Directors' Networks and Firm Valuation in a Concentrated Ownership Structure Economy*

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Abstract

We explore the implications of directors' networks for companies' valuation in a concentrated ownership environment and pyramidal control structures. Using common centrality indices on a sample of 727 directors serving in 105 Israeli listed firms, we show that the effect is very dependent on the type of director. Directors who are neither external nor ultimate owners, and therefore presumably experts, tend to promote firm valuation and mitigate the negative impact of a pyramidal control structure. Conversely, central external directors have a tendency to harm firm performance and even magnify the negative effect of the vote-ownership wedge, due to the pyramidal ownership structure. The findings support the claim that shareholders with controlling interests are, in fact, *shadow directors,* who utilize their excessive influence on external directors to carry out *tunneling* (i.e., the diversion of value from the company for their own personal gain/benefit).

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1. Introduction

Social networking is defined as a social structure comprised of individuals or organizations connected by types (one or more) of interdependency, such as friendship, common interests, knowledge, beliefs, etc. Technological developments over the last decade have emphasized the growing importance of social networking. In the financial economics literature, the question of the economic impact of social networks has been addressed from several perspectives: venture capital [Hochberg, Ljungqvist, and Lu (2007)], mutual funds [Kuhnen (2009), Cohen, Frazzini, and Malloy (2010)], employment [Ioannides and Loury (2004)], investment decisions [Duflo and Saez (2003)], and executive compensation [Barnea and Guedj (2009)]. The purpose of this research is to explore the effect of directors' centrality over firm value in a concentrated ownership structure economy. Concentrated ownership creates a conflict between insiders with controlling interests and other stakeholders, as controlling shareholders may be tempted to expropriate firm resources and reap private benefits of control, thereby damaging firm value [for example, Barclay and Holderness (1989) and Dyck and Zingales (2004)]. We examine the impact of directors' centrality on firm value in the Israeli economy, known as an economy with a highly concentrated ownership structure and many pyramidal business groups [La-porta et al. (2000, 2002), Dyck and Zingales (2004), and Barak and Lauterbach (2011)].[1]

The paper is organized as follows: Section 2 provides a brief literature review and some background on centrality indices, Section 3 presents the theory and

[1] Dyck and Zingales (2004) and Barak and Lauterbach (2011) estimate private benefits of control in Israeli firms to be about one-third of its equity market value, which is relatively high and above the world median.

hypotheses, Section 4 explains the methodology, Section 5 describes the sample, Section 6 presents the empirical results, and Section 7 concludes.

2. Scientific background

2.1 Literature review

The financial literature provides supporting evidence about the economic significance of positioning within networks, both from the perspective of performance as well as corporate governance variables and implications. Hochberg, Ljungqvist, and Lu (2007) and Barnea and Guedj (2009) are prominent examples of this literature. Hochberg, Ljungqvist, and Lu (2007) investigate the performance of American Venture Capital (VC) funds over the period 1980-2003, and show a significantly better rate of successful exits within VC funds whose parent company is more influential in the VC market, i.e., presents higher centrality measure scores.[2]

Barnea and Guedj (2009) investigate the effect of directors' centrality over CEO compensation schemes, and examine two opposing hypotheses: The *reputation hypothesis*, which argues that connected directors do not need to exert an effort, since their centrality serves them well enough (relative to non-connected directors who promote themselves by performing useful but costly monitoring), and the *bargaining power hypothesis*, which argues that connected directors have more bargaining power than the CEO (since they are less concerned about the management and the impact of monitoring on their reputation), and hence perform better monitoring, relative to non-connected directors. They find that firms with more connected boards grant higher

[2] Hochberg et al. (2010) expose another networking aspect effect by identifying network density as a major factor in the magnitude of barriers to entering local VC markets. Significant barriers presumably help incumbent capitalists to improve their bargaining power over entrepreneurs, and present excess yields.

pay to CEOs, a result which supports the *reputation hypothesis* over the *bargaining power hypothesis*.

In addition, there is ample evidence showing significant links between directorates' traits and firm performance. Yermack (1996), using a sample of 452 large American firms, finds negative relations between board size and firm value (Tobin's Q), supporting the claim that small boards are more effective in carrying out their necessary functions within the corporation.

Similarly, but concerning a different class of firms, Eisenberg, Sundgren and Wells (1998) discover significant negative correlations between board size and profitability in small and mid-size Finnish firms. Fich and Shivdasani (2006) show that firms are also less profitable when their majority of external/independent directors are (too) busy, i.e., hold three or more directorships. They also find that busy boards function less effectively when monitoring CEOs' behavior, by showing lower sensitivity of CEO turnover to firm performance. Bebchuk and Cohen (2005) document a significant negative relation between firm value (Tobin's Q) and entrenched (staggered[3]) U.S. boards. Menozzi, Urtiga and Vannoni(2012) investigate Italian state-owned firms and discover that directors with political connections tend to have a negative influence on firm performance, probably because their commitment to company profitability is lower than that of the political party or state authority to which they are linked.

The financial literature presents the economic and financial implications of a concentrated ownership structure economy. Such capital markets are characterized by many closely-held publically traded firms. Concentrated ownership creates a conflict

[3]On these boards, directors are grouped into classes; only one of these classes can be removed each election, making board removal much more difficult.

between insiders with controlling interests and other stakeholders, since controlling shareholders may be tempted to expropriate firm resources and consume private benefits of control, thereby damaging firm value [for example, Barclay and Holderness (1989) and Dyck and Zingales (2004)]. Moreover, concentrated ownership structure usually yields unique formations, such as pyramidal business groups. These business groups possess the potential of creating serious externalities, due to the potential to distort the arm's length markets by their excessive size and dominancy.

In addition, a pyramidal ownership structure imposes a morally hazardous situation, resulting from the wedge created between ultimate owners' voting power and their share in firm equity.[4] Higher voting power provides the ability to control a firm's actions, while a lower equity share shields against the negative consequences of improper and value-destroying proceedings. Thus, pyramid controllers might be highly tempted to expropriate firm resources for their own benefit, and divert funds from low equity to higher equity share firms in the pyramid, a practice referred to as *tunneling*.

Bertrand, Mehta, and Mullainathan (2002) find evidence of tunneling among Indian pyramidal ownership structures. It appears that controlling shareholders use related party transaction mechanisms in order to divert resources from low cash flow rights to higher ones in the pyramid. Volpin (2002) investigates pyramidal groups in Italy (another highly concentrated ownership economy), and documents a significant deterioration of a firm's Q for companies that are located at the bottom of the

[4] The person, family or business associates who sit at the top of the pyramidal ownership structure and practically control the firm.

pyramidal structure. Volpin (2002) also reports higher executive turnover in these firms, relative to upper pyramid (parent) companies, suggesting they are used by ultimate owners as a means to test and select the best managers, whereby the highest performing executives are promoted to the higher levels of the pyramid. The negative implication of the pyramidal structure is also documented in Barak and Lauterbach (2012), reporting a significant positive relation between the intensity of private benefits of control (level of firm expropriation by its controller), and the ownership-control wedge magnitude in Israeli pyramidal group firms.

