Paid for connections or too connected to be good? Social Networks and Executive and Non-Executive Directors Compensation

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ABSTRACT

We construct a social network that comprises of 4,279 UK firms and 24,685 directors and find that measures reflecting the centrality and dyadic constraint of the directors within their network of interlocking directorship ties exhibit significant association with directors' pay, after controlling for other economic determinants of compensation. Chief and other senior executive directors with higher centrality and lower dyadic constraint earn higher compensation. In contrast, Chairmen and other non-executive directors with larger networks and lower dyadic constraint earn lower compensation. Executive directors are rewarded for the resources they bring to a firm, through their networks, while non-executive directors whose connections are more constrained earn higher compensation since their relative isolation is perceived as an indication for their independence and superior monitoring capabilities. We also find that the predicted component of compensation, arising from these social characteristics, has a statistically significant association with future stock market performance and valuation.

JEL Classification : G30, G32, J33, L22, M41.

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1. Introduction

Social networks are an important element of corporate governance. For instance, more socially connected directors award their CEOs higher compensation (Barnea and Guedj 2007) and the more connected inside and outside directors are, through other directorships, also increases the level of CEO compensation (Larcker et al 2005). The purpose of this paper is to study whether social network measures exhibit an association with executive and non-executive directors' compensation and whether firms with better connected directors have better or worse future performance.

We find that measures reflecting different aspects of the connectivity of directors are associated with directors' compensation. We use various social network constructs to measure these characteristics, but we focus on closeness centrality and dyadic constraint in our main analysis. Closeness measures how central is an actor in a network. Dyadic constraint is a measure of the degree to which two actors who are connected to a third party are also connected. In the context of inter-board networks, such connections compromise the directors' potential brokerage capabilities (Burt, 2005). In particular, we find that executive directors, such as CEOs, CFOs and other senior managers, with larger networks and lower dyadic constraint earn higher compensation. This finding is consistent with directors being rewarded for providing resources to their firms by exploiting position in the social network. In contrast, non-executive directors with larger networks and lower dyadic constraint earn lower compensation. This finding corresponds well with the expected monitoring role of non-executive directors. Directors who are less centrally connected and whose connections are more constrained earn higher compensation because they are perceived as being more independent. In addition, this finding is compliant with the approach that emphasizes power relations between the directors and the corporation.[1] Hiring a non-executive director whose connections are constrained would increase the potential power of the corporation over that individual, as, *ceteris paribus*, she would be more dependent on that connection. These results hold both across and within firms, suggesting that even within a firm directors are compensated differently according to their social network position.

Next, we consider whether the predicted component of compensation arising from the social network measures is correlated with future operating and stock market performance. We find supporting evidence with respect to stock market performance, as captured by stock returns and market-to-book ratios, and future sales growth. Future return on assets is not correlated with the predicted component. These results hold even after controlling for past firm performance and therefore for the endogeneity of the director's selection decision. Collectively, our results suggest that executive directors are rewarded for being centrally connected while non-executive directors are rewarded for having relatively constrained and mediated social connections. Moreover, the resources and monitoring services, for which directors are compensated, are associated with future superior performance.

The remainder of the paper is organized into five sections. In section 2, we review the prior empirical literature on director compensation, social networks and performance. In section 3, we describe the sample and define the variables. In section 4, we document the association between the social network measures and compensation, the association between future performance and the predicted component of compensation and the robustness of the results to several sensitivity tests. Finally, section 5 concludes.

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[1] For notable examples, see Useem 1993; Davis 1991; Mizruchi 1988.

2. Literature Review and Hypotheses

From a corporate governance perspective, directors perform two functions (Adams and Ferreira 2007, Raheja 2005). First, directors monitor management on behalf of the shareholders (Fama and Jensen 1983) and it has been argued that monitoring by board of directors could reduce agency costs and improve firm performance (Fama 1980, Zahra and Pearce 1989). Second, directors provide resources to the firm (Pfeffer and Salancik 1978, Boyd 1990). These resources can help reduce dependency between the firm and external contingencies (Pfeffer and Salancik 1978), reduce uncertainty (Pfeffer 1972), lower transaction costs (Williamson 1984) and thereby improve a company's performance.

The agency and resource dependence views, described above can provide a framework of what determines a firm's demand for directors and thereby their compensation. Agency theory and the monitoring role suggest that director's compensation is going to be higher the better monitoring she is going to provide. Resource dependence theory and the strategic advisor role suggest that a director's compensation is going to be higher the more valuable resources the director can provide. We use social network measures, at the director level, as proxy for the value of resources and the ability of monitoring. Directors that have a more central position in their networks of inter-board connections and exhibit lower dyadic constraint provide legitimacy improving the social status of a firm (Selznick 1949), link the firm to other important entities (Hillman et al 2001), facilitate access to outside financing (Mizruchi and Stearns 1988), help in strategic decision making (Lorch and MacIver 1989) and provide information, expertise and advice (Lorch and MacIver 1989, Mintzberg 1983). Therefore, we hypothesize that these directors earn a higher compensation.

Whether directors that are more central to the network and exhibit lower dyadic constraint will also prove to be more capable monitors is not clear. On the one hand, such individuals are likely to be more experienced and more reputable. Therefore, by having relevant skills and through risking their reputations, they may provide effective monitoring of the firm's executive layer. However, these individuals will be less independent. By having central locations in their social networks, it may be hard for them to be effective monitors of people to which they are directly or very closely connected (Barnea and Guedj 2007; Larcker et al 2005). Raheja (2005) argues that executive directors are an important source of firm-specific information but that they have distorted incentives due to private benefits and lack of independence from the CEO. As a result, directors whose position is less central and is more constrained may be more capable of raising an independent voice at board meetings and therefore serve as effective monitors. Since the monitoring role is expected to be performed mainly by non-executive directors, we expect that, for executive directors, the resource provision role will overwhelm the monitoring role, thereby predicting a positive association between compensation and centrality and a negative association between dyadic constraint and compensation. For non-executive directors, it is not clear ex ante whether centrality and dyadic constraint will exhibit a positive or negative association with compensation. Moreover, the danger of leakage of competitive information is going to be higher in the case of non-executive directors who are well-connected, further suggesting a negative (positive) relation between compensation and centrality (dyadic constraint). As a result, the sign of the correlation will depend on whether less centrally connected and more constrained directors are perceived as better monitors, if the monitoring role carries more weight compared to the advising role and if boards consider the importance of protecting proprietary information. Hence, our first two hypotheses consist of one directional and one non-directional:

H_{1a}: Compensation of executive directors is positively associated to directors' network centrality and negatively to directors' network constraint.

H_{1b}: Compensation of Non-executive directors is associated to directors' network centrality and constraint.

Studies have also addressed whether board characteristics that proxy for lower agency costs or more valuable resources are associated with future performance. However, the results of these studies are mixed and difficult to interpret for policymaking (Hermalin and Weisbach 2003). MacAvoy et al. (1983), Hermalin and Weisbach (1991), Mehran (1995), Klein (1998), and Bhagat and Black (2002) all report insignificant relationships between accounting performance measures and the fraction of outside directors on the board. Hermalin and Weisbach (1991) and Bhagat and Black (2002) find that there is no noticeable relation between the proportion of outside directors and Tobin's Q. Finally, Bhagat and Black (2002) examine the effect of board composition on long-term stock market and accounting performance. Once again, they do not find any relation between board composition and performance.

