Concentration of Power Within Boards of Directors and Variability in Firm Performance*

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Abstract

In this study, we examine how the concentration of power within the board of directors affects the variability of firms' performance. Using directors' committee assignments as a proxy for power, we develop two unique measures of the concentration of decision-making power within the board. Our main finding is that firms with a greater concentration of power within their boards have higher variability in firm performance, as measured by monthly stock returns, annual return on assets, and annual Tobin's Q. Additional tests demonstrate that concentrated boards tend to adopt more extreme corporate strategies providing several mechanisms by which the concentration of power within the board can affect the volatility of firms' performance. Finally, we use the implementation of the Sarbanes-Oxley Act of 2002 as a quasi-natural experiment to alleviate concerns regarding endogeneity.

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1 Introduction

Theoretical work from organizational economics (e.g. Sah and Stiglitz, 1986, 1991; Sah, 1991) suggests that when the decision-making power within an organization is more equally distributed, we should observe fewer extreme decisions and outcomes. As the nature of decentralized decision-making typically lends itself to both compromise and consensus building, extreme events are less likely to occur (Sah and Stiglitz, 1988). Conversely, when authority is centralized, the need for decision makers to confer with others is lessened, leading to more variable performance, whether good or bad.

The board of directors provides a rich setting for testing these theories. While boards are ostensibly organized in such a manner that the type of measured decision-making alluded to above takes place, the underlying reality is much more complex. In fact, boards' internal organization can vary widely, with some boards having decision-making centralized in the hands of a few key directors while other boards possess a much more decentralized decision-making structure. This point is starkly demonstrated in Figure 1. Figure 1 displays the organizational structure of two different ten-member boards from 2005 to 2006. As can be seen in Panel A, Skyworks Solutions has a very concentrated authority structure where a relatively small group of directors appears to hold most of the decision-making power on the board. In contrast, the board of H&R Block, shown in Panel B, has a much more decentralized decision-making structure by virtue of delegating more work to committees and having all of its directors serve on at least one of its subordinate committees.

Figure 1 also highlights several reasons why decentralized decision-making may not lead to less variable corporate performance. First, echoing Aghion and Tirole (1997), there is no reason to expect that an organization's *formal* authority structure necessarily reflects its *real* power structure. For example, a board that appears decentralized may actually be dominated by a coalition of directors that acts similarly to a centralized decision-maker. As both theoretical (Malenko, 2014) and survey (Lorsch and MacIver, 1989) evidence point to the internal pressure that boards place on directors for conformity, the firm's performance may well rest on the quality of the controlling bloc's decision-making ability. [1] Second, the decentralization of authority intuitively leads to specialization (Bolton and Dewatripont, 1994). For example, the formation of an investment committee allows the board to largely delegate the selection of attractive acquisition targets to individuals who have the best ability to acquire and process information related to that task. While this specialization may be beneficial and lead to higher performance, it can also come at a cost. As specialization increases, the ability for non-specialists to parse the information provided by the specialist becomes more difficult (e.g. Cremer et al., 2007; Ferreira and Sah, 2012). This may hamper communication within the board, leading to an inhibited ability to reach consensus, resulting in more volatile performance. Finally, as noted by Alonso et al. (2015), one of the key advantages of having a centralized decision-making is that it allows one party to coordinate the actions of groups that often have differing goals and incentives from one another. This is especially important if the decisions made by the groups are interconnected. Thus, decentralization may lead to some boards "pulling in opposite directions" resulting in lower performance, while other decentralized boards can effectively coordinate without a centralized authority, producing higher performance. Therefore, whether concentration of power on boards leads to higher or lower performance volatility is effectively an empirical question.

In this paper, we seek to answer this question by examining how the distribution of decision-making authority within the board of directors affects the variability of firms' performance. We utilize directors' committee assignments as a proxy for the concentration of power within a board. Several empirical studies such as Klein (1998), Shivdasani and Yermack (1999), Faleye et al. (2011), and Hwang and Kim (2012) have demonstrated that directors sitting on board committees can exert significant influence on firm outcomes. Additionally, in Lorsch and MacIver (1989, p.

[1] Malenko (2014) presents a theoretical model where directors possess private information regarding the success of an investment and need to vote on whether to accept the project. She shows that some desire for conformity at the voting stage can actually be beneficial as it induces directors to reveal any concerns to their fellow board members prior to the vote. However, if the conformity bias among directors is very strong, it can also lead to directors failing to reveal their information for fear of violating the consensus. Meanwhile, Lorsch and MacIver (1989) finds that 49% of directors they surveyed felt inhibited in taking a minority position against their fellow board members.

59)'s survey of board members, one director remarked:

> "As long as I have been a director, most of the work that has gone on is in committees–the close working with operating executives and the preparation and development of analysis, plus recommendations as to what to do, staff support for it, along with preparation to deal with future questions as to why you did not do something else–all that goes on in committees."

Another director (p. 59) stated that:

> "He has to rely on the presentations of other board members on the committees considering the specific and detailed subjects that the company confronts."

Both empirical and survey evidence strongly suggest that the formation of a committee represents a meaningful delegation of authority from the board as a whole to the individual committee members. Accordingly, the share of committee memberships held by a given director represents a fairly direct measure of the authority that director possesses on the board.

Using the directors' shares of available committee positions, we develop two unique measures of the concentration of decision-making power based on the Herfindahl-Hirschman index of industry concentration.[2] The first measure, called the *Rank index*, captures power concentration by assigning greater weights to directors that occupy loftier positions in the board's internal hierarchy. For instance, the chairman of the board receives the greatest number of points when calculating the Rank index, followed by committee chairs, non-chair committee members, and finally directors lacking committee assignments . While the Rank index does an excellent job of encapsulating the authority structure of the board, it does implicitly assume that all chair positions, whether at the board- or committee-level, have equal influence regardless of the size of the board or the committee. Therefore, we develop a second measure of power concentration called the *Span index* which differs from the

[2] A detailed discussion of how the indices are constructed is presented in Section 2.2

Rank index by measuring authority as the number of "subordinates" a given director has under his oversight (e.g. the number of audit committee members under the audit committee chair). Our final hand-collected sample consists of 14,786 firm-year observations spread across 2,043 different non-regulated firms from 1996 to 2011.

Following the methodology developed in Glejser (1969) and utilized by Adams et al. (2005) and Cheng (2008), we find that firms with highly concentrated boards as measured by the Rank and Span indices tend to have higher performance variability as measured by monthly stock returns, annual return on assets (ROA), and annual Tobin's Q. To place our findings in the context of previously-done work (Adams et al., 2005; Cheng, 2008, respectively), our results imply that a one standard deviation increase in the Rank index is roughly equivalent to moving from having a non-powerful CEO to having a powerful CEO (for Tobin's Q volatility), or decreasing the size of the board by two members (for stock return and ROA volatility). Additional test focusing on within-firm, over-time variation support these findings. Further strengthening our results, subsequent investigations reveal that boards with higher concentration of power tend to be associated with more extreme corporate strategies, pertaining to executive compensation, dividend payout, capital expenditures, research and development spending, and leverage. Taken together, these results are consistent with the view that when decision-making power is concentrated in the hands of a few directors, boards tend to take more extreme decisions, resulting in more volatile outcomes for firms.

One concern that could be raised is that the relationship between boards' structure and the variability of firms' performance is likely to be endogenously determined. Indeed, theoretical work such as Thesmar and Thoenig (2000), Acemoglu et al. (2007), Rantakari (2013), and Alonso et al. (2015) does suggest that organizational design should be partially determined by the stability of the organization's operating environment.[3] To mitigate these concerns, we adopt the approach ofDuchin

[3]Broadly speaking, the results of Thesmar and Thoenig (2000), Acemoglu et al. (2007), Rantakari (2013) imply that increased operating volatility should lead to a more decentralized organizational structure as it aids the speed that value-relevant information is collected and acted upon. On the other hand, Alonso et al. (2015) argues that a more concentrated organizational structure may be preferable as it allows a centralized authority to coordinate activities across subordinates which reduces the

et al. (2010) and Armstrong et al. (2014) and use the passage of the Sarbanes-Oxley Act of 2002 (SOX) as a quasi-natural experiment to demonstrate what happens to the variability of performance given an exogenous shock to boards' organizational structure. In particular, we exploit that fact that some boards were compliant with the regulations set forth by SOX regarding participation by outside directors prior to the passage of the Act, while others were not, to help sharpen our tests.[4]

According to the theoretical model developed in Harris and Raviv (2008), assuming that there are prohibitive costs in becoming informed, as outside directors gain seats on the board, they will have a tendency to delegate decision-making in order to overcome their informational disadvantage. As a result, boards with more independent directors should be more decentralized, all else equal. Therefore, pre-SOX, we should expect to see that boards that were compliant with the Act's provisions prior to its passage were more decentralized than those that were not compliant. Furthermore, if the predictions of Sah and Stiglitz (e.g. 1986, 1991) and Sah (1991) hold, then the pre-SOX compliant firms should also have less variability than those firms that were not compliant pre-SOX. Assuming that the distribution of decision-making authority among the boards' directors was self-determined prior to SOX, the Act's passage would represent an exogenously-imposed constraint upon the non-compliant group of firms. As non-compliant boards were forced to add independent directors to the board, we should expect to find a decentralization of non-compliant boards' authority structure followed by a reduction in non-compliant firms' performance volatility.[5]

Overall, our empirical results substantiate these claims. As we show in Section 4, firms that were already compliant with SOX's requirements regarding the structure of the board prior to the Act's passage were indeed substantially less concentrated

possibility that the subordinates undertake actions that work in opposite directions.

