CEO and Boards, The Ill Performance of Similar Social Networks

Research Paper

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Paul Petrescu

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Prof. Nicolas Naillon

Abstract

This paper shows the negative impacts of boards of directors' interlocks and educational shared networks on the performance of the top 120 French companies. This negative impact is particularly due to the similarity between CEO and board of directors' social networks. Those findings are made on several performance metrics for the year 2016: sales growth, returns on assets, price-earnings ratio, Tobin's q and stock price returns.

Public report

Introduction

Any investor putting money in a new start-up will tell you that what matters is the team. This major criterion does not disappear when considering large and more mature companies. Corporate governance can be key when assessing business past and future performance. This paper aims at assessing the impact of Board of Directors (BoD) and management networks on French large companies' performance.

Ties between executive and non-executive directors can be of two types: i) direct ties based on sharing seats at different BoDs and ii) indirect ties based on having been at the same school or sharing other specific social networks. The goal of this paper is to measure the impact of social networks on the performance of French large companies with two angles: first, whether companies more connected are performing better, second, whether the similarities between CEO and BoD social networks (indirect ties) are impacting positively or negatively the performance of the company. The second topic relates to the argument between the agency theory and the stewardship theory. On the one hand, BoD has an advisory and controlling role on management of the company therefore it should be as independent as possible from it. On the other hand, a good company is based on having efficient management and directors working together. Shared social networks are helping better selecting executive and non-executive directors and efficiently functioning.

This paper looks at 116 top public companies in the French market, which are the most actively traded stocks listed in Paris. Data were gathered concerning each directors and CEO of those companies especially looking at their educational backgrounds and at the interlocks between boards. For the 116 firms in the scope of this paper, data on the performance during the year 2016 were also collected. Performance of companies is measured based on the following accounting and market-based metrics: sales' growth, return on assets, return on capital employed, return on equity, price-earnings ratio, price-to-book ratio, Tobin's q, economic value added and market adjusted stock returns.

Principal results of this paper are that more connected firms are performing worse accordingly to several performance metrics. This connectedness is assessed either through direct ties of interlocks or indirect ties of same educational backgrounds. To explain those rather not intuitive results, this paper shows that the similarity between CEO and BoD social

networks (educational networks) is negatively impacting the performance of the company. A specific analysis is made on CEO compensations that does not conclude to an impact of those different social networks on the level of compensation.

This paper is organized as follows. The first section provides a literature review on the relationship between firm performance and boards of directors, underlining the specific role of CEO. The second section details the different data gathered and the construction of the different firms' performance indicators. The third section analyses the impact of boards of directors' interlocks and educational backgrounds on firms' performance.

Section 1 Literature review

Social networks' impact on companies' performance is a growing field of study. Those studies must tackle two issues: first, what measurement of connection should be used concerning boards and management of companies and, second, how to assess properly companies' performance. The latter area of study is of course the most important field of questioning for corporate finance. Without going into too much details on that point, this paper will rely on few key metrics that can be considered as good proxies for business performance and will dive more on the former difficulty.

Corporate Governance Interlocks and Country Specific Schemes

Following Granovetter (1973) seminal paper, research has been looking at the impact of social networks on the way people do business. Part of corporate governance studies influenced by sociology of organizations has been focusing on depicting the differences between countries, regions and cultures regarding companies' networks. One of the main differences described is for example the Anglo-Saxon versus the Continental European and the Japanese corporate governance models. The Anglo-Saxon model is based on entrepreneurship and private property. Companies are owned by independent persons and/or individual shareholders. Management is responsible to the BoD and shareholders. The shareholding structure is dispersed with shares trading in stock market. The Continental Europe on the contrary has a shareholding structure more concentrated. It relies on banking market rather than on stock market to raise capital. The Japanese model is considered even more concentrated with cross-participations between companies creating a dense network between them (Aoki (1994) on the Japanese specificities).

More specifically looking at France, corporate governance is driven by two main factors: first, a strong involvement of the French State in big companies and second a relatively concentrated elite trained in few major schools. French State involvement must be traced back to the end of World War II. French State played a key role in rebuilding the French economy with major companies being state-owned. Though the 1980s and 1990s saw many privatisations, French State remains a major player for business companies. With many

companies, previously state-owned, still managed by former civil servants trained at Ecole Nationale d'Adminisration (ENA) or from Grands Corps accesses (X-Ponts, X-Mines, etc.).

Kramarz and Thesmar (2011) specifically show the impact of social networks on board composition and corporate governance of French companies for the years 1992 to 2003. They show the strong correlation between the CEO's network and that of his BoD, especially in the case of high civil servants' networks. They find that CEO's compensation, CEO's turnover and acquisition's decision-making are influenced by CEO's and BoD's company networks and links. This paper will build on their research while looking more at assessing companies' performance related to those networks.

Different studies tackle more the relationship between corporate social network and firm's performance.

Information is Key

The nature and specificities of the ties linking board and management people with their industries appear to influence over the performance of their firms. Indeed, one can understand that those networks are means to convey information which are major assets when making strategic decisions for one's company.

Better networked boards and management have access to crucial information via their networks that make them more informed in both their monitoring, advising and decision-making capacities. An interesting research by Schonlau and Singh (2009) sets light on the impact of boards' networks on merger post-performance. The paper shows that less-connected boards are associated with weaker performing acquisitions compare to more connected ones. They distinguish three capacities that more connected boards have developed: i) operational strategy to merge properly by learning by doing and sometimes failing at other boards, ii) better general knowledge on the industry and iii) reduce search efforts and asymmetry of information on many deals looked at. To sum up, firms that are more connected have more knowledge on the dynamic of their industry and the right acquisitions to be made. The impact of information is here key for making a good deal happening.

When considering companies performance more generally it is harder to fully identify the relationship between firm performance and executives' and non-executives' networks. As

a matter of fact, many studies have shown the impact on different specific key strategic decisions: Shonlau and Singh (2009) on merger performance and Gulati and Westphal (1999) on the formation of alliances for example. One could expect this impact on strategic decision to also impact companies' performance in the long run. An important paper realized by Cohen, Frazzini and Malloy (2008) shows the impact of the ties between mutual fund managers and corporate board members via shared education networks on performance of their investment. They find that portfolio managers place larger bets on connected firms and perform significantly better on these holdings relative to their peers. Having more inside information and betting on more connected firms is therefore apparently a good strategy indicating indirectly that the well-connected companies are potentially performing better.

To take a closer look at firm social networks a distinction must be made between CEO and BoD connectedness.

CEO versus BoD connectedness: Agency theory versus social network

Agency theory as developed by Fama (1980) modelled a firm as a set of contracts where ownership and control of the firm are two separate things. This creates an 'agency problem' as managers need to be incentivized in managing the company in the interest of the shareholders and not only in their own interest.

In this respect, one needs to differentiate between BoD and CEO connectedness. Whereas the former connectedness is seen in most studies as a positive factor for firm performance, the latter is a subject of discussion. Bebchuk and all (2007) especially argue that CEO centrality is negatively associated with firm performance. They find that greater CEO centrality entails: i) lower profitability, ii) lower stock returns especially after acquisitions of other firms, iii) lower CEO turnover and iv) greater compensation package not related to specific company performance. Nevertheless, Bebchuk and all use a rather simple and potentially problematic proxy of CEO centrality. In their study, CEO centrality is indeed measured by the fraction of the top-five compensation captured by CEO. This metric is certainly important when assessing corporate governance but it does not really correspond to CEO networks but rather to the CEO centrality inside the management of the company.

Another study from Kirchmaier and Stathopoulos (2007) finds that CEOs' large social networks have a negative impact on firm performance. Their measure is more accurate regarding CEO social network by calculating direct ties created through all CEO past appointments. It is a very empirical measure but probably more precise to really assess CEO connectedness. Their study supports the argument that well-connected CEO perform badly in serving the interest of shareholders. They are more inclined to use their power in their own interest without being too accountable to shareholders, their connectedness being in a way a guarantee for them to keep their job or find a new one in another company.

Adopting a similar approach to Kirchmaier and Stathopoulos, this paper will consider both CEO and BoD networks in France and their impacts on firm performance.

CEO Duality: Agency theory versus stewardship

A specific case where BoD connectedness and CEO connectedness are partially similar is CEO duality. It is an interesting topic of discussion as it opposes agency theory to stewardship theory. CEO duality is defined as one person heading both the management and the board of a company. This situation creates imbalances according to the agency theory as it concentrates corporate power in the hand of one person. Proper monitoring and independence of the board is questioned by this situation. On the contrary, stewardship theory (Donaldson and Davis (1991) opposes this vision by arguing that shareholders' interests are maximized by shared incumbency of the two roles. Empirical evidences have not yet enabled to provide a final answer to this discussion.

Social Network Metrics: Direct and indirect ties

Studies on corporate networks face a major difficulty which is the proper assessment of ties linking different BoD or executives together. As underlined by Gulati and Westphal (1999) there are different types of ties: i) direct ties or relational embeddedness and ii) more distant network ties or structural embeddedness. Two persons coming from the same school may have never met but nevertheless they share the same social network and have a lot in

common. Both structural and relational embeddedness can influence corporate behaviours. Different research by Gulati (1995) and Burt and Knez (1995) have specifically shown that relational embeddedness can be strengthened by structural one.

