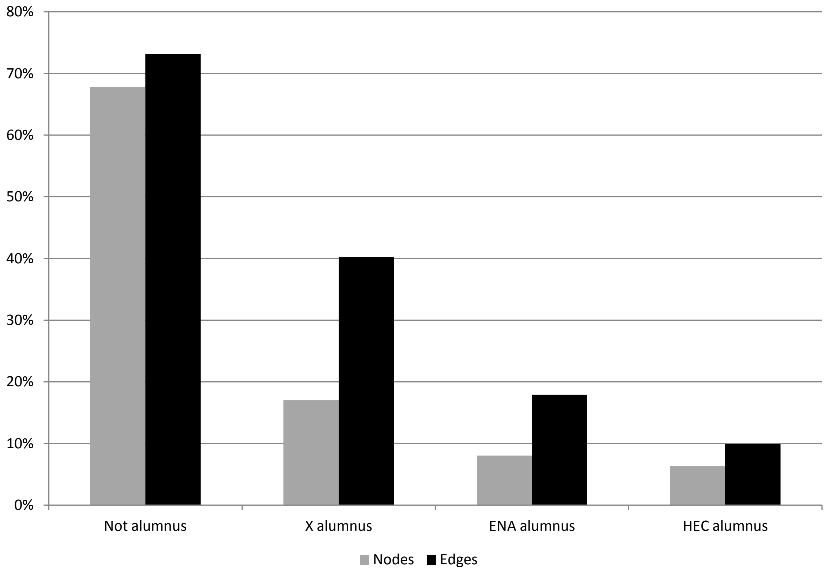


Figure B.5: Networks - summary
At the directors level



At the firm level

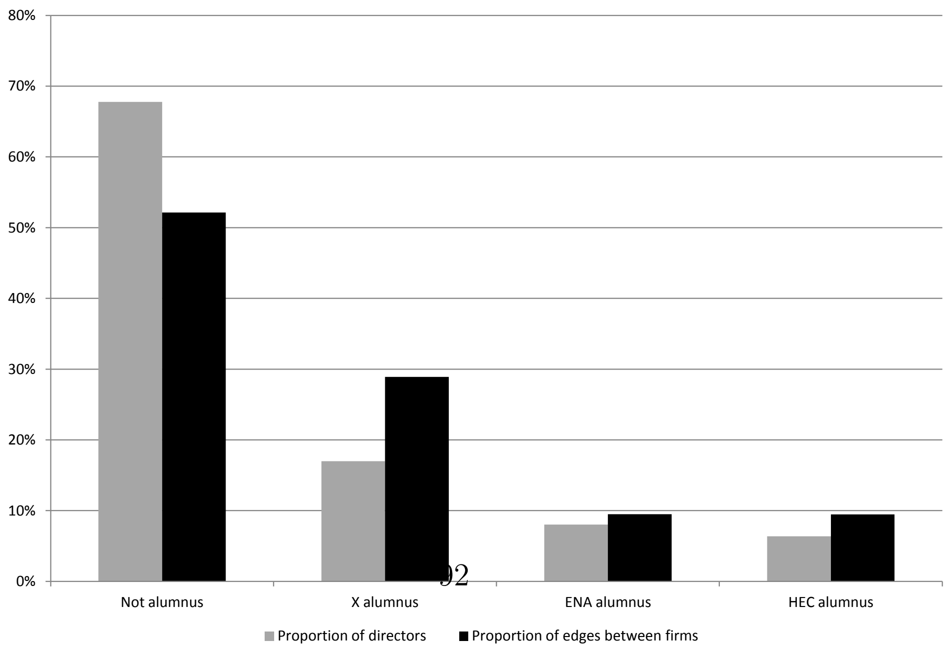
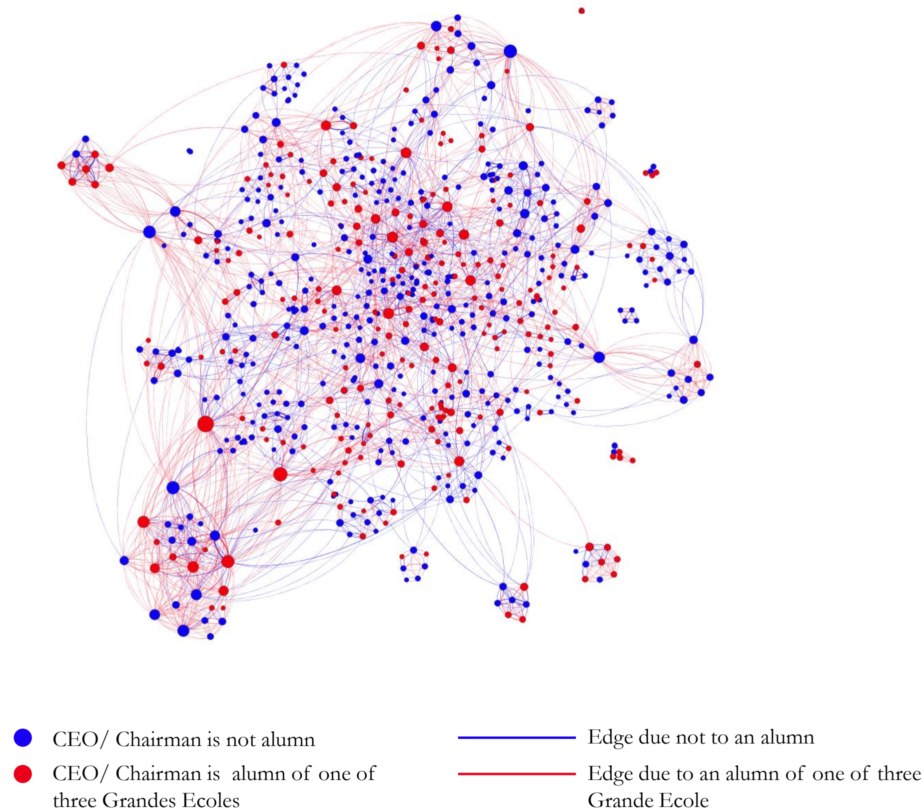