In contrast, Rosenstein and Wyatt (1990) examine the stock price reaction on the day of the announcement that outside directors will be added to the board. They find that on average there is a statistically significant 0.2 percent increase in stock prices in response to the announcement of these appointments. Yermack (1996) examines the relation between Tobin's Q and board size on a sample of large U.S. corporations, controlling for other variables that are likely to affect Q and finds that there is a significant negative relationship between board size and Q. Finally, Core et al (1999) find that firms with greater agency problems, as reflected by excess CEO compensation, perform worse.

If compensation is a function of the social network position of a director then this may have performance implications. If the director is compensated for providing resources to the firm or lowering agency costs then this may result in the firm having better future performance. However, the endogeneity of the selection process for directors is clear. It may be the case that better performing firms choose better directors that, consequently, get compensated for the high quality services they can provide. Therefore, it is important to control for past performance to attenuate this endogeneity. Using lagged performance in a cross-sectional model provides a way to account for historical factors that cause current differences in performance that are difficult to account in other ways (Wooldridge 2001). In addition, even if compensation reflects the quality of directors' services it is not clear that this will translate to superior future performance. If the profitability or valuation of the company already reflects the benefits due to the resources or monitoring provided by directors, then future performance (after controlling for past performance) is going to be unrelated to these services. Our third hypothesis is the following:

H_2: The predicted component of director compensation due to her social network will be positively associated to future firm performance.

3. Sample, Variables and Research Design

3.1. Sample

Our sample includes virtually the entire census of companies listed in London Stock Exchange (LSE) Main and Alternative Investment Market (AIM). Both directorship and compensation data are obtained from Hemscott, with other completions from BoardEx. All stock market and financial data are collected from DataStream and Worldscope. We calculate the network measures by taking into account 4,279 firms, 24,865 directors and 114,201 directorships-years (Table 1, Panel A). The period of study is 2000-2007. After excluding observations with missing or zero compensation the sample includes 3,478 firms, 18,130 directors and 79,476 directorships-years. These firms span a wide range of industries and range from very small firms (market value 100m pounds) to very large (market value 158b pounds).

Total compensation for each director is the sum of salary, bonus, options granted, pension benefits and other benefits. Panel B shows statistics for total compensation. Average compensation is 152,000 pounds, while median compensation is just 43,000. The spread of compensation is very wide with standard deviation being 256,758. Compensation is very persistent over time with a first order autocorrelation coefficient of 0.96. Panel C presents average compensation by director category. We obtain director classification by Hemscott, although in some instances it is hard to classify unambiguously a director.[2] As expected, CEOs have the highest compensation with 441,000 pounds, followed by COOs, other senior executives and CFOs. Chairs of boards have an average compensation of 113,000 pounds and Non-executive directors 49,000 pounds. These descriptive statistics provide also a validity check for the director classification since Chairmen and other Non-executive directors should earn lower compensation than Chief and other executive directors.

[2] For example, for some companies the Chairman might also be the CEO of the firm. Although for the vast majority of UK companies this is not the case (<5%), we might be misclassifying some directors to other categories. However, we do not expect this misclassification to bias our results in one direction but rather to add noise, reducing the power of the tests. We classified any directors as CEOs in case they had a dual function being both a CEO and a Chairman.

3.2. Network Variables

For our main analysis, we use two network measures, one reflecting the centrality of the director in the network and one reflecting the transitivity of the director. We also use other network measures to test the robustness of our results and we discuss those measures in the sensitivity tests section.

The operational measure related to connectivity is *closeness* centrality. Closeness centrality is calculated as the inverse of the mean geodesic distance (i.e. the shortest path) between a vertex v and all other vertices reachable from it (see Appendix). The higher this measure is, the more central is the director and usually the better access to information she has i.e. information has to travel through less mediators to reach a person with high closeness centrality that to an actor with low closeness centrality (Stephenson and Zelen 1989). The measure is normalized and ranges from zero to one. Average closeness is 0.106 with a standard deviation 0.046 (Panel B). The measure exhibits high persistence with a first order autocorrelation coefficient of 0.8. Average closeness does not differ significantly across director categories although CEOs, Chairmen and Non-executives have moderately higher closeness (Panel C).

Social network theory postulates that personal networks of actors tend to be transitive (Granovetter 1973): a director's friends are likely to become friends as well (Uzzi 1997). Transitivity is a tendency that two actors who are connected to a third party form mutual relationships over time. The main reason why triads, i.e., triples of actors, tend to be transitive is that actors strive to reduce inconsistencies and uncertainties in their social and cognitive worlds, and attempt to establish balances in interpersonal relationships (Heider

1964; Holland and Leinhardt 1976). Empirical studies have consistently found that the principle of transitivity applies in about 70-80 percent of all cases across a variety of small group situations (Robinson and Balkwell 1995). The operational measure for transitivity is *dyadic constraint*. Dyadic Constraint is based on Ronald Burt’s (1992) concept of structural holes, which postulates that redundancy in one’s ties lowers the potential efficacy of those ties. For example, if director A is interlocked with director B and director C, that connection would be less effective for director A if directors B and C would also be interlocked, as A is more likely to receive similar information from B and C. In addition, redundancy in one’s connections may constrain one’s actions because information regarding such actions flows in paths that are not independent of one’s direct influence (e.g. B and C can exchange information regarding A). The measure ranges typically between zero and one, but can be higher than 1 (for detailed explanation about the measure see appendix). Average dyadic constraint is 0.38 with a standard deviation of 0.21 (Panel B). The measure exhibits high persistence with a first order autocorrelation coefficient of 0.9. Social networks change slowly over time and as a result, both network measures exhibit small changes from year to year. Average dyadic constraint is higher for executive directors compared to Non-executive (Panel C).

3.3. Research Design

To test whether there is an association between compensation and network characteristics we use the following model:

$$Compensation_{ijt} = f(Social\ network_{it}, Controls_{ijt}) \quad (1)$$

where $\text{Compensation}_{ijt}$ is the total compensation for director i, directorship j at year t and $\text{Social network}_{it}$ is either the closeness or dyadic constraint measure for director i at year t. We include several control variables to capture economic determinants of directors' pay. The size of the firm, which is calculated as the logarithm of the market value of equity, is expected to be positively correlated with compensation since larger firms are more complex and thus require more skilled executives (Rosen 1992, Gabaix and Landier 2008). We also control for the market-to-book ratio (MTB), since this measure reflects growth opportunities, and we expect to be positively related to compensation (Smith and Watts 1992). Moreover we include return-on-assets (ROA), as a measure of profitability, 1-year stock price return and 1-year sales growth, as measures of performance (Core et al. 2008). Number of board members and tenure of the director are also included in the estimation since larger boards may be more entrenched and therefore approve higher compensation packages (Yermack 1996), and directors with more tenure will be more experienced and knowledgeable and as a result get higher compensation (Murphy 1999).[3] We also control for the gender of the director and we include 5 index membership, 44 industry indicators and year fixed effects. Finally, we cluster standard errors at the company level to mitigate serial and cross-director correlation within a firm.

To test whether there is an association between the predicted component of compensation and subsequent performance we first extract the predicted compensation from model 1.

[3] By controlling for tenure we are essentially biasing against our predictions since the tenure of a directors will partly reflect his social status. Therefore, our tests are conservative in nature.

Therefore, we estimate model 1 for 2000-2001 (estimation period) and we test the predictions in period 2002-2007 (test period).[4] The predicted compensation for firm i at year t is:

$Pcomp_{it}$ = Average (b_{CEO} x Social $network_{jit}$, b_{CFO} x Social $network_{jit}$, b_{EXEC} x Social $network_{jit}$, b_{COO} x Social $network_{jit}$, b_{CHAIR} x Social $network_{jit}$, b_{NONEXE} x Social $network_{jit}$) (2)

where b is the absolute value[5] of the estimated coefficient from model 1 for each category of directors and Social $network_{it}$ is either closeness or dyadic constraint for director j of firm i at year t.

