

Us Knows Us in the UK: On Director Networks and CEO Compensation

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Abstract

We analyze the relation between CEO compensation and networks of executive and non-executive directors for all listed UK companies over the period 1996-2007. We examine whether networks are built for reasons of information gathering or for the accumulation of managerial influence. Both indirect networks (enabling directors to collect information) and direct networks (leading to more managerial influence) enable the CEO to obtain higher compensation. Direct networks can harm the efficiency of the remuneration contracting in the sense that the performance sensitivity of compensation is then lower. We find that in companies with strong networks and hence busy boards the directors' monitoring effectiveness is reduced which leads to higher and less performance-sensitive CEO compensation. Our results suggest that it is important to have the 'right' type of network: some networks enable a firm to access valuable information whereas others can lead to strong managerial influence that may come at the detriment of the firm and its shareholders. We confirm that there are marked conflicts of interest when a CEO increases his influence by being a member of board committees (such as the remuneration committee) as we observe that his or her compensation is then significantly higher. We also find that hiring remuneration consultants with sizeable client networks also leads to higher CEO compensation especially for larger firms.

Keywords: Executive remuneration, Professional and social networks, Corporate governance, Managerial Power, Remuneration consultants.

JEL Classifications: G3, J3, L14

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Introduction

“The strength of a wide-band professional network is that it gives access to deep and tacit knowledge across a range of areas that you could never hope to touch, understand or gain access to.” (Mick Cope)

“The practice of interlocking directorates is the root of many evils. It offends laws human and divine.” ... “Applied to corporations which deal with each other it tends to disloyalty and to violation of the fundamental law that no man can serve two masters. In either event it tends to inefficiency; for it removes incentive and destroys soundness of judgment. It is undemocratic for it rejects the platform: ‘A fair field and no favors’ ” (Louis Dembitz Brandeis)¹

Social and professional networks govern our lives; they are established through education, sports interests, club memberships, as well as connections resulting from our professional activities. The economics and finance literature has begun to pay more attention to the influence of managers’ and non-executive directors’ connections on corporate decision making and monitoring. Indeed, the effectiveness of corporate governance and corporate decision making may be significantly affected by formal and informal professional and social networks. For instance, Seidel, Polzer and Stewart (2000) document the strong impact of social ties on wage negotiations of minorities. The discriminating effect against minorities in the recruiting process of US high-tech companies is substantially lower when individuals belonging to minorities are referred to the firm by a friend or relative working in that firm. Educational networks of mutual fund managers influence their investment decisions as they are more likely to invest in firms managed by people who have studied at the same university (Cohen, Frazzini and Malloy, 2008a). These investments in ‘connected’ firms perform better. Cohen, Frazzini and Malloy (2008b) also document the impact of sell-side analysts’ social networks on their ability to collect superior information. They find that analysts perform better in terms of their stock recommendations if they have educational connections with companies’ directors. Hochberg *et al.* (2007) conclude that venture capital (VC) funds’ performance is positively affected by the influence of the network positions enjoyed by the VCs’ parent firms. In contrast, networks may also have a detrimental effect on decision making. For instance, Kuhnen (2009) studies the effect of the professional networks of US mutual funds’ directors on their decisions on the hiring and contracting of fund advisors. If a candidate fund advisor is connected to the fund’s director through past business relationships, he/she is more likely to be appointed and paid a higher management fee. The fact that the returns of funds with advisors connected to the board of

¹ Brandeis was Associate Justice on the US Supreme Court and made this statement before the passing of the Clayton Act (1914) which prohibited extensive director networks as these could lead to collusion in concentrated industries. The quote appeared in the US House of Representatives Staff Report to the Antitrust Committee (1965:3).

directors are significantly lower than the returns on funds without such connections suggests that networks can bring about agency costs.

This paper examines the role of director networks on the top manager's compensation and the pay-setting process in the UK. It is important to note that we will use the UK definition of a director who can be either an executive or a non-executive director.² Over the past 15 years, executive compensation (around the world) has increased substantially at a pace significantly above inflation. Since the financial crisis that commenced in 2007, undeniable excesses in the remuneration policies have become manifest. When the S&P 500 stock index fell by 37.6% in 2008, 75% of the CEOs in the 2700 largest US companies received remuneration increases. Even in companies at the brink of bankruptcy, departing CEOs managed to enjoy huge severance packages. One example is Angelo Mozilo who was the CEO of Countrywide Financial that was saved by the Bank of America in June 2008, and was given \$188 million as a send-off package. The UK situation is similar: in 2009, large companies including Marks & Spencer and HSBC generously increased their CEOs' pay. In spite of academic doubts about the efficiency of the remuneration contract design (Bebchuk and Fried, 2003), the public debate on top management remuneration only flares up in times of crises such as the corporate governance/accounting disclosure crisis of 2000-2003 and the recent financial crisis. Each time, the top management remuneration practices are blamed to provide flawed incentives and to induce short-sighted corporate strategies (Hill, 2006). Curbing these remuneration practices proves to be difficult as soon as the outrage tones down. The arguments from the industry against curtailing managerial pay are usually that attracting talent necessitates adequate compensation as firms would otherwise lose their competitive edge. *"We're a very big bank, we employ 200,000 people around the world [...]. We have obviously got to pay our people appropriately. I think our customers will appreciate that people deserve a fair wage"* (HSBC gives its fat cats £ 1.6 billion bonuses, 2010 (Guardian)). This is indeed the key question: is it the competitive market for managerial talent that sets the compensation contract or is the contracting process hijacked by the executive directors? In order to provide a (partial) answer this question, we study whether managerial pay and the pay-for-performance sensitivity is affected by professional networks, while controlling for the traditional explanations such as shareholder control and board composition.

Networks may be valuable to the firm for the following reasons: first, connections with (peer) companies through directorships enable a firm to gain access to information, even prior to its public disclosure. Such information is especially valuable when a firm is planning strategic alliances, mergers or acquisitions, or is expanding into new markets. Early notice of critical business changes allows the company to reconsider and adjust their own strategy in time. Furthermore, directors with strong networks

² Executive directors are members of the board and exert a senior management position in the company (in the US, they would usually be called officers). The non-executive directors (in the US often called directors) are board members who are not involved in the daily management; they often are managers in other firms.

are or develop into reputable figures in the society with access to politicians, employers' organizations, and regulators. A network may also reflect managerial talent and a director's past success in other firms. Thus, a large network reflects information, reputation and experience, and can be regarded as a guarantee of an executive director's quality. For these reasons, directors' connections may be valuable for a firm and translate into higher compensation and/or a different compensation contract structure. Key is that the value of a director to a company depends on the *informational advantage* generated by these connections, which allows a company to increase the compensation of its better connected executive and non-executive directors. The examples on pay excesses given above suggest that remuneration contracting is not necessarily a means to reduce agency problems but may be an agency problem itself if the remuneration contracting process is controlled by top management. Networked executive directors may *accumulate power* and establish a stronger negotiation position vis-à-vis the board (and the remuneration committee) such that they are able to design compensation packages that are beneficial to themselves but not to their corporations.

While some recent papers, such as Barnea and Guedj (2009) and Horton *et al.* (2009), relate pay to networks, our paper contributes to the literature in the following ways. First, we distinguish between the different roles of networks: managerial influence accumulation and information collection. Second, we separately study the strength of networks at the *individual* director level and at the *company* level, which are often mixed in the existing literature. Third, in addition to degree and (normalized) closeness, the network measures most frequently utilized in the network literature, we also employ (normalized) eigenvector centrality and (normalized) betweenness to capture different aspects of networks. Fourth, whereas most papers on networks employ cross-sectional data or data on a subset of companies (which may de facto invalidate network measurement), we have gathered a large data panel consisting of virtually all listed UK companies for a 12 year period (1996-2007), amounting to 13,854 firm years. Fifth, we control for the role of networks of remuneration consultants in the pay-setting process as well as internal and external corporate governance devices (shareholder voting concentration, board structure and composition, CEO characteristics, and corporate performance).

Our empirical analysis generates these insights. First, the network measures that are proxies of managerial influence explain higher CEO compensation and lower pay-for-performance sensitivity. Network measures that capture access to information and resources valuable to the firm are related to larger CEO remuneration, but do not have any impact on the pay-for-performance sensitivity. We demonstrate that managerial influence derived from networks has a stronger impact on compensation than the information value of networks. Second, at the company level, we use network measures to test the busy board hypothesis. Our results are in line with the hypothesis that companies with strong direct connections (which signifies that these directors are active in other firms and may hence be less effective monitors of the firm) over-pay their CEOs. Companies with networks yielding better information access

pay out a lower compensation to their CEOs, as they may rely less on the individual network of the CEO. Third, we confirm that there are marked conflicts of interest when a CEO is a member of board committees (such as the remuneration committee) because his or her compensation is then significantly higher. Fifth, the size of the client network of remuneration consultants increases CEO compensation, especially in large firms.

This paper is organized as follows. In Section 2, we discuss the literature and formulate the hypotheses. We describe in Section 3 how networks are captured and calculate the centrality measures. We discuss the methodology in Section 4 and summarize the descriptive statistics. In Section 5, we explain the results, while we discuss the robustness checks in Section 6. Section 7 concludes.

2. The Literature and Hypotheses

2.1 Director Networks and CEO Compensation

The optimal remuneration contracting view has been challenged by the rapid increase in managerial compensation and the lack of pay-for-performance sensitivity (Jensen and Murphy, 1990). A CEO can influence his remuneration contract when he holds a powerful position on the board, when directors are on each others' remuneration committees which could lead to collusion, when non-executive directors are nominated by a dominant CEO, and when shareholder ownership concentration (and hence outside monitoring) is weak. We study this managerial power/influence (Bebchuk, Fried and Walker, 2002) or skimming (Bertrand and Mulainathan, 2001) view on compensation contracting, and focus – while controlling for shareholder control (Mehran, 1995) and board effectiveness (Yermack, 1996) – on the relation between executive and non-executive directors' networks and the CEO's compensation structure.

A CEO's network grows stronger when he accepts more external directorships (Conyon and Read, 2004). Such a network can be used to extend the CEO's power which could enable him to influence board decision-making to his own benefit. We label the connections built for the purpose of accumulating managerial discretion as *managerial influence*-oriented connections. Networks do not only increase a director's influence but they also bring additional skills, knowledge, and information to the company, which may lead to corporate governance and performance improvements. Connections maintained for the sake of information collection are referred to as *information value*-oriented connections. Although most studies do not distinguish between the two functions of director networks, we use different types of centrality measures to describe a network's different functions. Centrality measures that capture the level of connectedness in the local region based on adjacent connections are called the *direct centrality measures* and are proxies for managerial influence (although they also yield information). We call the centrality measures that enable us to analyze a director's position in the entire network by means of his

distance to all other directors *indirect centrality measures*. They are used to evaluate the information value-oriented networks. It is important to understand that managerial influence and information collection are two aspects of the same network. These two functions are not exclusive; direct measures expressing managerial power or influence also capture information collection ability that could benefit the company. Nonetheless, the correlation between the direct and indirect centrality measures is low (see Section 3). This suggests that direct and indirect measures do indeed capture different aspects of the network which necessitates a separate analysis.

The (normalized) direct centrality measures are degree and eigenvector centrality which capture the power of the directors (for calculation details, see Section 3). Our *managerial influence hypothesis* (hypothesis 1) states that: *CEOs whose network consists of many direct connections can exert more managerial influence which is reflected in higher total compensation with low performance sensitivity*. The value of the ‘managerial influence’ networks declines in the presence of a board with more non-executive directors and of stronger shareholder power.

Guedj and Barnea (2009) show that the CEO’s compensation augments with network size. This result supports their reputation hypothesis: when directors are connected, they relax their monitoring of the CEO, which leads to CEO compensation increases. This is also in line with the essence of the managerial influence argument. Brown *et al.* (2009) broaden the professional network by also considering connections through education and social activities (golf club, charity organizations, etc). They find a positive relation between a CEO’s social network centrality and his total compensation, and an inverse relation between centrality and pay-for-performance sensitivity. Larcker *et al.* (2006) present an analysis with new director network measures which distinguish between friendly links and independent connections. They show that short friendly links are positively related to CEO compensation but negatively related to operating performance. This finding is also in line with the managerial influence hypothesis.

Director networks can have many advantages at the level of information collection. Early access to information can give a company a competitive advantage. Such networks may enable firms to develop more effective corporate strategies. In the managerial labour market, companies would hire or pay more to directors with networks of higher information value. The level of connectedness in terms of information transfers can be measured by indirect centrality measures: (normalized) closeness and betweenness. Once information emerges and spreads along the paths in director networks, a director with a high normalized closeness and betweenness has a higher probability of receiving this information (for calculation details, see Section 3). Our *information-value hypothesis* (hypothesis 2) states that: *CEO compensation increases with his access to information, which is proxied by his indirect network centrality based on his distance to other directors and his position in the entire network. The value of this information-network is reflected in higher compensation and a higher pay-for-performance sensitivity*.

Crespi-Cladera and Pascual-Fuster (2008) analyze the correlation between executive directors' pay and networks in Spanish electronics companies and provide evidence that CEO compensation reflects the information-collection value of networks. Likewise, Horton et al. (2009) find that executives' network centrality is positively associated with their compensation. Executive directors seem to be rewarded for the resources they bring to a firm through their networks, while non-executive directors whose connections are more locally constrained earn a higher fee since their isolation may be perceived as an indication of their independence and superior monitoring capabilities.