Gulati and Westphal also underline that relationships between two executives may be characterized by distrust or at least independence. Interlocks are in the literature generally assumed to be positive connections that help the sharing of information and the overall cohesion of the network. But it is also known that executive suites are places of tough competitions and rivalry. Assessing that dimension is particularly difficult and will not be treated in this research, but it could weaken the modelling.

Considering more in detail the different measure of connectivity, three main metrics have been developed: i) degree (number of immediate connections), ii) eigenvector (measures the centrality of a board by looking at the board's number of interlocks and weighting those connections by the centrality of the interlocked firms) and iii) betweeness (measures how many boards' connected paths connect via a given board).

Depending on the metric chosen, the research findings can be quite different in terms of impact of corporate networks.

Firm Performance Metrics

When modelling firm performance, there are different potentially relevant metrics: i) traditional accounting and stock market metrics, ii) tobin's q and other specific ratios and iii) more complex valuation models such as economic value added.

Bhagat and Black (1999) study the interaction between board independence and firm performance. Directors of boards can be divided into inside directors (persons who are currently officers of the firm), affiliated directors (past inside persons, relatives of officers, investment bankers or lawyers) and independent directors (outside directors without such affiliations). Board independence depends on the number and the weight of independent directors. They study performance of companies notably by assessing market adjusted stock price returns, measured by cumulating daily returns minus the return on S&P 500 index. They believe this measure is better to assess performance than cumulative abnormal returns or standardized abnormal returns. An interesting element of their methodology is their use of

simultaneous equations to both assess the impact of firm governance on firm performance and firm performance on firm governance without making assumptions on which one causes the other. Indeed, they specifically argue that numerous firms in their dataset facing lower returns decided to increase BoD independence level.

David Yermack (1996) especially uses Tobin's q as an approximation of market valuation and found an inverse association between board size and firm value modelled by Tobin's q for years 1984 to 1991. To compute Tobin's q, Yermack needs for each firm the market value of assets (numerator) and the replacement cost of assets (denominator). The market value of assets depends on market value of common stock, valuation of preferred shares and debts and other liabilities being valued at book value. The replacement costs are computed through an algorithm taking into account inflation, real depreciation rates, capital expenditures and inventory valuation. Tobin's q is very interesting tool to assess firm performance but it does rely on numerous assumptions and a relatively complex modelling.

Adjaoud and all (2007) show in their paper no significant relationships between governance corporate governance and performance for Canadian companies when using accounting and stock market metrics such as ROE, EPS and market-to-book value. But they find links between board's quality and performance when using market value added and economic valued added. Nevertheless, their study does not look at BoDs' networks but only at BoDs' quality reflected by composition of BoDs, independence of different specific committee (audit and nominating), compensation and shareholder rights. The EVA is calculated as the difference between firm's net profit after tax and the total cost of capital employed being computed in their paper as cost of equity from CAPM multiplied by common equity.

Section 2. Data

2.1 Sources and sample characteristics

The sample corresponds to French companies listed in the SBF 120 (Société des Bourses Françaises) index, which is based on the 120 most actively traded stocks listed in Paris. The period of study is the year 2016. Data collection was divided into two tasks: data collection regarding BoD people and data collection for measuring firms' performance.

Among the companies listed in the SBF 120, a few companies were dropped because of: 1) merger or acquisition in the period of study or previously (Saft, Montupet, Technip), 2) not French-based company (Sartorius). After those exclusions, the sample is made of 116 companies. A list of all companies is provided in annex 1.

2.1.1 BoD variables and characteristics

To analyse network effects, data were gathered on each member of each BoD in the scope. This corresponds to 1248 individuals. Different sources were used to collect those data: i) registration documents of each company, ii) investor relations website of each company, iii) Who's Who database, iv) Bloomberg Executive Profile & Biography database. The following information were collected for each individual:

- Gender,
- Date of birth,
- Nationality,
- Position in the BoD (Chairman and or CEO, independent or non-independent director),
- Education (Grandes Ecoles, Universities, MBA),
- Other boards' positions.

In the scope of 116 firms, 47% have a CEO which is also chairman of the board. The share of independent directors in the board is on average of 44%. Table 1 provides summary statistics concerning BoDs' characteristics in the sample. The fact that French BoD are mostly constituted of French nationals will be useful in the study of school network impact. Indeed,

though many directors attended Anglo-Saxon universities for exchanges or MBA, school networks' impacts will be studied only concerning top French schools namely Sciences Po, ENA, HEC and Polytechnic (X).

The size of the board is an important factor as one can expect that the bigger the board the more chance to have interconnections with other boards. This relation is verified in the dataset with a correlation of 0.55 between BoD's size and the company centrality (eigenvector) in the network of 116 companies.

Table 1: Sample characteristics: boards of directors

	Size of BoD	Ratio of independent directors	Ratio of French directors	Age of directors	Ratio of women per BoD
Min	5 directors	0%	5%	27 years	7%
1st quartile	11 directors	33%	62.5%	52 years	31.5%
Median	12 directors	45%	80%	59 years	39%
Mean	13 directors	44%	75%	58 years	38%
3rd quartile	15 directors	59%	93%	65 years	44%
Max	20 directors	89%	100%	90 years	64%

Concerning directors' educational background, a comprehensive view on the background of each director was gathered. Table 2 sums up the 10 most common schools attended:

Table 2: Sample characteristics: Directors' education

School attended	Number of directors that attended
Sciences Po	164
ENA	106
HEC	103
X	91
Mines	45
ESSEC	43
Harvard	42
INSEAD	40

ESCP	29
ENS	26

Among the people that went to Sciences Po about half of them also did ENA (75 directors both went to ENA and Sciences Po) and 10 directors both did Polytechnic and ENA.

For the sake of simplicity, this study will only consider school networks' impact regarding the top 4 schools attended (Sciences Po, ENA, HEC and X).

2.1.2 Performance variables and characteristics

The period of study is the year 2016 and the evolution between the year 2015 end and the year 2016 end. Data on companies were collected in two ways: 1) using registration documents for year 2015 and 2016 of the companies and 2) financial information on stock prices' evolution using Yahoo Finance mainly (in some specific case data from other sources like investor relations websites or Google finance). The following information were collected for each company for year 2015 and year 2016:

- Sales,
- EBIT,
- Net financing cost,
- Net income,
- Weighted average number of shares outstanding,
- Basic EPS,
- Total assets,
- Total equity,
- Total liabilities,
- Net financial debt,
- Effective tax rate,
- CEO total compensation,
- Stock prices throughout the period.

Financial statements of 6 companies were not in euros: Aperam (USD), ArcelorMittal (USD), CGG (USD), LafargeHolcim (CHF), STMicroelectronics (USD) and Total (USD). The conversion exchange rates used were the ones of 31 December 2015 and 31 December 2016.

Furthermore, several companies' calendar results are not December-based (Elior, Eutelsat, Neopost, Pernod Ricard, etc.). To keep a similar market environment, the stock prices' period considered was the same for all companies despite those calendar discrepancies.

As mentioned in section 1, there are several ways of measuring firms' performance. In this research, the following metrics of performance are used:

- Sales' growth,
- Return on Assets (ROA),
- Return on Capital Employed (ROCE),
- Return on Equity (ROE),
- Price-earnings ratio (PE),
- Price-to-book value (PB),
- Tobin's q (QTob),
- Market adjusted returns (MAR),
- Economic value added (EVA).

The last 3 metrics will be described more thoroughly in the next subsection. For the different returns' and prices' ratios, the year of reference is the end of 2016; in some cases negative ratios and outliers were excluded from the analysis. Table 3 gives some statistics on the different 6 first metrics:

Table 3: Firm performance: sample characteristics

	Sales Growth	2016 ROA	2016 ROCE	2016 ROE	2016 PE	2016 PB
Min	-54%	0.1%	0.1%	0.1%	2	0.3
1st quartile	-1.4%	2.5%	6%	7.4%	12.5	1.1
Median	2.2%	4.1%	8.1%	10.1%	18.8	1.8

Mean	4.8%	4.3%	10.6%	11.3%	19.6	2.4
3rd quartile	6.9%	5.3%	12.2%	13.9%	25	3.1
Max	162%	26%	43.8%	36%	48.7	13.3
Sample	116	104	86	101	100	114

Strong sales' growths correspond to small companies (for example Innate Pharma +162%, Plastic Omnium -54%, Genfit +55% and DBV Technologies +47%) and were not excluded of this metric. On average, companies in the sample grew by 4.8%. Those are international and mature companies of relatively high scale.

Negative ROA are excluded from the scope, with 11 companies that have negative net income for the year 2016. Gaztransport and Technigaz company was also excluded with an ROA of 54%. GTT is a small but very profitable company (net income margin above 50%, only 359 staffs, market cap above €1.4 bn) with very few assets enabling it to have those important ROA levels. The ROA of 2016 was compared to the ROA of 2015 to check for big discrepancies. The two ROA are very similar with small variations for some companies. For each metric, year 2015 and year 2016 were compared to avoid big discrepancies.