[4]As noted by Linck et al. (2009), SOX mandated that each NYSE- and NASDAQ-listed firm must: (i.) have a board comprised of a majority independent directors, (ii.) have compensation and nominating or governance committees that were entirely comprised of independent directors, and (iii.) that the audit committee must have at least three members and be composed of financially-literate independent directors.

[5]In fact, Adams et al. (2015) find that the rate at which boards have delegated tasks to committees has increase substantially following the passage of the Sarbanes-Oxley Act of 2002.

than firms who were not compliant pre-SOX. Additionally, consistent with the results of Harris and Raviv (2008), the passage of SOX led to a significant decentralization of power within previously non-compliant firms coupled with a meaningful reduction in the variability of firms' stock returns, in line with the predictions of Sah and Stiglitz (1986, 1988, 1991) and Sah (1991). On the whole, these results suggest that our findings are largely robust to concerns over endogeneity.

Our work predominately contributes to an emerging literature that studies how the composition and design of the board of directors affects the variability of firms' performance. The paper closest to ours in this literature is Cheng (2008) which examines the relationship between board size and the variability of firms' performance. Based on the idea that boards with a greater number of directors will have a more difficult time reaching consensus, Cheng finds that firms with larger boards of directors tend to experience less extreme outcomes. While the outcome variables we analyze are almost identical, our approach differs from Cheng (2008) because he focuses on how the external structure of the board (i.e. the number of directors) affects performance variability while ours analyzes how the internal structure of the board (i.e. how the board delegates authority in order to accomplish its tasks) affects variability. Again, Figure 1 is informative for why this differentiation matters. Both Skyworks Systems (Panel A) and H&R Block (Panel B) have the same number of directors (i.e. 10). Under the approach employed by Cheng (2008), both of these board would be treated as identical. However, as Figure 1 clearly shows, they are organized very differently and therefore both the external and internal set-up of the board may matter when assessing boards' contribution to performance volatility.

To provide some additional support for our claim, Figure 2 graphs three different measures of performance volatility (i.e. the standard deviations of return on assets, Tobin's Q, and idiosyncratic stock returns) for firms sorted into quartiles based on the size of their board of directors and then conditionally sorted into quartiles based on either their Rank or Span index values. Board Quartile 1 contains the smallest boards (average number of directors is 6.23) while Board Quartile 4 includes the largest boards (average number of directors is 11.70). Likewise, Rank (Span) Quartile 1 contains the most decentralized boards, while Rank (Span) Quartile 4 possesses the boards with the greatest amount of concentrated authority. First, as can be easily seen across each of the panels, firms with smaller boards consistently have higher volatility than firms with larger boards, confirming the findings of Cheng (2008). However, it is also fairly evident that there is a substantial amount of difference in volatility *within* most board size quartiles when measured by either the Rank or Span indices. This suggests that both measures are useful in explaining firm-level performance volatility; a point that will be confirmed in our regression-based tests presented later in Section 3.

A more recent addition to this literature is Bernile et al. (Forthcoming). In this study, the authors find that more diverse boards, measured across a number of dimensions such as age, educational and professional experience, gender and race, lead to lower stock return volatility. Our paper differs from Bernile et al. (Forthcoming) in that we investigate on how the internal organization of the board of directors affects firm-level volatility, whereas the aforementioned authors analyze how the characteristics of the directors themselves affect performance volatility.

Our study also adds to a literature that questions how the concentration of power of corporate decision-makers affects the performance of firms. Generally, these studies have focused on the role of top-level management such as the Chief Executive Officer (CEO). One strand of this literature follows the so-called "quiet-life" hypothesis of Hicks (1935) and demonstrates that powerful managers may prefer to avoid making difficult decisions regarding capital budgeting (e.g. Bertrand and Mullainathan, 2003) and expenditures in research and development (e.g. Atanassov, 2013) in hopes of extracting long-run rents from shareholders leading to lower firm-level volatility (e.g. John et al., 2008; Gormley and Matsa, 2016). Conversely, other studies such as Adams et al. (2005) show that more powerful CEOs lead to greater variability in corporate performance. Our study augments this literature in two ways. First, as we examine how the allocation of decision-making authority within the board affects the volatility of performance, we are the first study in the literature to document how the concentration of power in the hands of a non-CEO corporate-level entity affects firm-level volatility. Second, as our findings show that boards with a more centralized power structure lead to more variable performance, our results provide further empirical support for those found by Adams et al. (2005).

Finally, our study augments a growing literature (e.g. Klein, 1998; Reeb and Upadhyay, 2010; Faleye et al., 2011; Adams et al., 2015) that explores how the internal structure of the board of directors affects corporate performance. As noted by Adams et al. (2010), the existing literature on the board of directors has widely ignored the role of committees and the internal structure of the board due to data limitations. We advance this literature by collecting arguably the most comprehensive sample of board committee assignments to date and creating two novel measures of how the decision-making power of directors is allocated. It is our hope that this study will serve as an impetus for other researchers to begin investigating how the organizational structure of the board of directors affects the functioning of firms.

The remainder of the paper is structured as follows: In Section 2, we discuss our data collection process as well as our construction of our measures of the concentration of power within the board, the Rank and Span indices. In Section 3, we present our primary empirical results and discuss our findings. Section 4 provides our results using the implementation of the Sarbanes-Oxley Act of 2002 as an exogenous shock to the distribution of boards' decision-making authority. Section 5 concludes the paper.

2 Measures of Concentration of Power within Boards

2.1 Data on Committee Memberships

To study the concentration of decision-making power within boards, we need data on the full committee structure of the board. The ISS/RiskMetrics database only provides the director memberships of regulatory committees (i.e. audit, compensation, and nominating committees); it does not contain memberships of other committees established by the board (e.g. finance committee or mergers and acquisitions committee). The full set of committee memberships is important to us in assessing how each board delegates and decentralizes its authority to all directors on the board. The relevant information is usually reported on each company's proxy statement under the section "Board Committees." However, there are no standardized formats used across proxy statements. The information we require can be reported in a paragraph format or a table format. In some cases, committee memberships are reported in the directors' bios section. As such, it is impossible to automate this process with a computer script. Therefore, we hand collect data on the full committee structure of the board: committee names, committee descriptions, chairpersons, and members. All data are independently verified in a second round to ensure accuracy.[6]

Another issue for us is that the committee information is applicable to the year leading up to the proxy statement, whereas the slate of directors captured in the ISS/RiskMetrics database includes new directors to be elected at the upcoming annual meeting, who may not have any committee assignments yet. In addition, this slate of directors excludes all directors who are retiring or leaving the board, and thus their committee assignments are omitted from the database. Figure 3 illustrates this issue. In this simplified and hypothetical example, there are ten directors on the board of ABC Inc. from June 2005 to June 2006, with three directors on the Audit committee (Directors 1, 2, and 6). The April 2006 proxy statement would report these three members under the Audit Committee section. However, two of the directors (Directors 1 and 2) are leaving the board, replaced by two new directors (Directors 11 and 12) to be elected at the upcoming 2006 annual meeting. The ISS/RiskMetrics database only reports the slate of ten directors continuing or to be elected at the 2006 annual meeting. Therefore, the database would only show one member of the Audit committee (Director 6).

We resolve this issue by hand collecting data on committee memberships of all directors, regardless of whether they are continuing or leaving the board, from the annual proxy statement. We then map these committee assignments to the slate of

[6] We are aware that BoardEx has recently provided data on all committee memberships of the board. However, BoardEx data coverage for the S&P 1500 firms only starts in 2001, whereas our sample begins in 1996.

directors from the previous year (in this hypothetical case in Figure 3: the 2005 slate of directors). For any director from the 2005 slate whom we cannot map to 2006 committee assignments, due to mid-year resignations or illnesses, we use her 2005 committee information. This methodology allows us to capture the board and its full committee memberships from 2005 to 2006, as illustrated in Figure 3.

Lastly, we require data on board chairmanships in order to construct our measures of concentration of power on the board. We first rely on the titles of executives in the ExecuComp database to identify the chairman of the board, as 60% of our firm-year observations have a CEO who also serves as Chairman of the board. For the remaining firm-years, we hand collect information on the identity of the board chairman from the proxy statement. For a small number of firms that do not report a board chair, we designate the lead director as the chair.