In this concentrated environment, and especially in the presence of pyramidal ownership structures, directors' networking and centrality have the potential of playing important roles in shaping firm performance. The relation between directors' centrality in a concentrated ownership economy, in conjunction with the effect of pyramids has, to the best of our knowledge, never been previously tested.

2.2 Analysis of Networks

The term *centrality* is defined as the importance (or relative importance) of a person in the network. In this study, we focus on three common *centrality measures* used in the social science literature discussing networks: *degree*, *Eigenvector* centrality (or closeness), and *betweenness*.

The *degree* of an agent in a network is simply the number of connections the agent has. In mathematical terms, a degree k_i of agent i is expressed by:

$$(1) \quad k_i = \sum_{j=1}^{n} A_{ij}$$

where A_{ij} equals one if agent i is connected to agent j, and zero otherwise.

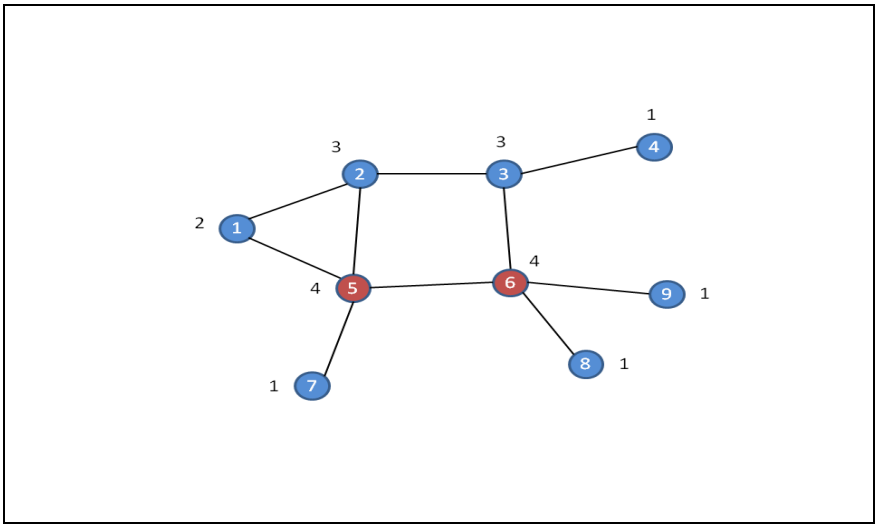

Figure 1: The *Degree centrality* measure

As shown in Figure 1, Agents 5 and 6 get the highest degree scores, as each one of them is connected to four other agents.

Eigenvector centrality, suggested by Bonacich (1972, 1987), evaluates the importance of the links that each agent has, acknowledging the fact that not all connections between two agents in the network are equivalent.[5] In general, connecting to an agent with more connections is more influential. The *eigenvector centrality* is defined as

$$(2) \quad \lambda y = Ay$$

where the eigenvector y_i denotes the centrality of Agent i with the matching eigenvalue λ.

[5] In the financial literature, *eigenvalue centrality* is sometimes defined as *closeness centrality* (for example, Barnea and Guedj, 2009). However, in the theory of networks, the term *closeness centrality* relates more to the concept of *betweenness centrality*, which focuses on the exploration of network paths.

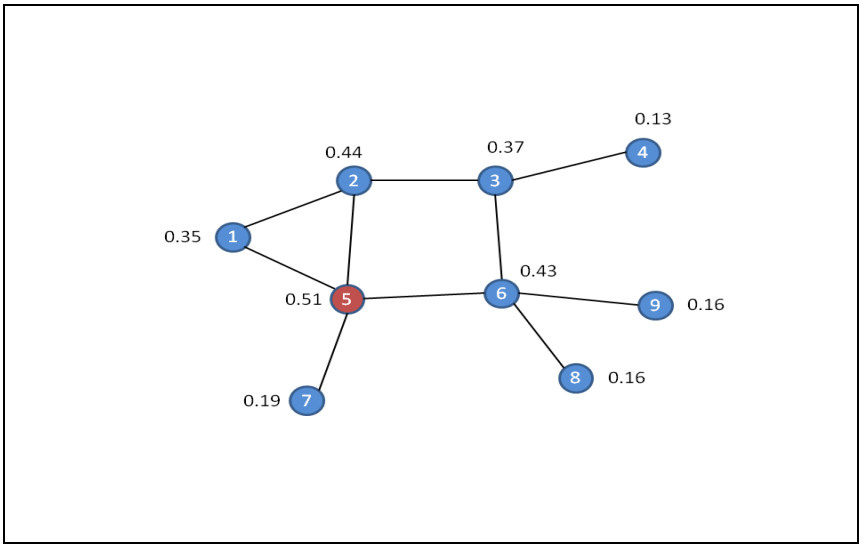

Figure 2: The *Eigenvector centrality* measure

Since we usually want centralities to be non-negative, λ must be the largest eigenvalue of the connections matrix A, and *y* its corresponding eigenvector.[6] Summing up, the eigenvector centrality of an economic agent depends both on the number and quality of its connections. Figure 2 illustrates this feature of the eigenvector centrality. Although Agents 5 and 6 have an equal number of connections to the other agents, Agent 5 possesses higher quality (connected) ties.

Betweenness centrality is based on the concept of network paths. A *path* in a network is the sequence of links from Agent *i* to Agent *j* across the network. As a result, there are several ways to define the links between two agents in the network. In our study, we define the *betweenness* centrality of an agent using *geodesic path*. A *geodesic path* is the shortest path between Agents *i* and *j* in the network. Geodesic paths are not unique, as there may be several shortest paths between two agents.