ROCE was calculated as:

$$ROCE = \frac{EBIT \times (1 - Tax\ Rate)}{Capital\ Employed}$$

The EBIT corresponds to continuing operating profit stated by companies in their financial statements. In this respect, this ROCE calculation is a strong approximation as the denominator is not retreated from discontinuing elements and the continuing operating profit is based only on the financial statement's value given and not by recalculating it. The ROCE metric is therefore not strongly reliable.

As for ROA, negative ROE are excluded from the scope: 11 companies with negative net income and two companies with negative equity (Solocal because of current restructuration and Edenred which was spun off Accor company). GTT group with an ROE close to 100% and Air France-KLM of 61% are also excluded.

Negative PE ratios were excluded from the analysis. Furthermore, a few companies with important PE were also excluded for this metric (Plastic Omnium, STMicroelectronics, ENGIE, Icade, Innate Pharma).

Concerning the PB ratios, only the two companies with negative equity were excluded from the scope.

2.2 QTob, MAR and EVA

2.2.1 Tobin's q

Tobin's q is defined as:

$$q = \frac{Equity\ Market\ Value + Liabilities\ Market\ Value}{Equity\ Book\ Value + Liabilities\ Book\ Value}$$

It is a relatively well used indicator in the financial literature, as most papers do this paper will assume the same value for the liabilities market and book value, this approximation enables a way more easy and quick calculation of Tobin's q. Tobin's q is therefore calculated as:

$$q = \frac{Equity\ Market\ Value + Liabilities\ Book\ \ Value}{Equity\ Book\ Value + Liabilities\ Book\ Value}$$

The main intuition is that if Tobin's q is higher than 1, the market value is higher than the book value indicating some unmeasured or unaccounted assets for the company. Tobin's q for a specific market evolves through market ups and downs. This is therefore a useful indicator of potential bubbles. When used not to compare time-period but across companies, it can also show intangible assets owned by each company (human capital, relational capital, organisational capital) and therefore it gives a specific view on companies' performance and capacity to generate future wealth.

Table 4: Tobin's q distribution

	2016 QTob
Min	0.78
1st quartile	1.03
Median	1.3
Mean	1.6
3rd quartile	1.7
Max	7.2
Sample	116

As for the other performance indicators, there are some high values slightly driving the mean up. Those high Tobin's q correspond to: i) small companies with high market cap valuations (GTT with a Tobin's Q of 7.2, DBV Technologies 6 and Adocia 5.7) but also bigger companies with intangible assets of different sorts (Hermès 7.1, Dassault 3.1 and L'Oréal 3.5 for example).

2.2.2 Market Adjusted Stock Price Returns

To measure company performance, one can be interested at looking at the stock evolution during the year. This measure can be impacted by volatility for some stocks. Financial papers often use cumulative abnormal returns (CAR). This metric is very useful when studying an event and its impact on a stock but CAR metric is less pertinent on longer period of time. Following Bhagat and Black (1999), this paper uses a more direct metric which they call market adjusted stock price returns (MAR), which correspond to daily returns minus the return on the market cumulated over the year. In this paper, the market return is measured by the SBF 120 index provided by Euronext. The returns were geometrically compounded rather than arithmetically summed. The MAR calculated are very close to the yearly stock returns.

Table 5: MAR

	2016 MAR
Min	-84%

1st quartile	-13%
Median	-1.3%
Mean	-0.3%
3rd quartile	12%
Max	169%
Sample	116

The 169% increase corresponds to ArcelorMittal which went from a stock close to €2 to a stock above €7 in the year 2016. The 84% decrease correspond to CGG company.

2.2.3 Economic Value Added

The economic value added (EVA) metric has been developed to further measure companies' performance. The EVA aims at measuring the wealth created in excess to the required return for a company to pay its shareholders and debt holders. Following Adjaoud, Zeghal and Andaleeb (2007), this paper uses the EVA to better model firms' performance. The EVA is defined as:

$$EVA = EBIT \times (1 - Tax\ Rate) - WACC \times Capital\ Invested \quad (1)$$

The Weighted Average Cost of Capital (WACC) corresponds to:

$$WACC = Cost\ of\ debt \times (1 - Tax\ Rate) \times \frac{Net\ Debt}{Net\ Debt + Equity} + Cost\ of\ equity \times \frac{Equity}{Net\ Debt + Equity}$$

If one neglects or cannot calculate the cost of debt, the EVA can be approximated by:

$$EVA = EBIT \times (1 - Tax\ Rate) - Cost\ of\ Equity \times Common\ Equity \quad (2)$$

Depending on the capacity to calculate the cost of debt, the EVA was calculated using the first or second formula. When both can be calculated, the two EVA are highly correlated (correlation of 0.94) and similar for each company. This indicates that the EVA based only on the cost of equity is a good proxy for the EVA based on the full cost of capital for the companies when the EVA based on full cost is not available.

Cost of capital: cost of equity and cost of debt

CAPM model was used to evaluate the cost of equity for each firm:

$$Cost\ of\ equity = Risk\ Free\ Rate + \beta \times Market\ Premium$$

The risk-free rate was set at 1% which is close to the actual rate of return of the 10 years OAT published by the Banque de France. The market premium was set at 10%.

Beta coefficients were calculated based on the covariation of the daily stock price return of each company and the daily return of the SBF 120 index divided by the variance of the daily return of the SBF 120 index.

The cost of debt was calculated by dividing the net financing cost by the net financial debt for each company. Only companies with a positive net financial debt and net financing cost were kept.

Table 6 summarizes the findings concerning the WACC which were calculated for 72 companies:

Table 6: WACC

	2016 WACC
Min	2.2%
1st quartile	5.2%
Median	6.3%
Mean	6.8 %
3rd quartile	8.4%

Max	15.9%
Sample	72

ENGIE beneficiates from the smallest WACC in the modelling. ArcelorMittal has the highest but it is notably driven by a high cost of equity for ArcelorMittal of 17% based on a high beta calculation.

EVA

Using equation 1 or equation 2, this paper gets an EVA estimation for each company. Some outliers' data were excluded from the scope of study. Table 7 gives general statistics on the EVA found:

Table 7: EVA

€Million	2016 EVA
Min	-1700
1st quartile	-90
Median	44
Mean	36
3rd quartile	210
Max	1800
Sample	100

For the year 2016 EDF company is destroying €1.7bn of wealth, being the lowest EVA value kept. While Safran is creating €1.8bn of wealth above what its debt holders and shareholders required.

2.3. CEO Compensation

This paper also studies the impact of BoDs' networks and education networks on the compensations of the CEO of each firm. Data were collected from the registration documents of each company. Table 8 provides simple statistics on the compensations of CEO:

Table 8: CEO Compensation

€Million	2016 Total Compensation
Min	0.125
1st quartile	1.25
Median	1.9
Mean	2.4
3rd quartile	2.9
Max	8.4
Sample	108

The lowest compensation corresponds to the compensation given to the CEO of Alten of about €125K for the year 2016. This does not take into account other revenues its CEO received as director of Alten and sub entity of Alten.

Section 3. Modelling

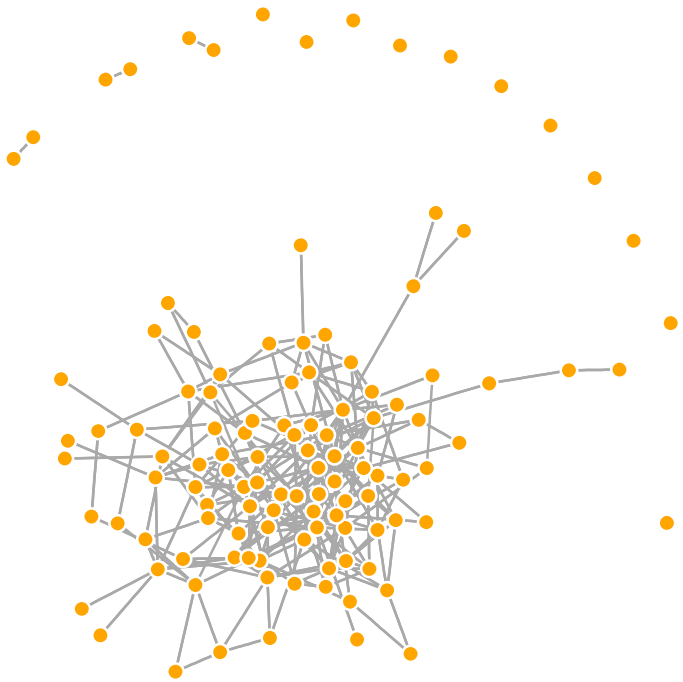
To study the impact of BoDs' networks and educational network on firms' performance, this paper had first to model those networks. The first subsection will explain the modelling of those networks before using them as inputs to see their impacts on firms' performance and CEO compensation in the following subsections.