2.2 The Rank and Span Indices

To measure the concentration of power within a board, we construct two indices similar in intuition to the Herfindahl-Hirschman index of industry concentration. The first measure, which we refer to as the Rank index, is designed to capture how decision-making power is distributed within the board by measuring how the leadership positions on the board are allocated among the board's members. The Rank Index is calculated using the following formula:

$$Rank\ index_{j,t} = \sum_{i=1}^{I} Rank\ share_{i,j,t}^2 \tag{1}$$

where $Rank\ index_{j,t}$ is the Rank index of firm j at time t, and $Rank\ share_{i,j,t}$ is director i's share of the total number of ranks available in firm j at time t. Each director that sits on the board, but does not have committee membership is entitled to a rank score of one. Directors that have non-chair committee seats receive an additional rank point for each committee seat they hold. Possessing a committee chairmanship earns a director two additional rank points as committee chairs are assumed to have more authority than non-chair members. Finally, as the chairman of the board sits at the apex of the board's hierarchy, they receive a rank score of three. For example, a board chairman who is also chair of the audit committee would have a total of five rank points (three + two), whereas another board member who is a member of the audit committee would have only two rank points (one + one). We sum the ranks of all directors on the board, and divide each director's number of ranks by the total number of ranks in the firm to obtain her rank share. We sum the squares of the rank share across all directors on the board to obtain the Rank index of the firm in that year. Higher Rank index values indicate boards with a greater concentration of decision-making power.

While the Rank index accounts for the fact that committee chairs have more decision-making power than committee members and board chairs have the most decision-making power on a board, it treats all committee chairs within a firm equally and all board chairs across firms equally. For example, under the calculation of the Rank index, a chair of a three-person committee would have the same influence as the chair of the five-person committee despite the fact that the chair of the five-person committee seemingly has a greater span of influence over his fellow board members. To address this issue, we construct a second measure, called the Span index, to accommodate the possibility that being the chair of a larger committee provides more authority than being the chair of a smaller committee. The Span index is calculated as:

$$Span\ index_{j,t} = \sum_{i=1}^{I} Span\ share_{i,j,t}^{2} \tag{2}$$

where $Span\ index_{j,t}$ is the Span index of firm j at time t, and $Span\ share_{i,j,t}$ is director i's share of the total number of spans available in firm j at year t. The Span index is calculated in the same way as the Rank index, with one important difference: Committee chairpersons are now awarded a span equal to the size of the committee, and board chairpersons are awarded a span equal to the size of the board. Board membership and committee membership each count as a span of one.

Table 1 provides a demonstration of how we calculate the Rank and Span indexes for Skyworks Solutions in 2005 (a slate of ten directors with committee information reported in the 2006 proxy statement). For the most part, the assignment of Rank and Span points is fairly similar across directors.[7] However, there are some noteworthy differences between the two measures. For instance, under the Rank index, the Chairman of the board, Dwight W. Decker, is only the fifth most influential director on the board. This is because a small set of other directors holds all of the committee assignments potentially giving them more sway in setting the board's policy. However, under the Span index, the Chairman receives the largest share of authority as his position as chairman provides him with a broad span of control over the other board members. Additionally, we can see that the distribution of power is different under each measure. In the Rank index, there are five directors that have fairly similar Rank shares (i.e. Directors Beebe, Decker, Furey, McGlade, and McLachlan) leading to a more equal distribution of power. The Span index, on the other hand, provides most of the authority to only two directors (i.e. Directors Beebe and Decker) leading to a higher measured concentration of power within the board.

Due to the nature of Herfindahl-Hirschman index-based measures, the Rank and Span indices have a mechanical inverse relationship with board size. Even if two firms distribute decision-making power equally between all directors on their boards, the firm with a smaller board will have a higher Rank or Span index than the firm with a larger board. For example, a board that distributes power equally between four directors will have a raw Rank index of 0.25, whereas a board that distributes power equally between ten directors will have a raw Rank index of 0.10. To address this issue, we estimate a regression of the raw Rank index against board size. This allows us to decompose the raw Rank index into a component due to the mechanical effect of board size (i.e. the fitted values of the regression) and a component due to the concentration of power on the board (i.e. the residuals of the regression). We call the component of the Rank index that is unrelated to board size the "decomposed" Rank index and use it instead of the raw Rank index as our main independent vari-

[7] The correlation between the two measures is 0.8624. The correlation falls to 0.7478 when the indices are decomposed.

able of interest. We repeat an identical procedure for the Span index to obtain the "decomposed" Span index used in our regression-based tests.

3 Empirical Methodology and Results

To investigate the relationship between concentration of power on boards and variability in firm performance, we employ the following multivariate regressions framework:

$$\begin{aligned} Firm\,performance\,variability &= \beta_0 + \beta_1 Board\,concentration\,of\,power \\ &+ \beta_2 Board\,size + \beta_3 CEO\,power + Controls \\ &+ Industry\,FE + Year\,FE + Errors \end{aligned} \tag{3}$$

where $Firm\,performance\,variability$ is one of three different measures of corporate performance volatility discussed below and $Board\,concentration\,of\,power$ is either the decomposed Rank or Span index. As both the Rank and Span indices are direct measures of power concentration, we predict the estimated coefficient of β_1 to be positive indicating that boards with more centralized authority structures have more variable performance. Since Cheng (2008) finds that smaller boards lead to higher variability in performance, we include the size of the board as a regressor. In addition, as Adams et al. (2005) find that powerful CEOs lead to higher variability in performance, we control for the presence of powerful CEOs by using an indicator variable equal to 1 if any of the following conditions is met: the CEO is also the founder of the company, the CEO is the chairman of the board, or the CEO is the only insider on the board.[8] We also use two other variables to proxy for CEO power, CEO tenure and the CEO's ownership of the firm's equity as a percentage of outstanding shares. We include control variables such as firms' current and lagged return on assets (ROA), book leverage, firm size (measured by the natural log of the firm's total assets), investment policy (proxied by the ratio of capital expenditures to assets),

[8] We follow Adams et al. (2005) and Cheng (2008) in assuming that founder CEOs joined their companies within two years of incorporation. Firms that were incorporated at least 64 years prior to the current year are assumed to not have a founder CEO.

maturity (measured by the firm's age), and operational complexity (quantified by the firm's number of operating segments) in our regressions to control for other sources of performance volatility. Finally, we account for variation across industries and time by including both industry and year fixed effects. Table 2 provides summary statistics for all our variables and the construction of the variables is discussed in Appendix A.

We collect data for S&P 1500 firms from 1996 to 2011, excluding both financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999). As discussed in Section 2.1, we hand collect data from proxy statements to obtain the full committee memberships of all board members. We use an index of all proxy statements (i.e. Form DEF 14A) filed with the Security and Exchange Commission and merge this index with the Compustat database using the GVKEY-CIK historical mapping provided by Compustat. We obtain financial accounting data from Compustat, stock returns from the Center for Research in Security Prices (CRSP), director characteristics from RiskMetrics/IRRC, and data on CEOs from the ExecuComp database. We require non-missing values for all our variables. Our final sample consists of 14,786 firm-year observations spread across 2,043 unique firms.

Following Adams et al. (2005) and Cheng (2008), we measure firm performance variability in two different ways. First, we use the test for heteroskedasticity developed by Glejser (1969). Under the this approach, we specify performance models to explain firms' performance levels as measured by firms' stock returns, ROA and Tobin's Q. The absolute value of the residuals from these regressions are then used as a measure of performance variability. While the methodology developed by Glejser (1969) helps us identify deviations from typical performance levels, it does suffer from one potential flaw. Namely, it contains both variation across firms and well as across time. Similar to the argument presented by Adams et al. (2005), if boards with high concentrations of power are either very good at making value-enhancing decisions or very good at decreasing firm value, then cross-sectional differences in concentrated boards' abilities may be driving our results, rather concentrated boards within the same firm causing variation in performance over time. To remedy this concern, our second measure focuses on within-firm, over-time performance volatility by taking the standard deviation of our performance measures (i.e. stock returns, ROA, Tobin's Q) over the whole sample period for each firm resulting in only one observation per firm for this analysis. By focusing on within-firm variation exclusively, we can be more confident that centralized boards produce more sporadic performance for their own firm rather than the difference being determined cross-sectionally.

3.1 Glejser's Heteroskedasticity-based Tests

To implement the procedure developed by Glejser (1969), we need to first establish benchmarks to describe firms' expected performance levels. To explain firms' stock returns, for each firm, we estimate the Fama-French three-factor model (Fama and French, 1993) on monthly returns from January 1996 to December 2011:

$$Ret_{j,t} = \alpha_j + \beta_{1,j} MKTRF_t + \beta_{2,j} SMB_t + \beta_{3,j} HML_t + u_{j,t} \tag{4}$$

where where $Ret_{j,t}$ is the stock return of firm *j* during month *t*, $MKTRF_t$ is the monthly excess return of the CRSP value-weighted market portfolio over the risk-free rate (i.e. the return on the one-month Treasury bill), SMB_t is the difference in returns between small firms and large firms where size is determined by market capitalization, and HML_t is the difference in returns between high book-to-market firms and low book-to-market firms. We take the residuals, $u_{j,t}$, from these regressions and use their absolute values as a measure firm performance volatility.

To obtain ROA and Tobin's Q residuals, we follow Adams et al. (2005) and Cheng (2008). We run panel regressions with ROA and Tobin's Q as the dependent variables:

$$ROA_{j,t} \text{ or } Tobin's\, Q_{j,t} = \alpha + \beta X_{j,t} + u_{j,t} \tag{5}$$

where $X_{j,t}$ is the set of following variables explaining performance levels: board size, powerful CEO indicator, CEO tenure, CEO ownership, ROA , prior year ROA, book leverage, log of assets, capital expenditures/assets, firm age, and number of segments.[9] Again, we use the absolute value of ROA and Tobin's Q residuals from

[9]We exclude ROA as an independent variable from the ROA performance regression. We only include

these panel regressions to use as measures of variability in firm performance.