[6] According to the Perron–Frobenius theorem, a real square matrix with positive entries has a unique largest real eigenvalue, and the corresponding eigenvector has strictly positive components. The centrality of Agent *i* is expressed as $y_i = \frac{1}{\lambda}\sum_{j=1}^{n} A_{ij} \cdot y_j$

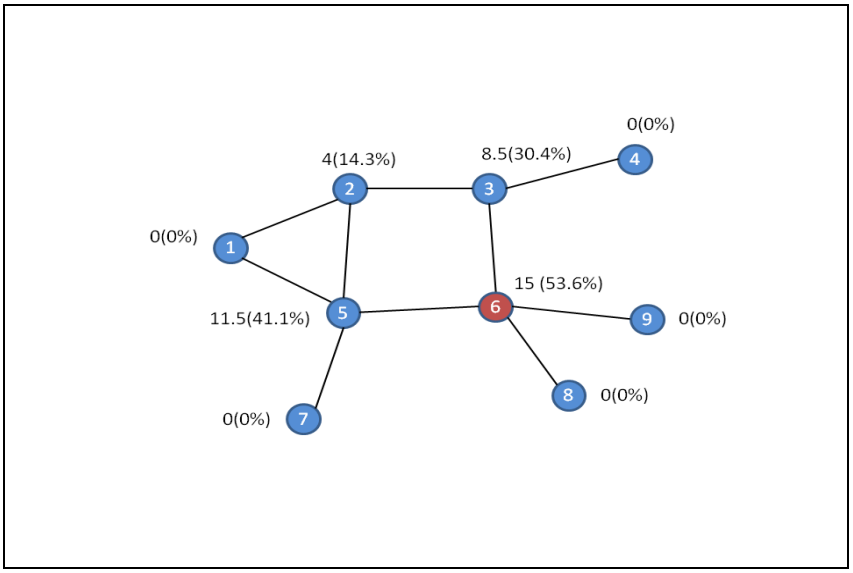

Figure 3: The B*etweeness centrality* measure

Thus, the *betweenness* centrality of Agent *z* is a summation of the fraction of the geodesic paths between Agents *i* and *j* that *z* falls on (Newman, 2008), which is usually normalized by dividing it by the total number of shortest paths in the network. Figure 3 shows that Agent 6 has the highest betweeness centrality score. The sum of fractions of shortest paths among all pairs of other agents that pass through it is 15, which is 53.6% of all geodesic paths in the network. In the context of this study, the betweeness index provides an advantage for those directors simultaneously serving large business groups.

3. Theory and Hypothesis

Improved location of the director's network has the potential to enhance firm value in various ways. First, better network positioning raises the availability, as well as the quality, of information and reduces the cost of searching for such [Wilson (1968), Sah and Stiglitz (1986)]. Second, influential directors have the privilege to access other relevant, key personnel more easily and effortlessly [Hochberg et al. (2007)]. Third, well-connected and powerful individuals can use their higher

bargaining power to impose better terms in more promising collaborations with other business entities [Lerner (1994), Hochberg et al. (2007)]. In sum, higher directorial centrality should be correlated with the ability to reduce frictions, improve efficiency, and usually indicates higher business reputation.

However, from a governance perspective, the reputation effect can have two contrasting and mutually exclusive implications: On one hand, the well-connected director will be motivated to justify and preserve his good name and reputation, harnessing his capabilities to promote the firm's value and supervise the ethical conduct within. On the other hand, higher reputation and important business ties might lead to overconfidence, insufficient monitoring [Barnea and Guedj (2009)], and even utilizing one's reputation to cross barriers in exploiting firm resources.

Thus, we base our research on two basic competing hypotheses:

Hypothesis 1.1: In closely-held firms, directors who are more central in the directors' network (have a better reputation) tend to promote firm value.

Hypothesis 1.2: In closely-held firms, directors who are more central in the directors' network (have a better reputation) tend to harm firm value.

Pyramidal ownership structure sharpens the agency problem aspect of directors' centrality, especially within companies at the bottom of the pyramid [Volpin (2002)]. In these firms, the wedge between ultimate owners' voting power and their equity holdings maximizes and amplifies the temptation to "*tunnel*" funds to parent companies. Following Volpin (2002) and Bertrand, Metha and Mullainathan (2002), we intend to reaffirm that the control-ownership wedge usually harms firm value in our sample as well.

Finding 1: The wedge between ultimate owners' voting power and equity share tends to decrease firm value.

Hypotheses 1.1 and 1.2, in conjunction with Finding 1, yield the following two competing hypotheses:

Hypothesis 2.1: The negative value impact of the control-ownership wedge is moderated proportionally with the centrality of the directorate.

Hypothesis 2.2: The negative value impact of the control-ownership wedge worsens proportionally with the centrality of the directorate.

Board size, i.e., the number of directors, is also one of the directorate-related traits that may have possible value implications. Previous literature documents the negative value impact of disproportionally large boards of directors, characterized by cumbersome decision-making processes and insufficient monitoring, due to increased communication and coordination problems [Yermack (1996), Jensen (1993)]. A concentrated ownership environment, like Israel, yields another problematic aspect of directorate size. In closely-held firms, directors are frequently nominated by large shareholders (controllers), who often prefer to hire their own family's relatives. In fact, prestigious nominations granting high salaries are part of controllers' private benefits of control [Barak and Lauterbach (2011), Amzaleg and Barak (2013)]. Israeli firms are known for their relatively high consumption of private benefits of control, which are above the world median.[7] Hence, unjustified directorate size may serve as a means to loot firm resources (through tunneling) and may be negatively correlated with firm value. Concluding the above, we expect bigger boards to have a negative value impact.

[7] See Dyck and Zingales (2004) and also Barak and Lauterbach (2011, 2012).

Hypothesis 3: There is a negative relation between directorate size (number of directors) and firm value.

3.1 External (independent) directors and the "shadow director" problem

Another important related issue is the presence of external (or independent) directors[8] on the board. External directors in a concentrated ownership structure economy may be strongly influenced by the reputation effect, as they are considered to be another monitoring device that should moderate controllers' tunneling acts. Pacces (2011) designates independent directors a crucial role in protecting shareholders against expropriation by insiders. The importance of independent boards is manifested in several empirical studies, most of them related to U.S. listed firms. Chhaochharia and Grinstein (2007) demonstrate how a higher proportion of external directors mitigates CEO agency problems; Knyazeva, Knyazeva and Masulis (2013) present a significant positive relation between board independency and firm value; likewise, Fogel, Ma and Morck (2014) find that companies with powerful independent directors (i.e., those belonging to the top quintile of centrality measures' scores) feature a higher Tobin's Q, better M&A decisions, and higher CEO turnover under conditions of poor performance.

Israeli corporate law also delegates a major responsibility to independent directors: the protection of minority shareholders (and other stakeholders as well) against the value-destroying acts of controlling shareholders. Besides their deterrent presence in board meetings, external directors also have mandatory seats in smaller forums (where they possess greater proportional voting power), such as audit committees in which they have the ability to object to disadvantageous related party transactions (self-dealing events), which must obtain committee approval before being

[8] Directors without any family (or business) ties with controlling shareholders (or management).

carried out. However, the cumulative evidence suggests that the impact of external independent directors in closely-held firms, where the majority of directors belong to the control group, may be much less effective than in the U.S. [see Barak &Lauterbach(2012), Menozzi,Urtiga&Vannoni(2012), Ferrarini&Filippelli(2014)]. Moreover, it is important to consider the decisive impact of external directors' nomination mechanism in Israel (and other concentrated ownership economies). In concentrated ownership structures, the surplus power of major shareholders becomes an exclusive channel for nominating candidates, as well as for ensuring the approval of their appointments in the shareholders' assembly. Such a mechanism creates a situation in which almost all external directors are personal appointees of controlling shareholders, which also dominate the appointed directors' future employment.[9]These conditions raise the possibility of a *shadow director*. A shadow director (in the context of our study) is a controlling, dominant shareholder who appoints an external director who is fully devoted to him, and who essentially represents his "long arm", for all practical purposes serving as the firm controller's "marionette" within the directorate. Thus, the presence of a shadow director(s) on the board might bias the classical interpretation of centrality by yielding high centrality scores to external directors who gained a (negative) reputation for collaborating with the controlling shareholders, instead of areal (positive) reputation or bargaining power abilities. Therefore, in order to address this different centrality view towards external directors, we create a separate hypothesis as follows:

[9] This was the case during the sample years. However, in 2011 the Israeli Parliament enacted the Corporate Law 16th Amendment Act, which restrained the influence of controlling shareholders on external directors by demanding the approval of the appointment by a non-controlling shareholders majority, prohibiting his/her dismissal and also obviating the consent of controlling shareholders for the extension of term.