3.1 Network modelling

3.1.1 BoD interlocks

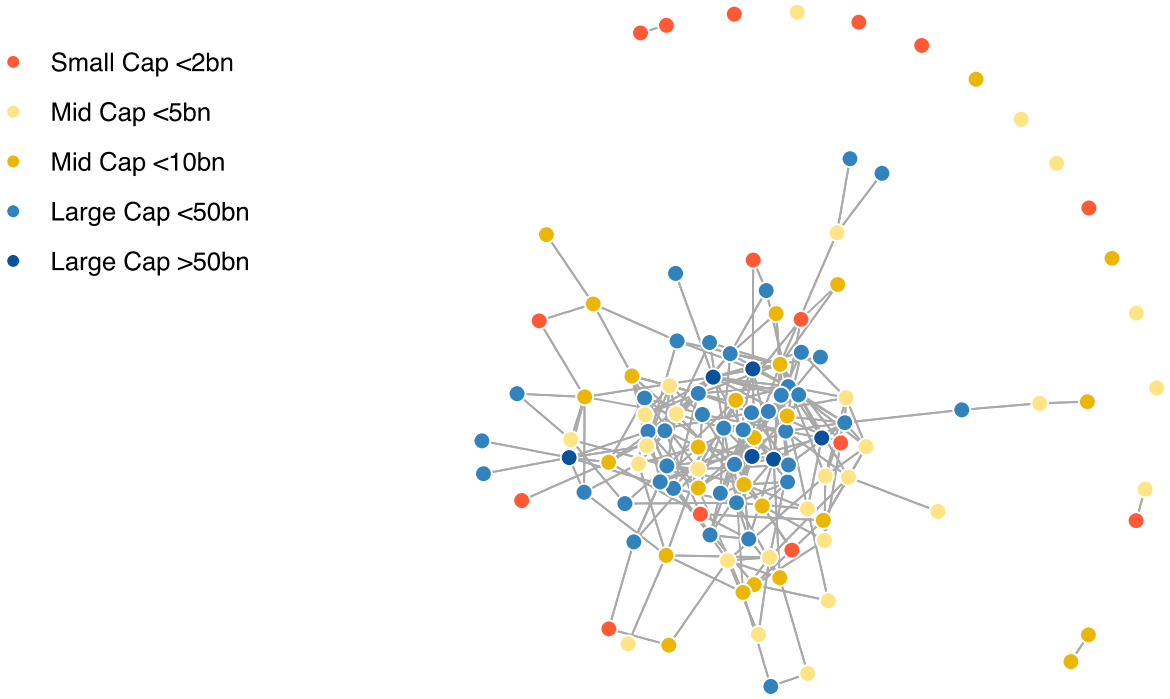
Boards are directly tied together by having directors seating at several boards. Those interlocks can be easily traced after having done a comprehensive inquiry on the board members of each company. Graph 1 provides a view on the network of the 116 companies in the scope.

Graph 1: BoD Network



This visualisation shows first the dense network of connections that corresponds to SBF 120 with multiple directors seating at different companies generating those ties. A few companies are nevertheless outside of this network. Those 17 companies that are outside of the general network are small cap companies as it is shown in Graph 2. On the contrary, the largest caps are more at the core of the network.

Graph 2: BoD Network by market caps



Centrality metrics

As mentioned in the literature review there are different ways of measuring the centrality of each node in this network: 1) the number of ties for each company to other companies in the network, 2) the eigenvector centrality that measures the centrality of a board by looking at the board's number of interlocks and weighting those connections by the centrality of the interlocked firms and 3) the betweeness centrality that measures how many boards' connected paths connect via a given board.

Table 9: BoD network centrality metrics correlations

	Number of ties	Eigenvector	Betweeness
Number of ties	1		
Eigenvector	0.92	1	
Betweeness	0.76	0.69	1

Table 9 shows the important correlation between those different metrics using this paper's sample. In this respect, the modelling will be mainly based on the eigenvector centrality.

Table 10 provides statistics on the eigenvector values:

Table 10: Eigenvector centrality

	Eigenvector
Min	0
1st quartile	0.04
Median	0.22
Mean	0.28
3rd quartile	0.45
Max	1
Sample	116

The eigenvector values are limited between 0 and 1. The major values correspond to the more connected boards namely: Imerys (value of 1), Bouygues (0.96), ENGIE (0.96), Veolia (0.92) and BNP Paribas (0.81).

3.1.2 Education networks

The impact of educational networks for each board was evaluated by measuring the share of directors who attended Sciences Po, ENA, HEC and or X during their studies compare

to the total number of directors in the board. Table 11 summarizes key statistics on this education board ratio (EBR):

Table 11: Education board ratio

	EBR
Min	0
1st quartile	0.18
Median	0.29
Mean	0.30
3rd quartile	0.39
Max	0.72
Sample	116

The minimum ratio corresponds to Alten, SES and Gemalto companies which have no directors from those top 4 schools. The maximum ratio corresponds to Coface which for a board of 11 members has 8 members who went through Sciences Po, ENA, HEC and or X.

Graph 3: EBR in the BoDs' network

Graph 3 shows a heterogeneous landscape when comparing education network to BoDs' network. The eigenvector centrality and the EBR can be judged relatively independent (this is confirmed by other statistics).

3.2 Networks' impact on firms' performance

3.2.1 Firms' performance and BoDs' interlocks

This paper aims at measuring the impact of BoDs' networks on firms' performance. Following Adjaoud and all (2007), OLS regressions are done to measure that impact:

$$Firm\ Performance = constant + b_1 BoD\ Interlocks\ Connection + b_2 \log(Firm\ Size)$$

The measure of BoD interlocks' connection used is the eigenvector values presented in the previous section. The log of the firm size, approximated by market caps, is used as a control variable in the regressions. Table 12 provides the results corresponding to those regressions:

Table 12: Regression BoD network and performance

	cst	b1	b2	R-square
Sales Growth	0.08** *2.17*	**-0.14*** *- 1.66*	0.004 *0.22*	0.03
ROA	0.05*** *7.05*	**-0.02*** *-1.69*	0.001 *0.22*	0.03
ROCE	0.10*** *5.31*	0.02 *0.46*	-0.002 *0.85*	0.003
ROE	0.11*** *8.11*	-0.003 *-0.11*	0.001 *0.15*	0.0002
PE	18.3*** *9.11*	-5.84 *-1.39*	1.44 *1.57*	0.03
PB	2.89*** *7.03*	-1.36 *-1.51*	-0.04 *-0.19*	0.03

QTob	2.04*** *10.6*	**-0.76*** *-1.72*	-0.09 *-1.03*	0.06
EVA	-128 *-1.23*	-169 *-0.68*	114** *2.16*	0.05
MAR	-0.07 *-1.54*	**-0.23**** *-2.16*	0.06*** *2.99*	0.08

The first row reports the estimated coefficient, the t-statistic is reported in the second row. P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

The coefficient of interest is the b1 coefficient. Those regressions provide two main findings.

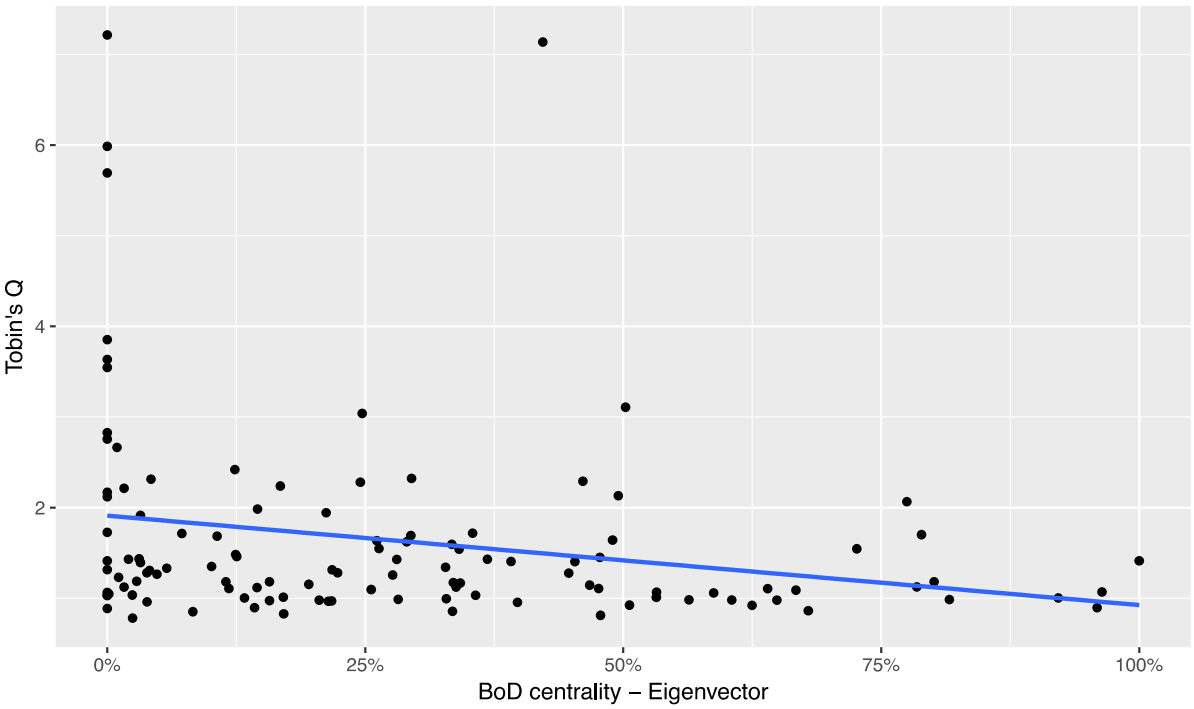
First, BoDs' interlocks appear to have in general a negative impact on firm performance. Indeed, the b1 coefficient is negative for most regression.

