Concentration of power within boards of directors and variability in firm performance

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Preliminary, please do not quote

Abstract: We study a new characteristic of the board of directors, the concentration of power within the board, and its impact on firm performance. Using committee assignments as a proxy for board power, we develop measures of boards' concentration of power. We find that firms with higher concentration of power within their boards have higher variability in firm performance, as measured by monthly stock returns, daily stock returns, annual return on asset, and annual Tobin's Q.

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1 Introduction

Prior studies in the corporate governance literature focus on two board characteristics: board independence and board size. Papers have found a link between board independence and firm performance (Duchin, Matsusaka, and Ozbas, 2010), and board size and firm value (Coles, Daniel and Naveen, 2008). In this paper, we study a board characteristic that, to our knowledge, has not been examined before: the concentration of power within the board, whether decision-making authority is concentrated in the hands of a few directors or equally distributed among all board members. Economic theories on team power dynamics and prior empirical studies on board and CEO power suggest that this particular board characteristic may have a significant influence on firm outcomes.

One the one hand, theories suggest that when decision-making power is equally distributed, we should observe fewer extreme decisions and outcomes. Sah and Stiglitz (1991) argue that there should be a greater variability in the quality of managers in a more centralized economy. The reason is that "highly capable decision-makers have greater beneficial effects on the managerial choices in a more centralized economy. By the same token, highly incapable managers placed in the same positions have greater deleterious effects" (p. 289). Intuitively, in a political context, powerful and capable dictators can lead their countries on a path to prosperity, whereas powerful yet incompetent dictators can lead their countries down the wrong path (Sah 1991). Adams, Almeida, and Ferreira (2005) find that when the CEO is powerful, firms experience higher variability in performance. Cheng (2008) finds that firms with smaller boards are associated with higher variability in performance, suggesting that smaller groups are likely to make more extreme decisions than larger groups. These theories and empirical results seem to

suggest that firms with higher concentration of power within their boards should have higher performance volatility.

On the other hand, it is possible that boards with power distributed equally between directors may find it harder to reach consensus, and thus the resulting outcomes are more erratic (Arrow, 1951). It is also possible that in this situation, it is easier for the CEO to influence and control the board. Bertrand and Mullainathan (2003) find that greater CEO power leads to a desire for a "quiet life" and thus lower variability in performance. This view would suggest that firms with highly concentrated boards should have lower performance volatility. Ultimately, whether concentration of power within boards leads to higher or lower performance variability is an empirical question for us.

We use committee assignments as a proxy for the concentration of power within a board. Survey evidence suggests that committees play an important role in a board. In Lorsch and MacIver (1989)'s survey of board members, one director remarked: "As long as we have been a director, most of the work that has gone on is in committees" (p. 59). In addition, several empirical studies demonstrate that directors sitting on board committees can exert significant influence on firm outcomes (Shivdasani and Yermack, 1999; Hwang and Kim, 2012). Using the directors' share of available committee positions, we develop two measures of board concentration of power, called the decomposed Rank index and decomposed Span index, based on the Herfindahl's index of industry concentration. The decomposition is necessary to remove the mechanical effect of board size. We describe this procedure in detail in section 2.2.

To perform our empirical analyses, we follow the methodology used in the Adams, Almeida, and Ferrari (2005) and Cheng (2008) studies. First, we apply tests of heteroskedasticity

to regressions of performance measures on the decomposed Rank index and Span index, and controlling for CEO power and board size. Second, we isolate the within-firm variability in performance over time by examining the relationship between standard deviations of performance measures over the whole sample and our measures of concentration of power within boards. Third, we use another measure of performance volatility, the annualized standard deviation of daily returns as in Bernile, Bhagwat, and Yonker (forthcoming), who find that board diversity leads to lower performance volatility.

Our final sample consists of 14,786 firm-year observations, with 2,043 unique firms, from 1996 to 2011. We find that firms with highly concentrated boards tend to have higher performance variability. Performance is measured as monthly stock returns, daily stock returns, annual ROA, and annual Tobin's Q. This is 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 the firms.

While one might argue variability in firm performance does not matter to firm value because it can be diversified away by investors, studies in the hedging literature have demonstrated that idiosyncratic risks may lead to the underinvestment problem. If investment opportunities are steady across different states or outcomes, then in the low-cash-flows states the firm will have insufficient cash flows to meet investment needs, leading to underinvestment and reducing shareholder value. Using the introduction of weather derivatives as an instrument, Perez-Gonzalez and Yun (2013) find that hedging with derivatives adds substantial value to firms exposed to weather risks.

Our paper contributes to the literature in a number of ways. First, to our knowledge, it is the first study that examines impact of board concentration of power on firm performance. We find that firms with more concentrated boards have higher performance volatility. Second, we add complementary evidence on a possible determinant of idiosyncratic risk (Campbell, Lettau, Malkiel, and Xu, 2001). Our paper is organized as follows. Section 2 discusses our data collection process as well as our construction of the measures of board concentration of power. In section 3, we present our empirical results and interpretations. Section 4 concludes.

