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Board of Diretor Education and Firm Performance: A Dynamic Approach

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Hung Phan

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Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

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Author Hung Phan

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Abstract I examine the relationship between board of director's (BoD) education and firm performance on a European dataset over the period from 1999 to 2013, employing a well-developed dynamic panel generalized method of moments (GMM) estimator to alleviate endogeneity issue in corporate governance study. I find no correlation between BoD education and firm's return on asset, after accounting for endogeneity issues. All else equal, firms with better educated board of director may appear to have better performance in the short-run, but that superiority will likely to reverse in the future.

Keywords corporate governance, firm performance, endogeneity

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1. Introduction

In this paper, I examine the impact of Board of Directors education background on firm's performance for European firm. Board of Director arose as a response to the agency problem inherent in governing corporation, and has since then become the representative of shareholders to establish corporate management policies and to make decision on major issues. According to the upper echelon theory developed by Hambrick and Mason (1984), an organization's outcomes – strategic choices and performance – are partially predicted by managerial characteristics, one of which is the manager's formal education level. Following empirical researches have been examining this association, notably the relationship between mutual fund manager education level and fund's performance; CEO formal training and corporate outcomes; but only a few has lined Board of Director's education and firm's performance, such as Darmadi (2010) with Indonesia firm sample. However, Darmadi paper does not propose any mean to alleviate endogeneity issue, which limit the causality interpretation between the variables in question. I will tackle the dynamic endogeneity issue by employing the GMM panel data model, proposed by Wintoki et al (2012) to give a better understanding about the causal relationship between board of director characteristics and firm's performance.

1.1 Background and motivation

Why should director educational background influence firm performance? One obvious reason is that education background is as a proxy for intelligence and expertise, and more intelligent directors will be able to give better strategic guidance to a firm's management team, which will have positive effect on the firm's performance. There are a number of studies which find that a more capable Board of Directors has a greater capacity to improve firm's performance and are competent in discrete tasks, such as hiring/firing the CEO, compensation and incentive package for executives, merger and acquisition activities, or defending against a takeover bid. Another reason is that more highly educated directors are more likely to advise sophisticated methodologies to improve firm performance. For example, it has been demonstrated by Graham and Harvey (2002) that CFO with finance background are more likely to use sophisticated methodologies when conducting capital budgeting and when estimating the cost of capital. Finally, it may be that director education is positively related to his/her social capital. That is, directors with higher educational profiles enjoy more social ties to other directors, executives and government officials, which may improve the performance of the firm. This is especially true for companies in early stages that need for environmental linkages between the firm and outside resources (Kumar and Zattoni (2013)).

Hambrick and Mason (1984) laid the groundwork for explaining the relationship between upper echelons (senior managers) background characteristics and organization's outcome. The authors argued thatrganizational outcomes—both strategies and effectiveness—are viewed as reflections of the values and cognitive bases of powerful actors in the organization. It is expected that, to some extent, such linkages can be detected empirically. From the resource-based view perspective, the sustainable competitive advantages of a firm depend on how it utilizes its unique bundle of resources (i.e. both tangible and intangible assets) to achieve organizational effectiveness, and human resource is one main contributor to the competitive advantage. However, some form of human capitals are costly, and an early investment in such capitals may not yield immediate effect substantially enough to offset the cost. Besides these two theories, managerial networking theory also argues that top executives' social ties and connections with salient external stakeholders can help their firms reduce transaction costs through facilitated exchange of resources, information and knowledge. This is especially true for directors, as many of them are appointed to utilize their relationship to external resources and industrial expertise (Kumar and Zattoni 2013).

Based on those premises, educational background should has certain contribution to a director's decision making and thus, should effect the company's performance. Furthermore, there are only few quantifiable and identifiable factor when determining the competency of a director. Interpersonal skills, leadership ability and strategic vision are among the traits that director should possess; these can be difficult to identify and even more difficult to measure. As a result, recruiters rely on those characteristics which they may be able to observe: work experience, track record, and highly likely education. From a personal perspective, I find it interesting to observe how managerial education background may effect a firm's performance as suggested by upper echelons theory (Hambrick and Mason(1984)), given how much resources and efforts an average person spend on their education.

1.2 Research questions

The objective of my research is to examine whether director education background affects company's performance; and if the causal relationship exist, does it subject to dynamic endogeneity issue. I will discuss further about dynamic endogeneity, its remedy in corporate governance studies proposed by Wintoki et al (2012) in the literature review. Board of director usually decide on strategic issues of the firm, and the effect of their decisions does not necessarily show immediately on the firm's performance, but rather later on. If director education is a proxy for their competence in decision making, I expect director education to have a lagged effect on firm's performance. With all that being said, here are my research questions:

1. Is there a relationship between board of director education background and firm's performance?

2. Whether the relationship in question (1) – if exist, is dynamic in its nature?

3. Does board of director education background effect firm's performance with a lag?

1.3 Contribution to existing research

To my knowledge, this is the first study to provide a comprehensive view on the relationship between director educational background and firm's performance on a European dataset. The relationship between corporate governance and firm's performance is a relatively well-studied topic in finance literature, with the first notion dated back to Adam Smith (1776), when he noted that directors of joint stock companies may not have the full intention to play the role of "vigilant guardian" over the owner's wealth. Further theoretical researches, notably Fama (1980), Fama and Jensen (1983), Holmstrom (1999), have stressed the need of a governance body to solve the agency issue and ensure the interest of investors is protected. Following empirical researches, such as Hermalin and Weisbach (1988), Bhagat and Black (200) have focused on board composition and firm's performance, observing the effect of main structural variables of a board i.e board size, independence level on firm's performance. Further characteristics, such as age (Bonn et al (2004), gender (Adams and Ferreira (2009)), busyness (Fich and Shivdasani (2006)), have been examined and yielded mixed result on firm's performance. However, few studies have paid attention to the role of board education on firm's performance, even though education is a much studied characteristics of managers. Chevalier and Ellison (1999) studied in depth the relationship between fund manager education and fund's performance and found that managers who attended better undergraduate institutions have systematically higher risk-adjusted excess return. Bertrand and Schoar (2002) found out that managers with MBA degree will follow more aggressive strategies. To my knowledge, only Darmadi (2013) has addressed the relationship between board of director education and firm performance, in the context of developing country. The author recognized the endogeneity issue, but did not propose any solution. In this paper, I will address the endogeneity issue by employing GMM estimator proposed by Wintoki (2012) as a way to alleviate sources of endogeneity in corporate governance studies. One reason why director education study is scarce is because director education data is hard to collect and is noisy, especially for the European dataset. I will discuss this issue further in limitation and data description.

1.4 Main findings

Static OLS suggests a positive correlation between board of director's education and firm's performance. This finding is similar to that of Darmadi (2013) in term of direction and magnitude. However, once I apply the dynamic model to alleviate the endogeneity effect, the correlation disappeared. This goes against upper echelon hypothesis of the correlation between manager's characteristics and organization's outcomes. One plausible explanation for this finding is that both director's education and firm's performance are effected by an unobservable heterogeneity factor – for example director's competence. One clear insight that emerges from the dynamic OLS model is the importance of lagged performance when assessing the effect of board characteristics on firm's performance. The R^2 improved significantly from 0.21 to 0.47, implying that past dependent variables help to explain a significant portion of current performance. This result matches the underlying assumption of the model, that is board characteristic is a choice variable that arises through a process of bargaining between the various actors in a firm's nexus contract, where the bargaining process is influenced by past performance and the actor's belief about the cost and benefits of particular board characteristics. One concern is that board decision has lagged effect on firm's performance, so I also test the model on a set of lagged dependent variables. After controlling for endogeneity factors, I also found no

1.5 Limitations of the study

This study employed the dynamic GMM panel estimation to reduce the endogeneity effect in traditional ordinary least square regression method. The idea behind this methodology is simple: Using past values as instrument for endogenous variables in cases where natural experiment or "external" instruments are hard to impose. However, the method comes with some limitations.The most significant one is potential problem of weak instruments, as the model employ lagged variables for identification. Increasing the instrument's lag length makes them more exogenous, but may also make them weaker; so it is important to choose the appropriate lag length. I will perform a series of test to check whether the instruments are strong enough under the exogenous constraint. Furthermore, the dynamic model assumes weak rational expectations (Muth,1961; Lovell, 1986), which means that future unexpected changes in performance are purely an expectational error, and implies that the empirical model includes every variable that could conceivably jointly affect both the dependent and explainatory variables. Given the imperfect nature of proxies in empirical research, this is unlikely to be the case.

Regarding the education variables, there are limitations to the way I define "education level" variables. Defining one's formal education level by the degree they obtained is arbitrageous at best, as a master degree from a Germany university does not necessarily yield the same value as one from a French university. The variable "prestigious" is calculated based on available university ranking tables, which methodologies are subjective and biased towards their own set of criteria. Averaging each university/institution ranking in all ranking tables does not make sure that my ranking is unbiased, but rather reduce the bias in each ranking. Last but not least, the method requires company to have data for all variables in at least 6 consecutive years, which reduced my dataset size significantly.

1.6 Structure of the study

The remainder of the study is organized as follows. In Section 2, I review relevant literature on corporate board function and formation, as well as the relationship between director education and firm's performance. Section 3 introduces the hypotheses, whereas Section 4 describes data used in the analysis and the methodology applied. Section 5 presents the results of my analysis and Section 6 concludes the thesis offering suggestions for future research.

2. Literature review

2.1 Function and formation of corporate board

Since the first economic address by Adam Smith in 1776, Board of Directors has always been a topic of interest among economists due to its crucial role in a corporation. Board could be simply put as a product of regulation: Between state incorporation laws and the stock exchange governance requirements, most firms are required to have a board that meets a multitude of requirements: number of members, various committees, and some fraction of the directors may be obligated to have some nominal independence from management (Hermalin and Weisbach 2003). However, its prevalent influence over time, across boundaries and in different organizational forms, has made it a market solution for agency problem that troubles any large organization. Agency problem arises from conflict of interest between principal agency and shareholders, so Board of Director was created to ensure that principal agents are appropriately monitored and advised to maximize shareholder value. Given its crucial role both in term of internal management and strategic direction, Board of Director usually consist of experienced executives, industry experts and academia with prominent track record.

2.1.1 Function of Corporate Board

The board has the ultimate legal authority over decision-making within the firm. According to the American Bar Association's Committee on Corporate Laws (1994, p. 4), this means, amongst others, that the board must review and approve fundamental operating, financial, and other corporate plans and strategies. (Adams and Ferriera 2007) categorized those activities into two functions: advisory and monitoring. The advisory function involves the provision of expert advice to the CEO and access to critical information and resources (Fama and Jensen, 1983). As one director puts it in Lorsch and Maciver (1989, p. 64): "Directors are sounding boards for management. They contribute their opinions as to general policy, and their judgement whenever a problem comes up." Thus, the board draws upon the expertise of its members to counsel management on the firm's strategic direction. Since many board members have full-time jobs in other corporations, they rely on the CEO to provide them with the necessary information to evaluate, for example, whether the company should enter a new line of business. The more information the manager provides and the better the manager synthesizes the information, the better is the board's advice. The monitoring role assess, discipline, and remove ineffective management teams, to pursue that the conduct of the management team is in line with shareholder interest. Advisory and monitoring roles of a sole board complement each other, because the board uses any information the manager provides during the advisory process both to make better recommendations and to implement better decisions. Adams and Ferriera (2007) suggest that this is not necessarily the case, as shareholder may play off one role against another in accordance with their strategic intention. For example, they may appoint more inside directors to encourage the CEO to disclose more information, and at the same time reduce the monitoring intensity of the management team. When the two roles are separated in the dual board model – in which the BoD is divided into two bodies: the supervisory board and the management board – the management does not face the trade-off in the provision of information. This purpose could also be achieved by the use of board committees.

In particular, the role of audit committee in the sole board system is similar to that of a supervisory board.