Table 3 presents the results of Glejser's heteroskedasticity-based tests. Robust t-statistics are included in parentheses below the point estimates. Industry fixed effects are included in the regressions to account for the possibility that certain industries may have more uncertain operating environments than others, thus they may have higher performance volatility and because there may be differences across industries pertaining to their choice of board centralization. Year fixed effects are also included to control for any period-specific changes to performance volatility. We note that we do not utilize firm fixed effects in our regressions because there is little time-series variation in the decomposed Rank and Span indexes, our main variables of interest. For instance, the correlation between the decomposed Rank index and its lagged value is 0.78, and the correlation between the decomposed Span index and its lagged value is 0.79. Accordingly, the inclusion of firm fixed effects may bias our tests toward find no relationship between board concentration and performance variability as they would eliminate the substantial cross-sectional variability that exists across boards with respect to the concentration of authority and instead focus on explaining how the relatively small differences in board concentration that occur over time explain performance volatility.[10] To alleviate concerns that are results are purely due to cross-sectional variation, tests in Section 3.2 will concentrate on the within-firm, over time variation in our data.

Overall, the results of Table 3 suggest that firms with higher concentration of power within their boards have higher variability in performance, even after controlling for board size and whether the CEO is powerful. Across all three measures of performance volatility, both the decomposed Rank and Span indices are statistically significant and have the correct sign. In terms of economic significance, a one standard deviation increase in the decomposed Rank index has a similar effect on firm performance variability as decreasing the number of firm segments by two.[11] Fur-

it in the Tobin's Q performance regression.

[10] See Zhou (2001) and Coles et al. (2008) for a similar argument.

[11] We standardize the decomposed Rank index and Span index and re-run the regressions in order to obtain the economic magnitudes. Results are untabulated.

thermore, in order to place our work in context with Adams et al. (2005) and Cheng (2008), we find that the impact of a one standard deviation increase in the decomposed Rank index is equivalent to decreasing the size of the board by two members (for stock return and ROA volatility), or moving from having a non-powerful CEO to having a powerful CEO (for Tobin's Q volatility). Therefore, our results appear to be economically meaningful as well. We cannot replicate Adams et al. (2005)'s results that powerful CEOs are associated with higher variability in monthly stock returns and annual ROA. However, this is also consistent with what Cheng (2008) reports when he uses a powerful CEO indicator as a control variable in his regressions.

3.2 Within-firm, Over-time Variability in Firm Performance Due to Power Concentration Within the Board

The panel regressions estimated in Section 3.1 utilize both cross-sectional and time-series information. As previously discussed, this raises the possibility that our results from Table 3 are largely due to cross-sectional difference and that the concentration of authority on the board does not effect within-firm performance over time. To provide additional support for our hypothesis that the concentration of power within the board influences performance volatility, we focus only on the effects of within-firm variability by calculating the standard deviation of monthly stock returns, annual ROA and Tobin's Q for each firm over the time they are in our sample. As a result, for these tests there is only one observation per firm for the entire sample period. Firms with only one firm-year or one firm-month are dropped as it is not possible to calculate a standard deviation. No firms are dropped in the standard deviation of stock returns regressions, and over 200 firms are dropped in the standard deviation of ROA and Tobin's Q regressions. To isolate the within-firm, over time variation, we regress the standard deviations of our performance measures against the sample averages of the decomposed Rank and Span indexes, as well as our other control variables. Industry fixed effects are included, but we omit year fixed effects since there is no longer a time dimension in this analysis.

The results presented in Table 4, are broadly consistent, albeit somewhat weaker, than those reported in the previous section. Firms with higher concentration of power within boards also have higher variability in performance, when performance volatility is measured either by standard deviation in monthly stock returns or annual ROA. The results are not statistically significant when we use standard deviation of Tobin's Q as a measure of performance volatility, but we still observe a positive and marginally non-significant coefficient (e.g. a t-statistic of 1.6 for the decomposed Span index). Taken together, our results suggest that firms with highly concentrated boards tend to have higher variability in performance.

3.3 Determining the Sources of Performance Variability Due to Board Concentration

Having found evidence consistent with our hypothesis that the concentration of decision-making power within the board is positively related to volatility of firms' performance, in this section, we try to ascertain the mechanisms by which the decision-making of the board may influence performance variability. Specifically, we examine whether centralized boards of directors are more likely to adopt extreme policy positions. We consider four broad categories of corporate actions that previous studies have identified the board of directors taking an active role in shaping strategy. The policy actions we investigate are investment spending (e.g. Burak Güner et al., 2008), capital structure (e.g. Harford et al., 2008), dividend policy (e.g. Hu and Kumar, 2004), and executive compensation (e.g. Chhaochharia and Grinstein, 2009).

To identify whether concentrated boards adopt extreme strategy positions, we create a variable that standardizes a given firm's policy position against the average policy position of its industry (defined at the two-digit SIC level) for a given year:

$$Standardized\,policy\,position_{j,t} = \text{abs}\left(\frac{X_{j,t} - \mu_t}{\sigma_t}\right) \quad (6)$$

where $X_{j,t}$ is firm j's policy position at time t, μ_t is the average policy position of firms located in firm j's two-digit SIC industry, and σ_t is the cross-sectional variation in the policy position held by the industry members at time *t*. We take the absolute value of this measure to reflect the fact that concentrated boards make take corporate policy positions that differ either positively or negatively from industry norms. We then regress these standardized policy variables against our two (decomposed) measures of board concentration and series of control variables:

$$Standardized\,policy\,position_{j,t} = \alpha + \beta_1 Board\,concentration\,of\,power_{j,t} \\ + Controls + Errors \tag{7}$$

If centralized boards do indeed take on more extreme corporate policy positions, then we expected the estimated coefficient on β_1 to be positive. We consider several different variables to determine the corporate policy position of the firm. To judge investment spending, we consider two measures; first, the level of capital expenditures to total assets, and second, the level of research and development (R&D) spending to total assets. In terms of capital structure, we look at firms' choice of book leverage and for dividend policy we study the dividend payout ratio. Finally, for executive compensation, we examine both (log) total compensation and (log) total cash compensation. We omit control variables that are related to the policy positions we analyze to avoid creating a mechanical relationship between the regressor and the dependent variable.[12] Additionally, as the standardization process already controls for variation across both time and industry, we do not include year or industry fixed effects in our regressions.[13]

Table 5 presents the results. As can be seen, across practically every corporate policy measure we consider, both the decomposed Rank and Span indices load positively and statistically significant at traditional levels as hypothesized. The lone exception is that the estimated coefficient on the decomposed Span index for the R&D spending standardized policy variable. Overall, the findings of Table 5 are consistent with boards with concentrated authority structures adopting more extreme corporate strategies. These results provide a plausible mechanism by which concen-

[12]For example, regressing our standardized measure of capital expenditures to assets against the capital expenditure-to-assets ratio.

[13]Results are materially unaltered with the inclusion of either year of industry fixed effects.

trated boards can affect the variability of firms' performance and therefore buttress our finds from Tables 3 and 4.

4 Addressing Endogeneity: The Sarbanes-Oxley Act (SOX) As a Quasi-Natural Experiment

As noted in the introduction, we acknowledge concerns that our results may be driven by endogeneity issues such as reverse causality or omitted variable bias. For instance, it is possible that firms that choose to have less extreme corporate decisions are also actively seeking to distribute decision-making power across directors on the boards or that unobserved firm factors are simultaneously driving both the concentration of power on boards and firm performance variability. To mitigate these concerns and to establish the causality of our results, we use the passage of SOX as a quasi-natural experiment in which there is a plausible exogenous shock to the structure of the board. SOX imposed the requirement that independent directors account for at least 50% of the board's membership and that certain committees such as the compensation and nominating committees be entirely comprised of independent directors (Linck et al., 2009). For the firms that were already in compliance with this requirement before the passage of SOX, the passage of the Act should have induced little to no change in their internal board structure. However, for the firms that did not have compliant boards, SOX constituted an exogenous shock to the structure of their board in the form of additional independent directors.

The theoretical model developed in Harris and Raviv (2008) suggests that outside directors will tend to delegate decision-making power in order to overcome their relative information disadvantage versus insiders. As a result, we expect that as additional independent directors are added to the board of non-compliant firms after the passage of SOX, the decision-making structure within these boards would become more decentralized, all else equal. Figure 4 confirms our expectation. For both the decomposed Rank index (Panel A) and the decomposed Span index (Panel

B), there is a sharp and significant decrease in the concentration of power within the boards of non-compliant firms after the passage of SOX in 2002, whereas there is only a small decrease for compliant firms.