Secondly, the impact is significant only for some firms' performance metrics. The following performance measures present a significant negative relationship with BoDs' connection: Sales growth, ROA, Tobin's q, Market Adjusted Returns. Those are both accounting based and market based metrics. This indicates a comprehensive negative impact not bound to market perception or specific accounting weakness.

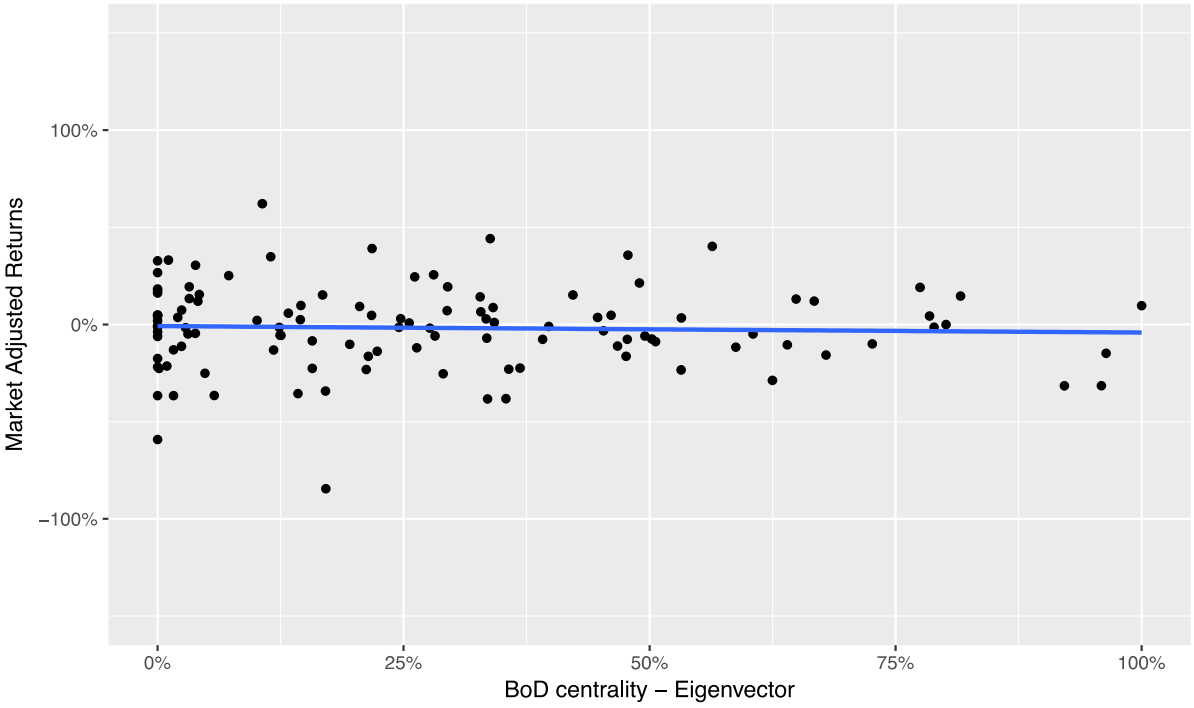
Interpreting the meaning of this negative impact is more difficult. It can be surprising to find that more connected boards are performing worse. An explanation can be that directors seating at different boards of big French companies are less accountable to the shareholders of a single company. In this respect, they pay less attention to the performance of each company they are seating at.

Graph 4 and 5 provide a view on the relatively loose but negative relationship between BoDs' centrality in the network and the firm performance for Tobin's q and MAR. In graph 4, the regression line is clearly directed downwards. Tobin's q are lower for firms that are more connected. In graph 5 the slope of the regression line is slightly negative too.

Graph 4: Relationship between firms' performance QTob and eigenvector – Regression line without control variable



Graph 5: Relationship between firms' performance MAR and eigenvector – Regression line without control variable



3.2.2 Firms' performance and education network

To measure the impact of educational network on firms' performance a similar regression is used:

$$Firm\ Performance = constant + b_1 BoD\ Education\ Connection + b_2 \log(Firm\ Size)$$

The BoD education connection corresponds to the EBR indicator developed in subsection 3.1.2. Table 13 gives the regression results. As for BoDs' connection impact, the education connections appear to have a negative impact on some firms' performances metrics. Sales growth, ROA, PE ratio and MAR are significantly impacted negatively by the ratio of directors from ENA, Sciences Po, X and HEC in the board.

Table 13: Regression education network and performance

	cst	b1	b2	R-square
Sales Growth	0.13** *2.65*	**-0.23*** *- 1.85*	-0.007 *-0.48*	0.04
ROA	0.06*** *6.61*	**-0.04**** *-2.03*	-0.001 *-0.47*	0.04
ROCE	0.12*** *4.99*	-0.06 *-0.98*	0.001 *0.18*	0.01
ROE	0.12*** *7.13*	-0.03 *-0.80*	0.001 *0.23*	0.007
PE	21.8*** *8.42*	**-13.6**** *-2.34*	0.93 *1.17*	0.06
PB	3.27*** *6.05*	-1.80 *-1.34*	-0.15 *-0.85*	0.03
QTob	2.13*** *8.04*	-0.53 *-0.80*	-0.16** *-2.02*	0.04
EVA	15.6 *0.11*	-564 *-1.58*	104** *2.26*	0.07

MAR	-0.001 *-0.03*	**-0.31**** *-1.98*	0.05** *2.40*	0.07

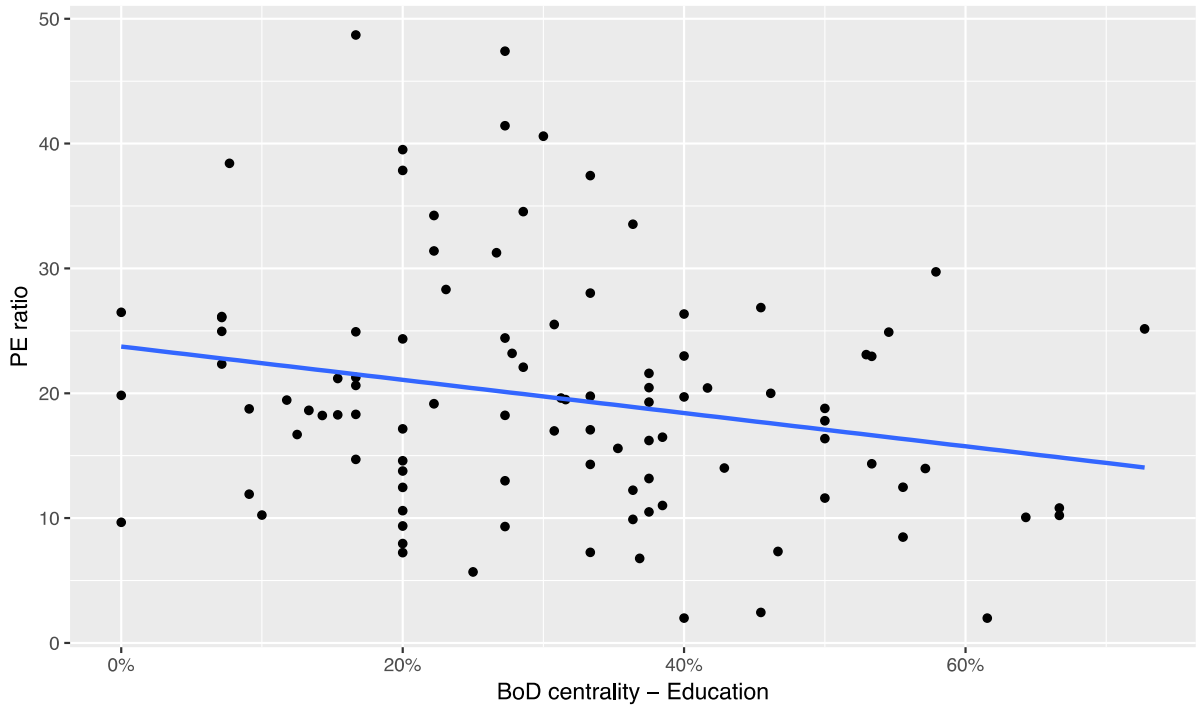
The first row reports the estimated coefficient, the t-statistic is reported in the second row. P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

Companies with a board composed of people from similar educational backgrounds are performing worse in terms of performance metrics. This relationship may be explained by the idea that people sharing very similar backgrounds are less prone to take independent and efficient decisions for the company or are less accountable for short-term bad performance such as stock price's undervaluation. The fact that those directors have very similar experience and overall careers may also be weakening their capacity to provide wider and more diverse information and knowledge that the board needs to be more efficient and the company to be better performing.