2.1.2 Formation of board of director and firm performance

2.1.2.1 Impact of board size on performance

Much of the literature on board size has called for smaller boards. The argument is that smaller groups are more productive and can monitor the firm more effectively. Larger groups are usually associated with free-rider problems and higher co-ordination cost, and hence are not good monitors. Jensen (1993) suggest that the optimal board size is seven or eight, as the higher board size is less likely to function effectively and are easier for CEO to control. However, the author also note that as the board size is small, it is hard for internal director to openly participate openly and critically in effective evaluation and monitoring of the CEO, so ideally the CEO should be the only inside director. Lipton and Lorsch (1992) agrees with this idea, stating that when the board gets bigger, it becomes hard for all board members to express their ideas and opinions in the limited time frame of the board meeting. In a worse case scenario, too many board member will lead to free-riding problem, in which some directors herd their decisions towards those more active ones in the Board. The results of Yermack (1996), who finds a negative relation between Q and board size for 452 large U.S. industrial corporations between 1984 and 1991, are interpreted by many to provide empirical support for the notion that smaller boards are better.

Most of the above studies are conducted in the US sampling large public companies, so one may argue that the consensus result could be driven by the sample firm characteristics. Studies of board size effects in smaller firms outside US are of interest because the factors that drive the choice of board structure in this firms type could differ from the factors influencing board size in large public firms. For example, small and midsized firms are frequently closely held, so the influence of agency problems between managers and owners on decisions affecting board size and structure are probably less prevalent in this class of firms Eisenberg et al (1998) studied approximately 900 small Finnish firm and found a negative correlation between firms' profitability, as measured by industry-adjusted return on assets, and board size. Therefore, a board-size effect exists even among SME in firms outside the US. The authors also provided an interesting explanation regarding the relationship between board size and firm's performance. Firm might increase their board size in response to poor profitability, thus lead to a negative correlation between board size and profitability.

Not all the odds are against a big board. Coles et al (2008) argue that certain classes of firms actually are likely to benefit from larger boards and boards with more insider representation. Firms with greater advising requirements, such as those that are diversified across industries, larger firms, and firms that rely on debt financing, are more likely to benefit from a larger board of directors. The relation between Tobin's Q and board size is U-shaped, which suggest that either very small or very large boards are optimal. Dalton, Daily, Johnson, and Ellstrand (1999) argue that larger boards offer better advice to the CEO, especially those of firms operate in multiple segments and tend to be complex. Diversification, firm size, and leverage are all proxies for complexity and the CEO's need for advice. As firm complexity increases along any of these dimensions, so, too, does the need for a bigger board. In a recent paper with empirical data from India, Kumar and Zattoni (2013) indicated that there was a significant and positive association between board size and financial performance. This result may reflect the nature of the environment in which corporations operate in India whereby greater board size supports the resource dependency theory, which stress the need for environmental linkages between the firm and outside resources.

2.1.2.2 Busy board and firm performance

The issue of ''over-boarded'' directors (directors that serve on several firms' boards) has received attention in both the academic literature and the business press. Fich and Shivdasani (2006) find that firms with busy boards, defined as those in which a majority of independent directors hold three or more directorships, have lower market-to-book ratios, weaker profitability, and lower sensitivity of Chief Executive Officer (CEO) turnover to firm performance. Core, Holthausen and Larcker (1999) find that CEOs of firms with busy directors are paid excessively, suggesting that busy boards may not effectively monitor management. Consistent with these suspected disadvantages of busy boards, the National Association of Corporate Directors, the Council of Institutional Investors, and Institutional Shareholder Services (2012), have all recommended various limitations with respect to the number of boards on which directors serve. Coinciding with these recommendations, 74% of Standard and Poor's (S&P) 500 companies limit the number of corporate directorships that their board members may hold. Field et al (2013), on the other hand, found out that firms with recent IPO, which have minimal experience and contact with capital markets and likely rely heavily on their director for advising, are benefitted from a busy board in tasks such as advice on how to navigate public markets, deal with the media, interact with analysts, etc. As these IPO firms mature, the frequency of busy board declines as the demand for advising role decreases and demand for monitoring role increases. Perris et al. (2008) found that the busiest directors are older outsiders working as executives, bankers, or consultants. They do not find a negative reaction towards an appointment of a busy director and no evidence that multiple directors failed to fulfill their responsibility.

2.1.2.3 Independence level and firm performance

An independent Board of Director is favored by companies with diffuse ownership structure. Such structure will lead to vertical agency problem – conflict between a strong management and a disperse shareholder control. In such a context, independent directors have clear incentives to monitor management and, hence, they are the ideal market choice (Fama, 1980; Fama and Jensen, 1983). At the end of the day, a firm purpose is to generate profit for its owners, so researches have been attempted to answer the question whether BoD independent level has any effect on firm's performance and valuation.

Conventional wisdom dictates that greater independence produce better corporate performance, and that board composition response to firm performance. Bhagat and Black (2001) initiated the studies of Board Independence and Firm Performance after series of regulatory changes requiring US public firms to have majority of independent directors. They found out that low-profitability firms respond to their business troubles by following conventional wisdom and increasing the proportion of independent directors on their boards. There is no evidence, however, that this strategy works. Firms with more independent boards (proxied by the fraction of independent directors minus the fraction of inside directors) do not achieve improved profitability, and there are hints that they perform worse than other firms. This evidence suggests that the conventional wisdom on the importance of board independence lacks empirical support.

Duchin et. al (2009) and Dahya & Mcconnell (2007) have studied the relation between outsider directors in the Board of Director and corporate performance, taking advantage of an exogenous shock to avoid endogeneity problems. Recent regulations have required corporations to increase the number of outside directors in their boards and the trend is growing among the corporate governance reformers. It is believed that outside directors, being independent from the management, will challenge the management of the company more than the insider directors and that way protect the shareholders. Duchin et. al (2009) found that the effectiveness of outside directors depends heavily on the cost of acquiring information about and within the firm. It seems that in firms where outsiders were able to acquire information at low cost, boards may have been constituted with too many insiders, and the mandated increase in outsider representation was a boon for shareholders. In contrast, in firms where outsiders suffer from severe information disadvantages, the mandates appear to have harmed shareholder interests. However on average adding outside directors to the board does not help or hurt the performance. So the question is not whether but when are outside directors effective. Their emphasis on the conditional effectiveness of insiders and outsiders is consistent with an evolution in the literature away from the view that more outsiders are always better, and toward a more textured view that appreciates the strengths and weaknesses of both insiders and outsiders, depending on the firm's environment (Coles, Daniel, and Naveen, 2008). Hermalin and Weisbach (1988) find that poorly performing companies tend to replace inside directors by independent directors in subsequent years. In particular, Hermalin and Weisbach control for previous firm performance, showing that the addition of independent directors comes after poor performance.

Black and Kim (2011) rely on Korean's 1999 legal rules on public Korean firm regarding outside director as a shock to governance. They offer evidence that a reformed BoD with higher independence level will increase firm value - roughly 13% increase in Tobin's q, or about 46% in share price. Dahya and McConnell (2007) confirms this finding with UK firm sample, noticed that UK firms that moved to three outside directors in conformance with the Cadbury Committee recommendation show an improvement in operating performance both absolutely and relative to various peer group benchmarks from before to after moving to three outside directors. They also find that firms that move to three outside directors have a statistically significant stock price increase at the time of announcement of this decision. The results strongly suggest that adding outside directors led to improved performance by U.K. firms and increased value for shareholders. Lefort and Urzua (2009) found that an increasing proportion of outside directors affects company's value after properly correcting for endogeneity from a Chile firm sample.

2.1.2.4 Board Gender Diversity and Firm Performance

Historically, women hold few corporate board seats. In the US, women held 14.8% of Fortune 500 board seats in 2007 (Catalyst, 2007). The percentage of female directors in Australia, Canada, Japan, and Europe is estimated to be 8.7%, 10.6%, 0.4%, and 8.0%, respectively (Equal Opportunity for Women in the Workplace Agency, 2006; and European Professional Women's network EPWN, 2004). This situation is changing because boards around the world are under increasing pressure to choose female directors. Many proposals for governance reform explicitly stress the importance of gender diversity in the boardroom. This trend is supported by empirical researches showing that women appearance in the board room actually benefits the company. Carter et al (2003) examined the relationship between board diversity and firm performance for Fortune 1000 firms. After controlling for size, industry and other corporate governance measures, they found statistically significant positive relationships between the presence of women directors and firm value as measured by Tobin's Q. Adam and Ferreira (2009) observed measures of board inputs: attendance behavior and committee assignment and concluded that female directors are less likely to experience attendance problems than male directors. Furthermore, female directors are more likely to sit on monitoring-related committees, except for compensation committee. This pattern, according to Adams and Funk (2012), is because male and female directors differ systematically in their core values and risk attitudes, but in ways that are differ from gender differences in general population. Due to the glass ceiling effect, female who want to go further in the corporate hierarchy must work harder and are less risk-averse than the gender's average.

However, imposing a quota of women appearance in the Board goes against the fundamental idea that firm choose Boards to maximize value. Ahern and Dittmar (2011) recorded a significant stock price drop and a large decline in Tobin's Q over the following years after Norway mandated that 40% of Norwegian firms' director must be female. Due to the limited poll of female directors, new women directors usually hold multiple directorships, are far less experienced and younger than the existing men directors. Thus, the quota led firms to grow in size, make more acquisitions, and realize worse accounting return. Rose (2007) quoted the herding effect as the main reason behind female director inability to generate added value for their firms in Denmark market: Female directors do not belong to the "old guys club" as thus have to adopt the behavior and norms of their male counterparts to socialize themselves with counterparts. As a consequence, the gains from having female board members are never realized or reflected in any chosen performance measure.

Adams and Ferreira (2009) concluded that diversity has a positive impact on performance in firms that otherwise have weak governance, as measured by their abilities to resist takeovers. In firms with strong governance, however, enforcing gender quotas in the boardroom could ultimately decrease shareholder value. One possible explanation is that greater gender diversity could lead to over-monitoring in those firms.

2.2 Board Education and Firm Performance

2.2.1 Theoretical background on the correlation between manager education background and organization's outcome.

Educational background measures the cognitive ability of the executive, which influences firm performance: Hambrick and Mason (1984) suggested that executives' educational background provides an indication of their knowledge and skill base. The type and number of degree of education one chooses serve as indicators of her or his values and cognitive preferences. Thus, based on personal values, cognitive preferences and specialized education, we might expect those with formal education in engineering to utilize different cognitive models in making decisions than those with formal education in business or finance (Hambrick and Mason, 1984). Hitt and Barr (1989) found that managers with higher levels of formal education made different managerial compensation decisions from those with less formal education. Hambrick and Mason (1984) proposed that firms having top managers with less formal education experience more variability in performance. It is speculated that those with less formal education have greater variance in their cognitive models because these models are partially the product of more general educational training. As the education level increases, trainings and perspectives become more specialized and focused, thereby creating greater conformity in cognitive models. Thus, it concludes that amount and type of formal education affect the cognitive models developed and thereby the strategic choices made. Chevalier and Ellison (1999) took the same view on mutual fund manager performance, suggesting that managers from better school have higher inherent abilities or receiving direct benefits from a better education.

Educational background uncover behavioral pattern of executives: Barker and Mueller (2004) found that companies run by CEO with degree in technical have significantly higher R&D investment than those run by CEO from other background. Conversely, CEOs with educational backgrounds in business or law tend to be more risk-adverse with regard to R&D. They also find that if the CEO advanced via technical or marketing channels then they were more supportive of R&D than CEOs that advanced through the accounting, finance or legal channels. In another study, Graham and Harvey (2002) find that chief financial officers (CFOs) holding MBAs were more likely than other CFOs to use such learned techniques as net present value for capital budgeting and the capital asset pricing model in cost of capital calculations.

Educational background and firm's social capital: It is well known that education can be a strong indicator of social prestige and class status. A part of why the executive rose to his or her position is due to their social network. In addition to using social capital for personal advancement up the corporate ladder, research by Belliveau et. al (1996) and Burt (1992) finds that executives with higher educational profiles enjoy more "weak-ties" to government officials and other decision makers that can improve firm performance. For example, a CEO with strong social linkages to politicians and policy makers can help the company receive government contracts or favorable tax treatment. Chevalier and Ellison (1999) hypothesized that managers from high SAT (Scholastic Assessment Test) scores may provide indirect benefits via the network of connections to other members of the financial community it provides. Such connections could result in having better source of information, improved access to IPOs or preferential execution of trades.