Given the significant decrease in the concentration of decision-making power that followed SOX, we expect that non-compliant firms will witness a greater reduction in performance variability after SOX relative to firms that were compliant before the passage of the Act. To investigate this hypothesis, we estimate a difference-in-difference regression. The specification for our test is as follows:

$$\begin{aligned} Firm\,performance\,variability &= \beta_1 NonCompliant + \beta_2 PostSOX \\ &+ \beta_3 NonCompliant * PostSOX + Errors \end{aligned} \tag{8}$$

where $Firm\,performance\,variability$ is one of the three firm variability performance measures we have used in our previous tests, $NonCompliant$ is a dummy variable equal to one if the firm was non-compliant with the provisions of SOX prior to its passage and zero otherwise, $PostSOX$ is a dummy variable equal to one if the year is 2002 or later and zero otherwise, and $NonCompliant * PostSOX$ is an interaction term between the two aforementioned binary variables. If our expectations are correct, the estimated coefficient on β_3 should be negative and statistically significant.

Table 6 reports the results of these tests. As can be seen, the results for ROA and Tobin's Q are not statistically significant at traditional levels. However, the coefficient on the interaction term is negative and statistically significant at the one-percent level for the monthly stock return measure of performance volatility, consistent with our hypothesis that non-compliant firms see a greater reduction is performance variability versus compliant firms after the passage of SOX. Thus, as they stand, our results do not provide consistent evidence one way or another.

5 Conclusion

Theories from organizational economics suggest that when power is concentrated in the hands of a few decision-makers, the performance of the organization may be come more variable. In this paper, we test the implications of these theories on the board of directors. We develop two novel measures of the concentration of decision-making authority within the board, the Rank and Span indices, and find that higher concentrations of power within the board of directors is associated with higher variability in firm performance as measured by variation in monthly stock returns, annual ROA, or annual Tobin's Q. These results are statistically significant even after controlling for board size and powerful CEOs, two potential sources of variability in firm performance that were previously identified in the literature (Adams et al., 2005; Cheng, 2008). Subsequent testing reinforces these results. We find that across a number of different corporate policies including capital investment and research and development spending, dividend and leverage policy, and executive compensation, firms with more highly concentrated board structures tend to adopt more extreme positions versus their industry peers. These results provide a credible avenue by which the centralization of power with in the board can affect the volatility of firms' performance. Finally, we attempt to alleviate concerns over endogeneity by using the passage of the Sarbanes-Oxley Act of 2002 as a quasi-natural experiment. Our findings here are mixed. While on one hand, we are able to find that the imposed decentralization that SOX imposed did lead to a reduction in stock return volatility for previously non-compliant firms, consistent with our predictions, the results do not appear to hold for variations in return on assets or Tobin's Q. In future work, we intend on sharpening our test design in this area.

Overall, we believe our study represents an important step forward toward answering the call made by Adams et al. (2010) to examine the internal structure of the board of directors and its effect on firm performance. It is our hope that our work will encourage additional researchers to investigate these topics as well.

Appendix A - Definitions and Sources of Data Used in This Study

Variable Name	Definition	Data Source
Monthly Stock Returns	RET in CRSP	CRSP
Return on Assets (ROA)	(Operating Income/Total Assets)	Compustat
Tobin’s Q	(Total assets – book value of equity + market value of equity) / Total assets	Compustat
Decomposed Rank (Span) index	Residuals of regression of raw Rank (Span) index against board size	SEC proxy statements
Board size	Number of directors on the board	SEC proxy statements verified by RiskMetrics/IRRC
CEO is powerful	Indicator variable equal 1 if any of the following conditions is met: the CEO is the company founder, the CEO is also the chairman of the board, or the CEO is the only insider on the board	RiskMetrics/IRRC
CEO ownership	Shares owned by CEO/Total shares outstanding at fiscal year end	ExecuComp and Compustat
Book leverage	(Long-term debt + Current debt)/Total assets	Compustat
Log(Assets)	Natural log of total assets	Compustat
Capex/Assets	Capital expenditures/Total assets	Compustat
Firm age	Current year – First fiscal year of available accounting data	Compustat
Number of business segments	Number of unique 2-digt SIC segments within a firm	Compustat Historical Segments

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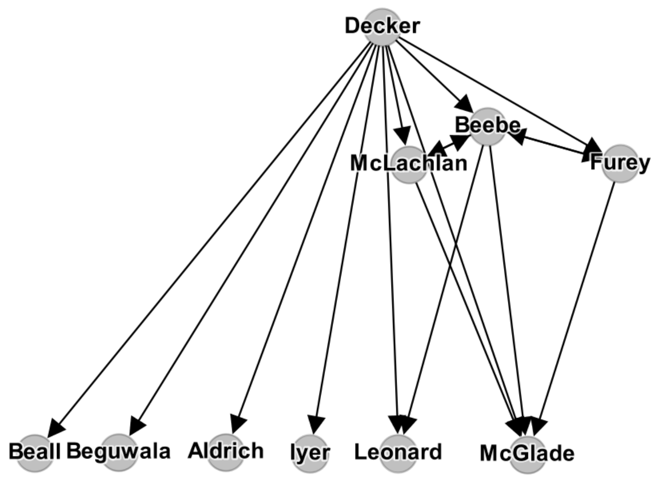
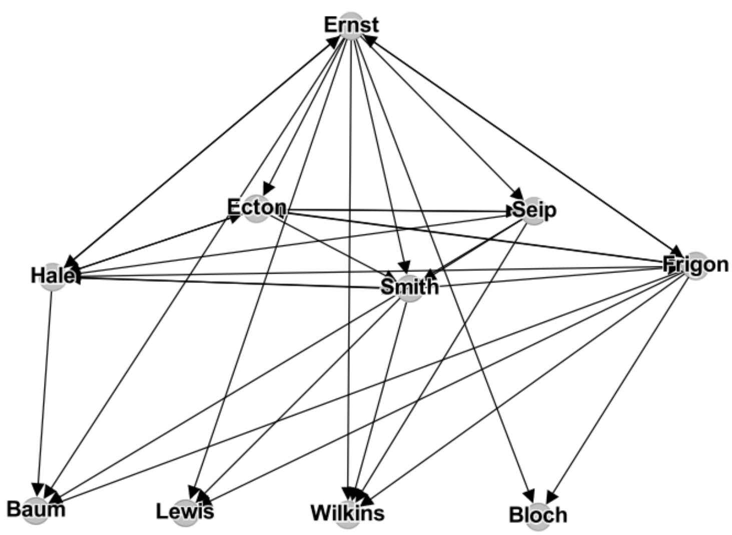
Figure 1: Authority Structures of Two Different Board of Directors. The figures below show the authority structures of two corporate boards from 2005 to 2006. Panel A displays a board with a highly centralized set-up (i.e. Skyworks Solutions), while Panel B demonstrates a board with a highly decentralized organizational structure (i.e. H&R Block). Note that each board has 10 members. Arrows originate from superiors and point toward subordinates. The highest node is filled by the board chairman. The next tier below is comprised of committee chairs and the lowest tier includes directors that have committee duties, but do not sit in a chair position and directors with no committee assignments. Skyworks Solutions has a Rank index value of 1,331 and a Span index value of 1,648 whereas H&R Block has a Rank index of 1,106 and a Span index value of 1,207.

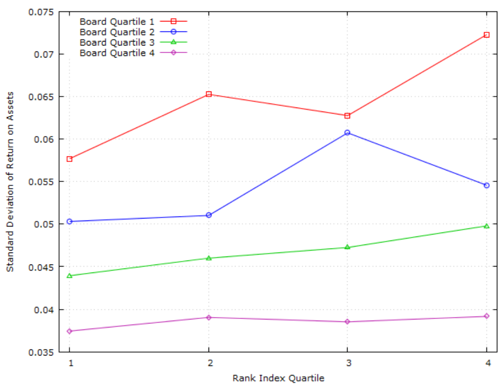


Panel A. Centralized Board - Skyworks Solutions

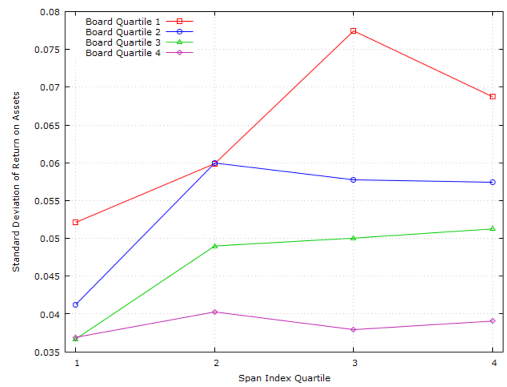


Panel B. Decentralized Board - H&R Block

Figure 2: Volatility of Performance Measures Within Board Size Quartiles Sorted by Rank and Span Indices. The figures below present measures of the volatility of firm performance within board size quartiles further sorted by the (decomposed) Rank and Span indices. Board Quartile 1 is comprised of the smallest boards (average size = 6.23 directors), while Board Quartile 4 has the largest boards (average size = 11.70 directors). Board Quartiles 2 and 3 have an average of 7.79 and 9.18 directors, respectively. Boards classified in either Rank or Span Index Quartile 1 are the most decentralized whereas those located in Quartile 4 are the most highly concentrated. Panel A illustrates the standard deviation of return on assets (ROA), Panel B shows the standard deviation of Tobin's Q, and Panel C displays the standard deviation of idiosyncratic returns.