Figure B.6: Network -every firms



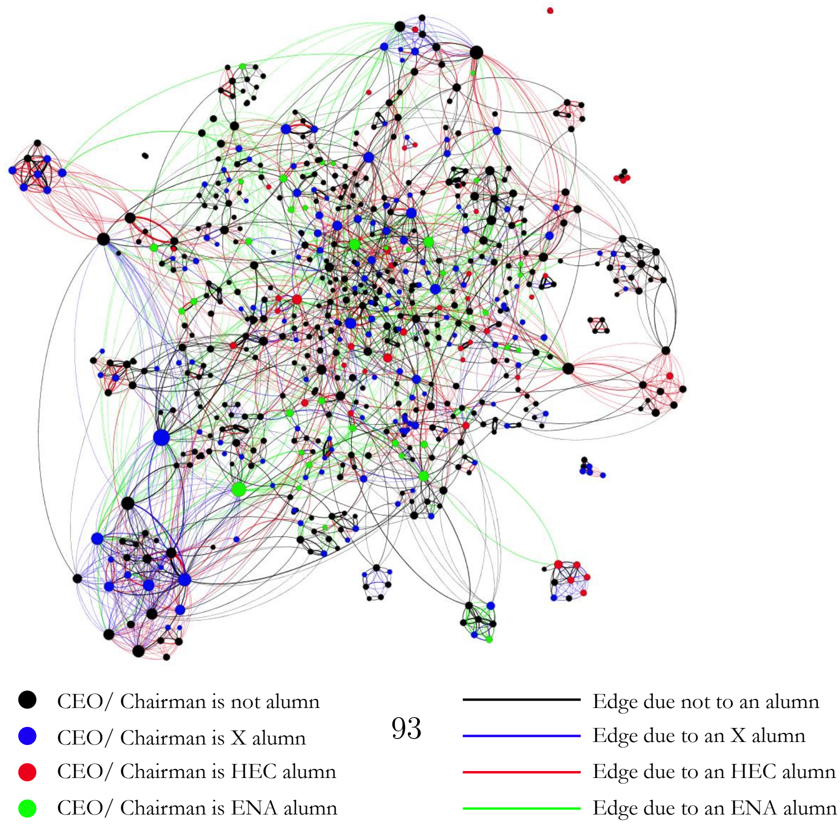


Figure B.7: Network - most connected firms

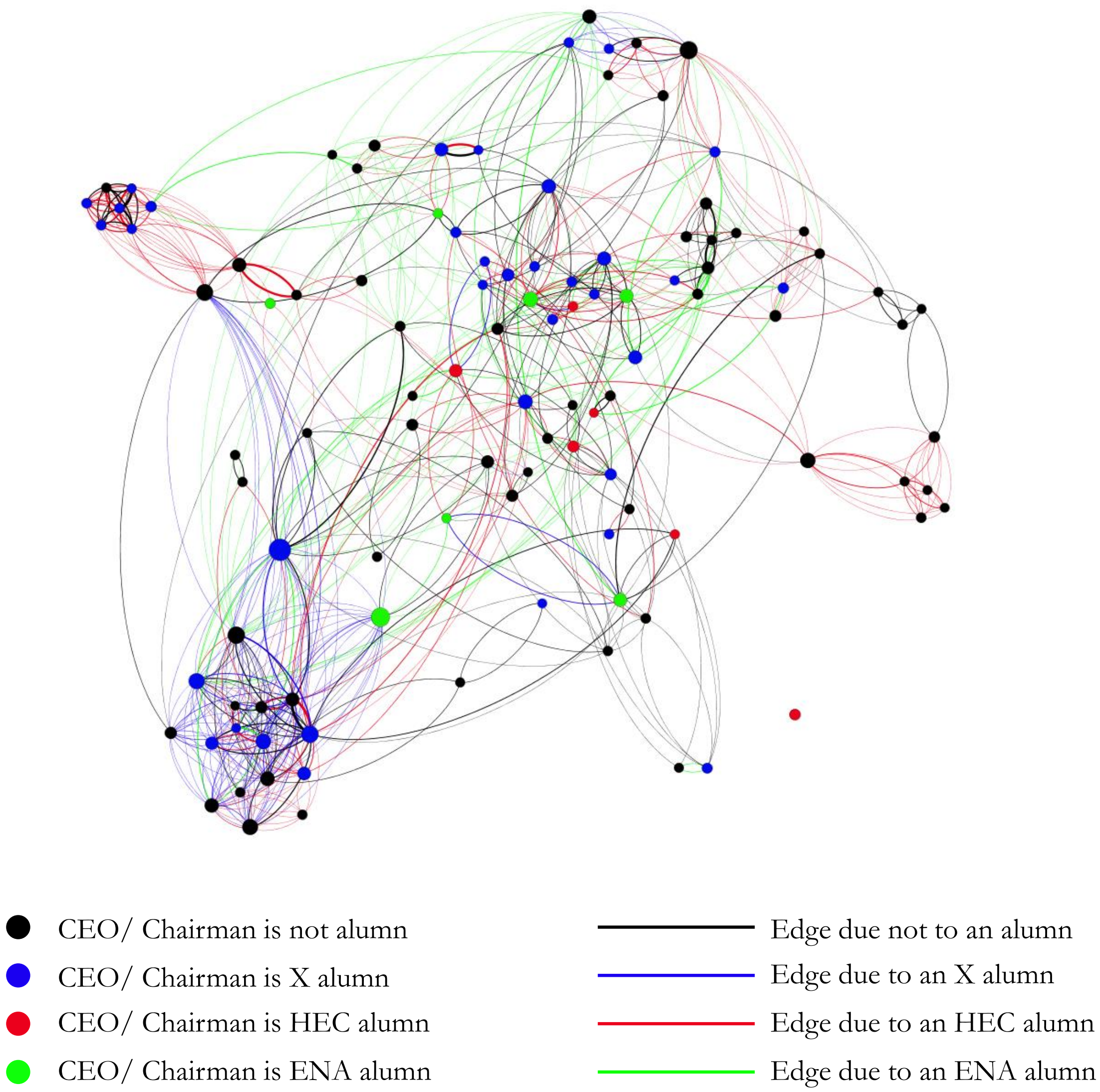
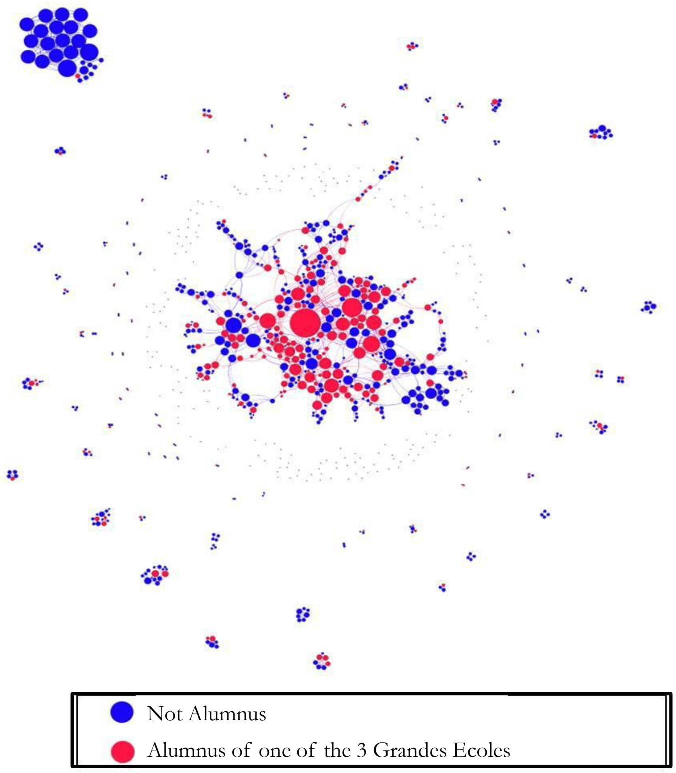


Figure B.8: Network -Directors by shcool



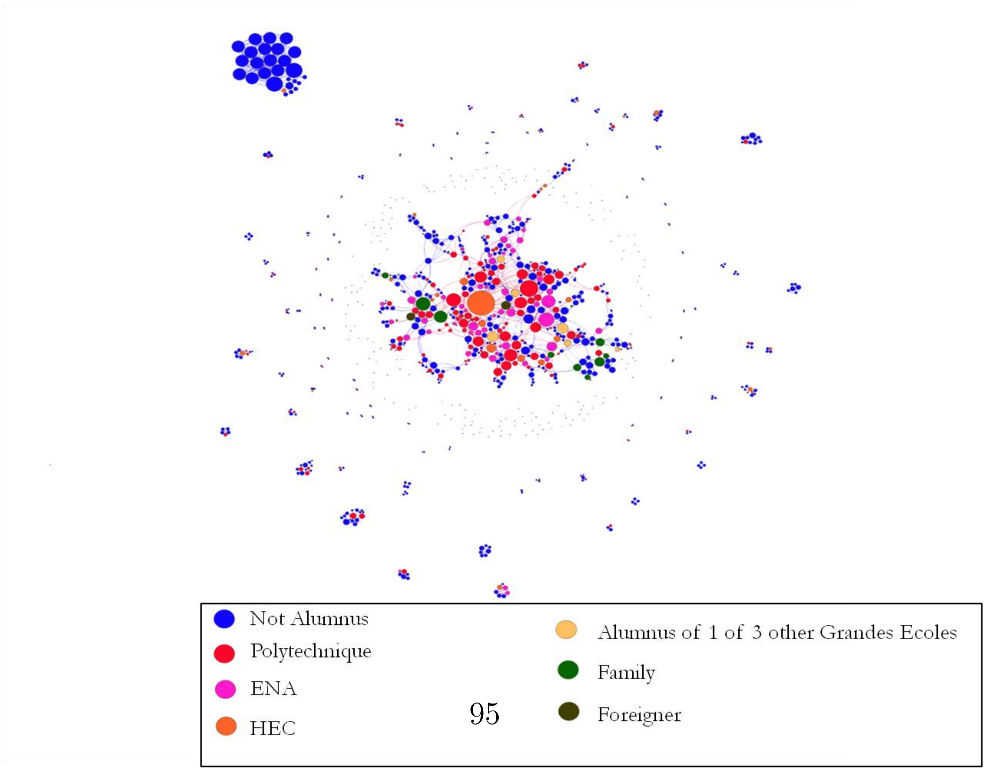


Figure B.9: Network - directors (male/female)