Besides the individual level network measures, we also build networks at the company level where companies are vertices in the graph and shared directors are links between companies. The next two hypotheses on director networks evaluate the effects of managerial influence and information value from the perspective of the company rather than the CEO. In the literature on networks at the company level, it is argued that if a company has a strong network, it may be managed less well because non-executive directors have less time to monitor their firm and executive directors' focus is dispersed (Fich and Shivdasani, 2006; Malmendier and Tate, 2009). Consequently, the governance of companies with many direct links may be deficient and may lead to a non-optimal compensation contracts. Hallock (1997) demonstrates that CEOs of interlocked companies earn on average a significantly higher monetary compensation than the non-interlocked ones and concludes (as do Fich and White, 2002) that board interlocks harm corporate governance efficiency and result in higher CEO compensation. We therefore formulate the *busy board/managerial influence hypothesis* (hypothesis 3) at the company level: *In companies with strong networks based on direct links, CEOs' total compensation is higher with a lower pay-for-performance sensitivity.*

If the company as a whole has good access to information throughout its directors' networks based on indirect links and hence does not depend on the CEO's network alone, there is less need to remunerate the CEO for his network. The company can then reward the CEO solely more for performance improvements. Therefore, we formulate the *information value hypothesis* (hypothesis 4) at the company level: *The information collection efficiency as measured by indirect centrality at the company level negatively affects the size of the CEO compensation package and improves the pay-for-performance sensitivity.*

2.2 Controlling for Other Determinants of CEO Compensation

CEO compensation may not only be influenced by networks but also by corporate performance, the role of remuneration consultants, CEO characteristics such as tenure, board composition, ownership concentration by shareholder type, and some other characteristics including firm size, risk, or industry.

Remuneration consultants

Remuneration consultants have the best access to information on current remuneration practices and are influential in setting the remuneration policy of large firms. Through its remuneration consultant, firm A may gain access to the remuneration practices in its peer companies. The impact of a remuneration consultant on the remuneration policy of firm A can be twofold. A sudden increase in the remuneration in firm B belonging to a remuneration consultant's network of clients may be quickly copied by the other clients (including A) of the consultant who hence spreads the information on the raising of the remuneration benchmarks. In contrast, remuneration consultants may advise that remuneration packages be based on objective standards and benchmarks that attenuate the upward spiral in compensation. Recent analyses seem to support that remuneration consultants are driving compensation up: Conyon, Peck and Sadler (2009), who investigate compensation consultants and executive pay in the US and the UK, conclude that CEO compensation is indeed larger and includes more equity-based compensation when a remuneration consultant is hired. Kabir and Minhat (2010) go one step further and report that CEOs' equity-based compensation in the UK linearly increases with the number of remuneration consultants a firm hires. Moreover, the larger the consultant's market share is, the higher the CEOs' remuneration in the firms they advise. The authors conclude that competition between remuneration consultants leads to significantly higher executive compensation. We therefore expect a larger remuneration consultant network to contribute to higher CEO compensation.

CEO characteristics

A CEO with longer *tenure* is likely to obtain a higher remuneration package to compensate him for his company-specific human capital. Furthermore, his long experience may also make him more competitive on the managerial labour market (Murphy, 1986). A CEO with long tenure may be more entrenched and thus have more influence on his remuneration. This will be especially the case if he has a longer tenure than most of the non-executive directors on the board and if he serves on the compensation committee. We use CEO's *tenure* and *age* to proxy for his overall experience (possibly acquired in several companies). Thus, we expect that older CEOs and CEOs with longer tenure receive higher pay.

Only rarely, women are leading listed companies: *female* top managers occupy only 3-5% of the (executive) board seats in listed US and UK firms. Apart from evidence of the existence of a glass ceiling, women managers also seem to be discriminated against in terms of salary. For instance, Bertrand and Hallock (2001) find that female top executives are earning 45% less than their male colleagues in large American companies. Kulich *et al.* (2011) confirm that only 3% of the executive board members are female in all listed UK firms and receive lower compensation than their male counterparts. In addition, compensation contracts of female managers are less performance-sensitive than those of male executives: female managers' remuneration packages have less upward potential in case of good corporate

performance, but they lose less in case of poor performance. Therefore, we expect that the total compensation of female CEOs is lower than that of male CEOs, even under similar performance.

Although *combining the functions of CEO and chairman* of the board is discouraged in the UK Corporate Governance code, we still find many such cases though predominantly in small and medium-sized companies. We expect that the CEO who also assumes the tasks of chairman receives a higher remuneration to compensate him for the additional tasks but also because this CEO will be in a more powerful position vis-à-vis the other (non-executive) directors (Conyon and Peck, 1998). The conflicts of interest even augment when the CEO is also a *member of the nomination committee* which allows him to appoint friends as new board members or when he is a *member of the remuneration committee*. We also control for the *notice period* included in the CEO's employment contract, and we expect that a longer notice period lowers the level of total compensation.

Board characteristics

Board composition has often been considered as one of the critical measures of corporate governance effectiveness. A high *proportion of non-executive directors, separation of the roles of CEO and chairman*, and the creation of *committees* are expected to be important to turn the board into an effective governance device. Core, Holthausen and Larcker (1999) confirm their hypothesis on the negative relation between CEO pay and board independence. More recent research on the US by Chhaochharia and Grinstein (2009) indicates that CEO compensation decreases in firms that comply with the new and stricter board structure regulations imposed on listed firms by the NYSE and NASDAQ in 2002-03. If a company has a larger percentage of non-executives on the board, we expect that CEO compensation can be restrained and that there is a stronger pay-for-performance sensitivity. Nonetheless, the effectiveness of the board has not always been satisfactory. For instance, Franks, Mayer and Renneboog (2001) find that non-executives seem to support the executive directors in the UK even in the wake of poor performance. If a company has a larger percentage of non-executives on the board, we expect that CEO compensation can be restrained and that there is a stronger pay-for-performance sensitivity.

Share stake concentration

A key aspect of corporate governance is the monitoring role exerted by major shareholders (Core et al., 1999). *Executive directors owning shares* in their firm have incentives that are more aligned with those of the other shareholders. Therefore, executive ownership may lead to more modest compensation packages. Less excessive compensation and a higher pay-for-performance sensitivity will arise in the presence of *major share blocks held by non-executive directors* (whose fiduciary obligations to monitor are now enhanced by stronger voting power) and *by outside shareholders* such as corporations,

and individuals and families whose voting power incentivises them to be active monitors. Given that the vast majority of institutional investors are rather passive monitors, we expect their presence to have little effect on CEO compensation.

Firm characteristics

Company size has been shown to explain most of the cross-sectional variation in total managerial compensation (Murphy, 2000; Core *et al.*, 1999). Larger companies pay their CEOs substantially more than medium-sized and small companies as it takes specific (and rare) managerial talent to lead large corporations, which also entails larger responsibilities. Therefore, we also expect that CEO compensation increases with firm size.

Including *corporate performance*-related incentives in the remuneration contracts is key in the classic principal-agent framework (Grossman and Hart, 1983). However, neither accounting nor stock market performance measures are perfect benchmarks. The former are backward looking and are liable to manipulation by the management in order to augment their bonus (Healy, 1985; Bergstresser and Philippon, 2006). Using stock prices as the yardstick has the advantage that one concentrates on (future) value creation, but can induce a myopic focus on the short term. Frequent overvaluation and undervaluation due to market sentiment may enable the management to take decisions that cater to this sentiment whilst aiming at maximizing their variable pay. We will include both accounting and stock performance measures in our models. Bertrand and Mullainathan (2001) and Renneboog and Trojanowski (2005) show that the benchmarks chosen in the remuneration contracts depend on the relative power of the management. Managers without principals prefer accounting benchmarks, and are frequently not remunerated for their intrinsic qualities but are paid for luck. In this study, we expect that the CEO's total compensation, salary, bonus, and equity-based compensation are sensitive to the company's performance, measured by both accounting and stock market performance.

It may take a CEO with specific human capital to manage a firm with a high level of *riskiness*. A risk-averse CEO may demand higher remuneration or a low pay-for-performance relation embedded in the contract to compensate him for managing a firm with more volatile cash flows or with a higher probability of financial distress.

3. Capturing Networks

3.1. The Network Definitions

To quantify directors' networks, we resort to several graph-theoretical measures. Figure 1 depicts the director network surrounding Andy Hornby, the CEO of HBOS plc, a banking and insurance company. Directors in HBOS plc are the dark grey circles at the right bottom corner. In 2006, Andy

Hornby was also a non-executive director in the life assurance and unit trust company St. James's Place plc, and in the retail companies GUS plc and Home Retail Group plc. This example is a fragment of a complete director network whereby a director is denoted by a *vertex* (or node). A connection between two vertices is called *link* (or edge, tie). The system of these vertices and links is a *graph* (or map). As links between two vertices are established when two directors are sitting on the same board, Andy Hornby's four directorships create connections with 38 directors. Besides Andy Hornby, HBOS and St. James's Place share two more directors: Dawson and Crosby. Jo Dawson was an executive director in HBOS and a non-executive director in St. James's Place. James Crosby was the CEO in HBOS before Andy Hornby. Similarly, GUS and Home Retail Group shared three directors: Stocken, Coombe and Duddy. Oliver Stocken was a non-executive director in GUS and chairman of the board in Home Retail Group. John Coombe was a non-executive director in GUS and senior nonexecutive director in Home Retail Group. Terry was an executive director in GUS and the CEO in Home Retail Group. A sequence between two vertices, visiting no vertices more than once, is called a path. In the above graph, multiple paths exist between John Peace and Richard Ashton. For example: Peace – Duddy – Ashton, Peace – Stocken – Ashton, Peace - Coombe – Hughes – Ashton and etc. The length of a path is the number of links it comprises and a *geodesic path* is the shortest path between two vertices (which is not necessarily unique). In the above example, both Peace – Duddy – Ashton and Peace – Stocken – Ashton are geodesic paths between Peace and Ashton.

[Insert Figure 1 about here]

3.2 Measures of Centrality

In order to illustrate the calculation of various centrality measures, we construct a hypothetical network with six companies and ten directors. In Panel A and the figure of Appendix B, the numbers refer to firms and letters stand for directors. In order to compute the centrality measures, we record the network into a symmetric matrix, where 1 denotes a link between the two directors (Panel B). This matrix enables us to calculate the centrality measures (Panel D). The degree and eigenvector centrality measures focus on direct (local) connections in order to assess the managerial influence. Measures of indirect connections such as closeness and betweenness are used to capture the information collection ability.

The *degree* centrality of a vertex is calculated as the number of links held by that vertex. In the above example, the number of links – the degree centrality - for director a is 6. Panel A shows that director a is connected to 2 directors in company 3 and 4 directors in company 5. Note that since degree counts the connections between the CEO and the other board members in her company, this measure could be affected by factors influencing board size. However, as the board size in our sample does not differ much across firms, most of the variation in the degree measure is caused by the connections gained from external directorships.

Eigenvector centrality of vertex v ($C_E(v)$) is equal to the sum of all adjacent vertices' eigenvector centrality scores:

$$C_E(v) = \frac{1}{\lambda} \sum_{j=1}^N A_{v,j} C_E(j)$$

This calculation process begins with assigning score 1 to all the vertices. At each iteration, the score of vertex v is calculated as the sum of all adjacent vertices' scores received in the previous iteration. In the above formula, matrix A is an $n \times n$ matrix with elements (v, j) and (j, v) equal to 1 if vertex j is adjacent to the target vertex v . Therefore, the centrality score for each vertex evolves after every iteration. The factor λ is to make sure that the centrality scores converge rather than explode after many iterations. The advantage of eigenvector centrality over other centrality measures is that it not only captures how many vertices are linked to the target vertex (as degree centrality does), but also includes the centrality of those adjacent vertices. Hence, a vertex will have a higher eigenvector centrality score if it is connected to more vertices with higher centrality scores.

The farness of a vertex is defined as the sum of geodesic distances between this vertex and all other vertices that can be reached. We transform the matrix of Panel B into the geodesic distance matrix by replacing all the zeros by the geodesic distance (Panel C). According to this definition, a higher farness value indicates that the vertex is further from other vertices. In order to define *closeness* (and normalized closeness), we calculate the inverse of the sum of all geodesic paths from vertex v to any other vertex t :

$$C_c(v) = \frac{1}{\sum d_G(v,t)}$$

In this formula, the closeness centrality of vertex v ($C_c(v)$) is equal to one divided by the sum of the lengths of geodesic paths (d_G) from v to any other vertex t . A high closeness value reflects the shorter distance to all other vertices, which suggests that the target vertex is more central in the network. The normalized closeness is defined by the following formula where n is the number of vertices in the graph.

$$C'_c(v) = \frac{100(n-1)}{\sum d_G(v,t)}$$

A higher normalized closeness score implies a shorter distance to other vertices, in which case the CEO is able to acquire the information faster. The closeness measure is defined over all the connected vertices in the graph (which entails that all isolated vertices do not have a closeness measure).

The *betweenness* of vertex v is defined as the sum of its betweenness ratios. A betweenness ratio is the number of geodesic paths from vertex s to vertex t passing through vertex v , divided by the number of geodesic paths from s to t . In the above example, no geodesic path needs to pass director c ,

therefore his betweenness score is zero. Geodesic paths between director c and all the other directors need to pass director b, which leads to the high betweenness score of director b. In formula form, this is:

$$C_B(v) = \sum_{\substack{s \neq v \neq t \in V \\ s \neq t}} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

where the denominator is the number of geodesic paths from vertex s to vertex t, the numerator is the number of geodesic paths from s to t with target vertex v on the geodesic paths. A high betweenness score of a CEO signifies that he has a ‘brokerage position’ between some otherwise separated groups. In the above example, director b would be the first person to know any information generated by director c. Such advantageous position is reflected in a high betweenness score.

One may argue that direct connections bring in information as well. This is true but direct centrality measures may be inferior to indirect ones in terms of quantifying information collection efficiency. For instance, directors with numerous direct connections in an isolated corner of the whole network can hardly receive information as quickly as directors in the centre of the network (even with fewer direct connections). Moreover, as suggested by Granovetter (1973), information from direct connections is likely to be of lower quality than that from distant connections, because directly connected individuals tend to have redundant (similar) information sources. Therefore, the indirect centrality measures are better proxies of the information collection efficiency of a CEO’s network. Panel D in Appendix B presents the different centrality measures for the directors in the above example.