2.2.2 Empirical researches on manager education

Vast majority of corporate governance literature studying about the relationship between executive performance/behavior and education focuses on executives and fund managers.

Among empirical studies focused on the direct correlation between executive's educational background and firm's performance. Kaplan, Klebanov and Sorensen (2008) found no relation between educational level proxy (SAT score and college selective level) and firm's performance. Gottesman and Morey (2008) found no positive relation between executive with either degree from prestigious school or an MBA degree with firm's performance. The author found, on the other hand, that compensation is somewhat higher for executives who attend more prestigious school. In the context of China, Cheng et al. (2010) show that university degrees held by the board chairman are positively associated with seven measures of performance, namely earnings per 8 share (EPS), ROA, cumulative returns, cumulative abnormal returns, change in EPS, change in ROA, and market-to-book ratio. Guner et al (2008) focuses on the financial expertise of US companies' directors, of which they found that financial experts significantly affect corporate decisions, though not necessarily in the interest of shareholders.

Most of the Board of Director social capital studies are done in the US, as this research branch requires disclosure data that only available in the U.S. Goldman et al (2012) studied about politically connected Board of Directors and the allocation of procurement contracts. The results suggest that, even within the confine of the strong legal system of the U.S., political board connections have a significant impact on the allocation of government resources. Companies usually looking or directors with industry expertise and relationship under the expectation that they may help to overcome information challenges, such as anticipating industry conditions and trends, and protecting against demand or supply shocks. Dass et al (2012) focused on this aspect and found that having directors with industry expertise and relationship will improve firm value and performance – especially when information problems are worse and boards have relatively greater power to monitor managers.

There is an interesting line of research on the relationship between fund's performance and manager's education background. One early prominent study is that by Chevalier and Ellison (1999), when they observed that mutual fund managers who attended more selective undergraduate institutions perform better than those attended less selective undergraduate ones, after controlling for differences in risk characteristics, survivorship bias and differences in expense ratio. Bertrand and Schoar (2002) recorded that fund managers with MBA degree follow more aggressive strategies, by choosing to engage in higher level of capital expenditures, hold more debt and pay less dividends. Gottesman and Morey (2008), on the other hand, found that education background yield no effects on fund's performance, except for the MBA variable. Managers who attend prestigious MBA program exhibit superior performance of both managers without MBA degree and managers with MBA from unranked programs. The author explained the result that rather than the manager simply being better, the argument is that items such as better support staff or better in-house research cause the fund to perform better.

2.3 Endogeneity in Corporate Governance Studies

Arguably, the most pervasive issue confronting studies in empirical corporate finance is endogeneity, which can be loosely defined0 as a correlation between the explanatory variables and the error term in a regression. Endogeneity leads to biased and inconsistent parameter estimates that make reliable inference virtually impossible. In many cases, endogeneity can be severe enough to reverse even qualitative inference. Yet, the combination of complex decision processes facing firms and limited information available to researchers ensures that endogeneity concerns are present in every study. Wintoki et al. (2012) categorized endogeneity into the three following types:

1. *Dynamic endogeneity*: This is present when a variable's current value is influenced by its value in the preceding time period. In the governance–performance relation, this occurs when the current governance structure, control characteristics and performance of the firm are determined by the firm's past performance. For instance, previous poor firm performance will likely cause the firm's shareholders to replace the board of directors with ensuing stricter corporate governance controls, which will in turn affect the firm's current governance structure, some control characteristics and performance (Hermalin and Weisbach, 1998)

2. *Simultaneity*: This is present when two variables are co-determined, such that each variable may affect the other simultaneously. In the governance–performance relation, the corporate governance mechanisms and control characteristics may be determined concurrently with the firm's level of performance. For example, the firm may choose a governance structure based on the expected performance of the firm; on the other hand, the firm's performance outcome will guide the governance structure.

3. *Unobserved heterogeneity*: This is present when a relation between two or more variables is affected by an unobservable factor. In the governance–performance relation, firm-specific characteristics—firm fixed-effects—may affect a firm's governance structure, control characteristics and performance, but may be unobservable to the researcher and therefore difficult to quantify. For instance, the ability of the firm's managers and the CEO's level of risk aversion could affect the firm's performance (Haubrich, 1998).

When available, natural experiments of carefully chosen strictly exogenous instruments, for instance regulatory changes, remain the "gold standard" for identifying the effect of explainatory variable on dependent variable. But given the rare occurrence of those natural experiments, corporate finance researches have to rely on other means to solve the endogeneity issue. Traditional research in corporate finance has explicitly recognized the last two sources of endogeneity and employed various method to excruciate those sources, notably two-stage least quares and fixed-effects. Two-stage least squares is the standard method to deal with simultaneity. For unobservable heterogeneity, the rationale is that traditional fixed-effects estimation can potentially reduce the bias arising from unobserved heterogeneity at an expense of a strong exogeneity assumption. That is, it assumes that current observations of the explainatory variable are completely independent of past values of the dependent one – an assumption Wintoki et al (2012) argue is not realistic as it omit the dynamic endogeneity source. They proposed a dynamic approach to tackle the endogeneity issue, which I will employ in this paper.

3. Hypothesis

This section will go through the research questions and hypotheses of this thesis. Board of Director characteristic and firm performance is a classic topic of corporate governance study, but studies about relationship between Director's education and corporate growth measures are considerably scare. Among those empirical studies, none have addressed the endogeneous issue between the dependent variable and explainatory factors. Due to these considerations, I will study the relationship between Board of Director educational background and firm performance, using the GMM panel model proposed by Wintoki et al (2012) to tackle the endogeneity issue on an extensive data set of European companies. Based on previous studies about managers and their education, I conduct the following hypothesis:

3.1 Doctoral Degree

Following previous studies in the US context (Jalbert et al., 2002; Gottesman and Morey, 2006a; Bhagat et al., 2010), educational quality is defined by the level of educational qualification. According to upper-echelon theory, higher education level is considered a good proxy for higher level of knowledge base and intellectual competence (Hambrick and Mason, 1984). As such, it is expected that higher educational level leads to better performance. A number of previous empirical studies provide evidence that the educational level of upper echelons is positively associated with financial performance, such as Hambrick et al. (1996), Jalbert et al. (2002), Bhagat et al. (2010), and Cheng et al. (2010). In this study, board doctoral degree level in one year is defined as the percentage of directors who obtained a doctoral degree at least one year prior to the year in question. The first hypothesis is formulated as follows:

H1: Doctoral degrees held by board members are positively correlated with firm performance.

3.2 Master of Business Administration (MBA) degree

Degrees in Business Administration provide director with management expertise and networking, which is very beneficial in the strategic management of the firm (Jeanjean and Stolowy, 2009). As explained by Lipton and Herzberg (2006), those expertise are crucial for board members in fulfilling their obligations, such as to oversee the firm and to monitor the performance of senior management. Golec (1996) and Bhagat et al. (2010) find that managers and CEOs holding an MBA perform significantly better than those without such a degree. An MBA holder should know some basic tenets of management as well as how to recognize the firm's bottleneck and profitable investments (Graham and Harvey, 2001). The author hypothesize that MBA holder will employ types of analyses that are taught in MBA programs, such as simulation analysis and value at risk (VaR).

H2: Master of Business Administration (MBA) degrees held by board members are positively correlated with firm performance.

3.3 Degree obtained from prestigious university

A number of previous empirical studies also define educational quality by the prestige of schools attended by the manager, since more prestigious schools are viewed to offer higher educational quality than their less prestigious counterparts. Those studies use different sources to determine the ranks of the schools or universities. For example, Gottesman and Morey (2006a, 2006b) determine the prestige of schools from which the CEO graduates based on the mean SAT, GMAT, and LSAT scores of each school. Jalbert et al. (2002) and Bhagat et al. (2010) rank universities based on the ranking produced by the US News and World Reports. Jalbert et al. (2002) report that executives holding degrees from top 25 graduate schools perform significantly better than their peers.

H3: Academic degrees held by board members from prestigious universities are positively correlated with firm performance

4. Data and method

4.1 Data

Data on Board of Directors of public European firms from 1999 to 2013 will be collected from BoardEx, and missing data is hand-collected from the firms' annual report and official website. BoardEx has education data of all individual directors they can collect, with each directors linked to their firm by firm year and company's ISIN. I arrange board of director data under panel form, with firm year and firm ISIN as sorting criteria. Each observation has director's academic degree, status of the degree (graduated, attended and attending), year of graduation and name of the institution. The data also provides board of director size, number of independent director and whether the CEO is also Chairman of the Board. As this is a European dataset, some of the degrees are recorded in languages other than English, so I have to hand-select them and trace back to the institutions who issued the degree. I omit those which cannot be verified to reduce the dataset's noise. Directors who either pursuing the degree or exit without graduating (degree status is attending/attended) are recorded as not obtained the degree in question. Based on the number of director from one firm in a given year, I filters firm years with sufficient education data of all directors to avoid any bias cause by data distortion. This initial sample from BoardEx includes 41,217 observation from 872 firms in the period from 1999 to 2013.

Next, using the unique ISIN firm identifiers from the above BoardEx file, I retrieve firm's fundamental data from Thompson One. Even though the reported dataset timeline only range from 1999 to 2013, I collect data of the previous ten years as the methodology requires lag data in the model. Variables of interest include net income, book and market value of asset, firm's long-term debt, equity market performance in the whole period, number of segments defined by Global Industry Classification Standard (GICS) code, firm size. All metrics are converted into USD for the shake of simplicity and comparison. The initial sample from Thompson One includes 16,588 observation in a panel format, sorted by firm year with the acquired fundamental data.

Now, I am able to combine the BoardEX and Thompson One sample. Education data is reformatted into firm year's board of director education level, and was matched to the fundamental data. The result is a panel data with each observation represents a firm year in the period from 1999 to 2013. As the methodology requires six consecutive firm years for the GMM model two-stage least squares regression analysis, I only keep observations that satisfy this constraint. This, plus the initial constraint of director education firm year, has significantly limited the amount of observations to 4221 firm years of 482 public firms in the period from 1999 to 2013. However, given the noisy nature of BoardEx data on director education, a prudent approach is necessary to reduce any bias from data manipulation.

4.1.1 Board of Director Education data.

In this research, I employ three education variables to measure the educational level of the Board of Director, namely Doctorate, MBA and Prestigious as describe below:

For MBA degree classification, directors who earned a Master in Business Administration are assigned value equal to 1 in the dummy variable MBA, and 0 otherwise. MBA degree is defined as a graduate degree achieved at a university or college that provides theoretical and practical Directors could also earn their MBA degree through short-term (6 months to one year) courses, which are designed for senior executive with years of experience of middle and larger capital companies. Those courses have no academic requirement for admission, and is popular among directors in my dataset (roughly 22% of directors attended executive training programs and graduated with an MBA degree). As I mentioned earlier, MBA degree has been employed by prominent corporate governance studies, such as Graham and Harvey (2001), Bertrand and Schoar (2003) as a method to measure the cognitive and management ability of managers.

Doctoral degree is defined as an academic degree awarded by universities that, in most countries, qualifies the holder to teach at the university level in the degree's field, or to work in a specific profession. Director comes from different background with varied doctoral degrees acquired from different countries, including those with degrees recorded in languages other than English, so I have to hand-select those data and trace them back to the issued institutions to make sure that the degree is an assort of doctoral degree. For doctoral degree classification, directors who earned a doctorate are assigned value equal to 1 in the dummy variable Doctorate, and 0 otherwise. One concern about this variable is that the percentage of director with doctoral degree is low, which makes the variable insignificant. Fortunately, the average percentage of director with doctorate degree is around 28% in this sample, varied enough to make the variable significant.