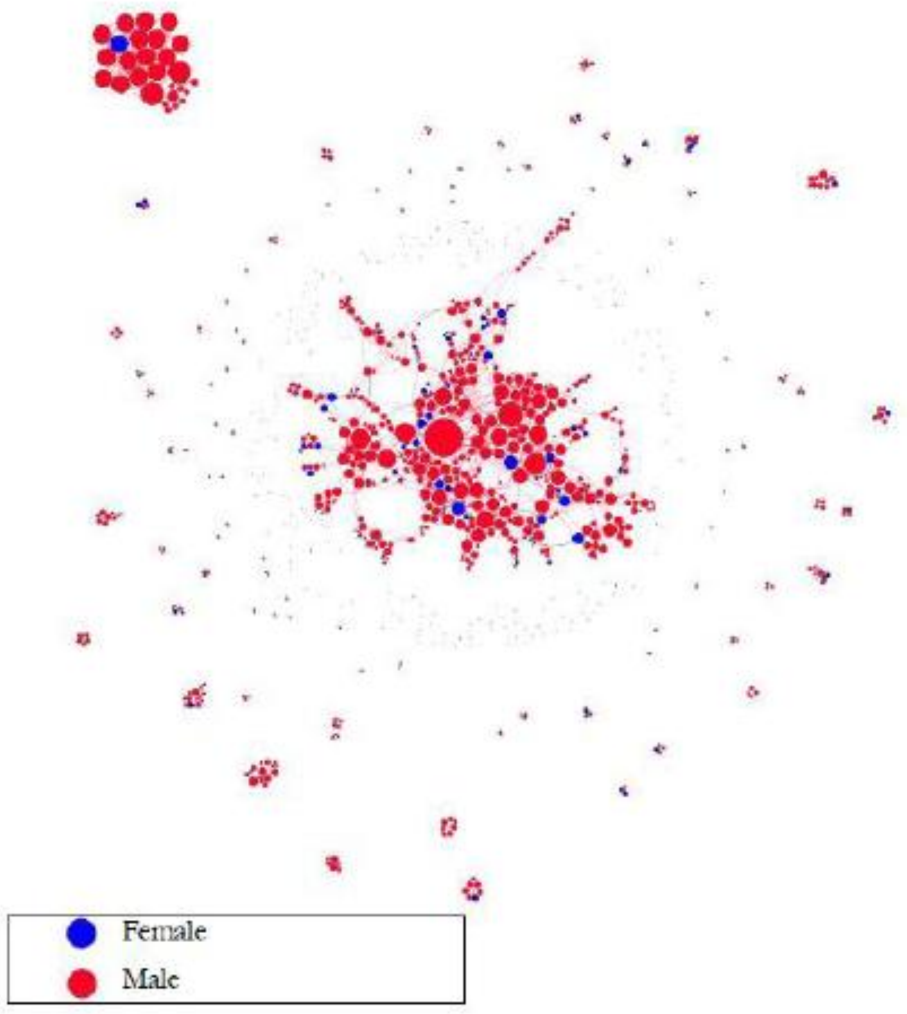
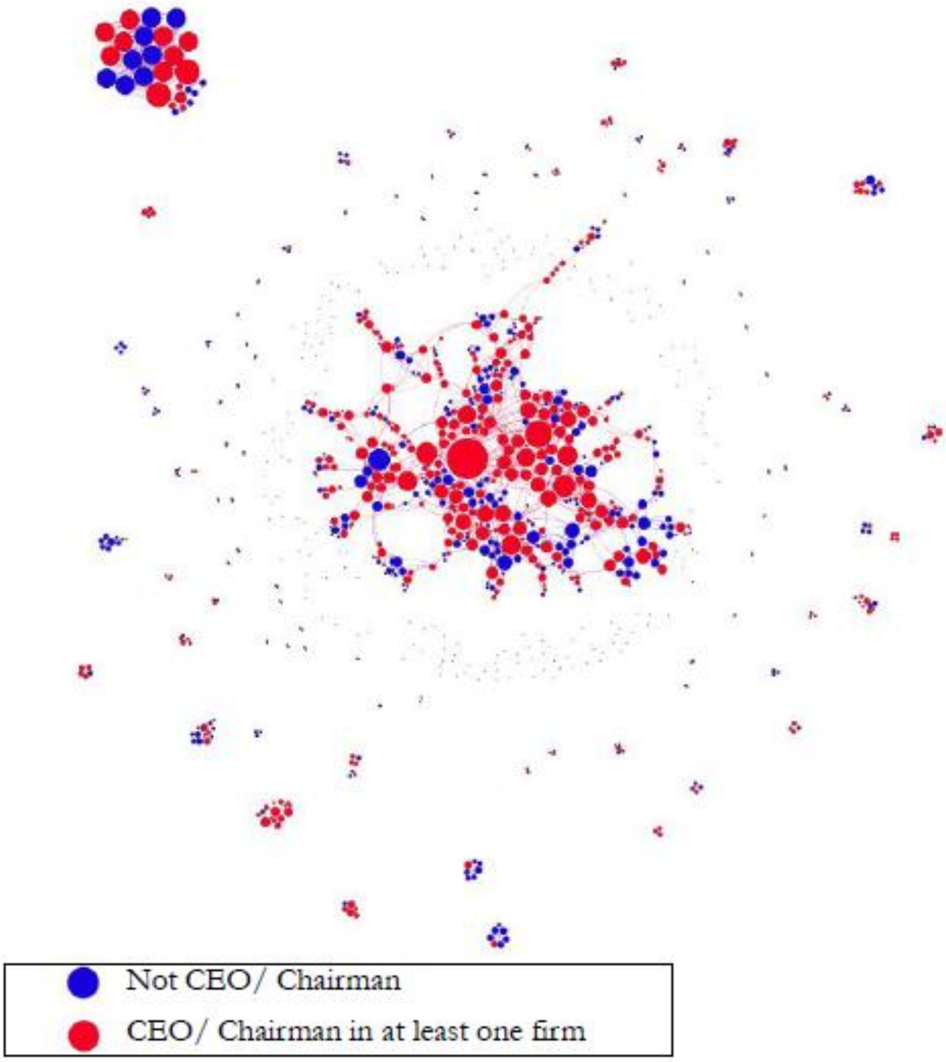


Figure B.10: Network - directors (CEO/not)



All networks graphics have been created with Gephi

Table B.1: Results for the firm level specification

	1	2	3	4	5	6
CEO is X						
Prop of X	3.63E+08	2.87E+06	1.91E+06	1.72		
	3.62E+08	*2.22E+06*	*1.42E+06*	*0.04*		
Prop of HEC	0.01	0.12	0.11	-0.51		
	2.00E-02	*2.00E-01*	*0.18*	*0.06*		
Prop of Ena	0.02	0.02	0.03	-0.89		
	4.00E-02	*4.00E-02*	*0.04*	*0.07*		
Capital	1.00	1.00	1.00	0.00		
	0.00E+00	*0.00E+00*	*0.00*	*0.00*		
Paris area	0.78	0.59		0.00		
	1.50E-01	*1.10E-01*		*0.01*		
Nb of employees	1.00	1.00	1.00	0.00		
	0.00E+00	*0.00E+00*	*0.00*	*0.00*		
Participations held by CEO	1.00	1.00	1.00	0.00		
	2.00E-02	*2.00E-02*	*0.02*	*0.00*		
Total participations held by board	1.00	1.00	1.01	0.00		
	0.00E+00	*0.00E+00*	*0.00*	*0.00*		
Previous CEO is X	0.03			-0.33		
	1.00E-02			*0.02*		
Previous CEO is ENA	0.39			0.07		
	3.10E-01			*0.03*		
Previous CEO is HEC	1.70			0.10		
	1.19E+00			*0.03*		
Length of appointment	1.00	1.00	1.00	0.00		
	0.00E+00	*0.00E+00*	*0.00*	*0.00*		
Constant				0.08		