To calculate network centrality at the company level, each company is considered as a vertex in the graph and two companies are linked if they share at least one common director. Once the graph of the company level network is drawn, the centrality calculation proceeds similarly to that at the director level. More specifically, the degree centrality of a company is the number of other companies it connects to through director interlocks. The closeness of a company measures how close it is to all the other reachable companies.

3.3 Sample Description: Director Networks

The degree measure for an average UK CEO is 10 with the median value of 8 (Panel A, Table 1). When we turn to the centrality scores of Andy Hornby, who has been the central director in the example shown in section 3.1, we find that he is much better connected than the average CEO in terms of direct links (38 direct links). It is safe to argue that the CEOs such as Andy Hornby with a large number of connections in adjacent companies have more managerial power on the board. However, a strong network based on direct links does not necessarily imply a strong position in the information collection networks. The normalized closeness measure for Andy Hornby is 0.05, which is slightly lower than the average and median level among the UK CEOs (0.054 and 0.052 respectively). Hence in this example,

although Andy Hornby is very active in networking, his network does not grant him better information collection ability.

Over time, the level of connectedness decreases, possibly due to more strict regulation³ on the maximum number of directorships the CEO can hold. Table 1 also exhibits that the CEOs of the largest corporations are significantly better connected than those leading FT Small Caps or FT fledglings.

[Insert Table 1 about here]

We now turn to networks on the company level: the average company has 4 interlocks with a median of 3 (Panel B, Table 1). All centrality measures indicate that the connectedness of British companies increased slightly at the beginning of our sample period (1996-1999), then remained stable until 2004 when a slight decline in the degree of connectedness commences. When we partition the sample companies according to size as reflected by index membership (FTSE 100, FTSE 250, FTSE Small Cap, and FTSE Fledging), we observe that larger firms have more direct links (degree) and are more closely related to other companies. The eigenvector centrality measure shows that FTSE 100 companies are in more important network positions than FTSE 250 firms, Small Caps and Fledglings. Lastly, the betweenness measures indicate that larger firms are more likely to be on any geodesic path in the graph, which implies that they are occupying the important network junctions.

The network differences between sectors are remarkable. On average, companies from the financial, IT, and medical sectors are more connected than the other sectors. However, networks have different structural features. In the financial sector, most companies are connected with each other within a large component (including 75 companies), and only a few smaller isolated coalitions exist (See Figure 2a). In the IT industry (Figure 2b), companies are likely to be linked to other companies in their sector, but the networks are clustered in medium-sized components. Although the size of the subsample of IT firms is similar to that of the financial sector, the size of the largest component in the IT sector is only one third of that in financial sector. Moreover, the network density and the average and the extreme values of centrality measures in the IT sector are very different from those in the financial sector.

[Insert Figures 2a and 2b about here]

In the context of managerial compensation policies, it is also interesting to study whether firms are connected by employing the same remuneration consultant. Those connections may imply that information on remuneration policies in other firms are more easily dissipated through the remuneration consultants' networks of clients. Over the period 1996-2007, 145 to 198 remuneration consultants were

³ The Higgs report (2003) requires that "the board should not agree to a full time executive director taking on more than one non-executive directorship in a FTSE 100 company nor the chairmanship of such a company." However, there are no direct limitations on the maximum number of directorships one can have.

active and we observe an increasing trend in the hiring of remuneration consultants. On average, a company is connected with more than 40 other companies through common remuneration advisors.

4. Data and Methodology

4.1 Estimation Methods

As our estimation method, we prefer random effects GLS regressions over fixed effects models because our panel data include a large cross-section (with more than a thousand companies a year). In addition, the random effects model has higher estimation efficiency and is a weighted average of between and within estimators. Lastly, the fixed effects model cannot estimate time-invariant variables, such as gender and position, which are important in our analysis. In virtually all model specifications, the explanatory variables are not correlated with the individual effects, as demonstrated by the Hausman test.

We run the following two sets of regressions on:

a. the level of the CEO's total compensation

$$\begin{aligned} \text{CEO total compensation}_{it} = & \alpha + \beta_1 \times \text{Performance measures}_{it} \\ & + \beta_2 \times \text{Network measures}_{it} \\ & + \beta_3 \times \text{CEO characteristics}_{it} \\ & + \beta_4 \times \text{Corporate governance measures}_{it} \\ & + \beta_5 \times \text{Ownership concentration}_{it} \\ & + \beta_6 \times \text{Firm characteristics}_{it} \\ & + \sum_{j=1}^{12} \sum_{t=1996}^{2007} \gamma_{j,t} \times \text{Industry}_j \times \text{Time}_t \end{aligned}$$

The *network measure* included is based on the director network function we intend to test (managerial influence versus information collection). We extend the analysis by replacing the above dependent variable by the compensation sub-categories such as salary, fees, bonus and equity-based compensation. The *performance measures* consist of accounting performance (return on assets) and a stock performance measure (market-adjusted return). *CEO characteristics* include the CEO's gender, tenure, age, membership in committees (audit, nomination and remuneration), and the combination of the positions of CEO and chairman of the board. Board structure variables are important internal *corporate governance* controls. *Ownership concentration* consists of the percentage of block holdings by category of shareholder. We categorize all the share stakes held by directors and all the blocks of 3% or more into the various shareholder categories that are discussed in Section 4.5. Lastly, we include some firm characteristics such as size, capital structure, and stock price volatility. All regressions also include industry and time dummy variables.

b. The pay-for-performance sensitivity of CEO compensation

$$\begin{aligned}
\text{Change in CEO compensation}_{it} = & \alpha + \beta_1 \times \text{Performance measure}_{it} \\
& + \beta_2 \times \text{Network measure}_{it} \\
& + \beta_3 \times \text{Network measure}_{it} \times \text{Performance measure}_{it} \\
& + \beta_4 \times \text{CEO characteristics}_{it} \\
& + \beta_5 \times \text{Corporate governance variables}_{it} \\
& + \beta_6 \times \text{Ownership concentration}_{it} \\
& + \beta_7 \times \text{Firm characteristics}_{it} \\
& + \sum_{j=1}^{12} \sum_{t=1996}^{2007} \gamma_{j,t} \times \text{Industry}_j \times \text{Time}_t
\end{aligned}$$

In the above pay-for-performance sensitivity regression, the change in total compensation or subcategory of compensation is the dependent variable.

An analysis of remuneration contracting should also be related to the examination of CEO departure and dismissal because disregarding the CEO turnover decision may cause sample selection problems in the remuneration analysis (Renneboog and Trojanowski, 2010). When the analysis of changes in compensation only includes ‘surviving’ CEOs, the sample distribution is restricted which may lead to estimation biases. In order to study the compensation and turnover decisions simultaneously, we also apply the following Heckman sample selection method (a type-2 Tobit model).

$$\begin{aligned}
& \left. \begin{aligned} & \text{Survival}_{it}^* = \mathbf{X}'_{1it} \boldsymbol{\beta}_2 + \varepsilon_{1it} \\ & \text{Compensation}_{it}^* = \mathbf{X}'_{2it} \boldsymbol{\beta}_2 + \varepsilon_{2it} \end{aligned} \right\} \begin{array}{l} 1) \\ 2) \end{array} \\
\text{CEO_stayed}_{it} = & \begin{cases} 1 & \text{if } \text{Survival}_{it}^* > 0 \\ 0 & \text{if } \text{Survival}_{it}^* \leq 0 \end{cases} \\
\text{Observed_compensation}_{it} = & \begin{cases} \text{Compensation}_{it}^* & \text{if } \text{Survival}_{it}^* > 0 \\ \text{not observed} & \text{if } \text{Survival}_{it}^* \leq 0 \end{cases}
\end{aligned}$$

where $\{\varepsilon_{1it}, \varepsilon_{2it}\}$ are drawn from a bivariate normal distribution with mean 0, variances σ_1^2 and σ_2^2 , and covariance σ_{12} (Amemiya, 1984). β_1 and β_2 are vectors of the model coefficients. In our models, i corresponds to a firm and t to a year. Turnover_{it}^* and $\text{Compensation}_{it}^*$ are underlying

latent variables that are not observable. However, the sign of the $Turnover_{it}^*$ variable can be observed and coded as a binary variable CEO_stayed_{it} : if a CEO loses his or her job (i.e., $Survival_{it}^* \leq 0$) it is coded as 0, otherwise it is coded as 1. Obviously, compensation is only observed for CEOs who are not dismissed. X_{1it} and X_{2it} are the sets of explanatory variables explaining CEO turnover and compensation, respectively. They include the measures enumerated above. The two sets of explanatory variables, i.e., X_{1it} and X_{2it} , are not disjoint (they can differ, however).

Throughout the paper, we call Equation (1) the selection equation, while Equation (2) is the regression equation. The selection equation explains CEO turnover, i.e., $CEO_stayed_{it} = 1$ corresponds to those firm-years when the CEO keeps his or her position. The regression equation explains the compensation of these CEOs in the subsequent year. As the notion of compensation sensitivity to performance is not meaningful for new CEOs, we restrict the remuneration analysis to CEOs with tenure of more than one year. Estimating the parameters of Equation (2) on the basis of the non-turnover sample only, would not be a valid alternative to the proposed method because the OLS estimator of β_2 is biased when the selection of the regression sample is endogenous (i.e., $\sigma_{12} \neq 0$).

4.2 Sample Selection and Data Sources

The dataset comprises information on 1,758 companies⁴ for which we have 9,789 firm-years with CEOs, 13,854 firm-years with CEOs and CEO-equivalents⁵ and 121,825 firm-years with all directors. All sample companies are listed on the London Stock Exchange (LSE). Virtually all companies belong to one of these indices: FTSE 100, FTSE 250, FTSE Small Cap, FTSE Fledgling, and FTSE AIM.⁶ The FTSE 350 comprises both the FTSE 100 (the 100 biggest companies that represent about 81% of the market capitalization) and the FTSE 250 (the next 250 largest companies with about 15% of the UK market). FTSE Small Cap includes companies that are relatively small, and cover about 2% of the total LSE market value. We have info on virtually the complete UK market. This fact is important in the context of network research as limiting the sample size to e.g. FTSE 350 only would give a distorted picture of the networks existing in UK listed firms.

We collect the remuneration data as well as detailed board information from BoardEx, Manifest, and annual reports. Other company-specific data including sector categorization, accounting information (profit measures, capital structure, and firm size), stock performance and volatility are

⁴ Note that in some regressions, we only include 1,216 firms because indirect centrality measures cannot be calculated for isolated firms.

⁵ Details about identifying CEO equivalents can be found in Appendix B.

⁶ FTSE All-Share can be seen as the aggregation of the FTSE 100, FTSE 250 and FTSE Small Cap Indices. It represents 98-99% of the UK market capitalization. FTSE AIM overlaps to some extent with FTSE Fledgling.

gathered from Datastream Advance. Ownership data is provided by Thomson Financial and PricewaterhouseCoopers. Our dataset starts in 1996 (after the release of the Greenbury Report on Managerial Compensation in 1995) and ends in 2007.

In case the length of the financial year deviates from 365/366 days (it is then more than 30 days longer or shorter than 365), the remuneration and accounting information are adjusted accordingly to make sure they are comparable to other annual values. When a financial year is not coinciding with the calendar year, we apply this rule: e.g. we regard a financial year ending between January and June 31st 2005 as the year 2004 whereas we consider a financial year ending between 1st July and 31st of December 2005 as the year 2005.

4.3 Remuneration Data

The total remuneration package of a director can be dissected into these sub-categories: (i) salary, (ii) fee, (iii) bonus, (iii) equity-based compensation (stock options and long term incentive plans), (v) miscellaneous remuneration, and (vi) other. The *salary* includes a fixed payment and is usually paid out in cash (and exceptionally in shares). *Fees* are usually paid for consulting and supervisory services rather than for operational work and are hence more often compensation for non-executive directors or former executive directors. The *bonus* can consist of cash or shares and is usually paid when specific benchmarks or targets were reached over the past year (or past few years). Bonuses can also be voluntarily deferred or are compulsorily deferred for a vesting period of usually three years. In practice, the initial cash deferral bonus is often converted into stock at favourable terms if the CEO commits to remain in his company or meets some performance criteria over the vesting period. A deferred bonus realized in stock is recorded as restricted stock and categorized as equity-based compensation.⁷

Equity-based compensation includes *restricted shares* and *stock options*. Restricted shares are granted under different schemes such as shares appreciation rights and deferred bonus schemes. In most circumstances, the restricted shares cannot be sold until certain goals are reached and before the vesting period. Restricted shares are valued at the market price of the grant date. The market price at grant date was collected from Datastream Advance. Stock options give the CEOs the right to acquire company stocks at a predetermined price (exercise price). Stock options in the executive remuneration packages in the UK have often vesting conditions (performance benchmarks) and always vesting periods, typically three to five years. We approximate the value of the stock options by means of the Black-Scholes option pricing formula. Most options are granted at the money; the market price and stock price volatility at the grant date are collected from Datastream Advance. As we lack information about the time to maturity of

⁷ We include the deferred bonus plans in cash terms at the grant date. All performance related sub-categories are recorded and valued at the grant date.

stock options, we use ten years (the usual time to expiration at the grant date) as the default maturity for all stock option value calculations. The interest rate of 10-year UK government bonds (Gilts) is used as the risk-free rate.