After estimating the predicted component, we average this variable over the years used for estimation to construct a firm level variable. Then we include this firm-level variable in a regression where the dependent variable is future performance.

$Performance_{it}$ = f($Pcomp_{it-1}$, $Performance_{it-1}$, Controls) (3)

where $Performance_{it}$ is average stock return, MTB, ROA or sales growth for firm i over 2002-2007 and $Performance_{it-1}$ is average stock return, MTB, ROA or sales growth for firm i over 2000-2001. Each firm enters only once in the regression. By including lag performance, we control for other potential omitted variables that can affect performance of a company persistently. While we do not expect stock returns to be serially correlated, we expect MTB, ROA and sales growth to exhibit high persistence over time.

4. Results

4.1. Association between compensation and network measures

[4] We also used 2000-2004 as the test period and 2005-2007 as the estimation period. The results were qualitatively similar to the ones reported here.

[5] We take the unsigned value of the estimated coefficients because for non-executive directors there are strong reasons to expect a negative coefficient.

Table 2 Panels A, B and C present correlation matrices for each director category. For all types of executive directors, compensation exhibits a strong positive correlation with closeness (0.29-0.38) and a strong negative correlation with dyadic constraint (0.40-0.52). In contrast, for a Chairman and a non-executive director these relations are much weaker at 0.07, 0.03 for closeness and -0.08, -0.04 for dyadic constraint. Compensation is positively associated to MTB, ROA, firm size, stock return, and board size and director tenure. Closeness also exhibits a positive association with MTB, ROA, firm size and board size. In contrast, dyadic constraint exhibits a negative association with these variables. These relations show that it is important to control for firm characteristics when testing the relation between social network measures and compensation.

Figures 1.1-1.6 show the total compensation by director type for portfolios of directors that are constructed according to the closeness and dyadic constraint measures. Directors are assigned to ten portfolios where portfolio 1 is the portfolio with the lowest values for closeness and dyadic constraint and portfolio 10 is the portfolio with the highest values for these measures. Figures 1.1-1.4 show that for CEOs, CFOs, COOs and other executive directors, compensation increases monotonically with closeness and decreases monotonically with dyadic constraint. For example, for portfolio one, CEO compensation is 200,000 pounds while for portfolio ten, compensation is close to 1m pounds. In contrast, Figures 1.5 and 1.6 show that there is no clear pattern between Chairman and Non-executive compensation and the network measures. For instance, Non-executive directors in portfolios 1 and 10 earn almost 40,000 pounds each.

Table 3 presents the results from estimating the association between compensation and the social network measures (model 1). In Panel A, closeness exhibits a significant positive association with compensation for CEOs, CFOs and other senior executives. One standard deviation increase in closeness increases CEO compensation by 15,000 pounds, CFO compensation by 6,000 pounds and senior executive compensation by 16,000 pounds. In contrast, the coefficient on closeness is negative and significant for Chairmen and non-executive directors. A one standard deviation increase in closeness decreases a Chairman's compensation by 7,000 pounds and a non-executive director's compensation by 3,500 pounds.

In Panel B, dyadic constraint exhibits a significant negative association with compensation for CEOs and CFOs. One standard deviation increase in dyadic constraint decreases CEO compensation by 27,000 pounds and CFO compensation by 8,000 pounds. In contrast, the coefficient on dyadic constraint is positive and significant for Chairmen and non-executive directors. One standard deviation increase in dyadic constraint increases a Chairman's compensation by 14,000 pounds and a Non-executive director's compensation by 11,000 pounds.

The coefficients on some control variables do not have the expected signs. Although the univariate correlation between compensation and ROA is positive, in the multivariate specification the coefficient is negative and significant. Moreover, the coefficient on stock return is negative and significant. However, such inconsistent coefficients have been documented empirically in other studies as well (Barbet et al 1998, Core and Guay 1999, Core et al 2008, Ferri and Maber 2008, Yermack 1995). Firm size and director tenure have significant positive coefficients, as expected. Finally, male non-executive directors earn higher compensation.

The above results show that social network measures can explain variation in compensation across firms. Another question is whether these measures can also explain variation in director compensation within a firm-year. Such a research design would provide evidence about whether a firm differentiates between its directors in setting their compensation. Moreover, it could address any concerns that the social network measures are associated with firm level characteristics that affect director compensation and have not been controlled for. In other words, if the network measures have explanatory power even within a firm-year, this would imply that our results are not driven by a correlated omitted firm variable.

Table 4 shows within firm-year estimation and therefore excludes any variables that are at the firm level. We group together CEOs, CFOs, COOs and other executive directors and we include dummy variables for the first three categories. Similarly, we group together a Chairman and a non-executive director and we include a dummy variable for the first category. For executive directors closeness and dyadic constraint are positively and negatively associated with compensation respectively. Both coefficients are statistically significant at 1% level. This provides evidence that firms compensate differentially their executive directors according to their social position. In contrast, for non-executive directors' closeness centrality and dyadic constraint are negatively and positively associated with compensation, respectively. Non-executive directors with higher closeness and lower dyadic constraint have lower compensation even within the same firm-year. Again, both coefficients are statistically significant at 1% level. Male directors and directors with more experience earn higher compensation. In summary, the centrality and constraint of a director in a social network explain both intra and inter-firm variation in director compensation.

To investigate further how social ties affect directors' compensation we perform a portfolio analysis, where we split firms based on characteristics that proxy for the level of agency costs. Large corporations are more likely to have diffuse ownership that separates effectively ownership of residual claims from corporate decision-making (Dey, 2008). Also, larger firms have a greater scale of operations, which provides greater opportunities for managers to shirk (Demsetz and Lehn, 1985). Therefore, we expect larger firms to have higher agency costs, higher demand for monitoring and thereby directors' compensation to be more negatively related to their dyadic constraint. Growth firms are another category that may have relatively high agency costs. First, firms that face significant growth opportunities will have more proprietary information that they would like to protect and conceal from competitors, thereby leading to a demand for independent non-executive directors. Second, growth companies, because of innovative nature of their operation, tend to demand directors that have firm-specific information (Adams and Ferreira, 2007; Linck et al, 2008) thereby increasing the costs of monitoring for directors. These two effects strengthen the relation between dyadic constraint and compensation. Finally, the more profitable companies will have more agency costs: managers in these firms are more likely to have greater discretion on how to employ the generated profits thereby potentially deploying the capital in suboptimal activities (Jensen, 1986). For firms with higher ROA, we expect the demand for effective monitoring to be higher and as a result to find a stronger association between compensation and dyadic constraint.

Table 5 presents multivariate models estimating the relation between dyadic constraint and compensation for directors that Chair the board and other non-executive directors. The models control for firm size, MTB, ROA, board size, an indicator variable if the director is male, industry fixed effects, index membership indicators and year fixed effects. We omit all the other control variables that were included in Table 3 to maximize the number of observations used. However, we also performed the analysis with the full set of control variables and we reached the same results. The resulting sample includes approximately 75,000 observations. Each year we assign a firm to one of 5 portfolios according to its size, its MTB or its ROA. Out of the 60 coefficients reported in Table 5 all but one have the expected positive coefficient and 58 of them are significant at the 5% level. All the coefficients increase as one moves from portfolio one (low size, MTB or ROA) to portfolio 5 (high size, MTB or ROA). In most of the cases, there is also a monotonic increase in the coefficients. The difference in the coefficients for the two extreme portfolios is always significant at 1% level of significance. For directors who serve as Chairs of the board, the sensitivity of compensation to dyadic constraint increases from portfolio one to portfolio five by a factor of 3, 2.3 and 2.7 for portfolios constructed based on size, MTB and ROA, respectively. The association in terms of pounds increases by factors of 7, 3 and 5, respectively. The same pattern is detected for non-executive directors. Overall, these results confirm that firms with higher agency costs have a higher demand for monitoring and therefore provide higher compensation to non-executive directors that are not central social actors.