Table B.2: Results for the firm level specification

	1	2	3	4	5	6
CEO is ENA						
Prop of X	21.09	25.08	26.26		-0.11	
	4.85E+01	*4.36E+01*	*45.61*		*0.02*	
Prop of HEC	0.00	0.00	0.00		-0.49	
	0.00E+00	*0.00E+00*	*0.00*		*0.03*	
Prop of Ena	1.47E+12	1.82E+10	2.84E+10		0.74	
	4.37E+12	*4.66E+10*	*7.39E+10*		*0.03*	
Capital	1.00	1.00	1.00		0.00	
	0.00E+00	*0.00E+00*	*0.00*		*0.00*	
Paris area	2.42	2.63			0.01	
	1.31E+00	*1.35E+00*			*0.00*	
Nb of employees	1.00	1.00	1.00		0.00	
	0.00E+00	*0.00E+00*	*0.00*		*0.00*	
Participations held by CEO	1.02	1.04	1.04		0.00	
	4.00E-02	*3.00E-02*	*0.03*		*0.00*	
Total participations held by board	1.00	1.00	0.99		0.00	
	1.00E-02	*1.00E-02*	*0.01*		*0.00*	
Previous CEO is X	0.78				0.03	
	5.60E-01				*0.01*	
Previous CEO is ENA	0.04				-0.10	
	4.00E-02				*0.01*	
Previous CEO is HEC	1.31				0.10	
	1.94E+00				*0.01*	
Length of appointment	0.99	0.99	1.00		0.00	
	1.00E-02	*1.00E-02*	*0.01*		*0.00*	
Constant					0.04	
					0.10	

Table B.3: Results for the firm level specification

	1	2	3	4	5	6
CEO is HEC						
Prop of X	0.01	0.01	0.01			-0.17
	2.00E-02	*3.00E-02*	*0.03*			*0.02*
Prop of HEC	8.97E+16	1.53E+15	1.40E+15			1.38
	3.57E+17	*5.35E+15*	*4.86E+15*			*0.04*
Prop of Ena	0.00	0.02	0.02			-1.00
	0.00E+00	*4.00E-02*	*0.04*			*0.04*
Capital	1.00	1.00	1.00			0.00
	0.00E+00	*0.00E+00*	*0.00*			*0.00*
Paris area	0.93	0.94				0.01
	3.50E-01	*3.20E-01*				*0.00*
Nb of employees	1.00	1.00	1.00			0.00
	0.00E+00	*0.00E+00*	*0.00*			*0.00*
Participations held by CEO	1.02	1.04	1.04			0.00
	6.00E-02	*5.00E-02*	*0.05*			*0.00*
Total participations held by board	1.01	0.99	0.99			0.00
	1.00E-02	*1.00E-02*	*0.01*			*0.00*
Previous CEO is X	1.26					0.03
	9.20E-01					*0.01*
Previous CEO is ENA	3.16					0.20
	2.97E+00					*0.02*
Previous CEO is HEC	0.03					-0.23
	2.00E-02					*0.02*
Length of appointment	0.99	0.99	0.99			0.00
	0.00E+00	*0.00E+00*	*0.00*			*0.00*
Constant						0.35
						0.13
R2̂ (or Pseudo)	0.54	0.47	0.47	0.36	0.15	0.27
Nb of observations	3699.00	3699.00	3699.00	3699.00	3699.00	3699.00

Table B.4: ENA alumni: linear probability

	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of ENA alumni*	0.402	0.402	0.621*	0.471	0.501	0.642*
	[0.329]	*[0.328]*	*[0.335]*	*[0.344]*	*[0.343]*	*[0.346]*
Proportion of HEC alumni*	-0.696*	-0.799**	-0.891**	-0.588	-0.678*	-0.757*
	[0.389]	*[0.389]*	*[0.387]*	*[0.404]*	*[0.405]*	*[0.403]*
Proportion of X alumni*	0.221	0.251	0.204	0.18	0.206	0.186
	[0.214]	*[0.215]*	*[0.213]*	*[0.225]*	*[0.226]*	*[0.224]*
Previous CEO			-0.224***			-0.201**
			[0.0832]			*[0.0892]*
Ile de France		-0.0602	-0.0454		-0.0824	-0.0679
		[0.0762]	*[0.0756]*		*[0.0826]*	*[0.0822]*
Paris		0.0938	0.103		0.0827	0.0847
		[0.0685]	*[0.0679]*		*[0.0754]*	*[0.0748]*
EBITDA*	-1.48E-07	-2.04E-07	-1.15E-07	-1.51E-07	-2.11E-07	-1.29E-07
	[1.81e-07]	*[1.81e-07]*	*[1.82e-07]*	*[1.83e-07]*	*[1.84e-07]*	*[1.86e-07]*
Capital*	0	0	0	0	0	0
	[0]	*[0]*	*[0]*	*[0]*	*[0]*	*[0]*
Dividends*	1.32e-07*	1.55e-07**	1.64e-07**	1.28e-07*	1.50e-07**	1.59e-07**
	[6.85e-08]	*[6.86e-08]*	*[6.80e-08]*	*[6.91e-08]*	*[6.92e-08]*	*[6.87e-08]*
Revenue*	2.17E-09	7.86E-09	-1.26E-08	4.19E-09	1.03E-08	-8.59E-09
	[3.63e-08]	*[3.62e-08]*	*[3.66e-08]*	*[3.68e-08]*	*[3.66e-08]*	*[3.73e-08]*
Revenue from exports*	-3.00E-08	-5.10E-08	2.11E-08	-3.71E-08	-5.92E-08	7.28E-09
	[1.29e-07]	*[1.28e-07]*	*[1.29e-07]*	*[1.30e-07]*	*[1.30e-07]*	*[1.32e-07]*
Proportion of firm held by bm.*	0.00420**	0.00416**	0.00382*	0.00466**	0.00451**	0.00419*
	[0.00209]	*[0.00208]*	*[0.00206]*	*[0.00216]*	*[0.00215]*	*[0.00213]*
Number of seats for the director	-0.0033	-0.000729	0.00344	-0.00823	-0.0038	0.000719
	[0.0142]	*[0.0143]*	*[0.0142]*	*[0.0148]*	*[0.0149]*	*[0.0149]*
Tenure	-0.00286***	-0.00261***	-0.00260***	-0.00294***	-0.00267***	-0.00273***
	[0.000796]	*[0.000810]*	*[0.000801]*	*[0.000857]*	*[0.000873]*	*[0.000866]*
Constant	0.828**	0.706**	0.677**	0.139	0.0645	0.0549
Controls for sectors	*[0.324]*	*[0.330]*	*[0.327]*	*[0.199]*	*[0.213]*	*[0.211]*
Observations	299	299	299	268	268	268
R-squared	0.173	0.191	0.211	0.173	0.192	0.208

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specifications 1 - 3 are run on all firms, 4-6 on the 3 largestquantiles in terms of capital