Hypothesis 4: In closely-held firms, when a controlling shareholder has a great influence on appointments to the board, external directors with higher centrality scores (gained a more negative reputation) tend to harm firm value.

Hypothesis 4, in conjunction with Finding 2, leads to our last hypothesis:

Hypothesis 4.1: The negative value impact of the control-ownership wedge worsens proportionally with the centrality of external directors.

4. Methodology

Our methodology differentiates among 3 groups of directors. The first refers to controllers' family member directors, which are common in a concentrated ownership environment. Clearly, this group of directors is not suitable for examining research hypotheses, as its members are aligned with the interests of the controlling group, making the monitoring effect attached to our assumptions irrelevant.

The second group we refer to is the cluster of external (independent) directors. In the sample year, the Israeli law obliges each publicly traded firm to appoint at least two external directors[10], and most Israeli firms have exactly two such directors on their board. In the previous section, we discuss the unique aspects of these directors. Justifying the need to treat them as a separate group deserves special hypotheses (Hypotheses 4 and 4.1).

The third, and apparently most important, group of directors we focus on is the cluster of directors who are neither family members of controlling shareholders (or employees), nor external directors. We assume that members of this group tend to be more professional or "expert directors", who received their nomination mostly because of their skills and expertise. Hence, we believe this group deserves major

[10] The Corporate Law 16th Amendment Act (2011) corrected this defect and stated that the proportion of external directors on the board should not be less than one-third

attention in the analysis, as it appears to be the most appropriate for testing our main research hypotheses regarding the reputation-overconfidence effect (Hypotheses 1.1 through 2.2).

The main purpose of this study is to reveal the effect of a director's importance in the network of directors, as reflected by the centrality measures in regard to firm performance. Our proxy for firm value is the customary Tobin's Q, defined as:

$$Q = \frac{Market\ \ Value\ \ of\ \ Equity + Book\ Value\ \ of\ Debt}{Book\ Value\ of\ Total\ \ Assets}.$$

Consistent with prior Tobin's Q literature [Himmelberg, Hubbard and Palia (1999), Volpin (2002) and Barak, Cohen and Lauterbach (2011)], we employ control variables that refer to firm size, financial leverage, growth rate, and ownership structure.

We detect the effect of directorates' centrality on firm performance, i.e., Tobins Q, in two ways. First, for each company we calculate the average board centrality indices score. According to this approach, each director's contribution to firm value is linearly proportional to his /her centrality tally.

However, measuring the centrality effect in this manner, especially in relation to larger boards, might underestimate the influence of high-scoring individual directors whose reputation and eminence lend them a special status within the board. It is plausible that the presence of these dominant directors could induce a monitoring effect on a scale that is higher than their relative share in the company's directorate. Therefore, taking this possible bias under consideration, we additionally quantify board centrality by using the highest score found among the firm's directors.

As a final yet very important methodological point, we shouldn't ignore the potential endogeneity problem embedded in our main research question. It is sensible that directors' centrality is endogenous, since influential and reputable directors will tend to sit on boards of higher-valued firms, in order to effortlessly protect and/or promote their status.

Prior CG studies relating to board composition were indeed aware of this potential pitfall, in the case of ignoring the dynamic described above. A recent example is the study of Fogel, Ma and Morck (2014), which shows a positive relation between board independency and performance in a time series sample of S&P1500 companies. The study utilizes two methods to work around the endogeneity problem, both appropriate for time series analysis. One method is to use the value effect (negative CAR's), which occurs when the sudden death of an important independent director has been announced. The second method involves employing the Granger's causality test. Another contemporary and prominent example is that of Knyazeva, Knyazeva and Masulis (2013), who report a similar relation between board independency and firm value among S&P500 companies. To handle the endogeneity issue, the authors apply the 2SLS method; a feature[11] of the local labor market for directors serves as an instrument. Other examples of coping with endogeneity when investigating the effect of boards are found in Hermalin and Weisbach (1991,1998), Bhagat and Black (2000), and Drakos and Bekiris (2010). All of these studies use structural simultaneous systems and apply the 2SLS/3SLS methods intermittently. Thus, aligned with the literature cited above, we also handle the endogeneity theme by basing our multivariate analysis on a structural simultaneous equations model.

[11] The availability of worthy and reliable candidates for a director position.

5. Data and Sample Construction

Our study focuses on the 150 largest cap companies traded at the beginning of 2010 on the Tel Aviv Stock Exchange (TASE). Data regarding ownership structure is taken from "Article 24" of the company's annual financial report of the 2009 fiscal year (available electronically from the official website of the Israeli Security Authority-ISA). Article 24 specifies the exact holdings of every member in the control group and identifies the person (ultimate owner) behind each business entity in the control group.

Using Article 24, we compute the vote percentage and equity percentage of the ultimate owners, taking into account pyramids and cross-holdings. Article 26 of the company's annual financial reports present personal data on all firm directors and is used to collect each director's attributes as well as to construct a directors' network according to which we calculated centrality indices. Market value of stocks obtained from "PREDICTA" (a commercial database) and other firms' attributes and financial data taken from the Annual Report are available on the official ISA website.

Firms were omitted from the sample for the following two reasons: first, we excluded the dual-listed firms. We believe these firms belong to and represent a different corporate governance regime. This notion is supported by their typical dispersed ownership structure (unlike almost all other non-dual-listed Israeli firms) and the lower detail level of ownership reporting. Moreover, board centrality in relation to the local directors' network may be underestimated, as most of the directors in these corporations are less active in the local economy and their business connections tend to be foreign. A second reason for exclusion is negative equity, which is typical to firms going through a restructuring process, facing deletion from

trading, and usually not representing the appropriate definition of a going concern. The final sample is comprised of 105 companies and their 727 directors.