Miscellaneous compensation includes compensation that is not paid out on a regular basis, and includes transaction bonuses, recruitment incentives, relocation expenses, and loss of office compensation. A *transaction bonus* is granted when the CEO has administered major corporate transactions, such as takeovers, or other types of asset restructuring. A *deferred cash bonus* (different from the deferred bonus defined above) is granted mainly with the aim of retaining the CEO. For instance, the CEO needs to remain employed for the vesting period (typically 3-5 years) in order to claim this cash award (which is not performance-related). The *recruitment incentive* is paid when a position is difficult to fill without such an additional allurements and is associated only with new appointments. *Relocation expenses* are awarded in case the newly-appointed CEO needs to move nearer to his new firm. The *loss of office compensation* is also known as severance pay (or a golden parachute). When the contract is terminated before it expires, the CEO is compensated for this early departure. The payment of the severance pay is often not contractually specified and is granted even when the CEO is fired following poor performance. Our dataset also contains a remuneration category labelled ‘Other’, which is rare and includes all forms of compensation and benefits that are not included in any of the above categories. It consists of the CEO’s (medical) insurance paid for by the firm, some ‘ad hoc benefits’ or ‘unusual compensation’ about which the firms do not give detailed information. We also have information about pension contributions done by the company for the benefit of executive directors. Given that this information is not complete, we do not include its value in the CEO’s compensation.

Table 2 reports descriptive statistics on remuneration for the whole sample period. The most important components of a CEO’s compensation package in the UK are equity-based compensation (restricted shares and stock options), fixed salary, and bonus. On average, £ 296,215 is paid to a CEO each year as equity-based compensation, which accounts for 44.8% of his total remuneration. The salary on average amounts to £ 202,931 or 30.70% of the total remuneration. The bonus is also a significant source for a CEO’s wealth accumulation with an average of £ 126,290 or 19.11% of the total compensation. The remaining compensation components such as fees, miscellaneous compensation and other are only marginal and add up to a mere 5% of CEO compensation.

[Insert Table 2 about here]

How did the value of compensation packages evolve? Figure 3 shows a strong increase in the total remuneration which peaked in the year 2000 (following the strong stock market boom of the 1990s), was followed by a short-lived decrease in 2001-2002 (coinciding with the equity market decline and the collapse of the M&A market) and then kept rising till 2007. By 2007, the total remuneration for the CEO

had almost doubled relative to 1996. Over the entire sample period, the total remuneration increased at an average rate of 9.43% per annum. There are only modest increases in the fixed salary over time, but the augmentation of the bonus and equity-based compensation are striking. Particularly in 2000, when the stock market peaked before the bursting of the high tech bubble, the equity-based compensation also became the most valuable aspect of a compensation package (amounting to 53.04% of the total remuneration). Moreover, if we look across the industries, the distribution of CEO compensation is highly skewed: a small number of well paid CEOs (mostly from FTSE 350) have driven up the average CEO compensation in the UK market. Lastly, equity-based compensation is still a smaller part of total remuneration of UK CEOs than that of US CEOs. In 2007, CEOs of S&P 500 companies were on average paid a total compensation of USD 13.4 million whereas UK CEOs of FTSE 100 companies received £ 4.3 million (USD 8.6 million).

[Insert Figure 3]

We find that the companies in the industries of Financial Services, Food Producing, Media, and Utilities reward their CEOs the most. The highest paid CEO in 2007 was Bart Becht from the Reckitt Benckiser Group with a compensation of £ 31 million, followed by Terence Leahy from Tesco's earning £ 21 million. For each of these CEOs (and most other top earners), more than 80% of their remuneration packages consist of equity-based compensation.

Partitioning the sample firms based on membership of the FTSE 100, FTSE 250, FTSE Small Cap and FTSE Fledgling, we find that the CEO remuneration of the largest firms (FTSE 100) is about 10, 5 and 2.5 times larger than that of the Fledglings, Small Caps and FTSE 250 firms, respectively. The growth in nominal salaries for the CEOs leading Fledglings is 9.84% per annum. The growth is stronger at about 19.5% annually for small caps and FTSE 250 firms, and 15.3% for the largest firms (FTSE 100). The structure of the compensation packages in large companies is markedly different from that of smaller firms. The bonus, restricted shares, and stock options make up a larger proportion (up to 70%) of the total executive directors' compensation of the largest companies (FTSE 350). In the FTSE Small Cap and FTSE Fledgling companies, the proportion of the performance-related compensation is less than 60% and 40%, respectively.

4.4 CEO, Board, and Firm Characteristics

The CEOs' average age is about 53 years. While this average age remains relatively stable over time, the average tenure declines from 8.7 years in 1996 to 4.9 years in 2007. Executive directors are somewhat younger than the nonexecutive directors; they are 50 and 58 years, respectively. The age and trend in tenure also persist in firms of different sizes and sectors - only the CEOs in the largest companies

have a shorter tenure. The vast majority of the CEOs is still male, although the proportion of female CEOs has slightly increased over time (from 0.8% in 1996 to 2.6% in 2007).

[Insert Table 3 about here]

Across our sample period, CEO turnover amounts to 23.75% which includes 1.1% turnover resulting from the decease of CEOs and 12.25% from retirements.⁸ We also collect information on the CEOs' contracts such as the notice periods. More than three quarters of the companies (77%) are required to inform the CEO twelve months prior to the dismissal. For about 12%, the notice period is longer than 20 months.

On average, the board consists of 8 directors of which 5 are non-executives (Table 4, Panel A). Merely 4% of the board members are female. In 13.1% of the firm-years, the CEO also chairs the board of directors. This high number is surprising given that board duality can harm the board's supervisory power and that the UK Corporate Governance Code discourages board duality. There is however a significant decline in board duality over time: in 1996, 21.0% of the CEOs had also assumed the tasks of chairman but this number dropped to 7.0% by 2007.

[Insert Table 4 about here]

The UK Corporate Governance Code also requires that a firm has audit, nomination, and remuneration committees. In the context of the functioning and independence of these committees, it is important to note that these committees should be staffed mainly by non-executive directors. Most companies, with the exception of a fraction of the very small firms, comply with the UK code and have audit (98%) and remuneration committees (88%). In more than 80% of all firm-years, there is a nomination committee (Table 4, Panel B). Panel C demonstrates that at least one executive director participates in the decision making of the nomination committee in more than half (53.5%) of the firm-years. The presence of executive directors on the remuneration committee is also remarkable. Conditional on the presence of a remuneration committee, at least one executive director is a member of the committee in one out of five firm-years. In Panel D, we examine the extent to which CEOs are present in the committees. Nomination committees have often been criticized for not being sufficiently independent from the CEO as he could influence the appointments of non-executive directors who are unlikely to oppose his views and to monitor the executive directors actively. In about 44% of the firm-years, the CEO is a member of the nomination committee which he chairs in 11.5% of the cases. CEO membership of the remuneration committee creates obvious conflicts of interest, and Panel D

⁸ The retirement turnover comprises the departure of CEOs who are 63 years old or above. Given that the true reason behind the turnover is not available – most firms use euphemistic terms to describe the CEO's departure - we do not distinguish between voluntary turnover and disciplinary turnover for the non-retirement cases.

exhibits that the CEO is a member of the remuneration committee in 10% of the firm-years and even chairs this committee in 2% of the cases. CEOs' committee membership linearly decreases with company size, but the CEO is still a member of the remuneration committee in about 2.5% of the firm-years in FTSE 100 firms and in 7% of FTSE 250 firms.

Remuneration committees frequently hire remuneration consultants (42% of all companies in 2007) and report who their main consultant is in the annual report. The most frequently hired remuneration consultant is New Bridge Street Consultants (hired by 15.3% of the firms), followed by Towers Perrin (5.8%), and Deloitte and Touche (4.9%). Of the listed companies, 22.8% report that they only use internal advice to set managerial pay.

4.5 Insider and Outsider Ownership Concentration

We categorize all the share stakes held by directors and all the blocks of 3% or more into the following shareholder categories: (i) investment and mutual funds, (ii) insurance companies, (iii) pension funds, (iv) banks, (v) nominee accounts, (vi) individuals and families not related to a director, (vii) industrial and commercial companies, (viii) CEO, (ix) executive directors (excluding the CEO)s and (x) non-executive directors. Categories (i) to (iv) constitute the institutional investors⁹, and classes (viii) to (x) make up the insider ownership. Table 5 exhibits that the ownership concentration is rather stable over time and fluctuates around 35%. Insider ownership amounts to about 7% over the whole sample period. Relative to other countries (the US and Continental Europe) where executive directors rarely hold a combined share stake of more than 0.5% in listed companies, executive ownership in the UK is high with an average of almost 4.7% of the equity that gives the insiders significant voting power. The average CEO holds 2.5% of the market capitalization. From 1998 to 2001, an upward trend in insider ownership concentration is visible, partly caused by an increase in the use of equity-based compensation for the top management. In the subsequent period, the combined insider stakes stabilize around 6.8%. The shareholder category with the highest ownership concentration is the investment funds which on average hold almost 14.7% of the equity. The investment funds' share stake has increased gradually over the sample period from 8.5% in 1999 to 17.5% in 2007. The ownership concentration held by banks and pension funds has remained relatively stable over time. All the institutional shareholder classes combined control around 20.7% of the concentrated voting rights. The combined equity stakes of industrial and commercial corporations amounts to almost 8%.

[Insert Table 5 about here]

⁹ The owners behind the nominee accounts are often also institutional investors (Franks, Mayer and Renneboog, 2001).

5. Results

5.1 Compensation and Director Network Centrality

Total compensation and its components

In Table 6, we estimate the impact of director networks on the CEOs' total annual compensation. The degree centrality at the individual director (CEO) level (Degree (D)) is positively correlated with the CEO's total compensation. This implies that CEOs with a strong network based on direct connections have higher compensation. When we replace degree by a second measure of direct networks at the director level, namely by the eigenvector centrality of the network, we reach similar results (not shown).

We also investigate the relation between networks based on indirect connections (the closeness level) which proxies for the information-value of the network, and CEO remuneration. Normalized closeness (nCloseness (D)) indeed significantly boosts CEO compensation. This implies that a CEO's network resources are valuable to and rewarded by the company. The correlation between direct and indirect centrality measures such as degree and normalized closeness is very small (0.18). When we include both measures in one model, both remain strongly statistically significant. This evidence suggests that both the managerial influence hypothesis (Hypothesis 1 - influential CEOs extract higher compensation) and the information-value hypothesis (Hypothesis 2 - CEOs with valuable information networks extract higher compensation) are upheld. We find that the direct links explain twice as much of the variation in the total CEO remuneration than do the indirect links, which implies that managerial influence hypothesis is more strongly supported.

[Insert Table 6 about here]

We now turn to the centrality measures at the company level. The degree of a company shows how many boards are interlocked with its own board. Company degree (Degree (C), column (2) of Table 6) has a significantly positive impact on the CEO's total compensation. A high degree at the company level signifies that the board members are active in many other companies as executive or non-executive directors, which implies that these directors divert some of their time and energy. The probability of collusion may also increase with the number of board interlocks. When a board is more interlocked, corporate governance may become less effective, and as a possible consequence, the CEO may be able to extract higher compensation. So, our findings fail to reject hypothesis 3 (busy boards/managerial

influence).¹⁰ In column (4) of Table 6, we evaluate the impact of closeness (nCloseness (C)) at the company level, namely the information collection ability of all directors collectively. We find a negative correlation between CEO remuneration and company closeness which signifies that, when a firm has many indirect links, it depends less on the CEO's individual network to attract valuable information and resources. Hence, the firm can afford to pay out a lower total compensation to the CEO, which supports hypothesis 4.

While centrality measures are related to total compensation, we also investigate whether they have a different impact on the various components of pay (not shown). In the fixed salary model, we find that our earlier results are upheld: the CEO's direct network (degree (D)) yields a higher fixed salary and so does the company's direct network (Degree (C)). We also find that indirect networks are valued in monetary terms given the positive correlation with fixed salary. In contrast, the CEO's fixed salary does not decrease when the company's information collection ability through the combined director network is high. We reach similar conclusions on the relation between direct networks, and the bonus and equity-based compensation. These two sub-categories of compensation increase with the degree at both the individual and the company level. Also, the closeness measure for individual CEO networks is positively correlated with the CEO's bonus and equity-based pay. Yet, the closeness on the company level limits these aspects of pay. So, it seems that a well-connected company that relies less on the CEO's network, pays lower bonuses and equity-based compensation. We do not find any impact of networks on fees and other types of compensation not included in the above categories.

To sum up, a CEO's network increases his compensation through two channels. In line with the managerial influence hypothesis, the CEO's direct links grant him more authority over the board. We also find evidence that if the CEO has a network valuable for information collection, his compensation increases accordingly. This is in line with the information collection hypothesis: a company rewards the CEO for the resources he contributes to the firm through his network. When we study the director networks at the company level, the managerial influence/busy board hypothesis and information collection hypothesis make different predictions. More specifically, we measure the direct links from the company to all 'adjacent' companies and the indirect links from the company to all companies in the population. The direct centrality (degree) has a positive correlation with CEO total compensation and its components. This result suggests that when there are many direct interlocks of board members (busy boards), corporate governance effectiveness may be weaker which can result in higher CEO compensation. A higher closeness at the firm level lowers CEO compensation because the board as a whole may now be better informed and hence relies less on the CEO's network. The CEO is then paid

¹⁰ In section 6.6, we try to disentangle the managerial influence and busy board hypothesis at the company level by only considering company networks based on the external networks of non-executive directors and those based on executive directors' external networks. Both the busy board and managerial power hypotheses at the company level are supported.

less. These two results demonstrate that it is important to have the ‘right’ type of network, which delivers valuable information rather than managerial influence.

Our results are not only statistically significant, but also economically. Considering a one standard deviation change in the centrality measures, we find that the degree measures at the individual level and company level have a large influence (9% and 15%, respectively) on the CEO’s total compensation. The information value related measures have a smaller impact: a one standard deviation increase in closeness (better individual information access) raises the total compensation by 4%. Closeness at the company level reduces total CEO compensation by about 4%. In short, networks that enhance managerial influence have a larger impact than information-collection networks.