Table B.5: X alumni: linear probability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proportion of ENA alumni*	-0.957***	-0.888***	-0.880***	-0.821***	-0.937***	-0.874***	-0.861***	-0.807***
	[0.213]	*[0.217]*	*[0.211]*	*[0.209]*	*[0.229]*	*[0.236]*	*[0.228]*	*[0.225]*
Proportion of HEC alumni*	0.0307	0.105	-0.205	-0.179	0.238	0.285	-0.0146	0.0409
	[0.311]	*[0.314]*	*[0.308]*	*[0.305]*	*[0.336]*	*[0.339]*	*[0.331]*	*[0.326]*
Proportion of X alumni*	0.203*	0.205*	0.588***	0.565***	0.12	0.112	0.536***	0.524***
	[0.118]	*[0.121]*	*[0.128]*	*[0.127]*	*[0.129]*	*[0.133]*	*[0.143]*	*[0.140]*
Previous CEO			-0.318***	-0.288***			-0.326***	-0.288***
			[0.0428]	*[0.0429]*			*[0.0463]*	*[0.0462]*
Age				-0.00700***				-0.00895***
				[0.00158]				*[0.00177]*
Ile de France		-0.0367	-0.0134	-0.0224		-0.0241	-0.00884	-0.0164
		[0.0392]	*[0.0382]*	*[0.0378]*		*[0.0428]*	*[0.0415]*	*[0.0409]*
Paris		-0.0728	-0.00841	-0.00338		-0.0584	0.0016	0.0154
		[0.0453]	*[0.0448]*	*[0.0444]*		*[0.0498]*	*[0.0489]*	*[0.0482]*
EBITDA*	-6.44E-08	-5.95E-08	-5.58E-08	-5.36E-08	-5.46E-08	-5.07E-08	-4.88E-08	-4.91E-08
	[5.10e-08]	*[5.12e-08]*	*[4.97e-08]*	*[4.92e-08]*	*[5.18e-08]*	*[5.21e-08]*	*[5.04e-08]*	*[4.96e-08]*
Capital*	0	0	0	0	0	0	0	0
	[0]	*[0]*	*[0]*	*[0]*	*[0]*	*[0]*	*[0]*	*[0]*
Dividends*	3.70E-09	3.91E-09	4.55E-09	2.32E-08	-6.44E-09	-5.94E-09	-7.26E-09	1.53E-08
	[5.78e-08]	*[5.77e-08]*	*[5.60e-08]*	*[5.56e-08]*	*[5.79e-08]*	*[5.79e-08]*	*[5.61e-08]*	*[5.54e-08]*
Revenue*	1.43E-09	1.76E-09	7.46E-09	6.70E-09	1.67E-09	1.95E-09	8.09E-09	7.14E-09
	[8.61e-09]	*[8.61e-09]*	*[8.39e-09]*	*[8.31e-09]*	*[8.62e-09]*	*[8.62e-09]*	*[8.40e-09]*	*[8.26e-09]*
Revenue from exports*	2.94E-08	2.89E-08	1.72E-09	2.22E-09	2.82E-08	2.73E-08	-1.19E-09	-3.50E-10
	[3.02e-08]	*[3.02e-08]*	*[2.95e-08]*	*[2.92e-08]*	*[3.02e-08]*	*[3.02e-08]*	*[2.96e-08]*	*[2.91e-08]*
Proportion of firm held by bm.*	-0.00012	-0.00035	8.98E-05	-0.000573	-0.00155	-0.00171	-0.000794	-0.00151
	[0.00119]	*[0.00120]*	*[0.00117]*	*[0.00117]*	*[0.00145]*	*[0.00146]*	*[0.00142]*	*[0.00141]*
Number of seats for the director	0.000925	0.000865	0.00458	0.00145	0.00142	0.00101	0.00435	0.000367
	[0.00993]	*[0.00996]*	*[0.00968]*	*[0.00960]*	*[0.0104]*	*[0.0104]*	*[0.0101]*	*[0.00995]*
Tenure	-0.00354***	-0.00356***	-0.00351***	-0.00321***	-0.00354***	-0.00356***	-0.00356***	-0.00313***
	[0.000597]	*[0.000597]*	*[0.000579]*	*[0.000577]*	*[0.000667]*	*[0.000667]*	*[0.000646]*	*[0.000641]*
Constant	0.422**	0.448**	0.341**	0.681***	-0.0577	-0.0349	-0.108	0.435*
	[0.173]	[0.174]	[0.169]	[0.184]	[0.216]	[0.217]	[0.211]	[0.233]
Controls for sectors	0.103	0.098	0.11	0.206	0.557**	0.552**	0.524**	0.529**
Observations	900	900	900	900	757	757	757	757
R-squared	0.109	0.112	0.165	0.183	0.118	0.12	0.176	0.204

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specifications 1 - 3+7 are run on all firms, 4-6+8 on the 3 largestquantiles in terms of capital

Table B.6: HEC alumni: linear probability

	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of ENA alumni*	-0.38	-0.38	-0.359	-0.458	-0.391	-0.318
	[0.376]	*[0.376]*	*[0.386]*	*[0.386]*	*[0.400]*	*[0.414]*
Proportion of HEC alumni*	1.666***	1.666***	1.688***	1.901***	1.812***	1.890***
	[0.304]	*[0.304]*	*[0.318]*	*[0.327]*	*[0.331]*	*[0.349]*
Proportion of X alumni*	-0.437	-0.437	-0.449	-0.132	-0.235	-0.284
	[0.305]	*[0.305]*	*[0.309]*	*[0.325]*	*[0.329]*	*[0.337]*
Previous CEO			-0.0311			-0.0956
			[0.128]			*[0.138]*
Ile de France	0.0797	0.0797	0.0811		0.13	0.137*
	[0.0748]	*[0.0748]*	*[0.0752]*		*[0.0791]*	*[0.0798]*
Paris	-0.012	-0.012	-0.0108		0.0333	0.0409
	[0.0730]	*[0.0730]*	*[0.0733]*		*[0.0804]*	*[0.0812]*
EBITDA*	-4.49E-07	-4.49E-07	-4.48E-07	-2.88E-07	-3.06E-07	-2.99E-07
	[3.81e-07]	*[3.81e-07]*	*[3.81e-07]*	*[3.82e-07]*	*[3.82e-07]*	*[3.83e-07]*
Capital*	5.63E-11	5.63E-11	5.54E-11	0	0	0
	[6.72e-11]	*[6.72e-11]*	*[6.74e-11]*	*[6.71e-11]*	*[6.73e-11]*	*[6.76e-11]*
Dividends*	6.20E-08	6.20E-08	6.08E-08	1.98E-07	1.34E-07	1.33E-07
	[2.47e-07]	*[2.47e-07]*	*[2.48e-07]*	*[2.35e-07]*	*[2.46e-07]*	*[2.46e-07]*
Revenue*	5.69E-08	5.69E-08	5.66E-08	3.07E-08	3.28E-08	3.12E-08
	[6.57e-08]	*[6.57e-08]*	*[6.58e-08]*	*[6.61e-08]*	*[6.60e-08]*	*[6.62e-08]*
Revenue from exports*	-2.03E-07	-2.03E-07	-2.01E-07	-2.00E-07	-1.73E-07	-1.67E-07
	[2.11e-07]	*[2.11e-07]*	*[2.12e-07]*	*[2.09e-07]*	*[2.12e-07]*	*[2.12e-07]*
Proportion of firm held by bm.*	-0.00188	-0.00188	-0.00182	-0.000561	-0.000369	-0.000467
	[0.00335]	*[0.00335]*	*[0.00337]*	*[0.00362]*	*[0.00362]*	*[0.00363]*
Number of seats for the director	0.0337**	0.0337**	0.0333**	0.0467***	0.0474***	0.0464***
	[0.0161]	*[0.0161]*	*[0.0162]*	*[0.0169]*	*[0.0170]*	*[0.0171]*
Tenure	-0.00315***	-0.00315***	-0.00315***	-0.00310***	-0.00315***	-0.00317***
	[0.000915]	*[0.000915]*	*[0.000917]*	*[0.000944]*	*[0.000943]*	*[0.000945]*
Constant	-0.136	-0.136	-0.125	-0.203	-0.246	-0.196
	[0.266]	*[0.266]*	*[0.271]*	*[0.314]*	*[0.315]*	*[0.324]*
Controls for sectors						
Observations	259	259	259	224	224	224
R-squared	0.287	0.287	0.287	0.309	0.319	0.32

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1
Note: *variables indicate that the variable is entered as difference from mean in the sample
Specifications 1 - 3 are run on all firms, 4-6 on the 3 largestquantiles in terms of capital