6. Empirical Results

6.1 Descriptive Statistics

In Table 1 (Panel A), we present descriptive statistics describing some major characteristics of the 105 firms in the sample. The Total Assets mean is over 3 billion New Israeli Shekels (NIS)- about 850 million U.S. dollars - but the median is only slightly higher than 1 billion NIS. The average Debt to Equity ratio is above 5, while the median is about 2. The results indicate an upward shift of the mean leverage in Israeli corporations, compared to prior findings.[12] This phenomenon may reflect the tendency of some Israeli firms to increase their financial leverage in response to the low interest rate set by the Central Bank in reaction to the 2008 global financial crisis.[13]

[Insert Table 1 about here]

The average 5-year annual growth rate of total assets[14] is 17.5% (with a median of 10.5%). This solid growth is correlated with the steady growth of the Israeli economy (despite the global crisis) in the second half of the last decade.[15] However, as can be seen, the impressive growth does not reflect the performance of all companies in the sample, as some of them even present a significant percentage of negative expansion. A similar pattern can be found with respect to the Q ratio,

[12] See, for example, Barak and Lauterbach (2012).

[13] Although the Israeli economy was not significantly damaged by the global crisis, the Central Bank took all the necessary precautions and joined the global trend of reducing interest rates. Thus, it looks like companies with relatively unharmed equity took advantage of the opportunity to increase their debt under fairly convenient terms.

[14] Measured as $Ln(TA_{2009}/TA_{2004})/5$

[15] According to the Israel Central Bank, the per capita GDP grew by about 30% during this period.

indicating higher market than book value of assets for most of the firms, despite the significantly lower ratio of others.

Noticeable diversity is also detected with respect to size and financial leverage, as described above, as well as the number of directors on the board, which is naturally correlated with firm size.

Average vote per ownership (VPO) is about 1.42 and the median is above 1, indicating that most of the firms in the sample belong to pyramidal business groups creating a gap between ultimate owners' voting power and their percentage in equity. This gap, which is a major factor in our analysis, intensifies the conflict between controlling shareholders and other stakeholders, and is typical to concentrated ownership economies. Summing up Panel A, our sample represents a diversity of firm attributes in a rapidly growing economy with a concentrated and complex ownership structure environment.

Panel B of Table 1 focuses on board centrality. It presents means of firms' centrality scores measured according to the two approaches offered in the methodology, namely the average score and the highest result on the board of directors. Both approaches employ all three conventional indices: Degree, Eigenvector, and Betweeness. Furthermore, and also accordance with the methodology, means are calculated separately for the group of external directors as well as for the group of (experts) "professionals".[16]

Clearly, the experts group presents superior centrality scores in almost all categories. Their advantage seems more noticeable when using the *Maximum Score*

[16] In the Methodology section, we claimed that directors who are neither external nor major shareholders' family members (or employees) are more likely to be highly professional and apparently experts in the company's operations.

approach, for which their centrality is significantly higher for all centrality indices (i.e., Degree, Eigenvector, and Betweeness), according to both parametric and non-parametric tests. This result may be an outcome of the regulatory restrictions that prevent external directors from serving in more than one company within the same business group. However, the larger centrality span of the experts group emphasizes the credence of the *Maximum Score* approach. If, as suggested, the monitoring effect is mainly a direct result of directors' reputation and status (regardless of board size), then looking at average centrality scores would be misleading.

6.2. The Impact of Directors' Centrality on Firm Performance

In order to *ceteris paribus* test the effect of directors' centrality, we now turn to multivariate analysis. As stated in the Methodology section and in accordance with prior literature our investigation should address the endogeneity embedded in the research question. Directors' centrality is likely to be endogenous, since the *a priori* (rational) preference of well-connected, highly reputed directors is expected to be companies with superior performance. Such companies' environments make the task of preserving and consolidating his/her status much easier.

To deal with this matter, we use a structural model comprised of two simultaneous equations. The first uses firm performance (LnQ) as a dependent variable, explained by traditional control variables, ownership structure specifications, and centrality score(s). The second equation tests the reversal effect of firm performance over board centrality, and therefore uses centrality score(s) as a dependent variable and LnQ as an explanatory variable.

Nevertheless, choosing the instrumental (exogenous) variables for this simultaneous system is not an easy task and should be done very cautiously. The reason for this is the very likely possibility that other important factors, such as firm

size and growth (along with other variables that appears to be highly correlated with them[17]), may also be "contaminated" by some of these endogeneity complications, for the same reason as that mentioned above.

Therefore, in order to avoid a possible bias of the estimates, we look for purely predetermined instruments and eventually choose industry attributes[18] and the ownership structure feature, which is the difference between an ultimate owner's voting power and his equity share. Using these instruments, we then employ the Three-Stage Least Square (3SLS) method.[19]

Table 2 presents the explicit equations and estimation results. Equation (1) is our basic model and, as mentioned above, its dependent variable is LnQ, which is the natural logarithm (Ln) of a firm's Tobin's Q. The explanatory variables in this equation are as follows: 1) LnSize is the natural logarithm (Ln) of the equity market value; 2) LEV is the firm's financial leverage, measured as the debt to equity ratio; 3) GROWTH is the average yearly growth in firm size (total assets) over 2004-2009 (as of December each year), calculated as (LnSize2009 – LnSize2004)/5; 4) H_VPO is a dummy variable equal to 1, if the ratio of the ultimate owners' vote percentage and equity percentage is above the sample median; 5) Dsize is the number of directors on the board of directors; 6) Centrality is the directorate's average/maximum centrality measure (Eigenvector, Degree or Betweeness); 7) Centrality*VPO is the multiplication of the selected directorate centrality measure by the control group's Vote Per Ownership ratio (the ratio of the ultimate owners' vote percentage and equity percentage). The above definitions also apply to equation (2), which examines

[17] Firm's leverage for example is significantly correlated with Size.

[18] Companies were classified into eight sectors, forming seven dummy variables.

[19] 3SLS takes into account any correlation between system error terms and is thus considered more efficient than 2SLS [see Dhrymes(1969), Belsley (1988) and others].

the reversal effects of performance (LnQ) over centrality scores. The system is estimated separately for each centrality index, as well as for each of the two measurement approaches (i.e., the board's average and maximum scores) - a total of six versions. Columns I and II present regression results, when the level of centrality is measured by average and maximum Degree (AvDeg and MxDeg). Similarly, Columns III and IV show the results of average and maximum eigenvectors (AvEign and MxEign), while Columns V and VI present the estimation outcomes of average and maximum betweeness (AvBet and MxBet).

One further note is necessary before we proceed. In a preliminary test, we checked and found that firm leverage (LEV) is significantly correlated with firm size (LnSize). Thus, to avoid multicolinearity problems, we "cleaned" the LEV variable from firm size effect, by regressing firm leverage on LnSize, and using the residuals as the leverage explanatory variable.[20]

[Insert Table 2. About here]

Panel A presents system estimates that refer to the cluster of professional ("experts") directors. Our main interest is the results concerning the effect of board centrality on performance. However, it would be appropriate to begin inspection of the Q equation with the intriguing significant estimates regarding the control explanatory variables.