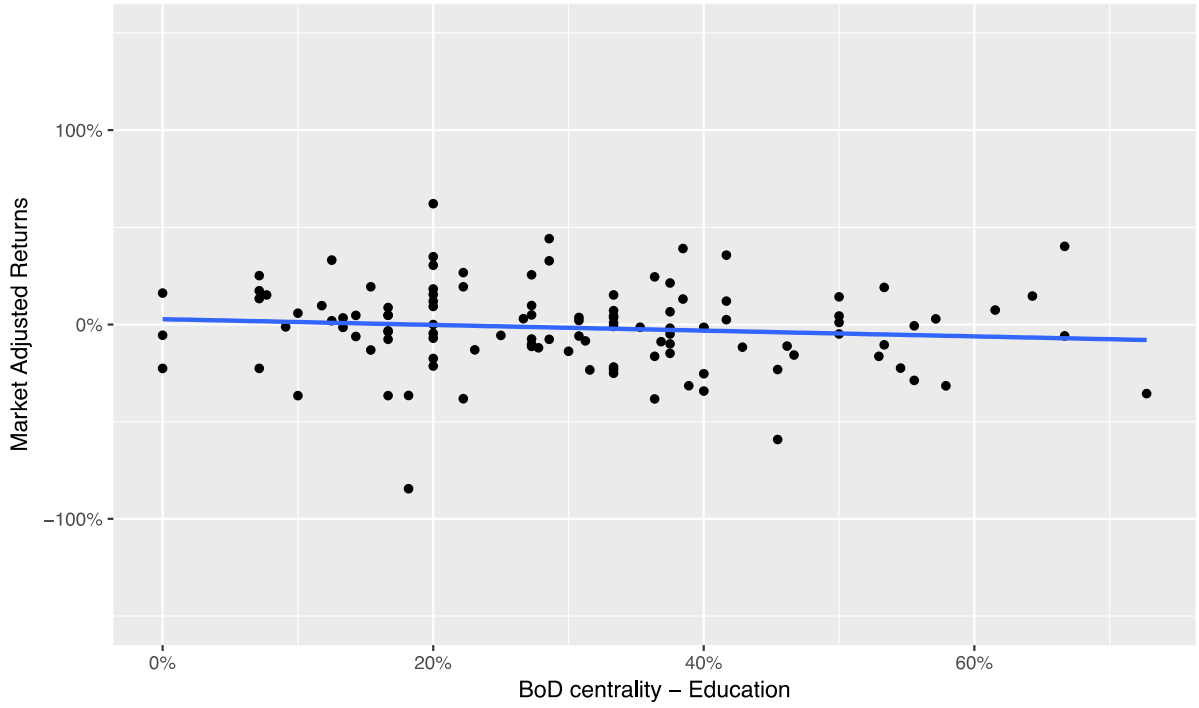
Graph 6 and 7 give a complementary view on this impact. The negative relationship is relatively strong for the market adjusted returns with a p-value lower to 5% and similarly for price-earnings ratios.

Nevertheless, one must underline that the overall negative relationship between education network and firm performance, as for BoD centrality, remains relatively weak with many regressions' coefficients that are not significant.

Graph 6: Relationship between firm performance PE ratio and education connection – Regression without control variable



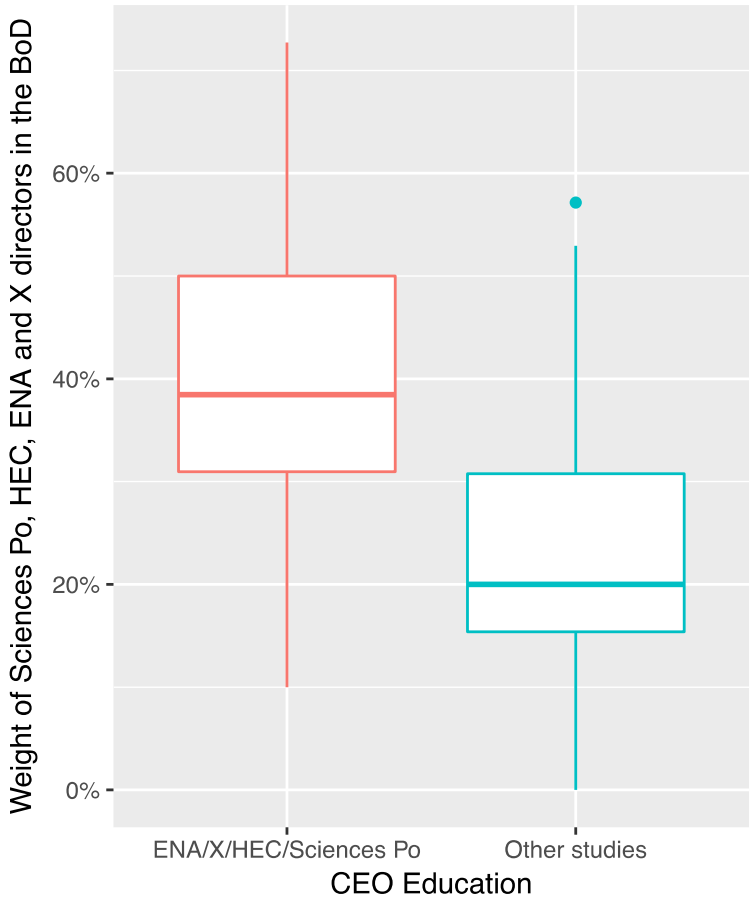
Graph 7: Relationship between firm performance MAR and education connection



3.2.3 Firms' performance and matching between CEO education and education network

An interesting fact that has been observed among the 116 firms studied is the important correlation between the CEO educational background and the ones of the directors of the firm.

Graph 8: Boxplot of education connection by CEO education



Graph 8 provides a picture of this important relationship. Companies that have a high ratio of directors from Sciences Po, ENA, X and HEC are led by former students from Sciences Po, ENA, X and HEC, with a mean ratio close to 40%. On the contrary, companies led by CEO with a different background have a strictly lower ratio of directors from those top 4 schools, with a mean ratio close to 20%.

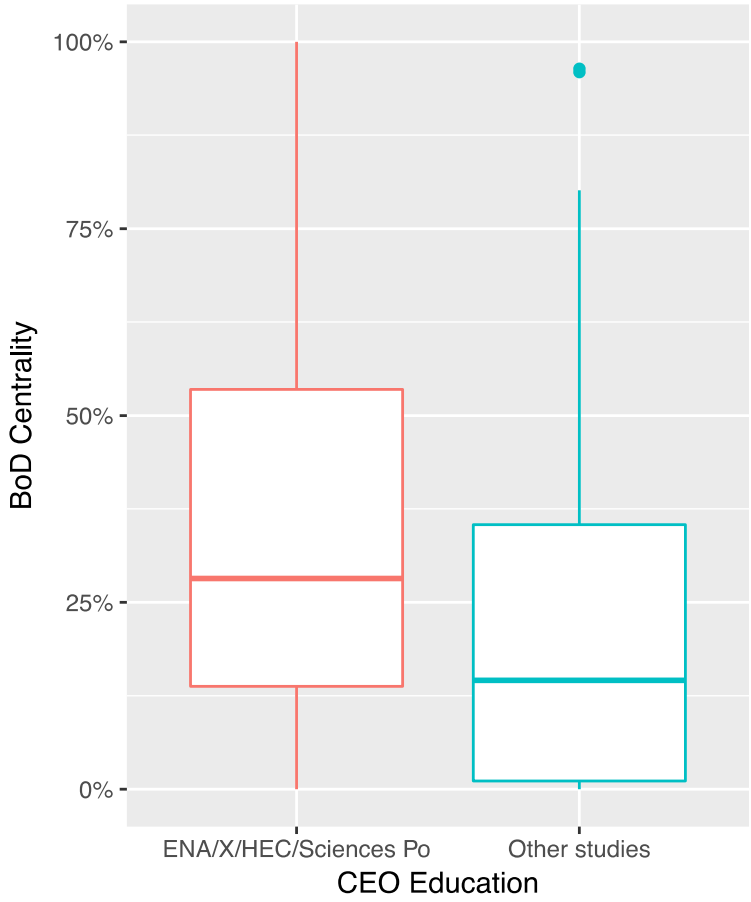
Other statistical measures such as an ANOVA study indicate the existence of those two groups of companies based on the similar education between the CEO education and its board of directors. The F-stat of the ANOVA analysis is of 44.5 corresponding to a p-value close to 0. When controlling for firms' size, using firms' market caps, the relationship remains highly significant.