Table B.7: ENA alumni: logit

	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of ENA alumni*	2.524	2.668	3.803**	2.822	3.104*	3.777**
	[1.765]	*[1.807]*	*[1.898]*	*[1.830]*	*[1.878]*	*[1.921]*
Proportion of HEC alumni*	-4.300*	-5.233**	-5.663**	-3.801	-4.604*	-4.968**
	[2.363]	*[2.515]*	*[2.479]*	*[2.380]*	*[2.527]*	*[2.509]*
Proportion of X alumni*	0.764	0.994	0.674	0.657	0.823	0.694
	[1.127]	*[1.169]*	*[1.180]*	*[1.185]*	*[1.241]*	*[1.244]*
Previous CEO			-1.206**			-1.044*
			[0.529]			*[0.541]*
Ile de France		-0.227	-0.117		-0.305	-0.193
		[0.460]	*[0.467]*		*[0.496]*	*[0.506]*
Paris		0.628	0.687*		0.591	0.617
		[0.387]	*[0.395]*		*[0.422]*	*[0.429]*
EBITDA*	-1.24E-06	-1.60E-06	-6.88E-07	-1.35E-06	-1.70E-06	-8.69E-07
	[1.18e-06]	*[1.24e-06]*	*[1.30e-06]*	*[1.19e-06]*	*[1.26e-06]*	*[1.32e-06]*
Capital*	-8.84e-10*	-8.04E-10	-7.58E-10	-9.40e-10**	-8.46e-10*	-7.85E-10
	[4.65e-10]	*[4.98e-10]*	*[5.02e-10]*	*[4.75e-10]*	*[5.13e-10]*	*[5.15e-10]*
Dividends*	1.26e-06**	1.44e-06**	1.40e-06***	1.26e-06**	1.41e-06**	1.38e-06***
	[5.36e-07]	*[5.90e-07]*	*[5.28e-07]*	*[5.26e-07]*	*[5.78e-07]*	*[5.29e-07]*
Revenue*	4.07E-08	7.46E-08	-1.18E-07	7.86E-08	1.11E-07	-6.73E-08
	[2.52e-07]	*[2.63e-07]*	*[2.74e-07]*	*[2.50e-07]*	*[2.60e-07]*	*[2.74e-07]*
Revenue from exports*	-3.06E-07	-4.50E-07	2.52E-07	-4.38E-07	-5.74E-07	7.27E-08
	[8.93e-07]	*[9.35e-07]*	*[9.71e-07]*	*[8.86e-07]*	*[9.27e-07]*	*[9.71e-07]*
Proportion of firm held by bm.*	0.0274*	0.0280*	0.0264	0.0286*	0.0289*	0.0278*
	[0.0157]	*[0.0161]*	*[0.0161]*	*[0.0155]*	*[0.0158]*	*[0.0160]*
Number of seats for the director	-0.018	0.00115	0.0255	-0.0484	-0.0183	0.00548
	[0.0775]	*[0.0793]*	*[0.0826]*	*[0.0814]*	*[0.0833]*	*[0.0862]*
Tenure	-0.0329***	-0.0310***	-0.0305***	-0.0317***	-0.0296***	-0.0298***
	[0.0112]	*[0.0107]*	*[0.0105]*	*[0.0111]*	*[0.0106]*	*[0.0106]*
Constant	0.668	0.177	0.00739	0.843	0.376	0.232
	[0.962]	*[1.047]*	*[1.052]*	*[0.964]*	*[1.065]*	*[1.069]*
Controls for sectors						
Observations	288	288	288	260	260	260

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specifications 1 - 3 are run on all firms, 4-6 on the 3 largestquantiles in terms of capital

Table B.8: X alumni: logit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proportion of ENA alumni*	-4.432***	-4.134***	-4.349***	-4.348***	-4.059***	-4.203***	-4.055***	-3.958***
	[1.041]	*[1.054]*	*[1.064]*	*[1.135]*	*[1.157]*	*[1.162]*	*[1.067]*	*[1.168]*
Proportion of HEC alumni*	0.225	0.577	-0.762	1.214	1.438	0.179	-0.656	0.55
	[1.393]	*[1.407]*	*[1.444]*	*[1.532]*	*[1.543]*	*[1.582]*	*[1.447]*	*[1.571]*
Proportion of X alumni*	0.960*	0.980*	2.849***	0.603	0.576	2.633***	2.778***	2.667***
	[0.530]	*[0.543]*	*[0.626]*	*[0.582]*	*[0.601]*	*[0.703]*	*[0.629]*	*[0.710]*
Previous CEO			-1.494***			-1.538***	-1.374***	-1.405***
			[0.215]			*[0.236]*	*[0.218]*	*[0.241]*
Age							-0.0320***	-0.0434***
							[0.00769]	*[0.00898]*
Ile de France		-0.158	-0.0574		-0.106	-0.0414	-0.11	-0.086
		[0.174]	*[0.180]*		*[0.191]*	*[0.197]*	*[0.182]*	*[0.202]*
Paris		-0.339*	-0.0556		-0.27	0.000827	-0.0464	0.0627
		[0.201]	*[0.211]*		*[0.223]*	*[0.234]*	*[0.214]*	*[0.239]*
EBITDA*	-4.25E-07	-4.08E-07	-4.00E-07	-3.82E-07	-3.70E-07	-3.74E-07	-3.59E-07	-3.43E-07
	[2.80e-07]	*[2.83e-07]*	*[2.97e-07]*	*[2.88e-07]*	*[2.90e-07]*	*[3.05e-07]*	*[2.99e-07]*	*[3.09e-07]*
Capital*	-7.69E-11	-7.37E-11	-5.27E-11	-6.07E-11	-6.07E-11	0	0	0
	[1.26e-10]	*[1.22e-10]*	*[1.53e-10]*	*[1.20e-10]*	*[1.18e-10]*	*[1.46e-10]*	*[1.36e-10]*	*[1.30e-10]*
Dividends*	-1.44E-07	-1.55E-07	-1.56E-07	-2.14E-07	-2.22E-07	-2.29E-07	-8.14E-08	-1.41E-07
	[3.07e-07]	*[3.10e-07]*	*[3.22e-07]*	*[3.09e-07]*	*[3.13e-07]*	*[3.23e-07]*	*[3.20e-07]*	*[3.23e-07]*
Revenue*	1.71E-08	1.88E-08	4.91E-08	1.73E-08	1.90E-08	5.16E-08	4.25E-08	4.36E-08
	[4.69e-08]	*[4.72e-08]*	*[5.05e-08]*	*[4.67e-08]*	*[4.70e-08]*	*[5.01e-08]*	*[5.08e-08]*	*[5.08e-08]*
Revenue from exports*	2.21E-07	2.24E-07	8.71E-08	2.29E-07	2.30E-07	8.40E-08	9.87E-08	1.01E-07
	[1.69e-07]	*[1.71e-07]*	*[1.75e-07]*	*[1.72e-07]*	*[1.74e-07]*	*[1.77e-07]*	*[1.80e-07]*	*[1.84e-07]*
Proportion of firm held by bm.*	-0.000522	-0.00157	0.000575	-0.00645	-0.00717	-0.00331	-0.00239	-0.00658
	[0.00512]	*[0.00517]*	*[0.00530]*	*[0.00645]*	*[0.00649]*	*[0.00678]*	*[0.00543]*	*[0.00693]*
Number of seats for the director	0.00734	0.00702	0.0244	0.0101	0.00835	0.0245	0.0129	0.0128
	[0.0436]	*[0.0439]*	*[0.0453]*	*[0.0460]*	*[0.0463]*	*[0.0477]*	*[0.0457]*	*[0.0484]*
Tenure	-0.0197***	-0.0199***	-0.0200***	-0.0196***	-0.0197***	-0.0200***	-0.0186***	-0.0183***
	[0.00379]	*[0.00378]*	*[0.00376]*	*[0.00420]*	*[0.00418]*	*[0.00414]*	*[0.00369]*	*[0.00407]*
Constant	-1.279*	-1.101	-1.174	0.586	0.672	0.581	0.533	3.133***
	[0.703]	[0.712]	[0.738]	[0.534]	[0.541]	[0.559]	[0.847]	[0.788]
Controls for sectors								
Observations	900	900	900	752	752	752	900	752