4.2. Association between predicted compensation and subsequent firm performance

Table 6 shows estimates from regressions of subsequent operating and stock market performance on the predicted compensation component from network variables and past performance. In Panel A, we use the predicted compensation from closeness to estimate the relation with future performance. If the predicted component of compensation reflects the superior information and resources that these executives bring to the firm and the decrease in agency costs due to better monitoring then we should find a significant positive coefficient on predicted compensation. The results are consistent with these predictions for future stock market performance and valuation. The coefficients on predicted compensation are 0.056 and 0.20, and significant at 1% level, one tailed test, respectively. One standard deviation increase in predicted compensation increases future annual stock return by 3.35% and MTB by 0.12 points. Therefore, the association is also economically significant. Predicted compensation has an insignificant association with ROA and a positive significant association with 3-year sales growth.[6] Both ROA and MTB exhibit high persistence with a coefficient of 0.5 on past performance. Sales growth also exhibits positive persistence (0.29) while stock returns, as expected, no persistence (0.003).

In Panel B, we use the predicted compensation from dyadic constraint to estimate the relation with future performance. If the predicted component of compensation reflects the independence of non-executive directors and therefore lower agency costs and/or the resources and advices offered by executives then we should find a significant positive coefficient on predict compensation. The results are consistent with these predictions for both future stock market performance and MTB. In the stock return and MTB specifications, the coefficients on predicted compensation are 0.085 and 0.272, both significant at 1% level, one tailed test. One standard deviation increase in predicted compensation increases future annual stock return by 2.72% and MTB by 0.10 points. In the ROA specification, the coefficient on

[6] We also estimate the relation between the predicted component of compensation and future performance separately for executive and non-executive directors. We find similar results for both categories, with predicted compensation to be significantly positively associated with MTB, stock returns and sales growth at 5% level.

predicted compensation is insignificant. Predicted compensation and sales growth exhibit again as expected a significant positive relation. In sum, the above results provide evidence that the compensation directors get for the resources and monitoring they provide is associated with future stock market performance, valuation and sales growth. This result holds even after controlling for past performance by using a lag value of the dependent variable as a determinant of future performance.

4.3. Sensitivity tests

4.3.1. Log compensation

Many compensation studies have used log-transformed compensation instead of the dollar level of compensation as dependent variable. Therefore, we replace the dollar value of compensation with its natural logarithm to assess the robustness of our results. All our results were found to be qualitatively similar, with the exception that closeness was negatively but not significantly associated with non-executive compensation and dyadic constraint was found to be negatively but not significantly associated with CFO and other executive compensation. For a one standard deviation increase in closeness CEO, CFO and other executive compensation increases by 6%, 5% and 6% respectively. Chair compensation decreases by 3.6%. For a one standard deviation increase in dyadic constraint, CEO and COO compensation increase by 5.5% and 5.7% respectively. Chair and non-executive compensation decrease by 8% and 6.1% respectively. With respect to subsequent performance, the results were very similar and the predicted component of compensation was significantly associated with future stock returns, MTB and sales growth, at the 2% level of statistical significance.

4.3.2. Alternative network measures

Instead of using closeness as a measure of centrality and dyadic constraint as a measure of transitivity we use betweeness and K-core respectively. Betweeness centrality is the ratio between paths connecting two directors that pass through a particular director and between all other paths that connect the two directors. Again, the measure is normalized (range 0-1). Betweeness indicates how much information flows 'through' a director and, consequently, the degree to which that director can serve as a broker between pairs of other actors. K-core is an area of the overall network (a subnetwork) where each director has at least k immediate neighbors (Seidman 1983). The higher the k of a director, the better connected are her neighbors and, consequently, the less brokerage opportunities she will have, her information will be relatively less scarce and her actions will be more constrained (Moody and White 2003). We divide this measure by the director's degree. The closer the result is to 1, the less relative advantage the director's information is likely to have. When using those measures all our results remained unchanged, but several of them are even more statistically significant.

4.3.3. LSE vs AIM

In the main analysis above, we use firms listed in the LSE (London Stock Exchange, which is the largest and longest-standing UK stock exchange, also referred to as the 'Main Market') and the Alternative Investment Market (AIM), which is a sub-market of the London Stock Exchange, lunched in 1995. One potential concern could be that firms listed in Main Market are larger, more visible and with better governance than those at the AIM. Consistent with this claim we find that our results are stronger for Main Market firms compared to firms listed in AIM. There is a stronger link between compensation and both closeness and dyadic constraint for CEOs and CFOs. Moreover, for non-executive directors the association between dyadic constraint and compensation is stronger as is for a Chair the link between closeness and compensation. Therefore, a director's social network seems to be more important for the determination of compensation for firms listed in the Main Market.

4.3.4. Using only salary and bonus

In the measure of total compensation, we have included also long-term compensation coming from stock options and pension benefits. However, the amount of compensation that is ultimately received from these components is uncertain at the time the compensation is awarded and their valuation is not straightforward (Core et al 1999). Thus, we replicated all our results by using only salary and bonuses as the compensation measures. All the results we got at this iteration mirror closely the ones presented above. Also, the correlation between salary and bonus and the total compensation measure, used in the main analysis, is 0.97.

4.3.5. Averaging director observations and Fama-MacBeth (1973)

Model 1 uses multiple times a director in the regression and although we cluster standard errors at both the firm and director level to eliminate serial and cross-sectional correlation, it is still possible that our standard errors are understated. Therefore, we average within a year all the variables for a director and we run cross sectional regressions for each year. Then, we calculate the time-series average of the coefficients and the t-statistics based on the average coefficient and the standard deviation of these coefficients (Fama and MacBeth 1973). The network measures are significantly associated to compensation across all specifications, except for 2002 where results have a robust sign but are statistically and economically weaker. This may be attributed to the recession the UK economy was experiencing during that time, which potentially affected the differential compensation among directors.

4.3.6. Sum of predicted compensation as a determinant of future performance

Model 3 uses the average of the predicted compensation from the social network variables to test the relation with future performance. However, it could be the case that a more relevant variable would be the sum of the predicted compensation across directors and within a firm. In other words, total resources provided by directors of a firm may be a more appropriate measure, compared to resources provided on average by directors. To test the robustness of our results, we re-estimate model 3 using as independent variable the sum of the predicted compensation. The correlation between average and sum of predicted compensation is 0.83. Estimation of model 3 yields very similar results to the ones presented in table 5. Specifically, we find the sum of the predicted compensation to be positively associated with future average stock returns, market-to-book ratios and 3-year sales growth, all at a 2% level of statistical significance.

5. Conclusion

In this paper, we adopt a social network perspective to test whether executive and non-executive directors' compensation is associated with the characteristics of their social connectedness. We find that measures reflecting the centrality and constraint of directors' ties are associated with compensation. Executive directors, such as CEOs, CFOs and other senior managers, with larger networks and lower constraints earn higher compensation. This is consistent with the hypothesis that such directors are being rewarded for the resources they provide to the firm. In contrast, non-executive directors with larger networks and low constraints earn lower compensation. Since the demand for non-executive directors arises mainly due to agency problems, directors that are less connected socially earn higher compensation since they are perceived as being more independent and hence more capable of monitoring management effectively. We also study whether the predicted component of compensation arising from the social network measures is correlated with future operating and stock market performance. We find strong evidence that the predicted component is positively associated with stock returns, market-to-book ratios and sales growth. Future return on assets is not correlated with the predicted component.