Prestigious is a variable to measure the percentage of directors who attend universities /institutions which are perceived to be prestigious. This variable was employed in other corporate governance studies, such as Palia (2001) and Bhagat et al (2010). In those studies, authors either relied on a preferred public ranking table or used dated ranking to decide whether the university is prestigious. Some studies in the U.S leverage their consolidated Scholastic Assessment Test (SAT) as a benchmark for university ranking. However, Europe does not have such uniform standardize test, so I rely on public university ranking publications for the school classification, as those are the only public materials related to this topic. Each of the ranking above has some limitations, most of which comes from bias selection and methodology. As most of the paper citation databases are focused on papers written in English, university with researches written in other languages will have significantly lower score in research citation-related indicators. Some of the rankings only rank universities which provides Bachelor, Master and Doctoral studies, thus ignore higher education institutions with focus solely on post-graduate or undergraduate education, for instance liberal arts colleges and research institutions. Therefore, I choose to use the average available ranking of each university in all publication within the reported period as the ranking of each university/institution. Employed university ranking publication, their methodology and limitation is discussed in details in appendix A. According to this classification, 614 out of 2271 universities/ institutions in the dataset are ranked and thus classified as prestigious. Some directors may attend more than one university/institutions, so I choose the one associated with the highest degree that director obtained to represent him/her for prestigious variable. Degree obtained are clustered into three categories: Bachelor and equivalent, Master and equivalent, and Doctorate and equivalent. If the director obtain multiple degrees at highest level, the one earned from higher ranking will be chosen to represent him/her for prestigious variable. Due to the nature of MBA degree as described earlier, I do not take into account the university/ institution associated with MBA in this prestigious variable**.** For example, if director A obtained one Bachelor degree, one Master degree, two Doctorate degrees and one MBA degree from university U1, U2, U3, U4, U5 respectively, with university ranking as following (U1 < U2 < U3 < U4< U5), then the one associated with director A is U4, as it is the most prestigious university from which the director obtained an academic degree. Directors who attended a prestigious university are assigned value equal to 1 in the dummy variable prestigious, and 0 otherwise.

4.1.2 Measuring performance

The primary performance measure I use in this study is Return on Assets (ROA), where ROA is defined as operating income before depreciation, divided by fiscal year-end total assets value.

Many studies used Tobin'Q – calculated by dividing Total market value of firm by Total asset value as a profitability measure. This can be a problem for a number of reasons. Tobin Q is a proxy for growth opportunities, and there is a strong theoretical reason argued by previous corporate governance studies to expect that growth opportunities are causes, rather than results of corporate governance variables. Lehn et al. (2009), Lunk et al (2008) and Wintoki et al (2012) provided both theoretical framework and empirical research to support this notion. Therefore, I will use market-to-book as a control variable rather than a performance measure.

Wintoki (2012) argue that board structure is highly persistent. This can reduce the power of panel data estimator, and dynamic estimator also requires that we assume transient errors are uncorrelated. The author mitigated this concern by sampling two-year interval instead of every year. However in this paper, due to limited dataset, I choose one-year interval, and the statistic from Table 3 shows that this data is varied enough for transience assumption.

4.1.3 Governance variables

Besides the board of director education variables, I use board size and board composition as control variables for board of director characteristics, which defined as follow:

- Doctorate: Percentage of Director with Doctoral degree on the board.
- MBA: Percentage of director with an MBA degree on the board
- Prestigious: Percentage of director who attended a prestigious university
- LogBsize: Natural logarithm of the number of directors on the board
- INDEP: The proportion of outside (non-executive) director

4.1.4 Control variables

Recent studies, including those by Raheja (2005), Coles et al. (2008), Boone et al. (2007), and Wintoki et al (2012) suggest that firms will choose their board structures based on the relative costs and benefits of each governance mechanism. The firm's chosen board structure will reflect the monitoring costs and private benefits of control the firm faces, as well as the scope and complexity of its operations. Thus, as suggested by prior research, I use size, age, the number of business segments, growth opportunities, and leverage as determinants of board structure. Specifically, I define our control variables as follows:

- LogMVE: Natural logarithm of the market value of equity.
- MTB: ratio of market-to-book value, calculated by dividing market value of equity plus book value of asset minus book value of equity, all divided by book value of asset.
- RETSTD: Standard deviation (of the past 12 months) of the firm's stock return.

- Debt: Ratio of firm's long-term debt to total asset. Long-term debt is defined as debt with maturity period larger than one year.
- LogSeg: Natural logarithm of the number of business segments, which are identified by Global Industry Classification Standard (GICS).

Table 2 reports summary statistics of our board characteristics, firm performance and firm's control variables. Average Board size is 41%, larger than that of Linck et al. (2008) dataset from 1991 to 2003, but is consistent with that from Wang et al (2013) paper. This difference could be explained by the dataset's firm size, with higher average and 75th percentile in compare to that of Linck et al. (2008). Larger firms have larger board, hence the data differences. Board independence is also slightly higher with average independence percentage increased by 7%. Independence level does not vary much between firm size and firm year, with 25th percentile and 75th percentile 20% apart.

Board of education data is also retrieved from BoardEx, with three variables MBA degree, Doctorate degree and Prestigious. Definition and classification methodology is defined below. Most Boards in this sample do not have a director with an MBA degree, with median percentage of director with an MBA education is 0 and average is 6.4%. Doctorate degree among Board members is quite popular, with median of 20% per Board. One interesting observation is that companies from German and Switzerland have significantly higher percentage of director with doctorate degree than the sample average (21.76% for German and 17.52% for Switzerland). This statistic suggests that education level is a country-specific variable, so I decide to include country effect in my fixed-effect regression model. Corporate governance researches also stress the importance of industry effect, but I do not find significant differences between industries in my sample regarding Board of Director education. On average, one third of the directors from each firm obtained degree from prestigious universities, which is consistent with my definition of prestigious university in this sample (521 universities/institutions out of 2421 institutions are classified as prestigious).

Majority of companies in the sample are conglomerate operating in different economic segments, with average number of segment per firm is 4. I use Global Industry Classification Standard (GICS) code to cluster the company's business into 10 sectors, including energy, materials, industrials, consumer discretionary, consumer utilities, health care, financials, information technology, telecommunication services and utilities. Sample's leverage ratio is similar to those of researches in the same period, while return volatility is slightly higher than that of Wintoki et al.(2012)' sample. Return on asset, on the other hand, reduced moderately in compare to that of the period from 1991 to 2003. Both of these numbers could be explained by macroeconomic factor, as the period in question is bounded by two major economic crisis: the 2000 dot com bubble and 2008 financial crisis, which drives the market volatility and lower return on asset in general.

Wintoki et al. (2012) argue that board structure is highly persistent. This can reduce the power of panel data estimator, and dynamic estimator also requires that we assume transient errors are uncorrelated. The author mitigated this concern by sampling two-year interval instead of every year. However in this paper, due to limited dataset, I choose one-year interval, and the statistic from Table 3 shows that this data is varied enough for transience assumption.

Table 3 shows the number of firm year that experience changes in board size, independence and Board education between 2001 and 2013. Within any two-year period, between 35% and 53% of my sample firms experience a change in the level of board independence (fraction of outsider) with average of 49%. I also find that between 17% and 43% of firms change their board size over a two year period, with the average of 30%. Change in board size is less common than change in board independence, as board independence level is under heavy regulatory scrutiny over the past decade. Among the education variables, change in MBA percentage is the one with most significant changes over the sample period, with between 52% and 68% of my sample firms experience a change in percentage of board members with MBA (Master of Business Administration) degree. Raw data analysis from BoardEx shows that MBA degree includes short-term business administration courses (average course period is 6 months for full-time participants) for experienced senior manager, so a Director could change their status of MBA degree in less than a year. Another plausible reason is that MBA degree is becoming more popular during the reporting period. By the end of the sample period, about 64% of the firm year experienced change either in the percentage of Doctorate, MBA or prestigious variable. This frequency of change suggests that there is enough time-series variation in my key variable to effectively use panel data estimation technique.

4.2 Method

In this paper, I will employ the method introduced by Wintoki et al. (2012) to address the relationship between board of director education and firm's performance. The author argue that large body of empirical research in the field of corporate governance is plagued with endogeneity issue, which leads to biased and inconsistent parameter estimates that make reliable inference virtually impossible. We often cannot ascertain if the causation is actually reserved (e.g performance drives governance) or if governance is merely a symptom of an underlying unobservable factor, which also affects performance. They applied a well-developed panel GMM estimator to address causes of endogeneity. This method improves on ordinary least square (OLS) or traditional fixed effects estimates in at least one of three ways. First, unlike OLS estimation, firm-fixed effects could be included to account for fixed unobservable heterogeneity. Second, unlike traditional fixed-effects estimates, it allows current governance to be influenced by previous realizations of, or shock to, past performance. Third, unlike either OLS or traditional fixed-effects estimates, a key insight of the dynamic panel GMM estimator is that if the underlying economic process itself is dynamic—in my case— if current governance is related to past performance—then it may be possible to use some combination of variables from the firm's history as valid instruments to account for simultaneity. Thus, an important aspect of the methodology is that it relies on a set of "internal" instruments contained within the panel itself: past values of governance and performance can be used as instruments for current realizations of governance. This eliminates the need for external instruments.

In most previous studies, the effect of board structure on performance have estimated a static model of the form:

Performance = f (board structure, firm characteristics, fixed effects)

While Wintoki et al. (2012) posit that the appropriate empirical model to address all three endogenity sources should be:

Performance = f (past performance, board structure, firm characteristics, fixed effects).

This model is based on arguments made by Hermalin and Wesibach (1998), Raheja (2005) and Harris and Raviv (2008), suggesting that board characteristic is a choice variable that arises through a process of bargaining between the various actors in a firm's nexus contract, where the bargaining process is influenced by past performance and the actor's belief about the cost and benefits of particular board characteristics. Thus, if board structure is dynamic and firm i (given its performance at time t − 1 or earlier) chooses a board structure X_{it} to achieve a particular level of expected performance at time t, then the dynamic model for board structure is:

$$\mathbf{X}_{it} = f(y_{it-1}, y_{it-2} \ldots y_{it-p}, \mathbf{Z}_{it}, \eta_i), \qquad (1)$$

where X, Z, and y represent board structure, firm characteristics, and performance, respectively, and η represents an unobserved firm effect.

Eq. (1) suggests that estimating the effect of board structure on firm performance, conditional on firm heterogeneity, requires estimating the following empirical model:

$$y_{it} = \alpha + \sum_s \kappa_s y_{it-s} + \beta X_{it} + \gamma Z_{it} + \eta_i + \varepsilon_{it} \quad s = 1,\ldots, p, \qquad (2)$$

where ε_{it} is a random error term and β is the effect of board characteristics on performance.

A key aspect of Equation (2) is that board structure is a choice variable, then it must be based on some expectation of performance, but not necessarily the one that maximizes firm value. However, once the bargaining has occurred, the board has been chosen, and associated expectations have been set, then any unexpected changes to performance would be genuine shock with respects with respect to the information the firm choose its board characteristics. It means that based on the estimation of Equation (2), current shocks are independent of historical realization of performance on board structure. This is not a strong assumption, since it allows current performance to be influenced by past and current realization of board characteristics. The assumption leaves open the possibility that firms strategically choose governance to affect current or future performance. If the board structure that we observe today is one that trades off the anticipated costs and benefits of particular structures, then the unanticipated component of performance, many years in the future, will not be related to the board structure that is chosen today. This intuition, which can be written in orthogonality form as $E(\varepsilon_{it}|y_{it-s}, X_{it-s}) = 0$, is essentially the same as assuming weak rational expectations among participants in the firm's nexus of contracts. So every endogenous time-varying variables that affected performance, then ε_{it} would be an expectational error and the orthogonality assumption would be valid. However, it could be the case that endogeneous time-varying variables that have an economically significant effect on both firm performance and board characteristics were omitted in equation (1).

Sources and solution of endogeneity in the governance/performance relation.

As mentioned earlier, sources of endogeneity come from simultaneity and unobservable heterogeneity. In the board of director characteristic and firm's performance set-up, if we assume firm choose their board based on a view towards achieving a particular level of performance in that period, then while board characteristics may affect performance, the reverse will also be true – board characteristics will also be affected by performance. We can say that this relationship is simultaneous, econometrically written as $E(\varepsilon_{it}|X_{it},Z_{it}) \neq 0$ in equation (2). Wintoki et al. (2012) suggests that one way of solving this issue is by applying a system of equation. In one equation, performance is allowed to depend on governance and other control variables while in other equations, governance is allowed to depend on performance and other control variables. However, estimating this system requires us to identify strictly exogenous instruments— there must be at least one variable in the governance equation that is not also in the performance equation, which is really difficult in practice.