Therefore, boards made of directors with similar educational backgrounds tends to choose a CEO that have the same educational background. As discussed in the literature review, for boards information is key when selecting the right CEO. Educational networks are helping the selection decision by providing information to directors. They know the candidates or indirectly know them via their networks. Knowing that the CEO went to a top French school is good signal for them when making their decision. Conversely, after being appointed the CEO, and even more when he is also the chairman of the board, may try to reshuffle the board to have more obedient directors. The CEO will pick specific directors more in their networks.

The relationship between the CEO education and the centrality of its company in the network of companies is less clear but existent (see graph 9). Doing an ANOVA analysis one cannot reject the existence of a relationship between the CEO education and the centrality of its BoD. Nevertheless, when controlling for firm size, the relationship is no more significant.

Therefore, CEO that went to ENA, X, HEC or Sciences Po are more present in more connected companies but it depends mostly on the size of the company.

Graph 9: Boxplot of BoD centrality by CEO education



3.2.3.1 Matching CEO and BoD educations: impact on firms' performance

In subsection 3.2.2, this paper has shown that education connection appeared to have a negative impact on some metrics of firm performance. Companies with a high ratio of people from the top 4 French schools were performing worse in terms of sales' growth, ROA, price-earnings ratio and market adjusted returns.

To further understand this relationship, the following model is analysed:

$$Firm\ Performance = cst + b_1 BoD\ Education\ \times\ CEO\ Education + b_2 \log(Firm\ Size)$$

The BoD education corresponds to the EBR indicator. The goal is to better assess the impact of the matching between the CEO education and the education of its directors. Table 14 summarizes the different regressions on the impact of this matching.

Table 14: Regression BoD and CEO education matching and performance

	cst	b1.1 CEO SP, ENA, HEC or X	b1.2 CEO other studies	b2	R-square
Sales Growth	0.13** *2.50*	**-0.23*** *- 1.85*	-0.25 *- 1.40*	-0.007 *-0.49*	0.04
ROA	0.06*** *6.60*	**-0.04**** *-2.07*	**-0.07**** *-2.12*	-0.001 *-0.64*	0.05
PE	20.3*** *7.50*	**-13.1**** *-2.30*	-1.6 *-0.19*	0.94 *1.20*	0.09
MAR	-0.005 *-0.07*	**-0.31**** *-1.98*	-0.35 *-1.52*	0.05** *2.37*	0.07

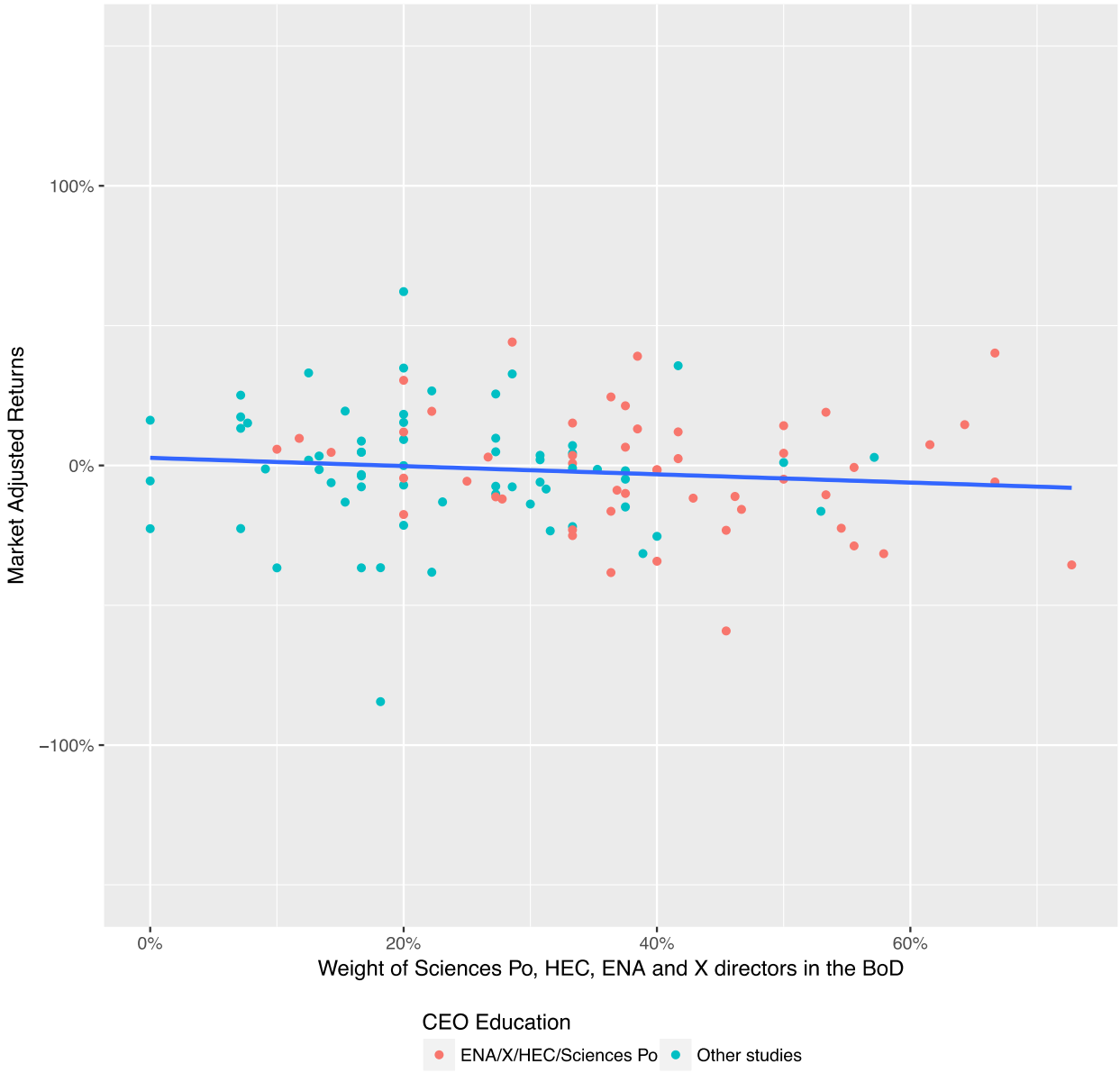
The first row reports the estimated coefficient, the t-statistic is reported in the second row. P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

This paper finds a significant impact of the matching between the CEO education and the education of its directors. Indeed, the significant negative coefficients are mainly the ones where the CEO education matches the education of its BoD (coefficients b1.1 in the table). Coefficients b1.2 are not significant using a p-value below 10% except for the ROA. In the case of sales growth and MAR the p-values are a bit above 10% (17% and 13% respectively). There is therefore a difference between the two groups with an even more negative impact of a BoD composed of too much people from the top 4 schools when their CEO has a similar background.

Those findings are in line with the agency theory that advocates an independence between the board of directors and its CEO in order that the BoD has a control role on the executive team. This control role is less efficient when the directors and their CEO are connected through different networks. This is of course the case when considering that they

went to similar schools and that they are part of similar educational and professional networks.

Graph 10: Relationship between MAR performance and matching of BoD and CEO education



The relationship between the education of the directors and the one of their CEO and its impact on the firm performance is observed in graph 10.

There is a clear distinction between the firms lead by CEO with other studies' background (green points) and the ones who went to Sciences Po, ENA, HEC and or X (red points). The former are on the left side of the graph corresponding to boards with low ratio of directors from Sciences Po, ENA, HEC and X. The latter are on the right side.

Overall, the MAR is going down accordingly to the EBR ratio. But, accordingly to the regression of table 14, this is mainly driven by the red points whereas green points present a less significant negative regression line.

3.2.3.2 Matching CEO education and BoD centrality: impact on firms' performance

To further inquire results of subsection 3.2.1, this paper also studied whether the educational background of the CEO had an impact on firm performance in relation with the BoD interlocks' connection. As seen, BoD interlocks appear to have a negative impact on some performance metrics. The following model is analysed:

$$Perf = cst + b_1 BoD\ Interlocks\ Connection\ \times\ CEO\ Education + b_2 \log(Firm\ Size)$$

Table 15: Regression BoD interlocks and CEO education matching on performance

	cst	b1.1 CEO SP, ENA, HEC or X	b1.2 CEO other studies	b2	R-square
Sales Growth	0.08** *2.17*	-0.13 *- 1.36*	-0.15 *- 1.49*	0.004 *0.21*	0.03
ROA	0.05*** *6.99*	-0.02 *-1.53*	-0.02 *-1.36*	0.001 *0.22*	0.03
QTob	2.04*** *10.6*	-0.68 *-1.36*	-0.87 *-1.61*	-0.10 *-1.05*	0.06
MAR	-0.07 *-1.45*	-0.20 *-1.65*	**-0.27**** *-2.08*	0.06*** *2.93*	0.08

The first row reports the estimated coefficient, the t-statistic is reported in the second row.

P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

Graph 9 already showed that the distinction between companies led by CEO who went to Sciences Po, ENA, HEC and or X and companies led by CEO who did other studies was less stringent regarding BoD interlocks connection. The different regressions shown in table 15 confirmed that situation with coefficient b1.1 and b1.2 being no more significant at a 10% p-value level.