Pay-for-performance sensitivity

The pay-for-performance sensitivity is captured by performance and the interaction term between networks and performance (in Table 7). When the number of direct connections increases, the change in total compensation becomes less sensitive to stock performance (column 1). This supports the managerial influence hypothesis as we show that the stock performance sensitivity declines for this type of CEOs. We do not find any evidence of accounting performance sensitivity.

When the degree at the company level is high we also find a lower performance-sensitivity of CEO remuneration (column 2). A higher degree at the company level signifies that all the directors combined have direct links with many other companies. This implies that the executive directors may be more powerful but also that the non-executive directors exert duties in other firms which may erode their corporate governance effectiveness (busy board hypothesis).

The information collection aspect of the director networks (the closeness measure for the CEO) has no significant impact on the pay-for-performance sensitivity of his remuneration. This implies that a stronger director network position for the purpose of information collection is not translated into a stronger pay-for-performance sensitivity. When we consider closeness on the company level, we observe less accounting performance-sensitivity, which fails to support hypothesis 4.

[Insert Table 7 about here]

In our models, we have also included the firms’ networks resulting from the connections of their remuneration consultants. This measure can also capture firms’ information gathering abilities. The firm then benefits from information on the remuneration practices of the consultant’s clients. The estimated network coefficient of the remuneration consultant is positive and significant, implying that companies associated with a remuneration consultant with a large client network pay their CEOs more. The interaction term of firm size with consultant network size is also significantly positive which signifies that bigger firms employing larger remuneration consultants grant their CEOs a larger total compensation.

5.2 Other Determinants of CEO Compensation

We have controlled the models in Tables 6 and 7 for corporate performance, company size, CEO characteristics, and corporate governance variables such as ownership concentration and board composition.

Both *accounting* and *stock price performance* have a significantly positive impact on total compensation. In the pay-for-performance analysis, the change in total compensation is more sensitive to stock performance than accounting performance. When we examine the changes in the components of compensation, we find that salary is more sensitive to accounting performance than to stock performance (not shown). Performance-related compensation including bonus and equity-based compensation is significantly positively influenced by both accounting and stock performance.

The debt to assets ratio is positively related to CEO compensation, which suggests that companies with high *gearing* (some of which may be financially distressed) need to attract or maintain CEOs at higher cost. CEO remuneration decreases with stock price volatility, which is somewhat counterintuitive. We would expect that a CEO be better compensated in risky firms which may be more difficult to manage or that he demand a larger equity-based compensation package. A possible explanation for this result is that the company offers more fixed compensation as the performance signal that determines the variable compensation contains too much noise.

We also investigate the impact of CEO characteristics on CEO remuneration. Contrary to some of the *gender* literature, we do not find any difference between the compensation of male and female CEOs, which may be the result of including other control variables such as tenure, age, industry, and corporate size. Not surprisingly, a CEO's compensation increases with *tenure*. Combining the function of CEO with the tasks of the *chairman* seems to decrease his salary. However, further investigation reveals that the combination of both functions is almost exclusive to small companies where the CEO compensation is lower. When we add the interaction term between the CEO-chairman duality and total assets, we notice that a CEO earns more if he is also the chairman. We also include a dummy variable that equals one if the CEO is a member of one of the committees (audit, nomination and remuneration), as such memberships augment his influence. The results confirm that *committee memberships* yield a larger compensation. When we include the membership of only the *remuneration committee*, we find clear evidence that conflicts of interests prevail because the CEO's total compensation is now higher. Lastly, the *notice period* of the CEO is not related to his pay.

Board characteristics include the *proportion of nonexecutive directors* and of female directors on the board. In most models, both ratios are positively correlated with CEO total compensation. Contrary to the US results of Chhaochharia and Grinstein (2009), our finding suggests that non-executive directors in the UK are lenient in setting CEO compensation. This may result from the fact that non-executive

directors are executives in other firms and raising the pay in one firm can have a spill-over effect on the compensation policy of their own firm.

The last set of control variables consist of the *ownership* variables. Among the three insider ownership categories, the CEO's stock holdings is the only factor that significantly influences total compensation. Intuitively, as the CEO acquires a larger share stake in his company, a larger fraction of his wealth is tied to corporate performance such that he may be less incentivized by remuneration. We also find that non-executive shareholders are not more effective supervisors. As for the outsider ownership, only block holdings held by individuals or families not related to a director and the share stakes held through nominee accounts reduce a CEO's compensation. These findings provide some evidence that outsider blockholders may curb excessive compensation, but industrial block holdings are not related to the level of compensation. If large share stakes are owned by institutions (bank, investment fund, pension and insurance company), the total CEO compensation is high. This is congruent with the fact that most institutional shareholders in the UK are passive monitors.

6. Further Analysis and Robustness Checks

6.1 Endogeneity

Possible criticism on the above models is that there could be one common factor which contributes to both high compensation and strong network connections. For example, a successful CEO who is well compensated attracts non-executive directorships because he has a good track record (good past performance). Therefore, we apply an instrumental variable approach with board size and the CEO's honorary title as the instrumental variables for the centrality measures at the individual director (CEO) level. The outcome confirms our earlier results in that it corroborates the managerial influence hypotheses as high CEO degree measures boost total compensation. Similarly, at the company level, the model with instrumental variables generates a similar conclusion as the one implied by the random effects models: high degree measures on the company levels (proxying both for executive power and busy boards) lead to higher CEO compensation. We do not find a significant impact of the closeness measures which capture the information collection value of a network. We also run a regression with individual CEO fixed effects, but reach the same conclusion: the relations between network centrality and compensation persist.

6.2 Heckman Sample Selection Equation

In most of the academic literature on compensation and turnover, the compensation and dismissal are examined separately. However, Renneboog and Trojanowski (2010) point out that disregarding CEO turnover in remuneration research causes sample selection problems. In order to take into account the information of new and old CEO contracts, we employ Heckman sample selection

equations to study turnover (the selection equation) and compensation (the regression equation) simultaneously. Table 8 shows that the type-2 Tobit model yields virtually the same results as those resulting from the random effects models.

[Insert Table 8 about here]

6.3 Other Centrality Measures

Besides the degree and closeness measures, we use additional network statistics to estimate the strength of networks based on direct and indirect links. We run the regression models with eigenvector centrality and the betweenness measures (see Section 3.1) as substitutes for degree and closeness, respectively. Both normalized eigenvector centrality and normalized betweenness at the director level are significantly positively correlated to total compensation, which is in line with our findings for degree and closeness. At the company level we find that, while the eigenvector centrality estimates are congruent with those for degree, the betweenness measure yields different results than closeness. Although the betweenness measure is defined very differently from degree, the correlation in this sample between betweenness and degree is high.

We also re-estimate our models implementing the following changes:

- *Outward degree*

We mentioned in the previous section that the degree measure on the individual level could be affected by board size. In order to resolve this problem, we create a degree variable that is only based on ‘outward’ connections to other firms (and thus excludes the connections to the directors of the own company). When we include the outward degree measure, we draw the same conclusion as before for the analysis of total compensation: the CEO’s outward degree significantly increases the total compensation. We also find evidence of a negative impact of outward degree on the stock price performance sensitivity of CEO remuneration. This suggests that it is mainly the outward direct connections that play an important role in the pay-setting process.

- *Zero closeness for isolated companies*

In the company level networks, the closeness centrality for isolated companies is not defined. An alternative approach is to put these missing closeness scores to zero in order to include these firms in the closeness analysis. Intuitively, the distances from these companies to others are considered as infinity such that closeness, which is the inverse of total distance, becomes zero. Applying this new definition of closeness, we obtain the opposite result: namely, the closeness measure at company level increases the CEO total compensation. The main reason for this result is that isolated companies are usually small with low CEO compensation.

- *Error terms as indirect centrality measures*

We have discussed in Section 2 that direct and indirect connections are not exclusive and can in some cases be complementary. In order to disentangle the effect of direct and indirect connections, we adjust the centrality measures. We first run regressions with closeness as the dependent variable on the degree centrality measure. The error term of this regression is the part of indirect centrality that cannot be explained by the direct centrality. When we include this orthogonal indirect measure into the total remuneration regression, we find that this indirect measure (at the individual level) increases the CEO's total compensation. This finding is in line with our earlier evidence based on closeness as an indirect centrality measure. Thus, our orthogonal measure at the director level also supports hypothesis 2.

In contrast, the orthogonal measure of indirect closeness at the company level does not lower CEO compensation, which differs from the prediction of hypothesis 4. In the pay-for-performance analysis, we expect that better information access at the company level can improve the pay-for-performance sensitivity of the CEO's compensation (hypothesis 4), but we do not find evidence supporting this prediction when using the orthogonal indirect centrality measure.

- *Change in centrality measures*

We investigate whether the change in the centrality measures affects the total compensation or pay-for-performance sensitivity, but do not find any statistical evidence for the relation between change in centrality and total compensation or pay-for-performance sensitivity.

6.4 Restricted Shares and Stock Options

In the above analysis, we have combined restricted stock (LTIPs) and stock options into a variable capturing the equity-based compensation. However, these two types of equity-based compensation have different characteristics in terms of risk and incentives. As stock options reward the owner in case of stock price appreciation but have a lower bound at zero in case the stock price drops, managers are incentivised to undertake riskier operations. Typically, stock options induce more risk-taking behaviour relative to restricted shares (Murphy, 1999). We use each type of equity-based compensation as the dependent variable. The level of stock options granted to the CEO increases with degree both at the individual and company level. This result is in line with our earlier results on total compensation and our expectations as formulated by hypotheses 1 and 3. The fact that closeness is not related to option compensation at both the individual and company level contradicts hypotheses 2 and 4.

Fewer restricted shares are granted to the CEO when closeness at the company is higher, which is in line with the result from the baseline model and hypothesis 4. Other centrality measures (e.g., degree at individual and company level and closeness at individual level) are not related to restricted

shares. In the pay-for-performance analysis, we find that compensation via stock options is less sensitive to performance changes if the CEO has a higher degree centrality score. This supports the managerial influence hypothesis (hypothesis 1).

6.5 Extended Pay-for-performance Sensitivity

While in the previous section, we have analyzed the total pay-for-performance sensitivity, we also examine the change in performance-related compensation (the sum of bonus and equity-based pay) to estimate the sensitivity. Our results are similar to those shown above. We also replace the level of performance in the sensitivity regression by the change in performance. This model yields results which are largely similar to the ones reported in Section 5.1. When we estimate models with the percentage changes in total compensation and performance, we obtain similar conclusions as in section 5.1, although with lower significance.

The relation between pay and performance is likely to be non-linear. Powerful CEOs prefer their pay to be performance-sensitive when performance increases, but not be sensitive in case of declining performance. We therefore run our regressions on the sub-samples of positive and negative performance changes, but find no significant difference between networks' impact in the pay-for-performance sensitivity in the two sub-samples.

6.6 Busy director measure

In section 5.1, we have used direct centrality measures at the company level to assess whether a board can be considered as 'busy'. Alternatively, we can consider directors with more than one directorship as busy directors and use the proportion of busy directors on board as a measure of busy board. On average, there are three busy directors on a board, occupying 29% board seats and 17% of the CEOs are busy directors. We find that the number and proportion of busy directors on the board have a significant positive impact on the CEO's total compensation.

6.7 Institutional Ownership Classification

We partition the category of institutional investors into more detailed shareholder classes in order to investigate which types of institutions are able to more effectively influence CEO pay. The results reveal that pension funds are able to restrain CEO compensation whereas the presence of blocks held by other classes of financial institutions does either have no or a positive effect on CEO pay.

6.8 Other Sample Specifications

New and old contracts

In the sample selection models, we have focused on on-going CEO contracts, but the compensation-centrality relation of a new CEO may be different from that of ongoing contracts. The compensation of the new CEO does not hinge on the past performance of his new firm (but his initial compensation may reflect his performance in his old firm). The first-year contract typically includes more extraordinary compensation components such as a sign-on bonus or relocation fee. These elements may be less relevant to the network-compensation relation. For both the models applied to the new and the on-going contracts separately, we find very similar results as the ones shown in Section 5 (except that the company level closeness measure loses its significance for new contracts).

Excluding financial companies

The current sample includes all UK companies listed on the London Stock Exchange (including the ones listed on the Alternative Investment Market). We have also included financial companies in the network calculations as some bankers also belong to the director networks of industrial and commercial companies. Given that financial companies have a different asset structure and comply with different regulatory requirements than firms from other sectors, we re-estimate our results excluding financial firms, although that the director network measures are still calculated based on the network including all companies. We find that our earlier results are still upheld and hence do not depend on the financial sector.

CEO and CEO equivalents

Some companies do not have an executive director bearing the title of CEO. These companies are usually small and led by managing directors or other senior executives. We did not include these ‘CEO equivalent’ managers in our main regression. As a robustness check, we run the regressions on the sample including both the CEOs and the CEO equivalents. The results from this larger sample are quite similar to those of the CEO sample.

7. Conclusion

We have examined the relation between directors’ networks, and CEOs’ compensation and pay-for-performance. Specifically, we distinguish between two functions of networks: the accumulation of managerial influence and the collection of valuable information. The former implies that powerful CEOs may take advantage of their position to extract benefits such as a higher compensation at a significant cost to the shareholders. The latter function of information collection can be beneficial to the company (and the director). Although the existing literature does not make this distinction, we empirically differentiate network centrality measures at the direct and indirect level. Strong direct networks

(measured by degree and eigenvector centrality) proxy for managerial influence, whereas strong indirect networks (measured by closeness and betweenness) can capture information-collection ability. We find that both strong direct and indirect networks are rewarded with a higher compensation (fixed salary, bonus, and equity-based compensation). When we examine the pay-for-performance sensitivity of CEO compensation, we find that a high direct centrality measure decreases the pay-for-performance sensitivity. The combination of high CEO compensation and low pay-for-performance corroborates the managerial influence hypothesis. While the information value of indirect networks is reflected in higher CEO compensation, it does not influence the pay-for-performance relation.