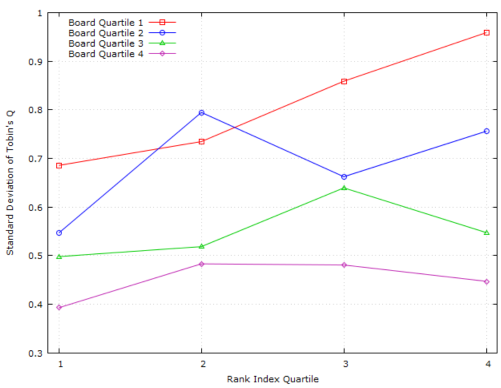


(i.) Rank Index

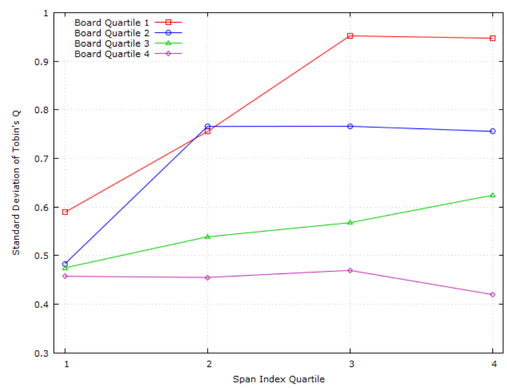


(ii.) Span Index

Panel A. Standard Deviation of Return on Assets (ROA)

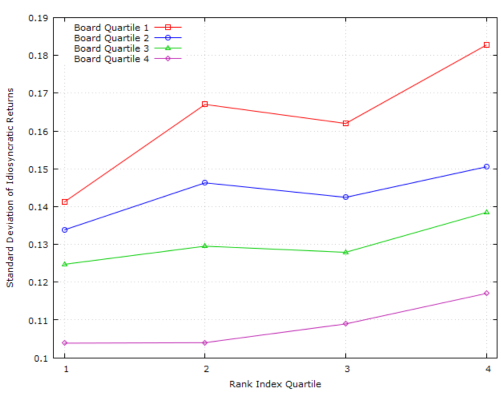


(i.) Rank Index

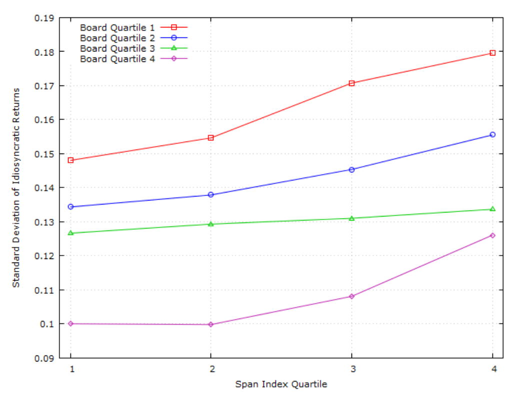


(ii.) Span Index

Panel B. Standard Deviation of Tobin's Q



(i.) Rank Index



(ii.) Span Index

Panel C. Standard Deviation of Idiosyncratic Returns

Figure 3: Illustration of Data on Committee Memberships Reported in Commercial Databases Versus Our Hand-collected Data Set. This figure presents a hypothetical situation where there is a mismatch between actual committee assignments and committee assignments reported in commercial databases. In this simplified situation, there are ten directors on the board of ABC Inc. from June 2005 to June 2006, with three directors on the Audit committee. The April 2006 proxy statement would report these three members of the Audit committee. However, two of the directors (Directors 1 and 2) are leaving the board, replaced by two new directors (Directors 11 and 12) to be elected at the upcoming annual meeting. The ISS/RiskMetrics database reports the slate of ten directors continuing or to be elected at the 2006 annual meeting, showing only one member of the Audit committee (Director 6). Our hand-collected dataset captures all of these twelve directors. We then map to the slate of directors reported on the 2005 proxy statement (Director 1 through 10) to correctly capture the board and its committee memberships from 2005 to 2006.

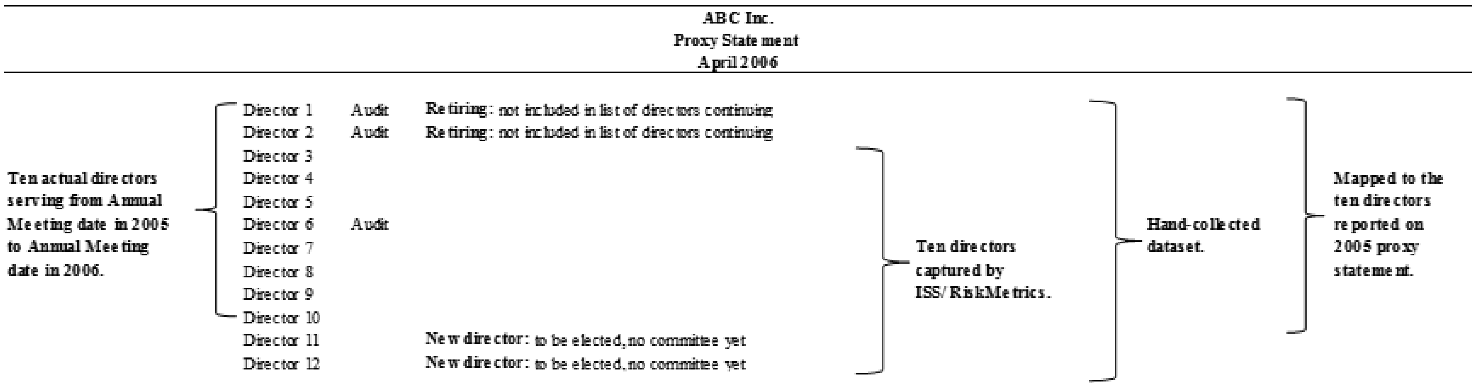
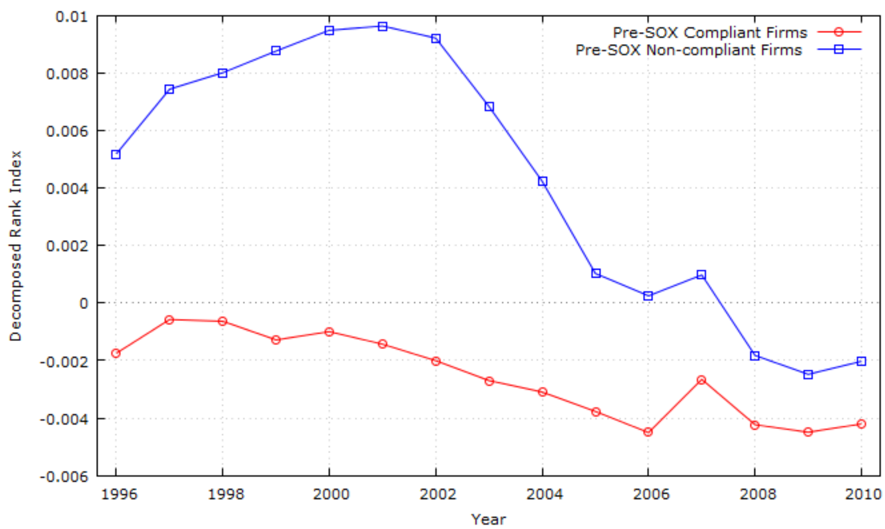
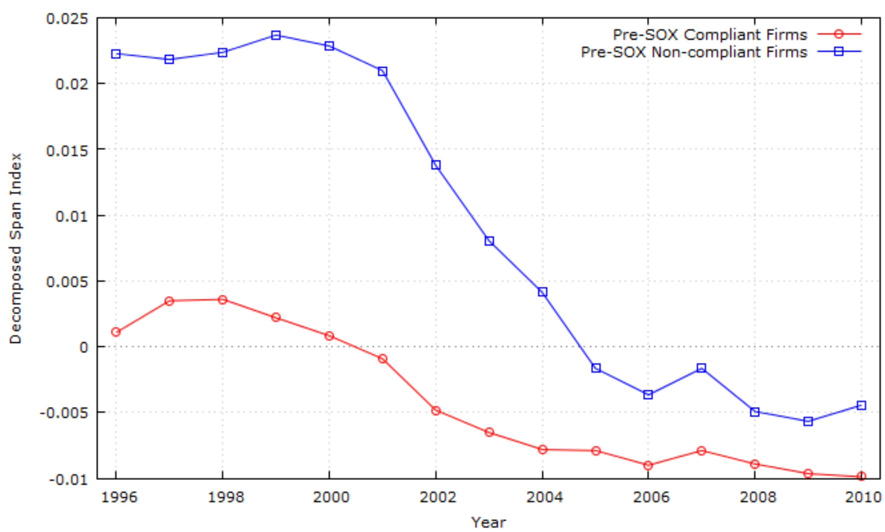


Figure 4: Board Centralization and the Sarbanes-Oxley (SOX) Act of 2002. The figure below shows how the average centralization of boards of directors changed over time. Boards are broken into two groups: boards that were compliant with SOX prior to the passage of the Act and boards that were not compliant with the Act prior to its announcement. Panel A measures the concentration of power within the board using the decomposed Rank index while Panel B measures the concentration of authority within the board using the decomposed Span index.