Econometrically, unobservable heterogeneity exists in Eq. (2) if $E(\eta_i |X_{it},Z_{it}) \neq 0$. Unobservable heterogeneity exist in the context of board characteristics and firm performance if there are factors affecting both performance and explainatory variables. A potential solution to the time-invariant or "fixed" part of unobservable heterogeneity, if panel data are available, is a fixed-effects or "within" estimation. Consider the linear model:

$$y_t = \beta x_t + \eta + \varepsilon_t , \qquad (3)$$

where η represents an unobserved fixed effect. A fixed-effects transformation, which requires time-demeaning all variables yields:

$$\ddot{y}_t = \beta\, \ddot{x}_t + \varepsilon_t , \qquad (4)$$

where $\ddot{x} = x_{it} - \bar{x}_i$ and $\ddot{y} = y_{it} - \bar{y}_i$.

However, what is often not recognized are the conditions under which a fixed-effects regression would be consistent and unbiased. A fixed-effects regression of the model in Eq. (2) would be consistent only if current values of the explanatory variables (governance) were completely independent of past realizations of the dependent variable (performance), i.e., if $E(\varepsilon_{is}|\mathbf{X}_{it},\mathbf{Z}_{it}) = 0, \forall s,t$. This means that fixed-effects estimates would be biased if past performance affects current values of governance. Wintoki et al.(2012) proposed to apply the dynamic GMM panel estimator to obtain a consistent and unbiased estimates, under the assumption that unobserved heterogeneity exists but is fixed or time-invariant. This estimator was introduced by Holtz-Eakin et al.(1998) and Arellano and Bond (1991), and further developed in a series of papers including Arellano and Bover (1995) and Blundell and Bond (1998). The basic estimation procedure consists of two essential steps. First, we write the dynamic model of (2) in first-differenced form:

$$\Delta y_{it} = \alpha + \kappa_p \sum_{p} \Delta y_{it-p} + \beta \Delta X_{it} + \gamma \Delta Z_{it} + \Delta \varepsilon_{it}, \quad p > 0. \qquad (5)$$

First-differencing eliminates any potential bias that may arise from time-invariant unobserved heterogeneity. After first-differencing, the author estimate (5) via GMM using lagged values of the explanatory variables as instruments for the current explanatory variables. That is, they use historical values of performance, board structure, and other firm-specific variables as instruments for current changes in these variables.

Second, the historical or lagged values must provide an exogenous source of variation for current governance. This means that lagged variables must be uncorrelated with the error in the performance equation in Eq. (2). Theory provides motivation for this. As discussed earlier, under the assumption of weak rational expectations, if the board structure that we observe today is one that trades off the anticipated costs and benefits of particular board structures, then current shocks to performance must have been unanticipated when the boards were chosen. Any information from the firm's past is impounded into current expected performance within p time periods. This means that p lags of past performance are sufficient to capture the influence of the firm's past on the present, i.e., including p lags ensures dynamic completeness of Eq. (2). Provided p lags of performance have been included, any information from the firm's history that is older than that has no direct effect on current performance and only affects performance through its effect on current governance and other firm characteristics. Thus, the firm's history beyond period $t - p$ should be exogenous with respect to any shocks or surprises to performance in the current or future periods.

If the exogeneity assumptions are valid, then the following orthogonality conditions could be applied:

$$E(X_{it-s}\varepsilon_{it}) = E(Z_{it-s}\varepsilon_{it}) = E(y_{it-s}\varepsilon_{it}) = 0, \ \forall \ s > p. \qquad (6)$$

However, despite the economic appeal of this procedure, it does have at least three econometric shortcomings. First, Beck et al. (2000) note that if the original model is conceptually in levels, differencing may reduce the power of the empirical tests by reducing the variation in the explanatory variables. Second, Arellano and Bover (1995) suggest that variables in levels may be weak instruments for first-differenced equations. Third, first-differencing may exacerbate the impact of measurement errors on the dependent variables (Griliches and Hausman, 1986). Arellano and Bover (1995) and Blundell and Bond (1998) argue that these shortcomings can be mitigated, and improved the GMM estimator by also including the equations in levels in the estimation procedure. We can then use the first-differenced variables as instruments for the equations in levels in a "stacked" system of equations that includes the equations in both levels and differences. This produces a "system" GMM estimator, that involves estimating the following system:

$$\begin{bmatrix} yit \\ \Delta \mathrm{yit} \end{bmatrix} = \alpha + \kappa \begin{bmatrix} yit - p \\ \Delta \mathrm{yit} - \mathrm{p} \end{bmatrix} + \beta \begin{bmatrix} \boldsymbol{X}it \\ \Delta \mathbf{X}\mathrm{it} \end{bmatrix} + \gamma \begin{bmatrix} \boldsymbol{Z}it \\ \Delta \mathbf{Z}\mathrm{it} \end{bmatrix} + \varepsilon_{\mathrm{it}} \qquad (7)$$

Unfortunately, the equations in levels still include unobserved heterogeneity. To deal with this, the author assume that while the governance and control variables may be correlated with the unobserved effects, this correlation is constant over time. This is a reasonable assumption over a relatively short time period if the unobserved effects proxy for factors like unobserved director ability, managerial productivity, etc. The assumption leads to an additional set of orthogonality conditions:

With the system GMM estimator, they obtain efficient estimates while controlling for time-invariant unobserved heterogeneity, simultaneity, and the dynamic relationship between current values of the explanatory variables and past values of the dependent variable. Series of tests are carried out to test the key exogenous assumption, is that the firm's historical performance and characteristics are exogenous with respect to current shocks or innovations in performance. The first test is a test of second-order serial correlation. The second test is a Hansen test of over-identification. All steps of the dynamic system GMM estimator are included in the xtabond2 function in Stata.

5. Result

5.1 Determine number of lags to ensure dynamic completeness

Wintoki et al. (2012) argued that understanding how many lags of performance needed to capture all informational in the past is important for two reason. First of all, failure to capture all influences of the past on the present could mean that Eq. (2) I misspecified, i.e there might be an omitted variable bias. But more important, the method employs older lags that are exogenous with the residual of the present as instrument for present values, so this test helps to determine how many lags is enough for the above two conditions. I estimate a regression of current performance on five lags, controlling for other firm-specific's characteristics. Table 4 shows the result. Result suggest that including five lags is sufficient to capture the dynamic aspect of performance/governance relation. In the first column, first four lags are significant at 1% level while the older lag is insignificant. I eliminate the recent lag in column two and include only the fifth lag. With this specification, the older lag is statistically significant. Thus, while older lags may contain relevant information in regard to firm's performance, that information is subsumed by more recent lags. One interesting observation is that performance measure at the second and fourth lags is negatively related to current performance measure, which suggests reversal effect of performance every other year in this sample.

5.2 How strongly is the present related with the past?

One key argument in this paper is that present board and firm characteristics are strongly correlated with past performance. I examine this assertion with series of test, of which the first one is an OLS regression of (1) current level of board characteristics variable and other firm's specific variables and (2) changes in these levels on past performance and historical value of the firm-specific variables.

The results are shown in Table 5, with Panel A shows results from OLS regression of the level of board characteristics and other firm characteristics on performance and characteristics from a year earlier. I find that MBA and Prestigious variables are significantly positively correlated with Return on Asset in the earlier year, while Doctorate are negatively related to past performance measure at 1% significance level. This suggests that firm usually reinforce their board of director with better educated directors after years with negative result, with focus on people with industrial and management expertise. Furthermore, current board size and independence level, as well as current measures of director's education, is significantly positively related to past firm size, which suggest that as firm gets larger, it will have larger board with better educated directors and higher level of board independence. The first assessment matches those suggested by Fama and Jensen (1983), and documented by Boone et al.(2007), Coles et al (2008), and Linck et al. (2008). In general, all control and dependent variables in the level equation of equation (2) are significantly correlated with past values. One may argue that the effect of board of director is sticky, i.e the decisions the board make in year t may only take effect in year t+2, t+3 or later on depends on the stickiness, making any interpretation of the Table 5 forceful. As this is only the intermediate step to check the endogenous level of explanatory variables, what matters is the significant level of correlation rather than result interpretation.

Panel B of Table 5 shows the result from OLS regression of changes in board characteristics and firm characteristics on the performance levels and characteristics from a year earlier. The result suggests that changes in board characteristics and firm control variables strongly correlated with past performance. Changes in percentage of doctorate degree holding are negatively correlated to past performance, while changes in prestigious level are positively correlated to past performance, both at 1% significant. Similar logic of Panel A is applied in this table, as I do not include the changes of same dependent variable in the equation, as the correlation is strong and might hinder others. Board characteristics variables are not included in regressions with dependent variables are those of firm control variables, as they do not have much correlation with the variable in question.

Table 5 shows that all the potential firm performance control variables are dynamically endogenous. Current levels and changes in market-to-book (MTB), natural logarithm of market value (LogMVE), standard deviation of stock return (RETSTD), natural logarithm of number of business segments (LogSeg), and leverage (Debt) are all significantly related to past performance. This again highlight Wintoki et al (2012) suggestion that it is not only corporate governance that can be considered endogenous, but also control variables proxies for the firm's operation and performance are likely to be endogenous as well.

A second test is the test of strict exogeneity suggested by Wooldridge (2002, p.285) under the following fixed-effect model:

$$y_{i,t} = \alpha + \beta X_{i,t} + \Omega W_{i,t+1} + \eta_i + \varepsilon_{it}, \qquad t=1999,2000,2001\ldots.2013 \quad (8)$$

where $W_{i,t+1}$ is a subset of future values of the corporate governance and control variables. Under strict exogeneity where $\Omega = 0$, i.e future realization of governance and control variables are unrelated to current performance.

Table 6 shows the results of equation (8), with different subsets of the governance and control variables, $W_{i,t+1}$. In every specifications in which they are included, the coefficient estimates for the future value of board MBA level (MBA_{t+1}) are significantly different from zero. Future values of Doctorate ($Doctorate_{t+1}$) and Prestigious ($Prestigious_{t+1}$) coefficients are significantly different from zero in the majority of specifications in which they are included. This suggests that all the board of director education variables are strictly exogenous and instead adjust in response to firm performance. The natural logarithm of number of segments at t+1 ($LogSeg_{t+1}$) is omitted in the last specification, as number of segment should not change significantly over such short period.

Table 5 and Table 6 suggests that all the board characteristics and firm characteristics variables employed in this paper are endogenous i.e not strictly exogenous. Table 6 confirms the theoretical prediction and the result from the OLS regressions in Table 5.

5.3 The relation between board structure and current firm performance

In this section, I examine the result from estimating the relation between board education and current firm performance. In order to show the dynamic relationship between performance and set of explanatory variables, as well as how the result change under different methods, I estimate the following models, following Wintoki et al.(2012) specification:

1. OLS model
2. Fixed effect model
3. A dynamic OLS model
4. A dynamic fixed-effect model (system GMM)

Table 7 reports the results of the above methods. I applied the same logic of Wintoki et al (2012) paper, with two lags of performance in the dynamic model. The result in Table 4 suggests that variables lagged five and six periods (t-5 and t-6 respectively) are suitable for all the endogenous variables in GMM estimates. My assumption in the GMM regression is that all regressors except year dummy and country dummy are endogenous. This assumption is further tested with result shown in Table 5.

OLS and fixed effects static models suggest a positive relationship between all education variables and firm performance. Only doctorate variable shows statistically significant result in both models, MBA is significant in the fixed effect model while prestigious variable shows no sign of statistically significance. The significant correlation between education variables and firm's performance confirms Hambrick and Mason (1984) upper echelon theory, which states that an organization outcomes – strategic choices and performance - are partially predicted by managerial background characteristics, one of which is the manager's formal education level. The result of MBA degree in static fixed effect model confirms finding of Gottesman and Morey (2006) that managers with MBA degree poses a positive effect on the organization's performance. The prestigious degree finding is similar to that of Bhagat et al (2010), which states that whether manager attends a prestigious university does not have significant impact on firm's performance. The OLS static model also confirms result of board characteristic control variables Indep and LogBsize in previous literatures, with positive correlation between performance and Indep, and negative correlation between board size and performance. In general, static OLS tells that a small and independent board with well-educated board members will facilitate firm's performance.