When we study director networks at the company level, we find that strong direct company networks are correlated with higher compensation and lower pay-for-performance sensitivity. This finding is in line with the managerial influence hypothesis and the busy board hypothesis because in companies with a high number of direct links, the executive and non-executive directors may exert too many duties outside their company such that they divert too much of their time and are less effective monitors. This may then be reflected in high CEO compensation with low pay-for-performance sensitivity. Closeness at the company level lowers CEO compensation because the board is better informed and relies less on the CEO's network. Taken together, these two results suggest that it is important to have the 'right' type of network: some networks enable a firm to access valuable information whereas others can lead to strong managerial influence that may come at the detriment of the firm and its shareholders.

In this study on centrality-CEO compensation relation, we have controlled for many CEO, board, and company characteristics. For instance, our empirical findings confirm that conflicts of interest emerge when a CEO is a member of the remuneration committee. In this case his compensation is significantly higher. We also document that remuneration consultants influence CEO compensation. When a firm hires a remuneration consultant with a large client network, CEO compensation is significantly higher even within the category of large firms.

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Figure 1. Example of a CEO's professional network

This Figure depicts the director networks surrounding Andy Hornby (white circle in the middle of the graph). Directors in the four companies served by Andy Hornby are represented as circles in different shades. In this figure, each circle stands for a vertex (director) in the network. Directors sitting on the same board establish links between them. The lines between circles are the links between vertices (directors). The size of a circle represents the number of links.

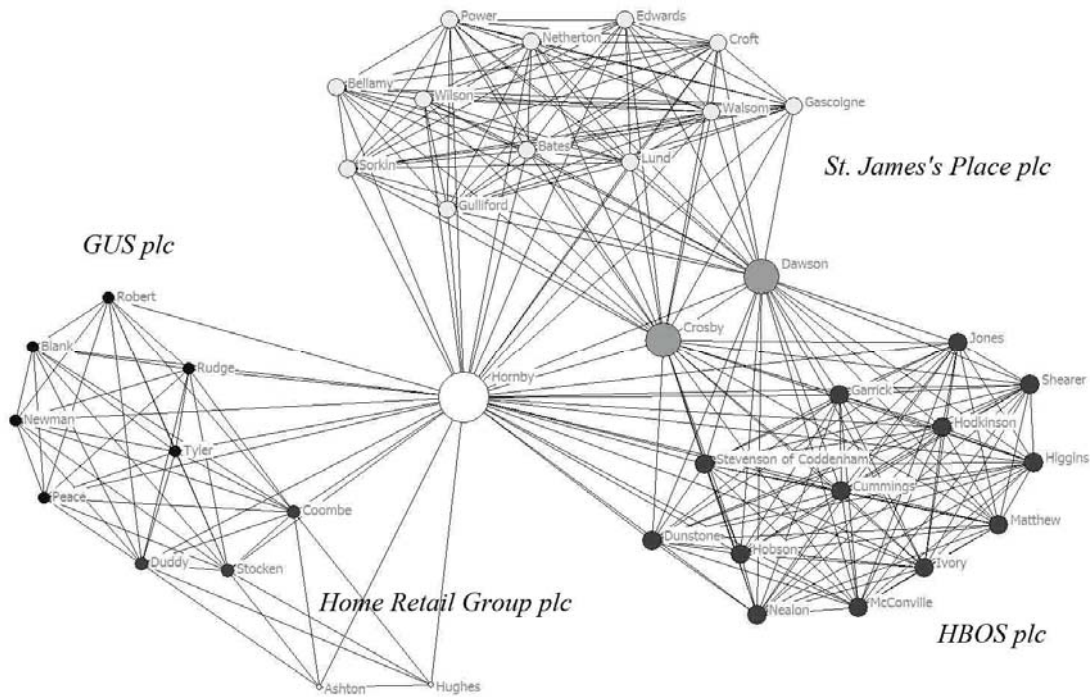


Figure 2a. The network of the financial sector

This is the company networks in the finance industry in the UK market, 2007. Each box stands for a financial company.

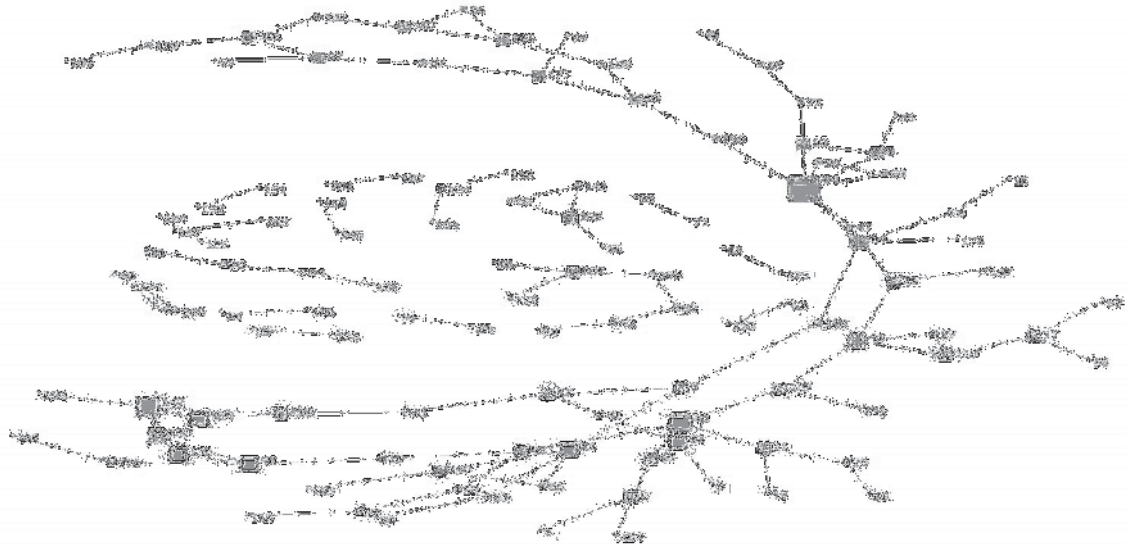


Figure 2b. The network of the IT sector

This is the company networks in the IT industry in the UK market, 2007. Each box stands for a company.

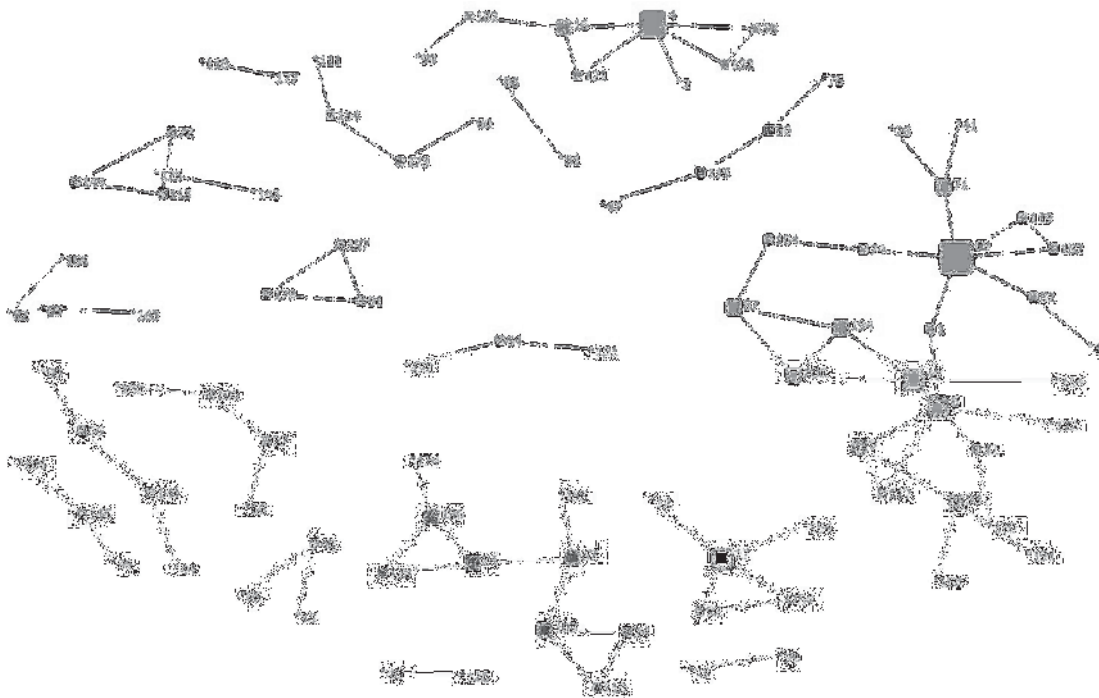


Figure 3. CEO Remuneration over the whole sample from 1996-2007

This figure shows the change in the value and structure of CEO compensation over the whole sample period.

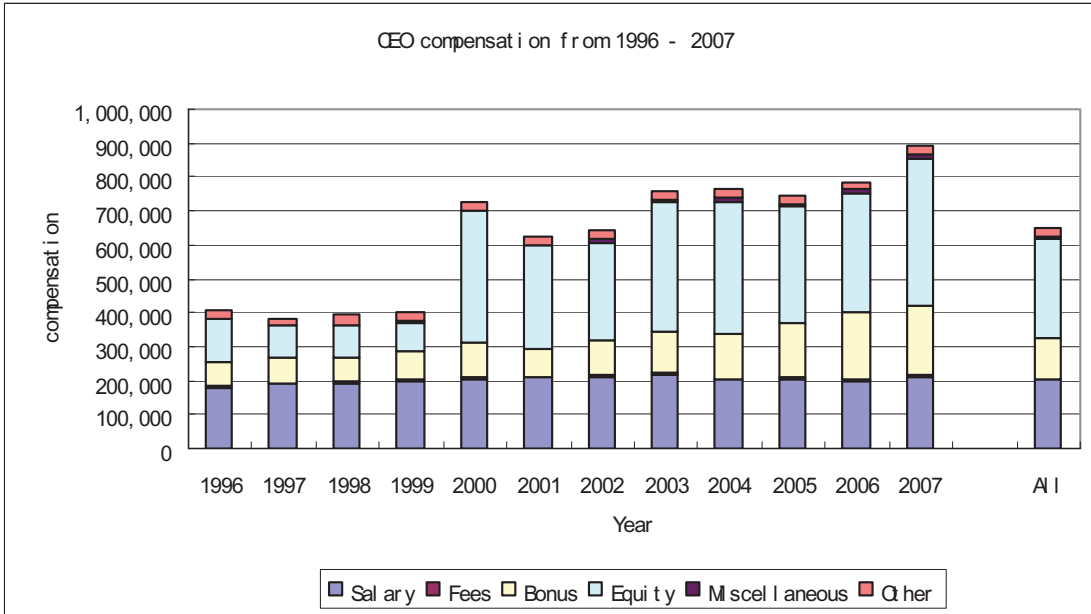


Table 1. Summary statistics of centrality measures

This table summarizes the key centrality statistics (degree, closeness, betweenness and eigenvector centrality) of the companies in the sample. N stands for is the number of observations (firm-years). Note that the number of observations is smaller for the closeness measure as closeness cannot be calculated for isolated (non-networked) companies. SD stands for standard deviation. P25, P50, and P75 are the values at the 25th, 50th, and 75th percentiles. The summary statistics are calculated over all firm-years. Below each centrality measure is the normalized version denoted by “n”. The centrality measures are calculated using Matlab and Ucinet. Data source: Own calculations based on BoardEx, Manifest and annual reports.

Panel A: individual level

Variable	N	Mean	SD	Min	P25	P50	P75	Max
degree	13854	9.99	6.83	0.00	6.00	8.00	11.00	62.00
(n) degree	13854	0.13	0.10	0.00	0.07	0.11	0.15	1.04
close	11319	22,500,000	20,900,000	6,513,209	10,500,000	16,800,000	20,000,000	80,200,000
(n) closeness	11319	0.05	0.02	0.01	0.05	0.05	0.07	0.09
eigen	13854	0.00	0.01	0.00	0.00	0.00	0.00	0.24
(n) eigen	13854	0.21	1.26	0.00	0.00	0.00	0.04	34.47
between	13854	10766	34,612	0	0	0	0	536,813
(n) between	13854	0.04	0.12	0.00	0.00	0.00	0.00	1.46

Panel B: company level

Variable	N	Mean	SD	Min	P25	P50	P75	Max
degree	13854	4.02	3.88	0.00	1.00	3.00	6.00	29.00
(n) degree	13854	0.35	0.36	0.00	0.09	0.26	0.52	3.49
close	11319	448,512	381,822	133,702	247,103	290,541	617,579	2,340,900
(n) closeness	11319	0.36	0.14	0.07	0.25	0.40	0.43	0.59
eigen	13854	0.01	0.03	0.00	0.00	0.00	0.02	0.36
(n) eigen	13854	1.94	3.68	0.00	0.00	0.48	2.25	50.23
between	13854	1,403	2,359	0.00	0.00	350	1,839	28,712
(n) between	13854	0.20	0.34	0.00	0.00	0.05	0.27	5.52

Table 2. CEO remuneration

This table shows CEO total remuneration and its components for the whole sample and over the period 1996 to 2007. N is the number of observations (firm-years). Mean stands for the average value; SD is the standard deviation. P25 and P75 are the value at the first and third quartiles, respectively. Percent captures the percentage of the total remuneration that is awarded via this type of remuneration. The values in bold are unconditional statistics, which takes into account all variables with a zero value. The other values are conditional statistics based on non-zero values only. Data source: Own calculations based on BoardEx, Manifest, annual reports, and Datastream.