Panel A. Decomposed Rank Index



Panel B. Decomposed Span Index

Table 1: Example Calculation of the Rank and Span Indices. The table below demonstrates how the Rank and Span indices are computed using the board of directors for Skyworks Solutions presented in Figure 1 as a guide. The slate of directors is obtained from the 2005 proxy statement and the committee information is obtain from the 2006 proxy statement. Each board membership and committee membership counts as one rank and one span. Committee chairmanships count as two ranks and a span equal to the size of the committee. Board chairmanships count as three ranks and a span equal to the size of the board. Rank share and span share are expressed as whole numbers instead of percentages to scale up our dependent variables and ease the reporting of coefficients in regressions.

Director	**Board Member**	**Audit Committee**	**Compensation Committee**	**Nominating Committee**	**Rank Points**	**Rank Share**	**Squared Rank Share**	**Span Points**	**Span Share**	**Squared Span Share**
Kevin L. Beebe	Yes	*Member*	*Member*	*Chair*	5	0.19	0.0370	8	0.21	0.0443
David P. McGlade	Yes	*Member*	*Member*	*Member*	4	0.15	0.0237	4	0.11	0.0111
Moiz M. Beguwala	Yes	No	No	No	1	0.04	0.0015	1	0.03	0.0007
Balakrishnan S. Iyer	Yes	No	No	No	1	0.04	0.0015	1	0.03	0.0007
Dwight W. Decker	*Chairman*	No	No	No	3	0.12	0.0133	10	0.26	0.0693
David J. McLachlan	Yes	*Chair*	No	*Member*	4	0.15	0.0237	5	0.13	0.0173
Timothy R. Furey	Yes	No	*Chair*	*Member*	4	0.15	0.0237	5	0.13	0.0173
Thomas C. Leonard	Yes	No	No	*Member*	2	0.08	0.0059	2	0.05	0.0028
David J. Aldrich	Yes	No	No	No	1	0.04	0.0015	1	0.03	0.0007
Donald R. Beall	Yes	No	No	No	1	0.04	0.0015	1	0.03	0.0007
					Rank Index		0.1331	**Span Index**		0.1648

Table 2: Summary Statistics. Listed below are the summary statistics for our variables of interest. Variable definitions can be found in Appendix A.

Variables	Observations	Mean	Std. Dev.	Min	25th Percentile	Median	75th Percentile	Max
Decomposed Rank index	14,786	-0.000	0.017	-0.025	-0.011	-0.004	0.007	0.153
Decomposed Span index	14,786	-0.000	0.027	-0.053	-0.020	-0.005	0.015	0.194
Monthly stock returns	177,456	0.012	0.139	-0.848	-0.059	0.009	0.077	9.374
Return on assets (ROA)	14,786	0.144	0.106	-1.319	0.096	0.141	0.194	0.965
Tobin's Q	14,786	2.010	1.464	0.391	1.208	1.583	2.282	39.119
Board size	14,786	9.071	2.377	4.000	7.000	9.000	11.000	22.000
CEO is powerful	14,786	0.813	0.390	0.000	1.000	1.000	1.000	1.000
CEO tenure	14,786	7.231	7.306	0.000	2.000	5.000	10.000	59.000
CEO ownership	14,786	0.024	0.062	0.000	0.001	0.003	0.013	1.295
Book leverage	14,786	0.215	0.176	0.000	0.059	0.205	0.325	1.743
Log(Assets)	14,786	7.418	1.491	2.819	6.361	7.264	8.331	13.590
Capex/Assets	14,786	0.057	0.055	0.000	0.023	0.040	0.071	0.815
Firm age	14,786	26.432	16.035	1.000	13.000	22.000	40.000	61.000
Number of segments	14,786	1.521	0.825	1.000	1.000	1.000	2.000	9.000

Table 3: Heteroskedasticity Tests of Firm Performance as a Function of Boards' Concentration of Power. This table presents the results of using the heteroskedasticity-based tests of Glejser (1969) to examine the relationship between variability in performance and measures of boards' concentration of power. The excess stock returns are obtained from using the Fama-French three-factor model to explain monthly stock returns. The ROA and Tobin's Q residuals are obtained from panel regressions of ROA and Tobin's Q on a set of variables. All variable definitions and sources are described in Appendix A. Robust t-statistics are reported in parenthesis. Significance levels are indicated by *, **, and *** and correspond to the 10%, 5%, and 1% significance levels, respectively.

Dependent Variable	**Absolute value of excess stock returns**	**Absolute value of excess stock returns**	**Absolute value of ROA residuals**	**Absolute value of ROA residuals**	**Absolute value of Tobin's Q residuals**	**Absolute value of Tobin's Q residuals**
Decomposed Rank index	0.102		0.097		1.956	
	(7.9)***		(3.4)***		(3.0)***	
Decomposed Span index		0.046		0.033		0.876
		(5.7)***		(1.8)*		(2.5)**
Board size	-0.001	-0.001	-0.001	-0.001	-0.025	-0.028
	(-11.9)***	(-13.1)***	(-2.5)**	(-3.0)***	(-5.7)***	(-6.1)***
CEO is powerful	0.001	0.001	-0.001	-0.001	0.044	0.042
	(1.5)	(1.4)	(-1.0)	(-1.2)	(2.0)**	(1.9)*
CEO tenure	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001
	(-0.3)	(-0.1)	(-0.8)	(-0.7)	(-0.6)	(-0.5)
CEO ownership	-0.011	-0.010	-0.028	-0.027	0.066	0.077
	(-3.0)***	(-2.8)***	(-4.5)***	(-4.3)***	(0.3)	(0.3)
ROA	-0.057	-0.057	-0.180	-0.180	0.139	0.130
	(-12.0)***	(-12.1)***	(-3.5)***	(-3.5)***	(0.4)	(0.4)
ROA (prior year)	-0.048	-0.047	0.071	0.071	-0.155	-0.152
	(-10.1)***	(-10.1)***	(1.1)	(1.1)	(-0.5)	(-0.5)
Book leverage	0.017	0.017	0.006	0.005	-0.452	-0.460
	(11.7)***	(11.5)***	(1.1)	(1.0)	(-4.4)***	(-4.5)***
Log(Assets)	-0.005	-0.005	-0.006	-0.006	0.001	0.003
	(-28.0)***	(-27.3)***	(-12.8)***	(-12.6)***	(0.1)	(0.3)
Capex/Assets	0.057	0.057	0.130	0.130	0.853	0.864
	(10.8)***	(10.9)***	(4.7)***	(4.8)***	(2.8)***	(2.8)***
Firm age	-0.000	-0.000	-0.000	-0.000	-0.008	-0.008
	(-20.3)***	(-20.0)***	(-4.2)***	(-4.2)***	(-13.5)***	(-13.8)***
Number of segments	-0.001	-0.001	-0.001	-0.001	-0.073	-0.073
	(-5.7)***	(-5.6)***	(-3.1)***	(-3.1)***	(-9.7)***	(-9.6)***
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	177,326	177,326	14,786	14,786	14,784	14,784
R-squared	0.092	0.092	0.185	0.184	0.105	0.104

Table 4: Within-firm, Over-time Variability of Firm Performance as a Function of Boards' Concentration of Power. This table presents the results of regressions of standard deviations of performance measures computed for each firm from 1996 to 2011. The dependent variable in column 1 and 4 is the standard deviation of monthly stock returns, column 2 and 5 is the standard deviation of ROA, and column 3 and 6 is the standard deviation of Tobin's Q. The independent variables are average values for each firm from 1996 to 2011. There is only one observation for each firm in this regression. All variable definitions and sources are described in Appendix A. Robust t-statistics are reported in parenthesis. Significance levels are indicated by *, **, and *** and correspond to the 10%, 5%, and 1% significance levels, respectively.

Dependent Variable	**Std. dev. of stock returns**	**Std. dev. of ROA**	**Std. dev. of Tobin's Q**	**Std. dev. of stock returns**	**Std. dev. of ROA**	**Std. dev. of Tobin's Q**
Decomposed Rank index	0.289	0.128	3.333			
	(2.7)***	(1.5)	(1.1)			
Decomposed Span index				0.159	0.092	2.821
				(2.7)***	(2.0)**	(1.6)
Board size	-0.003	-0.001	-0.022	-0.003	-0.001	-0.029
	(-2.9)***	(-1.3)	(-2.4)**	(-3.6)***	(-1.7)*	(-2.4)**
CEO is powerful	0.002	-0.004	0.070	0.002	-0.003	0.086
	(0.4)	(-0.9)	(0.7)	(0.4)	(-0.8)	(0.8)
CEO tenure	-0.000	0.000	-0.004	-0.000	0.000	-0.004
	(-0.2)	(0.3)	(-0.9)	(-0.1)	(0.2)	(-0.9)
CEO ownership	-0.016	-0.034	-0.185	-0.016	-0.035	-0.225
	(-0.8)	(-2.0)**	(-0.3)	(-0.7)	(-2.0)**	(-0.4)
ROA	-0.277	-0.358	-0.425	-0.282	-0.359	-0.427
	(-5.4)***	(-2.6)***	(-0.3)	(-5.5)***	(-2.6)***	(-0.3)
ROA (prior year)	0.033	0.236	0.476	0.037	0.237	0.486
	(0.7)	(1.6)	(0.4)	(0.7)	(1.6)	(0.4)
Book leverage	0.025	-0.003	-0.867	0.024	-0.004	-0.891
	(2.6)***	(-0.2)	(-4.7)***	(2.4)**	(-0.3)	(-4.7)***
Log(Assets)	-0.005	-0.004	0.073	-0.004	-0.004	0.080
	(-4.0)***	(-3.9)***	(3.5)***	(-3.6)***	(-3.7)***	(3.9)***
Capex/Assets	0.156	0.246	2.045	0.156	0.247	2.072
	(4.6)***	(4.9)***	(3.1)***	(4.6)***	(4.9)***	(3.0)***
Firm age	-0.001	0.000	-0.006	-0.001	0.000	-0.006
	(-6.7)***	(0.8)	(-4.9)***	(-6.4)***	(1.0)	(-4.5)***
Number of segments	-0.002	-0.003	-0.083	-0.002	-0.003	-0.083
	(-0.9)	(-2.5)**	(-3.9)***	(-0.9)	(-2.5)**	(-3.9)***
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,043	1,825	1,825	2,043	1,825	1,825
R-squared	0.370	0.300	0.124	0.369	0.300	0.126