Our results have several implications. First, the results concerning executive directors confirm a resource dependence theory by showing that executive directors are rewarded for the resources they can provide through their position in the social network. These resources have positive affect on future performance. Second, the results concerning non-executive directors confirm an agency theoretic perspective where these directors earn higher compensation when they have the potential to be more independent and thereby monitor management more effectively. This monitoring also affects positively the firm's future performance. Collectively, these results tend to suggest that there is a correlation between the services directors are expected to provide (from a corporate governance perspective) and the compensation they are rewarded.

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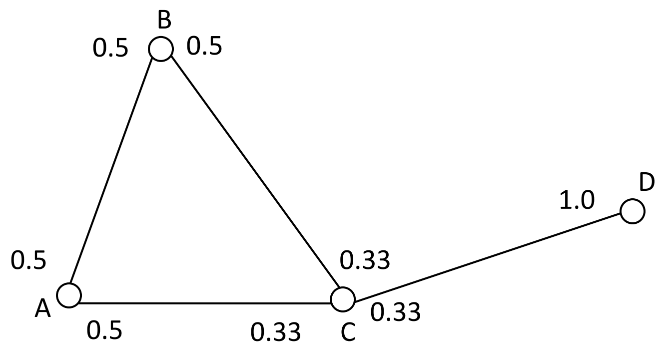
Appendix
Description of Network Measures

Closeness centrality refers to the relative position of a vertex (a node) within the network. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. In the context of an inter-board network closeness centrality measures how close a director is to all other directors or how central is the director in the network:

$$X_v = \frac{N-1}{\sum_{w=1}^{N} u(v,w)}$$

X is the closeness centrality of a vertex v in a network where N is the number of vertices and u(v,w) is the distance between the given vertex (v) and another vertex (w).

Dyadic Constraint is based on Ronald Burt's (1992) concept of structural holes, which postulates that redundancy in one's ties lowers the potential efficacy of those ties. For example, if director A is interlocked with director B and director C, that connection would be less effective for director A if directors B and C would also be interlocked, as A is more likely to receive similar information from B and C. In addition, redundancy in one's connections may constrain one's actions because information regarding such actions flows in paths that are not independent of one's direct influence (e.g. B and C can exchange information regarding A).
The simplest structure in which dyadic constraint is expressed and in is non-trivial is the triad: fully or partially connected set of three nodes. Structures that are more complex are decomposable to triads and hence, the calculation of dyadic constraint is based on breaking down network structures to triads. Using Pajek (de Nooy et al, 2005) we calculated dyadic constraint through the following algorithm, which we show here for the calculation of dyadic constraint for node C. First, the value of each of the ties that a node is part of is calculated as an inverse of its number of connections. Node C in the example below has three ties. Hence, each of node C's ties would have a value of 1/3, A and B have each two ties of value ½ and D has one tie of value 1. Second, using the values of the ties, the constraint that each of the ties imposes on C is calculated. Since C is part of the triad, A-B-C the tie A-B is limiting the value that C could have had from having separate connections with A and B. Therefore, the constraint that each of these nodes imposes on C includes not only the node's connection with C, but also the connection between them. To increase the impact of weight of the connection on the resulting outcome, the formula for the calculation of dyadic constraint multiples the 'indirect' tie in triad by the direct tie and the product is squared.



The constraint that the tie C-A imposes on C is calculated using the following: $[0.33 \text{ x } 0.5]^2$. This is also identical to the constraint of the C-B tie: $[0.33 \text{ x } 0.5]^2$. The tie C-D has no 'indirect' tie, as the triad C-D-B is 'open'. Therefore, the constraint of that tie is calculated as simply 0.33^2. Third to arrive at the total constraint that C's ties impose on that node, we aggregate the dyadic constraints calculated in step two. C's aggregate dyadic constraint is equal to: $[0.33 \text{ x } 0.5]^2 + [0.33 \text{ x } 0.5]^2 + 0.33^2 = 0.653$.

Using Pajek (de Nooy et al. 2005) we calculated dyadic constraint through the following algorithm: Pajek calculates the value of each of the ties that a node has as the inverse of its number of connections (for example, 4 ties would give a value of 0.25 for each connection). For node i, the value of each of the ties as a proportion of the total value of ties is calculated as:

$$p_{ij} = \frac{a_{ij} + a_{ji}}{\text{SUM}_k \, (a_{ik} + a_{ki})}$$

These proportions are then summed up for node *i*, to provide the overall constraint of the nodes:

$$p_i = \text{SUM}_j \, (p_{ij})$$

Figure 1.1 CEO Compensation

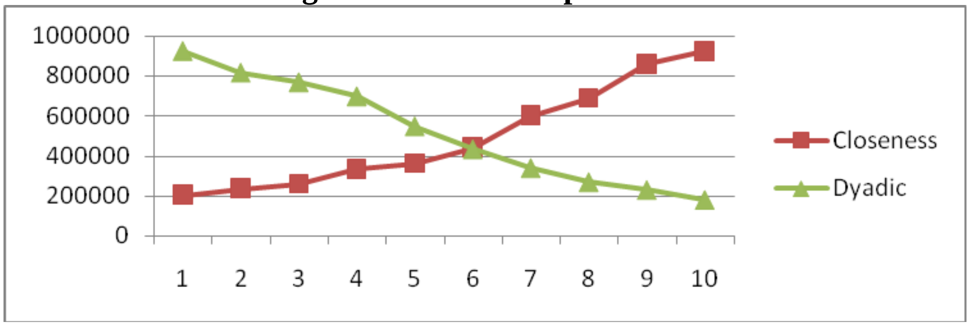


Figure 1.2 CFO Compensation

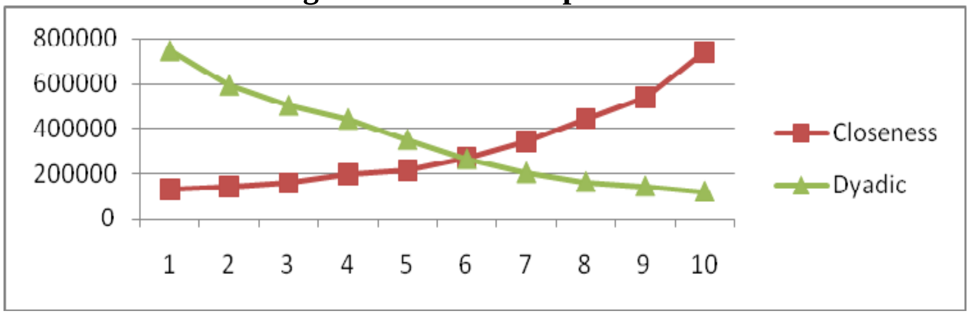


Figure 1.3 COO Compensation

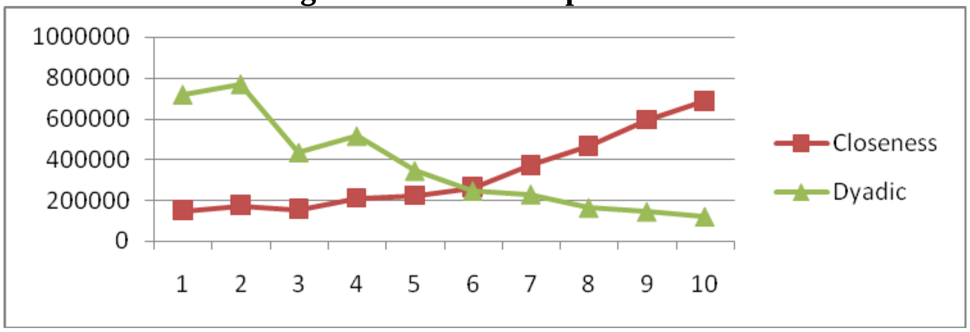


Figure 1.4 Other executive Compensation

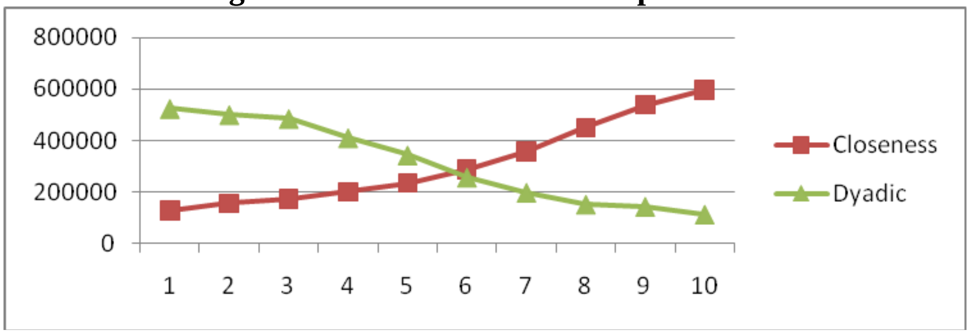


Figure 1.5 Chairman Compensation

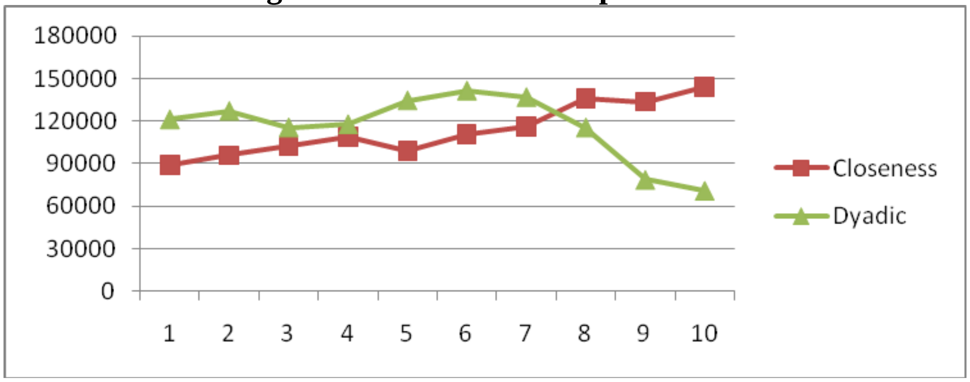
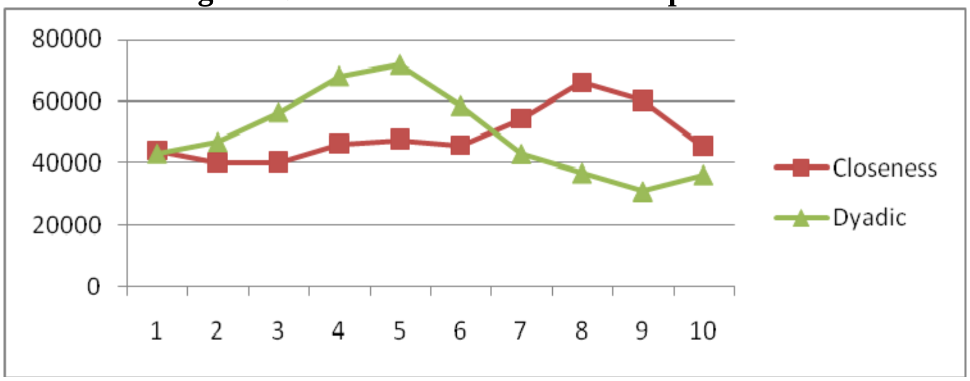


Figure 1.6 Other non-executive Compensation



Ten portoflios are constructed allocating directors according to their closeness and dyadic constraint measures. Portfolio 1 includes directors with the lowest values and portoflio 10 the directors with the highest values. Total compensation for each director is the sum of salary, bonus, options granted, pension benefits and other benefits. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. The measure is normalized and ranges from 0 to 1. Dyadic Constraint measures the redundancy of a director's ties. The measure is normalized and ranges from 0 to 1. The sample includes 3,478 firms, 18,130 directors and 79,476 directorships-years.

Table 1

Panel A: # of companies, directors and observations for network and analysis

	Network statistics	Excluding missing or zero compensation
Companies	4,279	3,478
Directors	24,865	18,310
Directorships-years	114,201	79,476

Panel B: Descriptive statistics for compensation and network measures

Measure	Mean	STD	Q3	Median	Q1	First order autocorrelation coefficient
Total compensation	152,102	256,758	170,000	43,000	18,086	0.964
Closeness	0.1067	0.0464	0.1353	0.1214	0.1029	0.796
Dyadic constraint	0.3841	0.2082	0.5129	0.3642	0.2160	0.911

Panel C: Average statistic by director category

Measure	CEO	CFO	COO	Executive	Chairman	Non-Executive
Total compensation	440,906	258,701	265,955	265,873	113,571	49,223
Closeness	0.1014	0.0975	0.0979	0.0974	0.1064	0.1124
Dyadic constraint	0.4397	0.4642	0.4546	0.4335	0.3610	0.3496
# of observations	8,614	7,889	1,490	8,918	13,907	38,658
Aggregate compensation	3,797,961,872	2,040,892,189	396,273,397	2,371,057,911	1,579,434,400	1,902,861,188

Total compensation for each director is the sum of salary, bonus, options granted, pension benefits and other benefits. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. The measure is normalized and ranges from 0 to 1. Dyadic Constraint measures the redundancy of a director's ties. The measure is normalized and ranges from 0 to 1. Panel B and C include 3,478 firms, 18,130 directors and 79,476 directorships-years.

Table 2

Panel A: Correlation coefficients for CEO and CFO

		CFO									
	Variable	**Compensation**	**Closeness**	**Dyadic**	**MTB**	**ROA**	**Size**	**Return**	**Growth**	**# Board**	**Tenure**
CEO	**Compensation**	#	0.34	-0.48	0.08	0.21	0.71	0.00	-0.04	0.52	0.22
	Closeness	0.38	#	-0.67	0.06	0.12	0.46	-0.02	-0.03	0.42	-0.03
	Dyadic	-0.52	-0.67	#	-0.08	-0.17	-0.63	0.00	0.01	-0.78	-0.03
	MTB	0.05	0.05	-0.07	#	-0.01	0.15	0.13	0.05	0.07	-0.03
	ROA	0.25	0.17	-0.22	-0.02	#	0.32	0.07	0.03	0.18	0.16
	Size	0.74	0.48	-0.64	0.13	0.36	#	0.09	0.00	0.67	0.06
	Return	0.02	-0.01	0.00	0.12	0.09	0.09	#	0.13	0.00	-0.02
	Growth	-0.08	-0.06	0.05	0.04	-0.02	-0.05	0.11	#	0.00	-0.09
	# Board	0.56	0.44	-0.77	0.07	0.23	0.71	0.01	-0.04	#	0.06
	Tenure	0.19	0.04	-0.11	0.01	0.20	0.12	0.00	-0.09	0.10	#