Variable	N	Mean	SD	Min	P25	Median	P75	Max	Percent
Total salary	13,854	202,931	203,891	0	0	166,000	296,600	2,400,000	30.70%
Salary in cash	3,392	302,738	220,312	1,846	151,086	249,500	395,000	2,248,685	
Salary in shares	8	21,412	27,830	2,993	2,999	5,000	41,374	69,554	
Total fees	13,854	4,032	45,895	0	0	0	0	4,939,000	0.61%
Fees in cash	685	32,777	50,598	448	19,000	23,000	29,412	1,000,000	
Fees in shares	1	755,555		755,555	755,555	755,555	755,555	755,555	
Total bonus	13,854	126,290	357,054	0	0	9,000	120,764	10,000,000	19.11%
Bonus in cash	7,006	221,039	401,899	130	50,000	112,500	241,000	10,000,000	
Bonus in shares	71	259,067	475,088	2,658	60,000	121,874	254,363	3,116,035	
Bonus vol deferred	74	284,467	299,701	6,445	81,975	166,500	420,000	1,312,500	
Bonus mand deferred	383	351,810	471,916	2,296	90,000	185,853	426,770	3,837,500	
Total equity	13,854	296,215	2,507,032	0	0	0	112,998	186,841,117	44.81%
Restricted shares	2,724	873,798	3,311,575	2	144,230	335,248	735,428	134,000,000	
Stock options	2,504	724,886	6,170,366	0	85,577	202,765	424,812	186,841,117	
Total miscellaneous	13,854	6,678	100,691	0	0	0	0	6,333,880	1.01%
Transaction Bonus	24	730,499	1,090,632	25,014	88,604	158,125	1,067,548	4,686,697	
Deferred Cash Bonus	74	315,155	763,065	573	66,973	138,000	299,623	6,333,880	
Loss of Office	88	372,080	327,852	20,775	156,500	267,550	442,500	1,544,745	
Recruitment incentive	29	535,351	800,968	4,556	87,500	221,799	539,000	3,225,044	
Reallocation expenses	28	121,207	134,532	5,000	38,146	72,000	130,055	500,000	
Other	13,854	24,867	102,144	0	0	10,000	20,000	6,624,000	3.76%
Overall Total	13,854	661,012	2,652,929	0	39,375	253,684	622,868	186,879,117	100%

Table 3. CEO characteristics: tenure, age, gender, and board duality

Panels A-D present the data on gender, age, tenure (in years). N stands for the number of firm-years. The mean is the average value; SD stands for standard deviation. P25 and P75 are the values at the 25% and 75% quartiles, respectively. The exceptionally old CEO of 97 years is Gerald Ashfield who joined London and St Lawrence Investment Company plc in 1952. Data source: Own calculations based on BoardEx, Manifest and annual reports.

Panel A. Male	N	Mean	SD	Min	P25	P50	P75	Max
CEO	13,289	0.981	0.137	0	1	1	1	1
Executive dirs. (excl CEO)	35,463	0.961	0.194	0	1	1	1	1
Non-executive dirs.	62,622	0.946	0.226	0	1	1	1	1
Panel B. Age								
CEO	13,289	53	8	26	47	53	58	97
Executive dirs. (excl CEO)	35,463	50	8	25	44	50	55	86
Non-executive dirs.	62,622	58	8	23	54	59	64	91
Panel C. Tenure								
CEO	13,289	6	7	0	1	4	8	51
Executive dirs. (excl CEO)	35,463	7	6	0	3	5	9	90
Non-executive dirs.	62,622	7	6	0	3	6	9	95

Table 4. Board structure and board committees

This table gives an overview of the board composition and structure and of the board’s committees. In Panel A, N is the number of observations. The mean is the average value; SD stands for standard deviation. P25 and P75 are the values at the 25% and 75% quartiles, respectively. Board size refers to the number of directors on the board. Percentage of executives is calculated as the number of executive directors divided by board size. The bottom row of Panel A shows the percentage of cases where the CEO is also the chairman of the board. Panel B shows the frequency of occurrence of the three main board committees in UK listed firms. The denominator is the number of firm years: 13,845). Panel C gives details on the staffing of the committees. The first row reports the size of the committee. The second row shows the proportion of committees with at least one executive director. The last row shows the average proportion of executives in the committee. Panel D reports the CEO’s presence in the committees. Data source: Own calculations based on BoardEx, Manifest and annual reports.

Panel A

	Mean	SD	Min	P25	P50	P75	Max
Board size	7.89	3.41	1	6	7	10	26
Number of executive dirs.	3.35	2.26	0	2	3	5	18
Percentage of executive dirs	41%	15.0%	0%	25.0%	35.3%	45.5%	100%
Percentage of male dirs.	96%	8%	0%	92.0%	100%	100%	100%
CEO-Chairman duality	13.1%	33.8%	0%	0%	0%	0%	100%

Panel B

Presence of Committee in listed firms (13854 firm-years)	Audit Committee	Nomination Committee	Remuneration Committee
Present	98.0%	80.1%	87.7%
Absent	0.5%	18.4%	10.8%
Unknown	1.5%	1.5%	1.5%

Panel C. Composition of Committee	Audit Committee	Nomination Committee	Remuneration Committee
Average committee size	3.81	4.30	3.80
Executive presence in the committee	17.7%	53.5%	20.2%
Proportion of executives in the committee	2.1%	14.7%	2.3%

Panel D. CEO presence in committees	Audit Committee	Nomination Committee	Remuneration Committee
No	80.7%	54.6%	88.8%
Yes as a Member	13.9%	32.5%	7.8%
Yes as the Chairman	3.9%	11.4%	1.9%
Unknown	1.5%	1.5%	1.5%

Table 5. Ownership concentration

This table shows how ownership concentration has developed over time. The numbers are based on all disclosed ownership stakes of 3% or more for all shareholder categories apart from the directors of whom all shareholdings are reported and included in this table. The share stake concentration of the executive directors includes that of the CEO. The table also shows the share percentages owned by institutions (including banks, insurance companies, investment funds, pension funds), and of other outsiders such as corporations and individuals, and families not related to a director. Data source: Own calculations based on BoardEx, Manifest and annual reports.

%	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	total
N	760	807	939	1078	1063	1103	1344	1386	1409	1398	11412
CEO	1.3%	2.4%	2.8%	3.1%	2.6%	2.6%	2.2%	2.7%	2.6%	2.2%	2.5%
Executive directors (incl. CEO)	2.6%	4.9%	5.5%	6.0%	4.8%	4.8%	4.1%	4.5%	4.9%	4.4%	4.7%
Non-executive directors	0.9%	1.8%	2.1%	2.8%	2.2%	2.2%	2.1%	2.2%	2.4%	2.4%	2.1%
Inside total	3.6%	6.7%	7.5%	8.8%	7.0%	7.0%	6.2%	6.6%	7.3%	6.8%	6.8%
Nominee accounts	0.7%	1.0%	1.1%	1.2%	1.1%	1.1%	1.3%	2.1%	2.2%	2.2%	1.5%
Institutions total	18.2%	19.1%	20.2%	21.6%	22.3%	22.7%	18.0%	20.9%	21.1%	22.3%	20.7%
Bank funds	2.9%	2.0%	1.4%	1.2%	1.5%	1.5%	1.6%	1.7%	1.8%	1.9%	1.7%
Insurance companies' funds	6.5%	6.6%	6.2%	4.4%	3.7%	3.6%	2.5%	2.5%	2.4%	2.4%	3.8%
Investment and mutual funds	8.5%	10.1%	12.1%	15.4%	16.4%	16.9%	13.3%	16.1%	16.4%	17.5%	14.7%
Pension funds	0.3%	0.4%	0.5%	0.7%	0.7%	0.8%	0.6%	0.6%	0.5%	0.5%	0.6%
Individuals and families	5.2%	1.6%	1.6%	1.8%	2.0%	1.8%	1.5%	1.6%	1.4%	1.3%	1.9%
Corporations	9.9%	9.0%	7.6%	6.9%	7.2%	7.1%	6.0%	7.6%	7.9%	9.3%	7.8%
Outside total	34.0%	30.7%	30.5%	31.4%	32.5%	32.7%	26.8%	32.0%	32.7%	35.1%	31.8%

Table 6. Random effects models explaining CEO total compensation

The dependent variable in these random effect models is the natural logarithm of the CEOs' annual total compensation. Performance is measured by return on assets and a market-adjusted stock return (with the FTSE All share index as the market). The definitions of the centrality measures are given in section 3.2. The D following the names of the centrality measures in the column titles refers to centrality measures on the individual director level; C refers to the company level. Gender equals to 1 if the director is male. Tenure is the number of years on the board. Committee membership is a dummy variable that equals 1 if the subject is a member in any of the board's committees. If the CEO is also the chairman, the Chairman-CEO duality variable equals 1. Also included is an interaction term between chairmanship and company size (measured by Total assets in GBP millions). The notice period is the contractual notice in months that a firm has to give to the CEO prior to his dismissal. The proportion of non-executive and female directors is based on the total number of directors. The size of the remuneration consultant is the number of his listed client firms. The ownership concentration data by type of shareholder are the accumulated stakes passing the 3% disclosure threshold. The director ownership concentration data consist of the aggregate of all reported shares. Company financial information is gathered from Datastream. The debt to assets ratio is the long term debt divided by the total assets. Stock price volatility is the variance of the stock prices over the financial year. Four year and twelve industry dummies are also included. Data Source: own calculations based on data from BoardEx, Manifest and annual reports, Thomson Financial, and the PricewaterhouseCoopers ownership database.

Table 6. (Continued)

Centrality measure	Dependent variable: Logarithm of CEO total compensation							
	(1)		(2)		(3)_		(4)	
	Degree (D)		Degree (C)		nCloseness (D)		nCloseness (C)	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	12.4124	0.000	12.3034	0.000	12.4806	0.000	12.2907	0.000
<i>Performance measures</i>								
Return on assets (%)	0.0045	0.000	0.0044	0.000	0.0042	0.000	0.0040	0.000
Market-adjusted stock return	0.0002	0.021	0.0002	0.021	0.0002	0.024	0.0002	0.085
<i>Centrality measure</i>								
Centrality measure	0.0136	0.000	0.0372	0.000	1.7933	0.001	-0.2807	0.032
<i>CEO characteristics</i>								
Gender (male=1)	0.0150	0.865	-0.0127	0.885	-0.0126	0.887	-0.0535	0.589
Tenure (months)	0.0068	0.000	0.0079	0.000	0.0077	0.000	0.0070	0.001
Committee membership (=1)	0.1207	0.000	0.1196	0.000	0.1253	0.000	0.1631	0.000
CEO=Chairman (=1)	-0.2875	0.000	-0.2478	0.000	-0.2669	0.000	-0.2274	0.000
Duality*firm size	0.0153	0.020	0.0136	0.039	0.0146	0.026	0.0133	0.040
Notice period (months)	0.0039	0.164	0.0040	0.152	0.0045	0.111	0.0058	0.048
<i>Board composition</i>								
Proportion nonexecutive directors	0.9046	0.000	0.7637	0.000	0.8625	0.000	0.9157	0.000
Proportion female directors	0.7917	0.000	0.7058	0.000	0.8261	0.000	0.9518	0.000
<i>Remuneration consultant networks</i>								
Degree of remuneration consultant	0.0020	0.000	0.0020	0.000	0.0020	0.000	0.0019	0.000
Consultant network degree*firm size	0.0000	0.039	0.0000	0.031	0.0000	0.047	0.0000	0.843
<i>Ownership concentration</i>								
CEO stock holdings	-0.0052	0.000	-0.0053	0.000	-0.0055	0.000	-0.0067	0.000
Executive directors. stock holdings	-0.0017	0.185	-0.0011	0.409	-0.0014	0.274	-0.0028	0.047
Non-executive dir. stock holdings	-0.0015	0.277	-0.0010	0.462	-0.0012	0.374	-0.0016	0.303
Nominee account block holdings	-0.0042	0.010	-0.0040	0.015	-0.0041	0.012	-0.0011	0.567
Institutional investors' block holdings	0.0020	0.001	0.0018	0.002	0.0017	0.002	0.0009	0.149
Corporations' block holdings	-0.0004	0.602	0.0000	0.963	-0.0002	0.800	-0.0006	0.514
Individuals and families' block holdings	-0.0031	0.057	-0.0030	0.069	-0.0034	0.037	-0.0048	0.008
<i>Firm size, capital structure and risk</i>								
Total assets	0.0001	0.788	0.0002	0.418	0.0001	0.587	0.0010	0.008
Debt to asset ratio	0.0027	0.000	0.0024	0.000	0.0027	0.000	0.0024	0.001
Stock price volatility	-0.0068	0.000	-0.0060	0.000	-0.0072	0.000	-0.0076	0.000
R-squared	0.3484		0.3716		0.3142		0.3157	
Number of observations	6773		6773		6773		5839	

Table 7. Random effects model explaining CEO pay-for-performance sensitive

The dependent variable is the difference between current year total compensation and that of the previous year.