Table 5: Do Concentrated Boards Adopt Extreme Policy Positions? This table presents the results of regressing firms' standardized policy positions against a set of non-policy control variables. Firms' policy positions are standardized by subtracting their policy position from the average policy for their two-digit SIC industry for a given year and dividing by the cross-sectional standard deviation of the policy across the industry-year. The absolute value of this measure is then taken to reflect the fact that policy may differ either positively or negatively from industry norms. The corporate policies considered are: investment policy (measured by the capital expenditure to total assets ratio and research and development spending divided by total assets), capital structure (measured by the book leverage ratio), dividend payout (measured by the dividend payout ratio) and executive compsensation (measured by the log of cash compensation and the log of total compensation). All variable definitions and sources are described in Appendix A. Robust t-statistics are reported in parenthesis. Significance levels are indicated by *, **, and *** and correspond to the 10%, 5%, and 1% significance levels, respectively.

Dependent Variable	Capital Expenditure	Capital Expenditure	R&D Spending	R&D Spending	Book Leverage	Book Leverage	Dividend Payout	Dividend Payout	Cash Pay	Cash Pay	Total Pay	Total Pay
Decomposed Rank index	0.816		1.103		0.868		1.194		2.586		2.737	
	(2.6)***		(3.1)***		(3.1)***		(3.4)***		(7.6)***		(9.2)***	
Decomposed Span index		0.577		0.238		0.766		0.371		1.419		1.418
		(2.9)***		(1.0)		(4.3)***		(1.7)*		(6.5)***		(7.4)***
Board size	-0.002	-0.003	0.000	-0.001	-0.015	-0.016	0.019	0.017	0.003	-0.001	-0.003	-0.007
	(-0.7)	(-1.1)	(0.1)	(-0.5)	(-5.8)***	(-6.4)***	(6.0)***	(5.6)***	(0.9)	(-0.4)	(-1.2)	(-2.7)***
CEO is powerful	-0.007	-0.005	-0.011	-0.013	-0.034	-0.032	-0.015	-0.017	-0.047	-0.046	-0.078	-0.077
	(-0.3)	(-0.2)	(-0.4)	(-0.5)	(-1.7)*	(-1.5)	(-0.6)	(-0.6)	(-1.9)*	(-1.8)*	(-3.5)***	(-3.5)***
CEO tenure	0.002	0.002	-0.001	-0.001	-0.000	-0.000	-0.001	-0.000	0.002	0.002	0.002	0.003
	(2.1)**	(2.1)**	(-1.0)	(-0.9)	(-0.2)	(-0.3)	(-0.6)	(-0.5)	(1.9)*	(2.0)**	(3.2)***	(3.4)***
CEO ownership	0.043	0.038	-0.044	-0.030	0.377	0.366	0.674	0.689	1.333	1.339	1.278	1.288
	(0.5)	(0.4)	(-0.4)	(-0.3)	(4.6)***	(4.4)***	(6.6)***	(6.8)***	(13.3)***	(13.3)***	(14.5)***	(14.6)***
ROA	-0.016	-0.016	-1.019	-1.027	-0.120	-0.119	-0.957	-0.954	-0.094	-0.100	-0.261	-0.268
	(-0.2)	(-0.2)	(-11.2)***	(-11.3)***	(-1.7)*	(-1.6)*	(-8.2)***	(-8.1)***	(-1.1)	(-1.1)	(-3.4)***	(-3.5)***
ROA (prior year)	0.316	0.316	-0.068	-0.066	0.221	0.219	0.464	0.465	0.070	0.072	0.246	0.249
	(3.9)***	(3.9)***	(-0.8)	(-0.7)	(3.1)***	(3.0)***	(4.2)***	(4.3)***	(0.8)	(0.8)	(3.2)***	(3.2)***
Log(Assets)	-0.023	-0.022	-0.072	-0.072	-0.033	-0.031	-0.044	-0.044	0.038	0.041	0.033	0.036
	(-5.1)***	(-4.8)***	(-13.9)***	(-13.8)***	(-8.2)***	(-7.6)***	(-8.8)***	(-8.6)***	(7.8)***	(8.3)***	(7.7)***	(8.3)***
Firm age	-0.002	-0.002	0.000	0.000	-0.001	-0.001	0.003	0.003	-0.000	0.000	0.000	0.000
	(-5.4)***	(-5.1)***	(1.2)	(1.1)	(-3.3)***	(-2.8)***	(8.9)***	(8.8)***	(-0.1)	(0.4)	(0.9)	(1.4)
Number of segments	0.000	0.000	0.021	0.021	0.013	0.013	-0.002	-0.002	0.036	0.036	0.020	0.019
	(0.0)	(0.0)	(2.7)***	(2.7)***	(2.1)**	(2.1)**	(-0.3)	(-0.3)	(4.9)***	(4.8)***	(3.1)***	(3.0)***
Intercept	0.910	0.909	1.341	1.356	1.145	1.140	0.840	0.849	0.288	0.297	0.462	0.474
	(29.8)***	(29.8)***	(38.3)***	(38.8)***	(42.0)***	(41.9)***	(23.3)***	(23.5)***	(8.7)***	(9.0)***	(15.9)***	(16.3)***
N	14,731	14,731	12,514	12,514	14,729	14,729	14,008	14,008	14,731	14,731	14,674	14,674
R2	0.014	0.014	0.057	0.056	0.027	0.028	0.020	0.019	0.027	0.026	0.032	0.030

Table 6: Using the Sarbanes-Oxley (SOX) Act of 2002 as a Natural Experiment. The table below shows the results of a difference-in-difference regression specification using the passage of the Sarbanes-Oxley (SOX) Act of 2002 as a natural experiment. The excess stock returns are obtained from using the Fama-French three-factor model to explain monthly stock returns. The ROA and Tobin's Q residuals are obtained from panel regressions of ROA and Tobin's Q on a set of variables. All variable definitions and sources are described in Appendix A. Robust t-statistics are reported in parenthesis. Significance levels are indicated by *, **, and *** and correspond to the 10%, 5%, and 1% significance levels, respectively.

Dependent Variable	**Absolute value of excess stock returns**	**Absolute value of ROA residuals**	**Absolute value of Tobin's Q residuals**
Non-compliant Firm	0.002	-0.001	-0.026
	(1.6)	(-0.6)	(-0.6)
Post-SOX	-0.017	-0.004	-0.253
	(-35.0)***	(-3.8)***	(-9.8)***
Non-compliant Firm*Post-SOX	-0.005	-0.000	-0.013
	(-4.4)***	(-0.0)	(-0.3)
Board size	-0.002	-0.001	-0.031
	(-16.1)***	(-3.8)***	(-6.7)***
CEO is powerful	-0.001	-0.003	0.024
	(-1.0)	(-2.0)**	(1.2)
CEO tenure	0.000	-0.000	-0.000
	(0.2)	(-0.0)	(-0.3)
CEO ownership	-0.005	-0.026	0.164
	(-1.5)	(-4.0)***	(0.6)
ROA	-0.071	-0.185	0.175
	(-15.1)***	(-3.7)***	(0.6)
ROA (prior year)	-0.037	0.075	-0.194
	(-8.1)***	(1.1)	(-0.6)
Book leverage	0.020	0.005	-0.425
	(13.4)***	(0.9)	(-4.2)***
Log(Assets)	-0.005	-0.005	0.005
	(-26.1)***	(-12.1)***	(0.5)
Capex/Assets	0.037	0.120	0.778
	(7.1)***	(4.5)***	(2.6)***
Firm age	-0.000	-0.000	-0.008
	(-22.2)***	(-4.5)***	(-14.4)***
Number of segments	-0.001	-0.001	-0.070
	(-3.8)***	(-3.2)***	(-9.2)***
Intercept	0.145	0.090	1.107
	(38.6)***	(13.1)***	(7.8)***
Industry fixed effect	Yes	Yes	Yes
N	177,326	14,786	14,784
R2	0.069	0.177	0.092