Similarly to previous findings about Tobin's Q, the coefficient of firm size (LnSize) is positive and different from zero at the 1% significance level. Conversely and inconsistently with most prior Q literature, we find the effect of firm assets growth to be significantly negative (1% significance level). We further investigate this

[20] By doing so, we also "clean" the LEV variable from any endogeneity that is likely to be embedded in firm size, since (as stated in the previous section) central directors tend to sit in larger companies.

unexpected result and find the bivariate LnQ-Growth Pearson correlation to be significantly negative (-0.43). A possible explanation of this puzzling anomaly could be the recent change in the method according to which listed companies in Israel report their financial statements. Since 2006, the ISA (Israeli SEC) directed listed companies to switch to reporting in accordance with the IFRS (International Financing Reporting Standard). This directive allowed them to update the book value of their fixed assets (most of which are real-estate) to their "fair" market value, instead of depreciated historic value (which fits the previous reporting rule). As a result, the equity of many firms has substantially grown without any change in their real economic indicators. Moreover, in many cases this artificial growth in equity provides an excuse for dividend distribution and even some extra bonuses that did not receive the sympathy of the stock market.[21] As a result, stock prices didn't reflect the "positive" change in equity, creating a negative relation between Tobin's Q and total asset growth.[22]

In an attempt to neutralize the unwanted IFRS effect, we obtain for each company in the sample the five-year average annual sales growth (instead of total asset growth). Very surprisingly, although the reassessment of the fixed assets shouldn't influence this item in the income statement, we find the relation between annual sales growth and Tobin's Q to be even more significantly negative than the parallel total asset growth-Q relation. Furthermore, we find the correlation between sales growth and total asset growth to be significantly positive (0.6). The only plausible explanation for these exceptional results argues that insiders in companies

[21] The most media-covered case was the unjustified dividends and bonuses paid in IDB (one of the largest and most influential conglomerates in Israel), while relying greatly on IFRS, during 2008-2010.
[22] It is important to remember that the estimator of Tobin's Q has total book assets in the denominator and stock prices in the nominator.

with higher sales growth felt more comfortable using IFRS features more aggressively i.e., relying on excessive estimates of fixed asset value, while the (efficient) market continues to rely mainly on real and reasonable economic indicators. The phenomenon described above emphasizes the need to further investigate the effect of major regulative changes, particularly in closely-held firms and concentrated ownership economies. Such an investigation, however, is beyond the aim and scope of the current study.

We continue the inspection of equation (1) in Panel A with the explanatory variable H_VPO representing the effect of the separation between control and ownership, which emerges from the pyramidal ownership structure. As expected, and similar to previous studies, the disparity between vote rights and equity percentage tends to harm firm performance. Companies with an above-median vote per ownership ratio have *ceteris paribus* lower Tobin's Q, as the coefficient of this ratio is significantly negative.

The Dsize coefficient, representing the effect of board size, is also significantly negative. This result supports our *Hypothesis 3* assuming that in a concentrated ownership structure, larger boards are a counterproductive burden, probably since some appointments are not driven by economic considerations, but is part of controllers' private benefits.

We now get to our main interest in the Q equation, which is the effect of board centrality on firm valuation. All centrality measures and their presentation modes (as shown in Regressions I through VI) yield positive coefficients. However, the most significant, positive estimate obtained for the *Eigenvector* centrality index in its maximum board score version. Apparently, the presence of well-connected and highly reputed expert directors on the board positively contributes to firm valuation. The

result supports Hypothesis 1.1, which postulates that in order to preserve her/his reputation, the professional expert director will use his capabilities and business ties in order to promote firm value, while imposing an adequate monitoring effect, in order to make sure that some of the surplus performance will eventually be conserved.

The significant result of the *maximum score* approach (and the higher T values of the *maximum score* version in comparison to the *average score*) gives credence to this approach. The central directors' monitoring effect seems to be independent of their share in the board.

With regard to the indices, it seems that the *Eigenvector* centrality measure is more beneficial in describing centrality differences among expert directors. However, while the superiority over the *degree* index is crystal clear at the definition level[23], dominance with respect to the *betweeness* index can be explained by the relatively small number of completely separate business groups in the concentrated Israeli economy. In this environment, it is most likely that real expert directors would be homogeneously dispersed among these few groups, leaving insufficient *betweeness* diversity to measure.

The last explanatory variable in the Q equation - Centrality*VPO, captures the combined effect of board centrality and the divergence of vote from ownership, due to a pyramidal ownership structure. The very significant positive estimates regarding all definitions of board centrality clearly confirm Hypothesis 2.1. The negative value impact of the control-ownership wedge is moderated proportionally with board centrality. In order to preserve their status, central expert directors will invest more effort in firms that are more exposed to exploitation. This morally hazardous situation

[23] The *degree* index only counts the ties, while the *Eigenvector* also considers each tie's quality.

probably makes both the public and media more alert, giving the director higher incentive to act more decisively, in order to protect her/his reputation.

To illustrate the potential magnitude of this combined effect, we use Regression IV with the higher explanatory power and take, for example, a firm with an average Q, centrality score and Vote Per Ownership ratio (1.42, 0.0444 and 1.42, respectively). The negative impact of the excessive voting power (according to the coefficient of H_VPO) is about 22% deprecation in Q.[24] However, an increase of 1% in the board centrality score is equivalent to a 4.8% raise in Q; a similar increase in VPO will moderate its negative impact by a 0.3% raise in Tobin's Q.

The estimation of equation (2) in Panel A supports the two-way causality relationship between directors' centrality and firm value. The significant positive coefficient of LnQ indicates that expert central directors prefer to sit on boards of companies with better market performance. Such companies will make the task of preserving and promoting directors' reputation and professional status much easier.

We conclude the inspection of Panel A with the results of the *Housman-Wu endogeneity test,* provided with each version of the structural equations. All tests confirm the endogeneity effect embedded in expert directors' centrality indicators. Apparently, the use of a simultaneous system was not redundant.

We now turn to Panel B, devoted to external directors. Evidently, the results point toward a different pattern of external directors as regards the centrality -firm performance relation. Most of centrality scores yield negative coefficients and the average degree index is even significantly negative (at the 5% significance level). These findings give credence to the *shadow director* phenomenon. This, in turn,

[24] Taking into consideration that our dependent variable is the natural logarithm of Q.

supports Hypothesis 4, representing the view that overpowered controlling shareholders use external directors as a rubber stamp for approving sub-optimal business maneuvers, which serves tunneling activities, i.e., the consumption of private benefits of control.[25] Thus, the source of external directors' centrality is probably a negative reputation for being easy collaborators with controlling shareholders. This view is also supported by the highly significant negative coefficients of LnQ in equation (2). According to this line of thought, external directors get higher centrality scores in firms with inferior performance. A plausible explanation for this observable fact would be that most collaborators' external directors (those who gained the most negative reputation) are chosen by major shareholders of firms with inferior performance, due to intensive tunneling procedures.