Panel B: Correlation coefficients for COO and other Executive director

		Executive Director									
	Variable	**Compensation**	**Closeness**	**Dyadic**	**MTB**	**ROA**	**Size**	**Return**	**Growth**	**# Board**	**Tenure**
COO	**Compensation**	#	0.30	-0.40	0.03	0.20	0.59	0.00	-0.05	0.42	0.16
	Closeness	0.29	#	-0.64	0.08	0.13	0.46	-0.01	-0.01	0.41	-0.03
	Dyadic	-0.44	-0.67	#	-0.07	-0.20	-0.65	-0.01	0.02	-0.77	0.01
	MTB	0.06	0.03	0.00	#	-0.06	0.15	0.12	0.05	0.08	-0.04
	ROA	0.17	0.10	-0.16	-0.01	#	0.33	0.06	-0.04	0.20	0.16
	Size	0.69	0.42	-0.59	0.15	0.37	#	0.08	-0.02	0.69	0.00
	Return	0.03	-0.02	0.03	0.09	0.07	0.12	#	0.08	0.00	-0.04
	Growth	-0.06	-0.01	0.02	0.06	0.02	-0.02	0.16	#	-0.02	-0.12
	# Board	0.51	0.44	-0.80	0.04	0.17	0.67	0.00	-0.02	#	0.00
	Tenure	0.21	-0.03	0.00	-0.04	0.18	0.10	-0.03	-0.10	0.04	#

Panel C: Correlation coefficients for Chairman and other Non-executive director

Non-executive Director (columns); Chairman (rows)

Variable	Compensation	Closeness	Dyadic	MTB	ROA	Size	Return	Growth	# Board	Tenure
Compensation	#	0.03	-0.04	0.03	0.05	0.21	0.00	0.01	0.23	0.03
Closeness	0.07	#	-0.67	0.02	0.15	0.39	-0.04	-0.05	0.25	-0.02
Dyadic	-0.08	-0.71	#	-0.04	-0.15	-0.46	0.02	0.03	-0.47	0.04
MTB	0.04	0.03	-0.05	#	-0.04	0.15	0.09	0.05	0.13	-0.05
ROA	0.11	0.15	-0.14	-0.05	#	0.29	0.06	-0.01	0.15	0.09
Size	0.40	0.38	-0.41	0.14	0.31	#	0.09	0.03	0.69	-0.04
Return	0.01	-0.02	0.00	0.11	0.08	0.12	#	0.12	0.03	-0.06
Growth	0.01	-0.05	0.02	0.05	0.01	0.03	0.12	#	0.04	-0.09
# Board	0.36	0.27	-0.43	0.11	0.16	0.67	0.04	0.05	#	-0.03
Tenure	0.17	-0.03	0.07	-0.05	0.17	0.09	-0.05	-0.10	0.07	#

Panels A, B and C present univariate Pearson correlation coefficients. Compensation for each director is the sum of salary, bonus, options granted, pension benefits and other benefits. MTB is market value of equity over book value of equity at fiscal year end. ROA is net income over total assets. Size is the logarithm of the market value of equity. Return is the stock price return over 1 fiscal year. Growth is the growth in sales over 1 fiscal year. # Board is the number of board members. Tenure is the number of years the director has been sitting on the board. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. The measure is normalized and ranges from 0 to 1. Dyadic Constraint measures the redundancy of a director's ties. The measure is normalized and ranges from 0 to 1.

Table 3

Panel A: Association between total compensation and closeness

	Total compensation											
	CEO		**CFO**		**COO**		**Executive**		**Chairman**		**Non-Executive**	
	Estimate	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**
Intercept	-108.13	-1.56	-175.88	-4.12	23.62	0.28	-153.56	-2.07	-125.35	-3.65	-61.95	-4.01
Closeness	**317.00**	**3.40**	**115.62**	**2.23**	**40.95**	**0.33**	**321.20**	**3.62**	**-149.09**	**-2.87**	**-68.50**	**-2.76**
MTB	-2.31	-2.39	-0.24	-0.31	-0.42	-0.31	-1.60	-1.06	-1.04	-1.53	-0.08	-0.21
ROA	-60.49	-4.48	-48.36	-5.90	-104.70	-4.13	-48.31	-2.74	-12.62	-1.82	-7.23	-1.48
Size	94.09	15.64	65.07	17.01	53.84	7.30	72.35	9.72	22.54	6.96	5.38	1.95
Return	-14.19	-2.64	-17.32	-5.41	-3.58	-0.41	-24.29	-4.75	-7.20	-2.47	-3.97	-2.92
Growth	-14.71	-1.92	-10.11	-2.14	-10.34	-0.80	-11.33	-1.46	-4.14	-1.11	-0.68	-0.36
# Board	-3.84	-0.18	18.58	1.36	55.44	1.46	-6.33	-0.27	26.94	1.64	38.52	4.93
Tenure	54.75	7.61	65.88	11.13	54.87	4.53	59.57	6.99	44.10	8.67	8.53	4.59
Male	-8.94	-0.83	8.01	1.26	9.34	0.68	22.32	2.94	2.51	0.67	9.74	4.46
Index memberships	Yes		Yes		Yes		Yes		Yes		Yes	
Industy f.e.	Yes		Yes		Yes		Yes		Yes		Yes	
Year f.e.	Yes		Yes		Yes		Yes		Yes		Yes	
N	6232		6176		1107		6503		9730		28147	
Adj-R squared	65.6%		64.9%		63.0%		46.8%		24.4%		8.3%	

Panel B: Association between total compensation and dyadic constraint

	CEO		CFO		COO		Executive		Chairman		Non-Executive	
	Estimate	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**
Intercept	56.88	0.69	-126.12	-2.33	21.11	0.18	-144.99	-1.83	-172.04	-5.24	-106.82	-6.67
Dyadic	**-131.65**	**-3.65**	**-39.11**	**-1.49**	**1.18**	**0.02**	**-0.27**	**-0.01**	**72.96**	**6.67**	**55.16**	**8.79**
MTB	-2.30	-2.40	-0.26	-0.34	-0.44	-0.32	-1.52	-1.01	-0.97	-1.44	-0.08	-0.22
ROA	-59.34	-4.38	-48.43	-5.88	-104.79	-4.12	-49.23	-2.78	-10.89	-1.57	-6.43	-1.32
Size	93.80	15.58	65.28	16.99	53.97	7.28	74.47	10.04	23.15	7.15	5.97	2.18
Return	-14.09	-2.62	-17.45	-5.48	-3.70	-0.42	-25.01	-4.89	-7.61	-2.62	-4.45	-3.25
Growth	-15.07	-1.96	-10.49	-2.21	-10.46	-0.81	-11.95	-1.54	-4.76	-1.28	-0.91	-0.48
# Board	-37.54	-1.47	8.25	0.48	57.82	1.17	0.88	0.03	39.50	2.34	48.40	6.13
Tenure	53.77	7.50	65.72	11.13	54.63	4.48	59.17	6.90	41.88	8.36	7.82	4.28
Male	-10.01	-0.92	7.79	1.22	9.03	0.66	23.37	3.07	2.32	0.62	9.84	4.50
Index memberships	Yes		Yes		Yes		Yes		Yes		Yes	
Industy f.e.	Yes		Yes		Yes		Yes		Yes		Yes	
Year f.e.	Yes		Yes		Yes		Yes		Yes		Yes	
N	6232		6176		1107		6503		9730		28147	
Adj-R squared	65.7%		64.9%		63.0%		46.6%		24.8%		8.8%	

Panels A and B present OLS regressions where dependent variable is compensation. Compensation for each director is the sum of salary, bonus, options granted, pension benefits and other benefits. MTB is market value of equity over book value of equity at fiscal year end. ROA is net income over total assets. Size is the logarithm of the market value of equity. Return is the stock price return over 1 fiscal year. Growth is the growth in sales over 1 fiscal year. # Board is the number of board members. Tenure is the number of years the director has been sitting on the board. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. The measure is normalized and ranges from 0 to 1. Dyadic Constraint measures the redundancy of a director’s ties. The measure is normalized and ranges from 0 to 1.