Static fixed effect model, which takes into account the effect of country, industry and year, also supports the above statement. MBA correlation increases from 0.182 in OLS model to 0.606, with t-value improved from 0.41 to 2.06, making it statistically significant at 1% level. The prestigious variable still yield a positive yet not statistically significant relationship with performance measure. Note that R^2 improves from 20.9% in static OLS model to 38.9% in static fixed effect model, which reflects that the According to Wintoki et al.(2012), the static model does not correctly reflect the relationship between explanatory variables and dependent variable, as it is plagued by endogeneity as confirmed by the result of Table 5 and Table 6.

Once we move to the dynamic models, all the results disappeared. In a simple OLS dynamic model, the percentage of MBA degree and Doctorate degree no longer significantly related to performance. In a dynamic OLs model, all board education variables are no longer significantly related to firm performance. For example, the coefficient of Doctorate is significantly positive in static OLS model (0.377 with t = 2.03), but is insignificant in dynamic OLS model (0.193 with t=1.69). All the signs of board characteristics do not change from static to dynamic model, with only board size poses negative effect on firm's performance. Magnitude of the coefficients drop as well, for example MBA coefficient drops from 0.182 to 0.012 and Doctorate coefficient drops from 0.377 to 0.193. This suggests that current board characteristic is correlated with past firm performance-another potential indicator of the endogeneity that arises from the relation between board characteristic and firm performance. However, it is possible that there is some unobservable heterogeneity that is not captured by past performance. R^2 improves from 20.9% to 47.1% in the dynamic model. In the OLS dynamic model, I include past performance, and through the improvement in R^2, it appears again that past performance explain a significant portion of the variation in current performance. However, note that this dynamic OLS is only an immediate step towards dynamic system GMM, and the result is yet to be conclusive. One clear insight that emerges from the dynamic OLS is explanatory power of lagged performance when assessing the relationship between corporate governance variables and firm performance. The system GMM model helps to estimate the governance/performance relationship while including both past performance and fixed-effects to account for the dynamic aspects of the governance/performance relation and time-invariant unobservable heterogeneity, respectively.

The results show that when I include fixed-effects in a dynamic model and estimate via system GMM, the coefficients on all education variables are statistically insignificant. For instance, Doctorate coefficient is 0.06 with t-value =0.11, while MBA coefficient changes from positive to negative sign. Except for ROA_{t-1}, all other explanatory variables coefficients are statistically insignificant. This is a sharp contrast to the results from the static fixed-effects model in which the coefficient on MBA and Doctorate are statistically significant and positive. The changes in significance level illustrates the bias arises from ignoring both unobservable heterogeneity and dynamic relation between board education and firm's performance.

One way to explain changes in the significant level of director education from simple OLS to dynamic GMM is through unobservable heterogeneity, which is solved in dynamic GMM model. Roberts and Whited (2012) noted that unobserved heterogeneity causes a bias term equal t the product of the effect of the omitted variable on the outcome variable, γ, and the effect of the omitted variable on the included variable, ϕj in the equation:

$$\text{plim } \hat{\beta} j = \beta j + \gamma\phi j \text{ , } j = 1, \ldots, k$$

If both γ and ϕj are positive, then the error term will be positive and thus plim $\hat{\beta} j$ will be over-estimated. One plausible omitted variable with positive effect on both performance and director variable is director's competence. Companies with highly competence directors will have better strategic decisions, and better performance in the long run. Education level is also linked to one's cognitive function and coherence, so directors with doctorate degree and graduate from prestigious university/institution are more competence than those without doctorate degree and graduate from less prestigious university. So not taken into account board of director competency will lead to overestimation of the effect of board education on firm's performance, which explain the changes in significant level of all three education variables. So one suggestion to improve the explanatory power of further researches in this field is to include board of director competence in the regression. Note that unobservable heterogeneity may explain the change in significance level, but cannot account for the sign flip of MBA variable.

Another way to explain the change in significance level is due to dynamic nature of the relationship between board of director characteristic and firm's performance. Suppose two firms, A and B, have the same average performance over t periods, likely due to their managers have similar abilities. Suppose at the t-1, firm A performed better than firm B due to purely exogenous events. If shareholder use firm performance as a proxy for managerial ability and board education variables are positively related to past performance, then firm A will have a slightly higher board education than firm B, at time t-1. However, since both firms have same average performance over the entire t periods, firm B will have better performance than firm A in period t. So a firm would appear to have better performance thanks to better educated board, while it is in fact due to a mechanical mean reversion of the firm's performance. So controlling past performance will help to reveal the true effect of board education on firm's performance, which is not statistically significant in this case.

The dynamic GMM model also suggests no significant relationship between board independent, board size and firm performance, which is similar to that reported by Wintoki et al.((2012), even though the sign is changed in vice versa manner (negative relationship between board size and firm performance, positive relationship between board independence and firm performance). Education

5.4 Strengths of instruments

In this section, I carry out a test suggested by Wintoki et al.((2012) to check the correlation between endogenous variables and their instruments by carrying out a first-stage regression of all endogenous variable on their instruments and examine the F-statistic. If y is performance and X includes all the regressor, system GMM involves estimating the following:

$$\begin{bmatrix} yit \\ \Delta yit \end{bmatrix} = \alpha + \beta \begin{bmatrix} \boldsymbol{X}it \\ \Delta \boldsymbol{X}it \end{bmatrix} + \varepsilon it$$

To assess the strengths of the instruments, I split my system into its level and 1st differencing equation and assess the strength of (1) lagged differences as instrument in the level equation and (2) lagged levels as instruments in the differenced equation under the following form:

$$y_{it} = \alpha_l + \beta_l \mathbf{X}_{it} + \nu_{it} \qquad \text{Instruments: } \Delta\mathbf{X}_{it-5}, \qquad (19)$$

and the equation in differences:

$$\Delta y_{it} = \alpha_d + \beta_d \Delta\mathbf{X}_{it} + \varepsilon_{it} \qquad \text{Instruments: } \mathbf{X}_{it-5}. \qquad (20)$$

Table 8 shows the result of my analysis. For the variables in levels, I obtained the F statistic by regressing each variable on all the lagged instruments used as instrument ($\Delta\mathbf{X}_{it-5}$). Similarly, F statistic in the 1st differencing is obtained by regressing each variable on all the lagged levels used as instrument ($\mathbf{X}_{it-5}$). Table 8 shows that F=statistics for all the first-stage regressions are significant, which implies that instruments provide significant explainatory power for the endogenous variables. This is determined by a rule of thumb suggested by Staiger and Stock (1997): if F-statistic is larger than 10, then the instrument provides significant explainatory power. So the test suggests that the result in table 7 is not driven by weak instruments.

5.5 Does board characteristic affect firm performance with a lag?

My analysis so far has focused on assessing the effect of current board characteristics on firm's performance. However, it is possible that board characteristics in this period affect governance in the next period i.e board structure affects firm performance with a lag. It is also the case that a strategic decision made in time t by board of director will only take effect in years after t, and thus only materialize on performances of years after t. Thus, it is necessary to look into the relationship between board characteristics and firm performance with a lag. I applied Wintoki et al.((2012) method to estimate an empirical model in the form:

$$y_{it} = \alpha + \kappa_1 y_{it-1} + \kappa_2 y_{it-2} + \kappa_2 y_{it-3} + \kappa_2 y_{it-4} + \beta X_{it-2} + \gamma Z_{it-2} + \eta_i + \varepsilon_{it},$$

where X contains the board characteristics variables and Z contains the control variables.

Wintoki et al.((2012) argued that estimating the effect of lagged board characteristics on current performance enables the research to do two things: assess the effect of board characteristics on firm performance using a set of different assumptions from those in Table 7. It also allows to apply an alternative dynamic panel estimator that does not rely on the instrument set that I used in the dynamic GMM in Table 7. Using lagged board variables in the regression does not eliminate either unobservable heterogeneity (since X_{it-2} is possibly still correlated with η_i), or the dynamic aspect of the board characteristics/performance relation, since values of board structure at time t-2 could have been determined at periods before t-2. However, using lagged board characteristics as opposed to current board characteristics reduces the impact of simultaneity since past board characteristics and current performance are not determined in the same period.

Table 9 shows the result of estimating the effect of current performance on lagged board characteristics, including board education. I show the result from simple OLS regression and dynamic GMM panel estimator. Both of the methods record no relation between lagged board education and firm's performance. In the simple OLs model, R^2 drops significantly in compare to that in Table 7, given the same number of explanatory variables (from 0.21 to 0.14), which signify the fact that past values do not explain current performance as well as present value of the same set of variables. So in this sample, lagged corporate governance variables do not effect current firm's performance.

6. Conclusion

I find no evidence that Board of Director education matters with respect to firm performance- either short or long term for this European dataset. All else equal, firms with better educated board of director may appear to have better performance in the short-run, but that superiority will likely to reverse in the future.This study suggests some practical implications. Even though intellectual competence should appear to be one of the considerations in the appointment of board members, the education qualification is not always a good proxy for superior advising or managerial quality. Education degrees are usually obtained long before the director's appointment, thus other cognitive experience such as industry knowledge and network should be better parameters of a director's competency. Secondly, Board of Director strategic decision usually shows material effects on firm's performance with a lag, so it is important to examine the correlation between lagged corporate governance structure and firm's outcome to have a more thorough understanding about the causality between those two elements.

Corporate finance research's interpretation has been complicated by endogeneity issue, with classic solutions including event study and external instrument variables. However, those solutions are not always available, and the use of lags of dependent and independent variables as instrument is a valid alternative. However, note that the use of lags as instrument relies on a key assumption – the weak rational expectation on the part of actors in the firm's nexus contracts, so the extend to which this method could be applied is limited for corporate finance studies.

Appendix

University ranking tables and methodology

A. QS University Ranking: The ranking is rated based on six performance indicators, four of which are based on hard data, and the remaining two are based on survey – one of academics and the other of employers. Each criteria carries a different weighting when calculating the overall scores. The primary aim of this ranking is to help students make informed comparison of leading university in the world.

1. Academic Reputation (40%): Measured using a global survey, in which academics are asked to identify the institutions where they believe the best work is currently taking place within their own field of expertise. Participants are not allowed to vote for their own institution, and only their most recent responses are used. In average, the ranking received 76,800 responses annually over the past 5 years. Regional weightings are applied to counter any discrepancies in response rates.
2. Employer Reputation (10%): Measured using a global survey, this criteria asks employers to identify the universities they perceive to be producing the best graduates. A higher weighting is given to votes for universities that come from outside of their own country, which promotes the pursue of international education.
3. Student-to-faculty ratio (20%): Measure of number of academic staff employed related to number of student enrolled. This indicator assume that higher level of individual supervision leads to better teaching quality.
4. Citation per faculty (20%): This indicator aims to assess research's impact. More citation is associated with more influence a paper/researcher has, and thus improve the academic impact of the university.

5&6. International faculty (5%) & International student ratio (5%): These two indicators aim to assess how successful a university has been in attracting students and academics from other nations.

B. Times Higher Education ranking: This ranking table focus on the academic achievement of university, with strong skewness to research citation and reputation. The performance indicators are grouped into five weighted areas:

1. Teaching (30%): Assess the learning environment of the university, with sub-indicators include reputation survey, staff-to-student ratio, doctorate-to-bachelor ratio, proportion of doctorate among academic staff and institutional income, which is scaled against staff number and normalized for purchasing-power parity.
2. Research (30%): Assess the reputation, income and volume of researches from the university. Reputation is based on survey response from academic peers, while volume data is collected from Elsevier's Scopus database per scholar, scaled for institutional size and normalized for subjects. Times Higher Education ranking admits that their research income calculation is controversial and biased. However, given the importance of funding, the ranking has assigned 6% weight to this criteria.
3. Citations (30%): Scored by the number of time a university's work is cited, with data extracted from Elsevier's Scopus. The indicator is defined with reference to a global baseline and intrinsically accounts for differences in citation accrual over time, differences in citation rates for different document types (reviews typically attract more citations than research articles, for example) as well as subject-specific differences in citation frequencies overall and over time and document types. The data are fully normalised to reflect variations in citation volume between different subject areas. This means that institutions with high levels of research activity in subjects with traditionally high citation counts do not gain an unfair advantage.
4. International Outlook (7.5%): Measure the international-to-domestic ratio of both staff and students, plus a category in which they calculate the proportion of a university's total research journal publications that have at least one international co-author.
5. Industry Income (2.5%): capture how much research income an institution earns from industry (adjusted for PPP), scaled against the number of academic staff it employs.