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specifications 1 - 3+7 are run on all firms, 4-6+8 on the 3 largestquantiles in terms of capital

Table B.9: HEC alumni: logit

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	CEO	CEO	CEO	CEO	CEO	CEO
Previous CEO			-0.0841			-0.376
			[0.772]			*[0.833]*
Proportion of ENA alumni*	-2.284	-1.801	-1.765	-2.708	-2.454	-2.27
	[2.107]	*[2.188]*	*[2.208]*	*[2.369]*	*[2.507]*	*[2.527]*
Proportion of HEC alumni*	9.697***	9.666***	9.713***	11.64***	11.65***	11.87***
	[1.910]	*[1.948]*	*[1.994]*	*[2.338]*	*[2.403]*	*[2.450]*
Proportion of X alumni*	-1.999	-2.434	-2.466	-0.581	-1.233	-1.406
	[1.607]	*[1.654]*	*[1.679]*	*[1.803]*	*[1.897]*	*[1.932]*
Ile de France		0.568	0.571		0.958**	0.977**
		[0.412]	*[0.413]*		*[0.465]*	*[0.468]*
Paris		-0.0729	-0.0698		0.285	0.303
		[0.387]	*[0.389]*		*[0.449]*	*[0.451]*
EBITDA*	-2.54E-06	-2.71E-06	-2.71E-06	-1.18E-06	-1.19E-06	-1.20E-06
	[2.47e-06]	*[2.52e-06]*	*[2.52e-06]*	*[2.37e-06]*	*[2.42e-06]*	*[2.42e-06]*
Capital*	0	0	0	-2.07E-10	-1.92E-10	-2.05E-10
	[4.86e-10]	*[5.16e-10]*	*[5.16e-10]*	*[4.97e-10]*	*[5.27e-10]*	*[5.30e-10]*
Dividends*	1.55E-06	1.08E-06	1.08E-06	2.33E-06	2.13E-06	2.14E-06
	[1.68e-06]	*[1.74e-06]*	*[1.75e-06]*	*[2.03e-06]*	*[2.00e-06]*	*[2.00e-06]*
Revenue*	2.45E-07	2.55E-07	2.55E-07	-6.34E-08	-1.54E-07	-1.57E-07
	[4.65e-07]	*[4.78e-07]*	*[4.79e-07]*	*[4.91e-07]*	*[6.00e-07]*	*[6.05e-07]*
Revenue from exports*	-1.35E-06	-1.13E-06	-1.13E-06	-7.16E-07	-4.28E-07	-4.18E-07
	[1.44e-06]	*[1.47e-06]*	*[1.47e-06]*	*[1.40e-06]*	*[1.52e-06]*	*[1.53e-06]*
Proportion of firm held by bm.*	-0.0137	-0.0128	-0.0128	-0.00426	-0.00465	-0.00497
	[0.0175]	*[0.0174]*	*[0.0174]*	*[0.0215]*	*[0.0210]*	*[0.0211]*
Number of seats for the director	0.181*	0.182*	0.181*	0.274**	0.288***	0.288***
	[0.0934]	*[0.0935]*	*[0.0936]*	*[0.108]*	*[0.108]*	*[0.109]*
Tenure	-0.0174***	-0.0177***	-0.0177***	-0.0187***	-0.0189***	-0.0191***
	[0.00578]	*[0.00582]*	*[0.00582]*	*[0.00622]*	*[0.00632]*	*[0.00635]*
Constant	-3.112***	-3.351***	-3.360***	-3.711***	-4.393***	-4.449***
	[0.999]	[1.062]	[1.066]	[1.052]	[1.161]	[1.171]
Controls for sectors						
Observations	256	256	256	222	222	222

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1
Note: *variables indicate that the variable is entered as difference from mean in the sample
Specifications 1 - 3 are run on all firms, 4-6 on the 3 largestquantiles in terms of capital

Table B.10: ENA alumni: probit

	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of ENA alumni*	1.522	1.52	2.285**	1.699	1.79	2.300**
	[1.069]	*[1.077]*	*[1.140]*	*[1.108]*	*[1.117]*	*[1.157]*
Proportion of HEC alumni*	-2.482*	-2.929**	-3.347**	-2.21	-2.619*	-2.959**
	[1.304]	*[1.347]*	*[1.381]*	*[1.352]*	*[1.405]*	*[1.433]*
Proportion of X alumni*	0.429	0.545	0.325	0.357	0.445	0.325
	[0.679]	*[0.698]*	*[0.704]*	*[0.717]*	*[0.741]*	*[0.743]*
Previous CEO			-0.707**			-0.621**
			[0.299]			*[0.311]*
Ile de France		-0.0905	-0.0108		-0.148	-0.0694
		[0.274]	*[0.278]*		*[0.298]*	*[0.303]*
Paris		0.389*	0.424*		0.365	0.386
		[0.234]	*[0.239]*		*[0.255]*	*[0.259]*
EBITDA*	-6.57E-07	-7.72E-07	-3.77E-07	-7.38E-07	-8.55E-07	-4.89E-07
	[6.70e-07]	*[6.77e-07]*	*[7.10e-07]*	*[6.80e-07]*	*[6.87e-07]*	*[7.21e-07]*
Capital*	-5.39e-10*	-5.17e-10*	-4.95e-10*	-5.59e-10**	-5.25e-10*	-4.97E-10
	[2.78e-10]	*[2.98e-10]*	*[3.00e-10]*	*[2.82e-10]*	*[3.06e-10]*	*[3.07e-10]*
Dividends*	7.65e-07**	8.73e-07**	8.62e-07***	7.50e-07**	8.49e-07**	8.38e-07***
	[3.18e-07]	*[3.50e-07]*	*[3.17e-07]*	*[3.12e-07]*	*[3.44e-07]*	*[3.17e-07]*
Revenue*	9.95E-09	1.21E-08	-7.44E-08	3.60E-08	3.81E-08	-4.28E-08
	[1.42e-07]	*[1.43e-07]*	*[1.49e-07]*	*[1.41e-07]*	*[1.43e-07]*	*[1.50e-07]*
Revenue from exports*	-1.37E-07	-1.61E-07	1.58E-07	-2.28E-07	-2.52E-07	4.67E-08
	[5.05e-07]	*[5.15e-07]*	*[5.31e-07]*	*[5.04e-07]*	*[5.14e-07]*	*[5.34e-07]*
Proportion of firm held by bm.*	0.0155**	0.0166**	0.0157**	0.0157**	0.0165**	0.0158**
	[0.00676]	*[0.00707]*	*[0.00712]*	*[0.00687]*	*[0.00714]*	*[0.00719]*
Number of seats for the director	-0.0104	-0.00108	0.012	-0.0285	-0.0124	0.00056
	[0.0476]	*[0.0486]*	*[0.0501]*	*[0.0498]*	*[0.0508]*	*[0.0522]*
Tenure	-0.0177***	-0.0168***	-0.0167***	-0.0173***	-0.0163***	-0.0165***
	[0.00515]	*[0.00507]*	*[0.00506]*	*[0.00528]*	*[0.00520]*	*[0.00518]*
Constant	0.435	0.133	0.00654	0.532	0.241	0.135
	[0.578]	*[0.620]*	*[0.626]*	*[0.581]*	*[0.634]*	*[0.640]*
Controls for sectors						
Observations	288	288	288	260	260	260

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1
Note: *variables indicate that the variable is entered as difference from mean in the sample
Specifications 1 - 3 are run on all firms, 4-6 on the 3 largestquantiles in terms of capital