Table 4

Within-firm association between total compensation and network measures

	Executive				Non-Executive			
	Estimate	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**
Intercept	-39.51	-9.33	-39.62	-9.33	-24.75	-14.36	-25.13	-14.57
Closeness	**2974.32**	**3.41**			**-1703.06**	**-11.33**		
Dyadic			**-94.36**	**-2.62**			**92.95**	**12.09**
Tenure	72.52	14.62	73.00	14.65	23.62	9.57	23.75	9.62
Male	5.41	2.15	5.38	2.13	7.87	5.36	8.22	5.57
Firm f.e.	Yes		Yes		Yes		Yes	
Year f.e.	Yes		Yes		Yes		Yes	
N	21292		21292		45208		45208	
Adj-R squared	23.28%		23.14%		7.75%		7.75%	
# of firms	2096		2096		3073		3073	

Panels A and B present OLS regressions where dependent variable is compensation. A firm is included in the estimation if it has on the board more than one executive director or more than one Non-executive director. Compensation for each director is the sum of salary, bonus, options granted, pension benefits and other benefits. MTB is market value of equity over book value of equity at fiscal year end. ROA is net income over total assets. Size is the logarithm of the market value of equity. Return is the stock price return over 1 fiscal year. Growth is the growth in sales over 1 fiscal year. # Board is the number of board members. Tenure is the number of years the director has been sitting on the board. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. The measure is normalized and ranges from 0 to 1. Dyadic Constraint measures the redundancy of a director's ties. The measure is normalized and ranges from 0 to 1. In the Executive directors' specification indicator variables for a CEO, CFO and COO are included. In the Non-executive directors' specification an indicator variable, if a director is a Chairman, is included. Standard errors are robust to heteroscedasticity and clustered at the firm level.

Table 5

Association between Dyadic Constraint, log and linear compensation of Chairman and Non-executive director for different size, MTB and ROA portfolios

	Chairman											
	Size				MTB				ROA			
Dependent	Log Compensation		Compensation		Log Compensation		Compensation		Log Compensation		Compensation	
Portfolio	Estimate	t	Estimate	t	Estimate	t	Estimate	t	Estimate	t	Estimate	t
1 (Low)	0.239	1.93	34	3.89	0.307	2.75	40	3.30	0.385	3.07	37	3.98
2	0.347	3.36	35	4.04	0.425	4.22	64	5.55	0.189	1.65	65	5.37
3	0.580	4.80	89	6.45	0.735	5.37	113	6.77	0.388	3.79	85	6.67
4	0.846	4.92	182	5.67	0.912	6.71	126	6.48	0.748	5.32	119	5.57
5 (High)	0.914	3.90	245	4.20	0.719	4.98	121	5.31	1.074	7.12	181	6.69
5 minus 1	0.676***		211***		0.412***		81***		0.689***		144***	

	Non-Executive											
	Size				MTB				ROA			
Dependent	Log Compensation		Compensation		Log Compensation		Compensation		Log Compensation		Compensation	
Portfolio	Estimate	t	Estimate	t	Estimate	t	Estimate	t	Estimate	t	Estimate	t
1 (Low)	-0.046	-0.61	13	5.87	0.176	2.37	24	3.84	0.217	3.04	26	6.79
2	0.227	3.51	23	6.48	0.153	2.55	27	5.15	0.137	1.74	45	6.48
3	0.372	3.80	43	4.52	0.548	5.84	75	6.28	0.172	1.76	48	4.45
4	0.721	5.70	115	5.54	0.602	5.94	83	6.71	0.434	4.81	73	5.23
5 (High)	0.957	4.39	298	3.82	0.416	4.14	72	5.62	0.530	5.66	74	6.67
5 minus 1	1.003***		285***		0.241***		48***		0.313***		48***	

Table 5 presents coefficients on dyadic constraint when dependent variable is compensation or log compensation. Other control variables included in the estimation but not reported are log of market value of equity, MTB, ROA, log of board size, an indicator variable if the director is male, industry fixed effects, index membership indicators and year fixed effects. Each portfolio includes on average 700 unique firms. Standard errors are robust to heteroscedasticity and clustered at the firm level.

Table 6

Panel A: Association between predicted compensation from closeness and subsequent performance

	Closeness							
	Return		MTB		ROA		Sales growth	
	Estimate	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**
Intercept	-0.1089	-5.29	-1.1810	-5.00	-0.1167	-3.02	-0.0823	-0.50
Lag Return	0.0031	0.11						
Lag MTB			0.4906	15.70				
Lag ROA					0.5118	13.57		
Lag 3-year Growth							0.2853	8.20
Predicted SN Compensation	**0.0559**	**2.54**	**0.1991**	**2.38**	**-0.0076**	**-1.37**	**0.0688**	**1.92**
Market value	-0.0110	-2.19						
MTB	0.0418	5.73						
Sales			0.1122	5.86	0.0110	7.66	0.0114	1.11
Industy f.e.	Yes		Yes		Yes		Yes	
N	1290		1247		1300		1161	
Adj-R squared	9.51%		43.43%		44.81%		22.92%	

Panel B: Association between predicted compensation from dyadic constraint and subsequent performance

	Dyadic Constraint							
	Return		MTB		ROA		Sales growth	
	Estimate	**t**	**Estimate**	**t**	**Estimate**	**t**	**Estimate**	**t**
Intercept	-0.1058	-5.05	-1.1490	-4.83	-0.1181	-3.08	-0.0835	-0.50
Lag Return	0.0023	0.08						
Lag MTB			0.4909	15.65				
Lag ROA					0.5120	13.57		
Lag 3-year Growth							0.2856	8.22
Predicted SN Compensation	**0.0851**	**2.36**	**0.2715**	**2.08**	**-0.0102**	**-1.15**	**0.1197**	**1.92**
Market value	-0.0112	-2.21						
MTB	0.0421	5.77						
Sales			0.1110	5.78	0.0110	7.66	0.0116	1.12
Industy f.e.	Yes		Yes		Yes		Yes	
N	1290		1247		1300		1161	
Adj-R squared	9.40%		43.32%		44.79%		22.94%	

Panels A and B present OLS regressions where dependent variable is firm performance. Predicted SN Comp is the predicted compensation from model 1 due to the closeness or dyadic constraint. We estimate model 1 for 2000-2001 (estimation period) and we test the predictions in period 2002-2007 (test period). After estimating the predicted component we average this variable within a firm to construct a firm level variable. MTB is market value of equity over book value of equity at fiscal year end. ROA is net income over total assets. Market Value is the logarithm of the market value of equity. Return is the stock price return over 1 fiscal year. Sales is the logarithm of the firm's sales. All performance variables are averaged across the estimation or test period. Closeness centrality is defined as the inverse of the mean geodesic distance (i.e the shortest path) between a vertex v and all other vertices reachable from it. Closeness can be regarded as a measure of how long it will take information to spread from a given vertex to other reachable vertices in the network. The measure is normalized and ranges from 0 to 1. Dyadic Constraint measures the redundancy of a director's ties. The measure is normalized and ranges from 0 to 1. Each firm enters only once in the regression. Standard errors are robust to heteroscedasticity.