The weight is re-calibrated for each subject, with the weightings changed to reflect different publication habits in different fields.

C. Center for World University Rankings (CWUR): This ranking uses eight objective and robust indicators to rank the world's top 1000 universities.

1. Quality of Faculty (25%): Weighted number of faculty members who have won one or some of prize/medal selected by the ranking. This selection contains large collection of awards covering virtually all academic disciplines.
2. Quality of Education (25%): number of university alumni who have won major international awards, prizes and medal relative to the university's size. Alumni is defined as students who obtained Bachelor, Master or Dotoral degrees. International awards defined in the quality of faculty part.
3. Alumni Employment (25%): This indicator measures the weighted number of an institution's alumni who currently hold CEO positions at the world's top 2000 public companies relative to the institution's size. The top companies are those listed on the Forbes Global 2000 list.
4. Publication, influence, citation, broad impact and patents: for publication, the list of journal is obtained from Thompson Reuters's journal citation report, with the focus on the number of publication in the top-tier journals in the database. Influence score is calculated as the sum multiple of number of publications and reputation score of each journal of each university. Patents registered to the World Intellectual Property Organization in the year T-2 are collected. Paper's impact level is calculated by h index from Hirsch (2005).

D. Academic Ranking of World University (ARWU): This ranking employs a long list of indicators, including Quality of Education (10%), Quality of Faculty (20%), Research Output (20%) and Per capital Performance (20%). The benchmark and quality definition is quite close to that of CWUR. Research Output is defined by number of paper published in Science Citation Index-expanded & Social Citation Index, and in Nature and Science.

Each of the ranking above has some limitations, most of which comes from bias selection and methodology. As most of the paper citation databases are focused on papers written in English, university with researches written in other languages will have significantly lower score in research citation-related indicators. Some of the rankings only rank universities which provides Bachelor, Master and Doctoral studies, thus ignore higher education institutions with focus solely on post-graduate or undergraduate education, for instance liberal arts colleges and research institutions. QS Ranking and Times Ranking rely on surveys, which causes data manipulation and selection biases;

while CWUR and ARWU employed subjective benchmarks for their quality assessment. University ranking is a relatively new concept with most of the ranking tables established within the past 15 years, and there is no widely accepted framework for ranking, so for each university in the director education sample, I will get the equal-weight average ranking from the available dataset annually. As the Director Education dataset from BoardEx is noisy with different input name for the same university/institution, I have to manually check and match the data as so the university names in the ranking and BoardEx data fit. The result is a list of 472 ranked universities/institutions over the sample of 2842 universities/institutions.

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Table 1. The effect of Board of Director characteristics on firm's performance

This table reports the findings of previous studies that examine the impact of board characteristics on firm's performance. Q stands for Tobin Q, calculated as the market value of a company divided by the replacement value of the firm's assets. ROA stands for Return on Asset, calculated by dividing a company's annual earnings by its total assets, and is displayed as a percentage. ROS stands for Return on Sales, calculated by dividing net income before interest and tax by sales.

Paper	Sample	Period	Performance Measure	Relationship
Panel A: Papers examining relationship between board independence and firm performance				
Hermalin and Weisbach (1991)	134	1971-1983	Q, ROA	None
Agrawal and Knoeber (1996)	800	1988	Q	Negative
Bhagat and Black (2002)	2002	1988-1991		Negative
Coles, Daniel, and Naveen (2008)	8,165	1992-2001	Q, ROA, ROS, Market returns	Negative for high Research and Development (R&D) firms
Wintoki, Linck, and Netter (2012)	6,000	1991-2003	ROA, Q	None
Black and Kim (2012)	2,165	1998-2004	Q	Positive
Panel B: Papers examining relationship between board size and firm performance				
Eisenberg et al. (1998)	879	1992-1994	ROA	Negative
Adams and Mehran (2005)	35	1986-1999		None
Guest (2009)	2,745	1981-2002	ROA, Q, ROE	Negative
Wintoki, Linck, and Netter (2012)	6,000	1991-2003	ROA, Q	None

Paper	Sample	Period	Performance Measure	Characteristics	Relationship

Panel C: Papers examining relationship between other board characteristics and firm performance

Fich and Shivdasani (2006)	508	1989-1995	ROA, MTB	Board Busyness	Negative
Adam and Ferreira (2009)	1,939	1996-2003	ROA, Q	Gender Diversity	Negative for well-governed firms
Darmadi (2013)	383	2007	ROA, Q	Education	Positive

Table 2. Summary statistics of board and firm characteristics

The table contains the sample characteristics of the board and firm characteristics of the firms used in the study. The results are based on a sample of 482 firms and 4,221 firm years selected every from 1999 to 2013. The firm characteristics come from ThompsonOne while board characteristics from BoardEx. Board size is the total number of directors on the board. Board independence is the percentage of directors who are not employees of the firm. MBA degree is the percentage of director with an MBA degree. Doctorate degree is the percentage of director with doctorate degree. Prestigious is the percentage of director attending universities/institutions classified as prestigious. Firm size is the market value of equity. Segments is the number of business segments the firm operates in, as reported by Thompson One. Debt is the ratio in percentage of long-term debt to total assets. RETSTD is the standard deviation of the firm's stock returns in the previous 12 months. Market-to-book is obtained as the value of equity plus book value of assets minus book value of equity minus deferred taxes, all divided by book value of assets. Values are shown in Mean, Median, 25th percentile and 75th percentile

	Mean	Median	25th percentile	75th percentile
Board Characteristic				
Board Size	11.82	11	8	15
Board Independence	0.77	0.8	0.67	0.87
Board Education				
MBA Degree	6.4%	0.00%	12.5%	42.8%
Doctorate Degree	28.3%	20.0%	12.5%	54.2%
Prestigious	37.9%	33.0%	25%	53.8%
Firm characteristic				
Firm size (million US dollars)	998	1,087	281	4,349
Segments	4	4	3	6
Debt (%)	17%	14%	2%	26%
RETSTD	19.03%	17.2%	2.16%	47.6%
Market-to-book	3.18	1.71	0.93	3.12
Return on Assets	4.46%	3.11%	0.617%	8.92%

Table 3. Summary statistics of changes in board characteristic variables

This table contains the summary statistics of changes in board size and board independence over any two-year period between 1999 and 2013. The results are based on a sample of 482 firms and 4,221 firm years selected every from 1999 to 2013. The firm characteristics come from ThompsonOne while board characteristics from BoardEx. Board size is the total number of directors on the board. Fraction of outsider is the percentage of directors who are not employees of the firm. MBA degree is the percentage of director with an MBA degree. Doctorate degree is the percentage of director with doctorate degree. Prestigious is the percentage of director attending universities/institutions classified as prestigious

	2001	2003	2005	2007	2009	2011	2013	2001-2013 Percent of firm year
Change in fraction of outsider	35.7%	38.96%	42.17%	43.28%	48.91%	53.11%	51.82%	45.27%
Change in Board size	16.67%	18.21%	27.27%	35.71%	31.16%	34.91%	43.22%	29.96%
Change in Doctorate%	27.49%	25.67%	31.88%	32.55%	23.07%	26.53%	28.61%	27.75%
Change in MBA %	59.44%	56.44%	61.29%	67.58%	61.84%	58.31%	52.18%	59.45%
Change in Prestigious %	17.77%	19.26%	19.6%	15.11%	21.41%	18.26%	17.55%	18.45%
Number of firm year	341	371	296	355	406	411	387	

Table 4. How many lags of firm performance are significant?

In this table, we report results from the OLS estimation of the model:

$$y_{it} = \alpha_1 + \sum_{p=1}^{p=6} k_p y_{it-p} + \kappa Z_{it} + \eta_i + \varepsilon_{it}, \ t = 2004, 2005, 2006, \ldots, 2013$$

y_{it} is ROA. Z_{it} includes firm size (LogMVE), market-to-book ratio (MTB), standard deviation of stock returns (RETSTD), number of business segments (LogSeg), and leverage (DEBT). The results are based on a sample of 482 firms and 4,221 firm years selected every from 1999 to 2013. The firm characteristics come from ThompsonOne while board characteristics from BoardEx. t-statistics are reported in parentheses. All t-statistics are based on robust, firm clustered standard errors. ***, * and * represent significance at the 1%, 5% and 10% level, respectively.

Dependent Variable	Performance ROA	Performance ROA
ROA_{t-1}	0.445***	
ROA_{t-2}	-0.139***	
ROA_{t-3}	0.278***	
ROA_{t-4}	-0.674***	
ROA_{t-5}	0.126	0.148***
ROA_{t-6}	-0.211	-0.392**
LogMVE	0.0074**	0.00765**
MTB	-0.0146***	0.0055***
RETSTD	-0.0017	-0.0017
LogSeg	-0.175***	-0.165***
Debt	-0.139**	-0.206**
R^2	0.367	0.225

Table 5. Relationship between board characteristic, firm-specific variables, and past performance

In this table we report the results of OLS regressions of current board size (LogBsize), independence (Indep), Board's education variables (Doctorate, MBA and Prestigious) and current firm-specific variables, on past performance and historic values of the firm-specific variables. Performance is measured by return on assets (ROA). The firm-specific variables include firm size (LogMVE), market-to-book ratio (MT B), standard deviation of stock returns (RETSTD), number of business segments (LogSeg), and leverage (Debt). The results are based on a sample of 482 firms and 4,221 firm years selected every from 1999 to 2013. The firm characteristics come from Thompson One while board characteristics from BoardEx. Panel A reports the results of the regressions in which the dependent variables are current levels. Panel B reports the results of the regressions in which the dependent variable is the change from t − 1 to t. All t-statistics are based on robust, firm clustered standard errors. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

Panel A: Dependent variable is level at time t

	MBA	Doctorate	Prestigious	Indep	LogBsize	LogMVE	MTB	RETSTD	Logseg	Debt
ROA_{t-1}	0.023***	-0.046***	0.03***	0.041**	-0.048**	0.35	-0.27***	5.95***	-0.077***	-0.012***
MBA_{t-1}		0.343**	-0.51***	-0.05	-0.584***					
$Doctorate_{t-1}$	-0.008		0.137***	0.0156	-0.102**					
$Prestigious_{t-1}$	-0.005	0.24***		-0.048	0.016					
$Indep_{t-1}$	0.158***	0.091	0.144**		-0.549***					
$LogBsize_{t-1}$	-0.039***	-0.176**	0.046	-0.33***						
$LogMVE_{t-1}$	0.0033**	0.04***	0.042***	0.044***	0.107***		0.356***	-0.876***	0.1***	0.006***
MTB_{t-1}	-0.005 ***	-0.11**	-0.0005	-0.015***	-0.01***	0.201***		-1.439	-0.02***	-0.0003
$RETSTD_{t-1}$	5.79e - 06	0.01***	-0.047***	-0.001***	-0.0004	0.007	-0.011		0.003	0.000003

$LogSeg_{t-1}$	-0.002	0.094**	-0.144***	0.039	0.181***	3.392***	-0.711	-15.51		-0.0081
$Debt_{t-1}$	0.115***	0.06	-0.059	0.067*	0.166**	4.284***	1.04	19.3	-0.449***	
R^2	0.36	0.57	0.46	0.39	0.18	0.11	0.16	0.22	0.27	0.09