We continue the analysis of external directors' centrality consequences by examining the combined effect of centrality and the divergence of voting power from equity percentages (*Centrality*VPO*). The coefficients in most regressions are negative, and three of them are significantly negative, supporting Hypothesis 4.1. It turned out that the trend described above intensifies, the lower the company's location in the pyramidal ownership structure. The greater the (negative) reputation of the external director as a collaborator, the greater is the desire of controlling shareholders to recruit him to firms in which they possess higher incentives to consume private benefits. This negative, combined effect regarding external directors appears to be strong and significant enough to contain all the explanatory power (diversity) of the pyramid effect, rendering the H_VPO coefficient insignificant.

[25] According to Dyck and Zingales (2004) and Barak and Lauterbach (2011), the level of private benefit consumption in Israel is above the global median.

However, according to Panel B, the dynamic above has one exceptional centrality effect. It appears that external directors with higher *betweeness* scores tend to improve firm performance and even eliminate the negative excessive voting power effect in pyramids. It also seems that those external directors who serve in several important business groups are similar in character to professional (expert) directors. It is plausible to assume that they are, in fact, experts who were specially chosen for external director positions in order to gain market sympathy, and thus much less (or completely not) subject to the improper damaging influence of controlling shareholders.

Finally, the Hausman-Wu endogeneity tests, although less pronounced than in the previous case, justify the use of appropriate means to address the problem of endogeneity.

Summary and Conclusions

In this study, we explore the implications of directors' networks for listed companies' performance in a concentrated ownership environment and pyramidal control structures. Our results provide interesting insights for practitioners as well as for policymakers.

Using common centrality indices on a sample of 727 directors serving in 105 Israeli listed companies, we show that director type is a crucial argument when assessing the effect of board centrality on valuation. According to our findings, well-connected (central) directors - who are neither ultimate owners' family members (including employees) nor independent/external directors - promote firm valuation. These professional directors, who probably received their position as a result of their expertise and business connections, preserve their reputation through the constructive

use of skills and status, whilst monitoring and restraining controlling shareholders' tunneling activities.

Furthermore, the constructive efforts and their value effect are of a larger scale, as the company is closer to the bottom of a pyramid ownership structure and the wedge between controllers' vote and equity percentage increases. It appears that well-connected, highly reputed directors are concerned about this gap's potential to draw public attention for being an incentive to exploit the company. Such public awareness, accompanied by intensive media coverage, may result in criticism and a damaged reputation in the case of underperforming. The intensified efforts made in this situation by central expert directors mitigate the negative impact of the pyramidal control structure.

Compared to the above, a similar analysis of external directors yields opposite conclusions. Central and well-connected external directors seem to harm firm performance, and even to magnify the negative effect of the vote-ownership wedge due to the pyramidal ownership structure. The results support the claim that centralized ownership structure invites the *shadow director* phenomenon. When the surplus power of controlling shareholders is not moderated properly, the bulk of external directors become the long arm of dominant shareholders and their tunneling (value-destroying) acts. These findings support Hypothesis 4 (and thus 4.1) claiming that an external director's higher centrality score is not an indication of skills and professional reputation but, in most of the cases, simply a result of a "bad" reputation for being submissive and obedient towards the dominant shareholders. The more cooperative the director is, the more popular he is among controlling shareholders who are pleased to appoint him to the board and thereby enhance his network centrality. Moreover, from the perspective of ultimate owners in pyramids, it is most

efficient to appoint the external directors with the worst reputations to serve in companies located at the bottom of the pyramidal structure. In these companies, due to the vote-ownership wedge, the incentive to exploit firm resources is higher, tunneling activity is more intensive, and the presence of a "convenient", concurrent external director is more essential.

The only exceptional external directors are those who serve simultaneously in major business groups (gained higher betweeness centrality scores). It appears that these unique directors possess characteristics similar to those of the expert professional director group, and were probably appointed due to intensive public attention towards major business groups. Thus, a higher betweeness centrality score in this case indeed reflects a proficiency reputation which the director would like to preserve.

The conclusions of this study can serve as another tool for professional investors and portfolio managers who operate in a complex concentrated ownership structure environment and overpowered / unbalanced controlling interests. In such capital markets, value maximizing for non-controlling stakeholders strongly depends on the proper functioning of a board that adequately monitors controlling shareholders and moderates tunneling activities.

Our findings should also be of interest to policymakers and regulators in concentrated ownership economies. The *agency problem,* which emerges from the separation between ownership and control in these economies, may be mitigated by a strong, independent board. The recommendation of this study suggests the establishment of mechanisms that will restrain the influence of shareholders with controlling interests on the processes of the appointing and dismissing of directors - especially external ones. Moreover, it is important to apply a mandatory appointment

of at least one highly reputed expert director to the board. Such a proposed mechanism will ensure minimum consumption of private benefits of control which, according to the financial literature, is negatively correlated with quality of capital markets and economic growth [see LLSV (2002)].

One last comment bears mentioning. Our study is based on a sample of Israeli firms from the beginning of 2010. The Israeli economy and capital markets have undergone major regulation and structural reforms in recent years. One of these reforms, the Corporate Law16th Amendment, was first enacted in 2011 and directly relates to the subjects and conclusions of this study. Thus, there is a need for further research in order to examine the effectiveness of the evolving regulation which, in this case, has become more important, going beyond the regular practice / habit of calling for future validation.

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Table 1

Descriptive statistics of samples - 105 firms and 727 directors

Panel A presents the simple statistics of some important characteristics concerning sample firms according to the financial reports of the 2009 fiscal year. SIZE is total assets in millions of NIS; LEV is a firm's debt to equity ratio; GROWTH is the annual growth rate of a firm's Total Asset over the years 2004-2009, calculated as $ln(TA_{2009/}\ TA_{2004})/5$; VPO is the ratio between aggregate ultimate owners' vote percentage and equity percentage; Q ratio is the firm's Tobin's Q, calculated at the end of 2009 (the beginning of 2010) as the market over book value of assets. Panel B presents firms' board average and maximum score centrality measures (Degree, Eigenvector and Betweeness), classified by the type of directors (professional vs. external/independent) along with the tests for centrality scores' differences among these types of directors.