The only specific situation is concerning MAR performance. In that case, it seems that there is an even more negative impact on firm performance of having directors that are well-connected because of interlocks while their CEO is less connected regarding its educational background.

One must underline the fact that the p-values are better for coefficients b1.2 than coefficients b1.1 (this can be judged in table 15 by considering the t-stats). This provides an additional view by showing that CEO being connected by their educational background is not a bad thing per se. It is the interaction between the CEO network and the ones of the firm's directors that matters. Too similar networks are weakening the capacity of both the executive team and the non-executive team to work more efficiently and help the company performing better.

3.3 Networks' impact on CEO compensation

In the literature on firms' governance, a specific interest is given to CEO compensation. As a complementary element, this paper analyses the impact of education networks and BoD interlocks on CEO compensation. As a first point of reflexion, one must underline the fact that in the scope of research there appears no relationship between the CEO compensation and the firm performance.

The following regressions were done:

$$Firm\ Performance = cst + b_1 \log(CEO\ Compensation) + b_2 \log(Firm\ Size)$$

Table 16 provides only the b1 coefficients of those regressions. They are all not significant. There is no clear relationship between the CEO compensation and the different firms' performance metrics used in this paper.

Table 16: Firm performance and CEO compensation

	Sales Growth	ROA	ROCE	ROE	PE	PB	QTob	EVA	MAR
b1	-0.01	0.001	0.004	0.001	1.02	0.32	0.12	76.2	0.02
	-0.51	*0.39*	*0.34*	*0.18*	*0.75*	*1.10*	*0.81*	*1.00*	*0.87*

The first row reports the estimated coefficient, the t-statistic is reported in the second row. P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

The second point of analysis is to look at the impact of BoD interlocks' connections and education connections. The following regressions are performed changing the second variable of interest accordingly (corresponding to b1 coefficient):

$$Log(CEO\ Compensation) = cst + b_1 Variable\ of\ Interest\ + b_2 \log(Firm\ Size)$$

Table 17: Regression education network and performance

	Log (CEO Compensation)	
cst	3.20***	3.28***
	3.43	*3.58*
Variable of interest:		
BoD Interlock Connection	0.04	
	0.13	
EBR		-0.30
		-0.64
Log(Firm Size)	0.27***	0.27**
	4.62	*4.67*

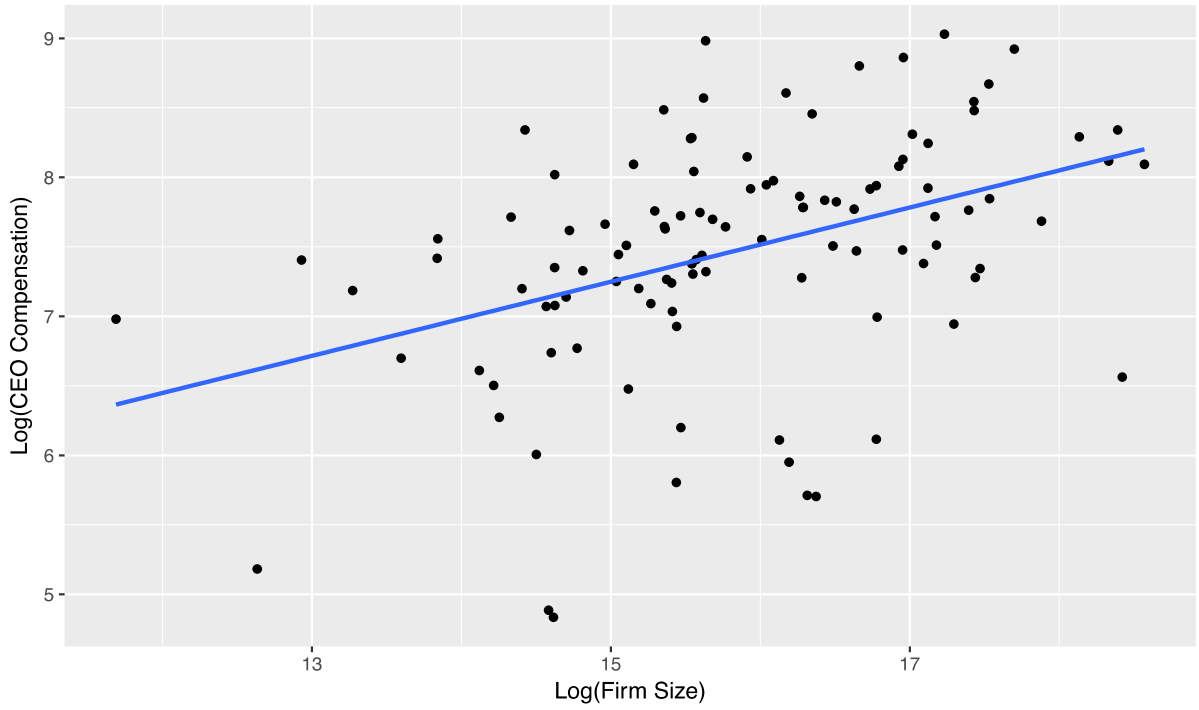
R-square	0.17	0.17

The first row reports the estimated coefficient, the t-statistic is reported in the second row. P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

The different b1 coefficients are not significant. Therefore, when controlling for firm size, the degree of centrality and the ratio of directors from Sciences Po, ENA, HEC or X are not impacting the CEO compensation.

CEO compensation is mainly driven by the firm size. This is shown in graph 11 with a clear positive relationship: the bigger the firm, the bigger the payroll of its CEO.

Graph 11: Relationship between CEO compensation and firm size



A final model was implemented to check whether CEO educations had an impact on their compensations. Taking both 4 schools together does not provide any significant results.

But when differentiating each school, one additional factor appears. Table 18 sums up the regressions made accordingly to each school attended by the CEO.

Companies led by CEO from ENA are for the year 2016 paying less their CEOs compare to the overall 116 companies. Some of those companies are partially state-owned companies probably explaining that situation (for example CNP Assurance and Aeroport de Paris).

Table 18: Regression education network and performance

	Log (CEO Compensation)			
cst	2.95*** *3.27*	3.07*** *3.29*	3.06*** *3.28*	3.20*** *3.44*
CEO ENA	**-0.72***** *-2.77*			
CEO X		0.09 *0.49*		
CEO HEC			0.11 *0.56*	
CEO Sciences Po				-0.39 *-1.38*
Log(Firm Size)	0.29*** *5.11*	0.28** *4.70*	0.28*** *4.72*	0.27*** *4.65*
R-square	0.25	0.19	0.19	0.20

The first row reports the estimated coefficient, the t-statistic is reported in the second row. P-Value significant coefficient at 1% (***), 5% (**) and 10% (*)

Conclusion

This paper has found that social networks have an impact on firms' performance. Direct ties created by interlocks between boards of directors and educational networks based on same universities' and schools' attending are impacting the way boards work and the way they prompt the performance of the firm. Contrary to some intuitions, more connected firms do not appear to fare better than less connected firms concerning key accounting and market based metrics of performance that are sales growth, return on assets, stock prices' evolution, price-earnings ratio and Tobin's Q ratio. The interaction between the CEO and its boards is a key element here to better explain that bad performance. Boards and CEO that have too similar educational backgrounds are not leading companies towards their best. The counter-power that must be played by each of the two is no longer existing making them less accountable to shareholders. Complementarily, well-connected directors, that seat in different boards, need a differently but yet well-connected CEO to better conduct the company.

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Annex 1

AccorHotels	DBV Technologies	Kering	Sanofi
Adocia	Edenred	Klepierre	Schneider Electric
Aeroport de Paris	EDF	Korian	Scor
Air France-KLM	Eiffage	L'Oreal	SEB
Air Liquide	Elior	LafargeHolcim	SES
Airbus	Elis	Lagardere	SFR
Alstom	ENGIE	Legrand	Societe Generale
Alten	Essilor	LVMH	Sodexo
Altran	Eurazeo	M6	Solocal
Aperam	Eurofins Scientific	Maurel et Prom	Solvay
ArcelorMittal	Euronext	Mercialys	Sopra Steria
Arkema	Eurotunnel	Michelin	Spie
Atos	Eutelsat	Natixis	STMicroelectronics
AXA	Faurecia	Neopost	Suez
BIC	Fonciere des Regions	Nexans	Technicolor
bioMerieux	GTT	Nexity	Teleperformance
BNP Paribas	Gecina	Nokia	TF1
Bollore	Gemalto	Orange	Thales
Bouygues	Genfit	Orpea	Total
Bureau Veritas	Havas	Pernod Ricard	Ubisoft
Cap Gemini	Hermes	Plastic Omnium	Unibail-Rodamco
Carrefour	Icade	PSA	Valeo
Casino	Iliad	Publicis	Vallourec
CGG	Imerys	Remy Cointreau	Veolia
CNP Assurances	Ingenico	Renault	Vicat
Coface	Innate Pharma	Rexel	Vinci
Credit Agricole	Ipsen	Rubis	Vivendi
Danone	Ipsos	Safran	Wendel
Dassault	JC Decaux	Saint-Gobain	Zodiac Aerospace

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