Table B.11: X alumni: probit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proportion of ENA alumni*	-2.734***	-2.547***	-2.636***	-2.667***	-2.486***	-2.521***	-2.452***	-2.366***
	[0.623]	*[0.633]*	*[0.639]*	*[0.678]*	*[0.694]*	*[0.697]*	*[0.639]*	*[0.700]*
Proportion of HEC alumni*	0.13	0.331	-0.506	0.675	0.798	0.00365	-0.453	0.224
	[0.844]	*[0.853]*	*[0.873]*	*[0.928]*	*[0.936]*	*[0.960]*	*[0.867]*	*[0.952]*
Proportion of X alumni*	0.605*	0.609*	1.698***	0.382	0.359	1.567***	1.659***	1.592***
	[0.326]	*[0.334]*	*[0.373]*	*[0.358]*	*[0.370]*	*[0.418]*	*[0.375]*	*[0.422]*
Previous CEO			-0.905***			-0.935***	-0.833***	-0.853***
			[0.127]			*[0.139]*	*[0.130]*	*[0.142]*
Age							-0.0202***	-0.0267***
							[0.00464]	*[0.00536]*
Ile de France		-0.0897	-0.0232		-0.0607	-0.0168	-0.0591	-0.0483
		[0.107]	*[0.109]*		*[0.118]*	*[0.120]*	*[0.110]*	*[0.122]*
Paris		-0.208*	-0.0327		-0.165	0.00264	-0.0237	0.0449
		[0.123]	*[0.128]*		*[0.136]*	*[0.141]*	*[0.130]*	*[0.144]*
EBITDA*	-2.58E-07	-2.49E-07	-2.32E-07	-2.30E-07	-2.24E-07	-2.14E-07	-2.10E-07	-1.97E-07
	[1.69e-07]	*[1.70e-07]*	*[1.75e-07]*	*[1.73e-07]*	*[1.75e-07]*	*[1.80e-07]*	*[1.77e-07]*	*[1.83e-07]*
Capital*	0	0	0	0	0	0	0	0
	[7.07e-11]	*[6.97e-11]*	*[8.24e-11]*	*[6.82e-11]*	*[6.77e-11]*	*[8.06e-11]*	*[7.54e-11]*	*[7.34e-11]*
Dividends*	-7.54E-08	-8.12E-08	-8.13E-08	-1.16E-07	-1.21E-07	-1.24E-07	-3.13E-08	-6.67E-08
	[1.84e-07]	*[1.87e-07]*	*[1.89e-07]*	*[1.87e-07]*	*[1.90e-07]*	*[1.92e-07]*	*[1.91e-07]*	*[1.95e-07]*
Revenue*	9.88E-09	1.09E-08	2.82E-08	1.03E-08	1.13E-08	2.98E-08	2.45E-08	2.55E-08
	[2.84e-08]	*[2.86e-08]*	*[2.99e-08]*	*[2.84e-08]*	*[2.85e-08]*	*[2.97e-08]*	*[3.02e-08]*	*[3.02e-08]*
Revenue from exports*	1.30E-07	1.32E-07	5.01E-08	1.33E-07	1.34E-07	4.71E-08	5.67E-08	5.65E-08
	[1.03e-07]	*[1.04e-07]*	*[1.06e-07]*	*[1.04e-07]*	*[1.06e-07]*	*[1.07e-07]*	*[1.08e-07]*	*[1.11e-07]*
Proportion of firm held by bm.*	-0.000336	-0.000971	0.000313	-0.00401	-0.00445	-0.00224	-0.0015	-0.00394
	[0.00316]	*[0.00320]*	*[0.00331]*	*[0.00396]*	*[0.00399]*	*[0.00418]*	*[0.00333]*	*[0.00417]*
Number of seats for the director	0.00545	0.00475	0.0158	0.00706	0.00558	0.0161	0.00844	0.00881
	[0.0270]	*[0.0272]*	*[0.0276]*	*[0.0285]*	*[0.0286]*	*[0.0291]*	*[0.0279]*	*[0.0294]*
Tenure	-0.0112***	-0.0113***	-0.0117***	-0.0111***	-0.0111***	-0.0117***	-0.0110***	-0.0109***
	[0.00196]	*[0.00196]*	*[0.00200]*	*[0.00216]*	*[0.00216]*	*[0.00221]*	*[0.00203]*	*[0.00227]*
Constant	-0.795*	-0.687	-0.619	0.351	0.409	0.354	0.409	1.902***
	[0.421]	[0.427]	[0.410]	[0.321]	[0.324]	[0.337]	[0.482]	[0.460]
Controls for sectors								
Observations	900	900	900	752	752	752	900	752

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specifications 1 - 3+7 are run on all firms, 4-6+8 on the 3 largestquantiles in terms of capital

Table B.12: HEC alumni: probit

	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of ENA alumni*	1.522	-1.231	-1.217	-1.763	-1.603	-1.504
	[1.069]	*[1.286]*	*[1.300]*	*[1.399]*	*[1.456]*	*[1.470]*
Proportion of HEC alumni*	-2.482*	5.717***	5.735***	6.793***	6.740***	6.875***
	[1.304]	*[1.115]*	*[1.144]*	*[1.320]*	*[1.350]*	*[1.387]*
Proportion of X alumni*	0.429	-1.427	-1.439	-0.287	-0.619	-0.712
	[0.679]	*[0.974]*	*[0.989]*	*[1.071]*	*[1.091]*	*[1.112]*
Previous CEO			-0.0335			-0.207
			[0.456]			*[0.486]*
Paris		-0.0622	-0.0607		0.127	0.141
		[0.230]	*[0.231]*		*[0.262]*	*[0.264]*
EBITDA*	-6.57E-07	-1.46E-06	-1.46E-06	-6.63E-07	-6.91E-07	-6.90E-07
	[6.70e-07]	*[1.37e-06]*	*[1.37e-06]*	*[1.38e-06]*	*[1.41e-06]*	*[1.41e-06]*
Capital*	-5.39e-10*	5.06E-11	0	-8.71E-11	-7.69E-11	-8.45E-11
	[2.78e-10]	*[3.10e-10]*	*[3.10e-10]*	*[3.05e-10]*	*[3.19e-10]*	*[3.21e-10]*
Dividends*	7.65e-07**	5.25E-07	5.24E-07	1.27E-06	1.10E-06	1.10E-06
	[3.18e-07]	*[1.04e-06]*	*[1.04e-06]*	*[1.34e-06]*	*[1.23e-06]*	*[1.24e-06]*
Revenue*	9.95E-09	1.22E-07	1.22E-07	-3.69E-08	-7.98E-08	-8.24E-08
	[1.42e-07]	*[2.55e-07]*	*[2.55e-07]*	*[2.75e-07]*	*[3.47e-07]*	*[3.50e-07]*
Revenue from exports*	-1.37E-07	-4.97E-07	-4.96E-07	-3.48E-07	-1.91E-07	-1.82E-07
	[5.05e-07]	*[7.49e-07]*	*[7.49e-07]*	*[7.69e-07]*	*[8.30e-07]*	*[8.33e-07]*
Proportion of firm held by bm.*	0.0155**	-0.00778	-0.00778	-0.00169	-0.00194	-0.00211
	[0.00676]	*[0.0107]*	*[0.0107]*	*[0.0131]*	*[0.0127]*	*[0.0128]*
Number of seats for the director	-0.0104	0.0973*	0.0970*	0.143**	0.151**	0.151**
	[0.0476]	*[0.0535]*	*[0.0536]*	*[0.0592]*	*[0.0598]*	*[0.0599]*
Tenure	-0.0177***	-0.0103***	-0.0103***	-0.0107***	-0.0107***	-0.0108***
	[0.00515]	*[0.00328]*	*[0.00328]*	*[0.00351]*	*[0.00349]*	*[0.00349]*
Constant	0.511	-1.857***	-1.860***	-2.057***	-2.382***	-2.410***
	[0.549]	*[0.593]*	*[0.595]*	*[0.569]*	*[0.630]*	*[0.634]*
Controls for sectors						
Observations	288	256	256	222	222	222

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Note: *variables indicate that the variable is entered as difference from mean in the sample

Specifications 1 - 3 are run on all firms, 4-6 on the 3 largestquantiles in terms of capital

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