Centrality measure	Dependent variable: change in CEO total compensation							
	(1)		(2)		(3)		(4)	
	Degree (D)		Degree (C)		nCloseness (D)		nCloseness (C)	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	-1412719	0.000	-1369275	0.000	-1215036	0.006	-1130887	0.018
<i>Performance measures</i>								
Return on assets (%)	-336.8	0.905	588.6	0.771	2378.0	0.420	10111.9	0.036
Market-adjusted stock return	685.1	0.263	478.1	0.212	261.6	0.647	-649.6	0.594
<i>Centrality measure</i>								
Centrality measure	7469.2	0.085	3477.3	0.661	-928624.6	0.500	-291071.3	0.491
Centrality measure * Return on asset (%)	206.7	0.486	261.2	0.574	-24585.0	0.652	-24647.7	0.057
Centrality measure * Market-adjusted return	-120.6	0.099	-337.6	0.002	-11408.2	0.315	314.6	0.921
<i>CEO characteristics</i>								
Gender (male=1)	231534.5	0.227	244213.6	0.203	248487.1	0.195	290942.9	0.225
Tenure (months)	18663.4	0.000	19160.1	0.000	19095.0	0.000	24595.3	0.000
Committee membership (=1)	76242.8	0.170	87919.7	0.113	88413.2	0.110	86399.1	0.184
CEO=Chairman (=1)	-1797.7	0.983	-3165.1	0.970	-10541.2	0.899	3074.6	0.976
Duality*firm size	15594.5	0.458	17506.1	0.404	17878.6	0.394	16492.7	0.468
Notice period (months)	4165.1	0.518	4370.5	0.498	4535.1	0.482	5600.3	0.473
<i>Board composition</i>								
Proportion nonexecutive directors	947533.8	0.000	981613.9	0.000	1004398.0	0.000	1167013.0	0.000
Proportion female directors	454863.4	0.209	510939.9	0.159	517574.3	0.152	647428.7	0.126
<i>Remuneration consultant networks</i>								
Degree of remuneration consultant	-204.0	0.608	-74.4	0.853	-84.7	0.831	-270.7	0.542
Consultant network degree*firm size	8.2	0.095	8.7	0.075	9.1	0.062	6.5	0.321
<i>Ownership concentration</i>								
CEO stock holdings	1447.7	0.655	1180.8	0.715	938.2	0.772	353.2	0.930
Executive directors. stock holdings	6100.9	0.070	6244.9	0.064	6061.9	0.072	7419.3	0.072
Non-executive dir. stock holdings	-1063.8	0.749	-1302.4	0.697	-1709.1	0.609	-2034.7	0.639
Nominee account block holdings	1069.5	0.798	1326.2	0.751	736.5	0.860	2227.8	0.677
Institutional investors' block holdings	2399.8	0.106	2205.6	0.137	2091.0	0.156	2617.5	0.125
Corporations' block holdings	-3280.5	0.099	-3129.5	0.117	-3320.5	0.095	-4262.1	0.071
Individuals and families' block holdings	950.8	0.814	495.3	0.902	294.4	0.942	-224.9	0.962
<i>Firm size, capital structure and risk</i>								
Total assets	-113.8	0.781	-123.6	0.763	-156.9	0.702	542.5	0.517
Debt to asset ratio	-816.7	0.537	-802.6	0.545	-578.9	0.662	-1003.8	0.536
Stock price volatility	8.5	0.997	-221.9	0.918	-357.1	0.868	-67.8	0.979
R-squared	0.0261		0.0270		0.0271		0.0331	
Number of observations	5131		5131		5131		4384	

Table 8 Heckman sample selection models explaining CEO total compensation

The table below shows the results from the regression equation of the Heckman sample selection equations.

Centrality measure	Dependent variable: Logarithm of CEO total compensation							
	(1)		(2)		(3)		(4)	
	Degree (D)		Degree (C)		nCloseness (D)		nCloseness (C)	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	11.6193	0.000	11.7811	0.000	11.7591	0.000	12.3836	0.000
<i>Performance measures</i>								
Return on assets (%)	0.0065	0.000	0.0064	0.000	0.0065	0.000	0.0069	0.000
Market-adjusted stock return	0.0002	0.166	0.0002	0.116	0.0001	0.509	0.0002	0.355
<i>Centrality measure</i>								
Centrality measure	0.0385	0.000	0.0842	0.000	2.2339	0.000	-0.9001	0.000
<i>CEO characteristics</i>								
Gender (male=1)	0.1721	0.031	0.1091	0.166	0.2025	0.014	0.0749	0.417
Tenure (months)	-0.0017	0.353	0.0004	0.804	-0.0001	0.945	0.0025	0.217
Committee membership (=1)	0.1533	0.000	0.1476	0.000	0.2096	0.000	0.2563	0.000
CEO=Chairman (=1)	-0.3343	0.000	-0.2244	0.000	-0.3289	0.000	-0.2396	0.000
Duality*firm size	0.0359	0.000	0.0361	0.000	0.0468	0.000	0.0396	0.000
Notice period (months)	-0.0022	0.400	-0.0031	0.224	-0.0008	0.769	0.0025	0.403
<i>Board composition</i>								
Proportion nonexecutive directors	1.6030	0.000	1.2854	0.000	1.7617	0.000	1.7716	0.000
Proportion female directors	1.0307	0.000	0.8281	0.000	1.2423	0.000	1.1883	0.000
<i>Remuneration consultant networks</i>								
Degree of remuneration consultant	0.0032	0.000	0.0028	0.000	0.0036	0.000	0.0031	0.000
Consultant network degree*firm size	0.0000	0.294	0.0000	0.248	0.0000	0.074	0.0000	0.416
<i>Ownership concentration</i>								
CEO stock holdings	-0.0035	0.012	-0.0043	0.002	-0.0055	0.000	-0.0089	0.000
Executive directors. stock holdings	-0.0029	0.041	-0.0001	0.951	-0.0019	0.187	-0.0014	0.366
Non-executive dir. stock holdings	-0.0087	0.000	-0.0062	0.000	-0.0100	0.000	-0.0096	0.000
Nominee account block holdings	-0.0045	0.013	-0.0034	0.054	-0.0051	0.006	-0.0028	0.184
Institutional investors' block holdings	-0.0015	0.019	-0.0015	0.011	-0.0033	0.000	-0.0047	0.000
Corporations' block holdings	-0.0017	0.039	0.0004	0.611	-0.0010	0.251	-0.0019	0.037
Individuals and families' block holdings	-0.0115	0.000	-0.0101	0.000	-0.0144	0.000	-0.0134	0.000
<i>Firm size, Capital structure and risk</i>								
Total assets	-0.0003	0.210	-0.0002	0.391	-0.0003	0.221	0.0028	0.000
Debt to asset ratio	0.0032	0.000	0.0028	0.000	0.0038	0.000	0.0039	0.000
Stock price volatility	-0.0026	0.002	-0.0006	0.474	-0.0041	0.000	-0.0061	0.000
P-value chi ²	0.000		0.000		0.000		0.000	
Number of observations	6564		6564		6564		5630	

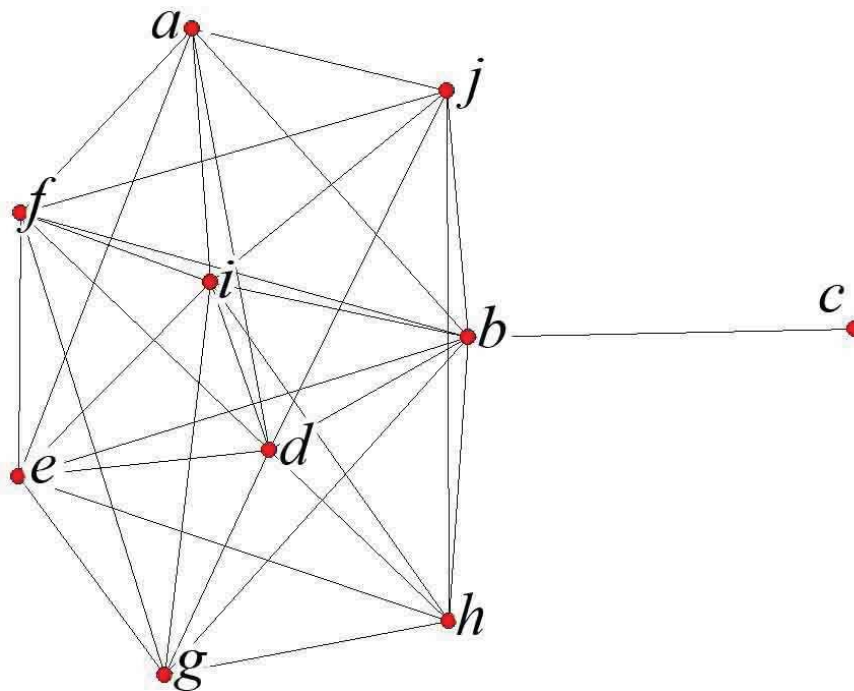
Appendix A. Variable definitions

Variable	Description	Source
<i>Remuneration</i>		
Total	Sum of all remuneration items listed below.	Annual reports/Manifest/BoardEx
Salary	Fixed remuneration paid to executive directors	idem
Fee	Fixed remuneration mainly paid to non-executive directors.	idem
Bonus	Performance-related remuneration paid out annually	idem
Equity-based compensation	Remuneration paid as restricted shares and stock options (valued by means of Black-Scholes formula)	idem
Miscellaneous	Sum of transaction bonus, deferred cash bonus, severance pay, recruitment incentive and relocation fee	idem
Other	Sum of rare remuneration components such as e.g. medical insurance	idem
<i>Performance indicator</i>		
Return on assets	Net income prior to financing costs divided by total assets then multiplied by 100.	Datastream
Market-adjusted stock return	Annual stock return minus the return of the FT All Share index	Datastream
<i>Centrality measure</i>		
Degree (ndegree)	Number of links of a vertex.(normalized degree)	Own calculations based on Annual reports/Manifest/BoardEx
Closeness (ncloseness)	The inverse of the geodesic distance from a vertex to all reachable vertices. (normalized closeness)	idem
Betweenness (nbetweenness)	The probability that a specific vertex is on the geodesic path between any other two vertices. (normalized betweenness)	idem
Eigenvector centrality (neigenvector)	The aggregation of centralities of adjacent vertices. (normalized eigenvector)	idem
<i>CEO information</i>		
Gender (male)	Equals 1 if male and 0 if female.	idem
Tenure	Number of years in current position	idem
Committee membership	Equals 2 if chairman of a specific committee, 1 if member, 0 if not member.	idem
Chairmanship-CEO duality	Equals 1 if the target CEO is also the chairman of the board, 0 otherwise.	idem
Notice period	The notice period is the contractual notice in months that a company has to give to the CEO before his dismissal.	idem
<i>Board composition</i>		
Prop. Nonexecutives directors	Proportion of non-executive directors on board (denominator is total board size)	idem
Prop. female directors	Proportion by female directors on board (denominator is total board size)	idem
<i>Remuneration consultant networks</i>		
Size remuneration consultant network	The number of firms to which a remuneration consultant gives advice	idem
<i>Ownership structure</i>		
CEO stock holding	The CEO's share stake.	idem
Executive stock holding	The sum of all executive directors' stock holdings.	idem
Non executive stock holding	The sum of all non-executive directors' stock holdings.	idem
Nominee account block holding	The sum of the share stakes of 3% or more on nominee accounts.	idem
Institutional block holding	The sum of the share stakes of 3% or more held by banks, insurance companies, pension funds and investment, and mutual funds.	idem
Corporate block holding	The sum of the share stakes of 3% or more held by industrial or commercial firms.	idem
Individual block holding	The sum of the share stakes of 3% or more held by individuals or families not related to a director.	idem

<i>Firm size, Capital structure and risk</i>		
Total assets	Sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets, except for financial companies.	Datastream
Debt to asset ratio	Sum of short term debt, current portion of long term debt and long term debt divided by total assets then multiplied by 100, except for financial companies.	idem
Stock price volatility	The stock's average annual price movement to a high and low from a mean price for each year: $(\text{high}-\text{low})/(\text{high}+\text{low})$.	idem

Appendix B. A Director Network Graph

This figure is a hypothetical director network graph used for centrality illustration.



An example of director network

These tables explain how director networks are mathematically recorded and calculated. Panel A is an overview on the example network. Panel B is the matrix used to record the network. Panel C calculated the geodesic distance between each pair of directors. Panel D shows the basic centrality measures calculated for this example network.

Panel A : Example of a network

Company	Director	Company	Director
1	a	5	a
		5	b
2	b	5	j
2	c	5	f
		5	d
3	a		
3	e	6	b
3	f	6	g
		6	d
4	h	6	e
4	d	6	h
4	i	6	i
4	j		

Panel B : Matrix representation of above table.

	a	b	c	d	e	f	g	h	i	j
a	0	1	0	1	1	1	0	0	1	1
b	1	0	1	1	1	1	1	1	1	1
c	0	1	0	0	0	0	0	0	0	0
d	1	1	0	0	1	1	1	1	1	1
e	1	1	0	1	0	1	1	1	1	0
f	1	1	0	1	1	0	1	0	1	1
g	0	1	0	1	1	1	0	1	1	0
h	0	1	0	1	1	0	1	0	1	1
i	1	1	0	1	1	1	1	1	0	1
j	1	1	0	1	0	1	0	1	1	0

Panel C : Geodesic distances

	a	b	c	d	e	f	g	h	i	j
a	0	1	2	1	1	1	2	2	1	1
b	1	0	1	1	1	1	1	1	1	1
c	2	1	0	2	2	2	2	2	2	2
d	1	1	2	0	1	1	1	1	1	1
e	1	1	2	1	0	1	1	1	1	2
f	1	1	2	1	1	0	1	2	1	1
g	2	1	2	1	1	1	0	1	1	2
h	2	1	2	1	1	2	1	0	1	1
i	1	1	2	1	1	1	1	1	0	1
j	1	1	2	1	2	1	2	1	1	0

Panel D : Centrality measures

	Degree	Closeness	Eigenvector	Betweenness
a	6	12.000	0.299	0.167
b	9	9.000	0.379	8.933
c	1	17.000	0.054	0.000
d	8	10.000	0.372	0.933
e	7	11.000	0.336	0.567
f	7	11.000	0.336	0.567
g	6	12.000	0.299	0.167
h	6	12.000	0.293	0.367
i	8	10.000	0.372	0.933
j	6	12.000	0.293	0.367

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