Panel B: Dependent variable is change from t −1 to t

	ΔMBA	ΔDoctorate	ΔPrestigious	ΔIndep	ΔLogBsize	ΔLogMVE	ΔMTB	ΔRETSTD	ΔLogseg	ΔDebt
ROA_{t-1}	-0.004	-0.003***	0.005***	0.01**	0.015**	0.113**	0.131***	0.93	-0.277***	-0.014***
MBA_{t-1}		0.0912	-0.04	-0.015***	-0.026***					
$Doctorate_{t-1}$	-0.006**		-0.028***	-0.002	0.024***					
$Prestigious_{t-1}$	-0.005	-0.019		0.032***	-0.02***					
$Indep_{t-1}$	-0.005***	0.04***	-0.017		-0.063					
$LogBsize_{t-1}$	-0.018**	0.046**	-0.003***	-0.022***						
$LogMVE_{t-1}$	0.003**	-0.006**	0.002	0.001***	0.002		-0.044	0.108***	0.01***	0.004***
MTB_{t-1}	-0.0002	0.002	-0.001	0.0002	0.001	-0.016		0.09***	0.0008	-0.002
$RETSTD_{t-1}$	0.0005	0.00008	0.001**	0.001	-0.001***	0.006	0.009		0.00002	0.0003

$LogSeg_{t-1}$	0.0057***	-0.016	-0.0006	0.009	-0.01	0.237	0.48**	0.06		-0.016**
$Debt_{t-1}$	-0.008**	0.034	0.072**	-0.0062	0.031	0.866	1.38**	-0.96	0.12***	
R^2	0.26	0.28	0.18	0.09	0.26	0.08	0.31	0.22	0.18	0.08

Table 6. Does board characteristic adjust to past performance? Tests of strict exogeneity

In this table, we report results from the fixed-effects estimation of the model:

$$y_{i,t} = \alpha + \beta X_{i,t} + \Omega_{i,t+1} + \eta_i + \varepsilon_{it}, \qquad t=1999,2000,2001\ldots.2013$$

where W_{it+1} is a subset of forward values of the corporate governance and control variables, X. y is firm performance (ROA). X includes board size (LogBSIZE), board independence (INDEP), Board's education variables (Doctorate, MBA and Prestigious), firm size (LogMVE), market-to-book ratio (MTB), standard deviation of stock returns (RETSTD), number of business segments (LogSeg), and leverage (Debt). The results are based on a sample of 482 firms and 4,221 firm years selected every year (from 1999 to 2013). The board variable data come from BoardEX. The firm characteristics come from Thompson One. $\Omega = 0$ is the null hypothesis of strict exogeneity. All t-statistics are based on robust, firm clustered standard errors. *, ** and *** represent significance at the 1%, 5% and 10% level, respectively.

	1	2	3	4	5	6	7
MBA_t	-0.07	-0.075	-0.069	0.35	-0.095	0.228	0.24
$Doctorate_t$	0.482	0.48	-0.084	0.487	0.465	0.275	0.314
$Prestigious_t$	0.02	0.014	0.038	0.012	0.174	0.082	0.075
$Indep_t$	-0.076	-0.16	-0.038	-0.064	-0.058	-0.19	0.403
$LogBsize_t$	-0.504	-0.583	-0.547	-0.583	-0.565	-0.552	-0.464
$LogMVE_t$	0.11***	0.108***	0.102***	0.109***	0.109***	0.107***	0.031***
MTB_t	0.0014	0.001	0.002	0.002	0.0022	0.0028	0.016
$RETSTD_t$	0.002	0.0024	0.003	0.0026	0.002	0.0027	-0.001
$LogSeg_t$	0.18***	0.177**	0.175***	0.177***	0.17***	0.175***	0.16**
$Debt_t$	0.005	0.006	0.02	0.019	0.005	0.026	-0.156
MBA_{t+1}				-0.474***		-0.346**	-0.348**
$Doctorate_{t+1}$			-0.441***			-0.232	-0.21
$Prestigious_{t+1}$					-0.216	-0.216	-0.065

$Indep_{t+1}$		0.117				0.152	0.403
$LogBsize_{t+1}$	-0.108					-0.011	-0.14
$LogMVE_{t+1}$							0.08
MTB_{t+1}							-0.018**
$RETSTD_{t+1}$							0.004
$LogSeg_{t+1}$							ommitted
$Debt_{t+1}$							0.165
R^2	0.127	0.127	0.139	0.144	0.13	0.147	0.160

Table 7. The effect of board characteristic on current firm performance.

In this table, I report results from the estimation of the model:

$$y_{it} = \alpha_1 + \kappa_1 y_{it-1} + \kappa_2 y_{it-2} + \kappa_3 y_{it-3} + \kappa_4 y_{it-4} + \beta X_{it} + \gamma Z_{it} + \eta_i + \varepsilon_{it}, \quad t= 2003, 2004, 2005,\ldots,2013$$

y_{it} is return on assets (ROA) which is defined as operating income divided by assets. X_{it} includes board size (LogBsize), board independence (Indep), Board's education variables (Doctorate, MBA and Prestigious). Z_{it} includes firm size (LogMVE), market-to-book ratio (MTB), standard deviation of stock returns (RETSTD), number of business segments (LogSeg), and leverage (Debt). The results are based on a sample of 482 firms and 4,221 firm years selected every year (from 1999 to 2013). The board variable data come from BoardEX. The firm characteristics come from Thompson One. t-statistics are reported in parentheses. For the static models, it is assumed that $\kappa_1 = \kappa_2 = 0$. All t-statistics are based on robust, firm-clustered standard errors. ***, ** and * represent significance at the 1%,5% and 10% level respectively. AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen test of over-identification is under the null that all instruments are valid. The Diff-in-Hansen test of exogeneity is under the null that instruments used for the equations in levels are exogenous. The instruments used in the GMM estimation are: differenced equations: y_{it_5}, y_{it_6}, X_{it_5}, X_{it_6}, Z_{it_5}, Z_{it_6}, ΔDit ; level equations: Δy_{it_5}, ΔX_{it_5}, ΔZ_{it_5}, D_{it} .

	Static Model		Dynamic Model	
Dependent Variable ROA	Pooled OLS	Fixed Effects	Pooled OLS	System GMM
MBA	0.182	0.606**	0.012	-0.02
Doctorate	0.377***	0.227***	0.193	0.06
Prestigious	0.013	0.081	0.012	0.0055
Indep	0.45**	0.63	0.23	0.25
LogBsize	-0.45***	-0.193	-0.026	-0.175
LogMVE	0.134***	0.093***	0.017***	-0.0001
MTB	-0.043***	-0.029***	-0.001***	-0.019
RETSTD	0.00007	0.0023	-0.0022	0.00067
LogSeg	0.123	0.046	-0.15***	0.185
Debt	-0.089	-0.26	-0.124	-0.27
ROA_{t-1}			0.4***	0.518**

ROA_{t-2}			-0.147***	-0.0078
ROA_{t-3}			0.27***	0.341
ROA_{t-4}			-0.63***	0.095
R^2	0.21	0.39	0.47	
AR(1) test (p-value)				0.559
AR(2) test (p-value)				0.726
Hansen test of over-identification (p-value)				1
Diff-in-Hansen tests of exogeneity (p-value)				1

Table 8. First stage regression and for System GMM estimates

In this table, I report the F-statistics and R^2s of OLS first-stage regressions of levels and first-differenced variables on lagged differences and lagged levels respectively. The variables are board size (LogBsize), board independence (Indep), Board's education variables (Doctorate, MBA and Prestigious), firm size (LogMVE), market-to-book ratio (MTB), standard deviation of stock returns (RETSTD), number of business segments (LogSeg), and leverage (Debt). The results are based on a sample of 482 firms and 4,221 firm years selected every year (from 1999 to 2013). The board variable data come from BoardEX. The firm characteristics come from Thompson One. For the levels variables (X), the dependent variables are: $\Delta LogBsize_{t-5}$, $\Delta Indep_{t-5}$, ΔMBA_{t-5}, $\Delta Prestigious_{t-5}$, $\Delta Doctorate_{t-5}$, $\Delta LogMVE_{t-5}$, ΔMTB_{t-5}, $\Delta RETSTD_{t-5}$, $\Delta Logseg_{t-5}$, $\Delta Debt_{t-5}$, ΔROA_{t-5}; year, firm and industry dummies. For the first-differenced variables (ΔX), the dependent variables are: MBA_{t-5}, $Prestigious_{t-5}$, $Doctorate_{t-5}$, $LogBsize_{t-5}$, $Indep_{t-5}$, $LogMVE_{t-5}$, MTB_{t-5}, $RETSTD_{t-5}$, $LogSeg_{t-5}$, $Debt_{t-5}$, ROA_{t-5}, year and firm and industry dummies.

	F-statistic	P-value	R^2
MBA	24.71	0.00	0.062
Doctorate	43.48	0.00	0.11
Prestigious	19.67	0.00	0.054
Indep	63.14	0.00	0.19
LogBsize	9.61	0.00	0.026
LogMVE	19.76	0.00	0.057
MTB	29.80	0.00	0.094
RETSTD	18.88	0.00	0.056
LogSeg	55.12	0.00	0.15
Debt	40.31	0.00	0.12

	F-statistic	P-value	R^2
ΔMBA	0.182	0.00	0.04
ΔDoctorate	22.08	0.00	0.032
ΔPrestigious	21.14	0.00	0.031

ΔIndep	65.48	0.00	0.11
ΔLogBsize	21.77	0.00	0.036
ΔLogMVE	52.72	0.00	0.086
ΔMTB	48.11	0.00	0.073
ΔRETSTD	19.40	0.00	0.028
ΔLogSeg	47.53	0.00	0.071
ΔDebt	31.39	0.00	0.044

Table 9. The effect of lagged board characteristic on current firm performance

In this table, I report results from the estimation of the model:

$Y_{it} = \alpha_1 + \kappa_1 y_{it-1} + \kappa_2 y_{it-2} + \kappa_3 y_{it-3} + \kappa_4 y_{it-4} + \beta X_{it-2} + \gamma Z_{it-2} + \theta D_{it} + \eta_i + \varepsilon_{it},$ t=2003, 2004, 2005,….,2013

y_{it} is return on assets (ROA) which is defined as operating income divided by assets. X_{it} includes board size (LogBsize), board independence (Indep), and Board's education variables (Doctorate, MBA and Prestigious). Z_{it} includes firm size (LogMVE), market-to-book ratio (MTB), standard deviation of stock returns (RETSTD), number of business segments (LogSeg), and leverage (Debt). D_{it} includes year dummy, industry dummy and sector dummy. The results are based on a sample of 482 firms and 4,221 firm years selected every year (from 1999 to 2013). The board variable data come from BoardEX. The firm characteristics come from Thompson One. t-statistics are reported in parentheses. For the static models, it is assumed that $\kappa_1 = \kappa_2=0$. All t-statistics are based on robust, firm-clustered standard errors. ***,** and * represent significance at the one percent, 1%, 5% and 10% level, respectively. AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen test of overidentification is under the null that all instruments are valid. The Diff-in-Hansen tests of exogeneity is under the null that instruments used for the equations in levels are exogenous. The instruments used in the GMM estimation are: differenced equations: y_{it-5}, y_{it-6}, X_{it-5}, X_{it-6}, Z_{it-5}, Z_{it-6}, ΔD_{it}; level equations: Δy_{it-5}, ΔX_{it-5}, ΔZ_{it-5}, Δ_{it}.

Dependent variable (ROA(t))	Pooled OLS	System GMM
MBA_{t-2}	-0.29	-0.15
$Doctorate_{t-2}$	0.17	0.075
$Prestigious_{t-2}$	0.074	0.01
$Indep_{t-2}$	0.78	0.15
$LogBsize_{t-2}$	-0.49	0.014
$LogMVE_{t-2}$	0.129	0.004
MTB_{t-2}	-0.115	-0.0008
$RETSTD_{t-2}$	0.0005	-0.0006
$LogSeg_{t-2}$	0.088	0.023
$Debt_{t-2}$	-0.28	-0.029
ROA_{t-1}		0.416***

ROA_{t-2}		-0.172
ROA_{t-3}		0.251
ROA_{t-4}		0.181
R^2	0.14	
AR(1) test (p-value)		0.226
AR(2) test (p-value)		0.312
Hansen test of over-identification (p-value)		1
Dif-in-Hansen tests of exogeneity (p-value)		1

Robust, but weakened by many instruments.