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Panel A - Firm Characteristics

Variable	*Obs.*	*Mean*	*Median*	*Standard deviation*	*Maximum*	*Minimum*
SIZE (million NIS)	105	3,085	1101	7,277	64,411	146
LEV	105	5.48	2.20	7.48	38.93	0.01
GROWTH (%)	105	17.5	10.5	3.59	231	-44
VPO	105	1.42	1.09	0.704	5.45	1.00
Dir-Size	105	8.58	8.00	3.01	16.00	3.00
Q ratio	105	1.42	1.07	0.96	6.87	0.77

Panel B - Means of Firm Directorates' Centrality Measures by type of director

	Obs.	*Prof*	*Ex*	*p-value of t test for difference*	*p-value of Wilcoxon test for difference*
AverageDegree	105	10.295	9.602	0.160	0.071
MaxDeg	105	17.771	12.419	<0.001	<0.001
AverageEign	105	0.0116	0.0106	0.699	0.008
MaxEign	105	0.0444	0.0217	0.001	<0.001
AverageBet	105	0.224	0.228	0.947	0.005
MaxBet	105	0.985	0.525	0.023	<0.001

Table 2-The impact of director centrality on firm performance

We present 3SLS results of the following simultaneous equations system

$$(1)\ LnQ_i = \beta_0 + \beta_1 \cdot LnSize_i + \beta_2 \cdot LEV_i + \beta_3 \cdot Growth_i + \beta_4 \cdot HVPO + \beta_5 \cdot Centrality_i + \beta_6 \cdot Centrality * \text{VPO} + \beta_7 \cdot Dsize + e_i$$

$$(2)\ Centrality_i = \beta_0 + \beta_1 \cdot LnQ_i + e_i$$

LnQ is the natural logarithm (Ln) of a firm's Tobin's Q, LnSize is the natural logarithm (Ln) of the equity market value ; LEV is the firm's financial leverage measured as the ratio of debt to equity; GROWTH is the average yearly growth in firm size (total assets) over the end of 2004-2009, computed as ($LnSize_{i2009} - LnSize_{i2004}$)/5; H_VPO is a dummy variable equal to 1 if the ratio of ultimate owners' vote percentage and equity percentage is above the median; Centrality is the directorate's average/maximum centrality measure (Degree , Eigenvector, or Betweeness); Centrality*VPO is the multiplication of the directorate's centrality measure chosen by the control group's Vote Per Ownership ratio (the ratio of ultimate owners' vote percentage and equity percentage); Dsize is the number of directors on the board of directors. Panel A presents estimates for centrality measures of professional (experts) directors, while estimates referring to external directors are shown in Panel B; in all models the instruments (pre-determined factors) are industry attributes' dummy variables and the gap between voting power and ownership percentage (due to the pyramidal ownership structure). To avoid multicollinearity problems, LEV is "cleaned" from Size effects, i.e., in the regressions of this table we use the residuals of LEV (over Lnsize) regressions instead of the raw variable itself. Columns I and II present regression results when the level of centrality is measured according to average and maximum Degree, respectively. Columns III and IV (V and VI) follow the same pattern for the Eigenvector (Betweeness) centrality measure. T-statistics are presented in parentheses below the coefficients. *, **, and *** indicate that the coefficient is significantly different from zero at the 10%, 5%, and 1% significance levels, respectively.

Panel A: Professional Directors

	III AvDeg	IV MxDeg	I AvEign	II MxEign	V AvBet	VI MxBet
Q Equation						
LnSize	0.175*** (3.70)	0.160*** (3.47)	0.146*** (3.01)	0.138*** (3.03)	0.165*** (3.34)	0.164*** (3.30)
LEV	-0.0001 (-0.02)	0.0006 (0.08)	-0.0008 (-0.11)	0.001 (0.20)	-0.004 (-0.62)	-0.004 (-0.58)
Growth	-1.122*** (-7.04)	-1.14*** (-7.21)	-0.972*** (-6.08)	-0.987*** (-6.58)	-1.088*** (-6.64)	-1.09*** (-6.76)
H_VPO	-0.438*** (-3.54)	-0.381*** (-3.24)	-0.261** (-2.32)	-0.250** (-2.31)	-0.266** (-2.28)	-0.274** (-2.37)
Dsize	-0.064*** (-3.39)	-0.065*** (-3.42)	-0.058*** (-3.02)	-0.058*** (-3.12)	-0.067*** (-3.43)	-0.074*** (-3.69)
Centrality	0.050 (0.96)	0.020 (1.52)	3.415 (1.41)	4.419** (2.04)	0.275 (0.67)	0.069 (0.73)
*Centrality*VPO*	0.032*** (4.98)	0.016*** (5.75)	13.828*** (5.66)	4.220*** (6.34)	0.371*** (5.54)	0.110*** (5.39)

Table 2-The impact of director centrality on firm performance - Panel A (continued)

	III AvDeg	IV MxDeg	I AvEign	II MxEign	V AvBet	VI MxBet
Centrality Equation						
LnQ	1.418	6.930*	0.014**	0.062***	0.210	0.926
	(1.15)	(1.82)	(2.05)	(2.62)	(1.18)	(1.32)
Sys Weighted R-Sq	0.273	0.299	0.297	0.353	0.274	0.272
P Value of Hausman-Wu test for endogeneity	0.04	0.03	<0.01	0.04	<0.01	<0.01

Panel B: External Directors

	III AvDeg	IV MxDeg	I AvEign	II MxEign	V AvBet	VI MxBet
Q Equation						
LnSize	0.151***	0.144***	0.142***	0.138***	0.156**	0.150***
	(4.31)	(3.36)	(3.24)	(3.32)	(2.68)	(2.62)
LEV	-0.006	-0.007	-0.006	-0.005	-0.004	-0.003
	(-1.25)	(-1.08)	(-0.94)	(-0.83)	(-0.56)	(-0.42)
GROWTH	-0.980***	-0.938***	-0.923***	-0.923***	-0.876***	-0.885***
	(-8.66)	(-6.85)	(-6.74)	(-7.08)	(-5.08)	(-5.12)
H_VPO	-0.140	-0.056	-0.009	0.009	-0.077	-0.008
	(-1.43)	(-0.49)	(0.09)	(0.1)	(-0.59)	(-0.69)
DSIZE	-0.053***	-0.058***	-0.046**	-0.041***	-0.065***	-0.065***
	(-3.63)	(-3.19)	(-2.56)	(-2.39)	(-2.94)	(-2.94)
Centrality	-0.054**	-0.017	-13.588	-7.196	0.427	0.244
	(-2.30)	(-1.01)	(-1.09)	(-1.23)	(1.02)	(1.36)
*Centrality*VPO*	-0.008	-0.010**	-0.046**	-11.461***	0.137	0.094***
	(-1.46)	(-2.22)	(-2.56)	(-12.30)	(1.56)	(2.95)
Centrality Equation						
LnQ	-10.230***	-13.591***	-0.020***	-0.044***	0.067	0.51
	(-5.01)	(-3.19)	(-3.11)	(-3.48)	(0.28)	(0.88)
Sys Weighted R-Sq	0.399	0.337	0.459	0.512	0.155	0.179
P Value of Hausman-Wu test for endogeneity	0.06	0.06	0.09	0.02	0.14	0.06