2 Data

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.[3]

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 2 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 directors from the previous year (in this hypothetical case in Figure 2: 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

[3] 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 starts in 1996.

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 2.

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 Construction of Measures of Concentration of Power within Boards

To measure the concentration of power within a board, we construct two indexes similar in intuition to the Herfindahl-Hirschman index of industry concentration. First, the Rank Index is calculated using the following formula:

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

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 board member gets one rank, and each member of a board committee receives another rank. Committee chairmanships count as two ranks, and board chairmanships count as three. For example, a board chairman who is also chair of the audit committee would have a total of five ranks (three + two), whereas another board member who is a member of the audit committee would have only two ranks (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.

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. We construct a second measure, the Span Index, to accommodate the possibility that being a chair of a four-person committee provides more authority than being a chair of a two-person committee:

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

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. Each board membership and committee membership still counts 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 10 directors with committee information reported in the 2006 proxy statement).

Due to the nature of Herfindahl-Hirschman index-based measures, the raw Rank and Span indexes have a mechanical and 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 raw 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 perform a decomposition of the raw Rank index into a component due to the mechanical effect of board size and a component due to the concentration of power on the board. We call the component of the Rank index that's unrelated to board size the decomposed Rank index. We repeat this procedure for the Span index to obtain the decomposed Span index.

2.3 Sample Selection and Summary Statistics

We collect data for S&P 1500 firms from 1996 to 2011, excluding financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999). As discussed in the previous section, 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 (form DEF14a) filed with the SEC and merge this index with Computsat by 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. Finally, data on CEOs come from the Execucomp database. Because Adams, Almeida, and Ferreira (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[4], the CEO is also the chairman of the board, or the CEO is the only insider on the board. We use two additional variables to proxy for CEO power: CEO tenure and CEO ownership as a percentage of outstanding shares. In addition, Cheng (2008) finds that smaller boards lead to higher variability in performance, so we

[4] We follow Adams et al (2005) and Cheng (2008) in assuming that founder CEOs joined their companies within 2 years of incorporation. Firms that were incorporated at least 64 years prior to the current year are assumed to not have a founder CEO.

include board size as a control variable. The definitions of all variables and their sources are presented in Appendix A.

We require non-missing values for all our variables. Our final sample consists of 14,786 firm-year observations, with 2,043 unique firms. We need monthly stock returns for some of our tests, and there are 177,456 firm-months in our sample. Table 2 provides summary statistics for all our variables. The mean and median for our decomposed Rank and Span indexes are close to zero. The correlation between the decomposed Rank (Span) index and board size is 0.0006 (0.0003) and non-significant, whereas the correlation between the decomposed Rank (Span) index and powerful CEO indicator is -0.0921 (-0.1222) and statistically significant. The remaining variables have statistics similar to those reported in prior studies (Cheng, 2008).

3 Empirical methodology and results

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

$$\begin{aligned} &firm\ performance\ variability \\ &\quad = \alpha + \beta_1\ board\ concentration\ of\ power + \beta_2\ board\ size \\ &\quad + \beta_3\ CEO\ is\ powerful + Controls + Industry\ FE + Year\ FE \\ &\quad + errors \end{aligned}$$

We measure firm performance variability in three different ways. First, we use Glejser (1969)'s test for heteroscedasticity, which requires us to specify performance models to explain firms' performance levels. The absolute value of the residuals from these regressions are then used as a measure of performance variability. Second, we focus on within-firm, over-time

performance volatility by taking the standard deviation of performance measures (stock returns, ROA, Tobin's Q) over the whole sample period. Thus, there is only one observation per firm in this analysis. Third, we measure performance volatility as the annualized standard deviation of daily returns. The first two measures are similar to those used in Adams, Almeida, and Ferreira (2005) and Cheng (2008), whereas the third measure is similar to that used in Bernile, Bhagwat, and Yonker (forthcoming). We document our results in each of the next three sub-sections.

3.1 Heteroskedasticity tests

To explain firms' stock returns, we use Fama and French's (1993) three-factor model for monthly returns from January 1996 to December 2011. For each firm, we run the regression:

$$Ret_{j,t} = \alpha_j + \beta 1_j MKTRF_t + \beta 2_j SMB_t + \beta 3_j HML + \mu_{j,t}$$

where $Ret_{j,t}$ is the stock return of firm j during month t, $MKTRF_t$ is the excess monthly market return over the risk-free rate, where market return is the value-weighted return on all stocks, SMB_t is the difference in returns between small firms and big firms, and HML_t is the difference in returns between high book-to-market firms and low book-to-market firms. We take the residuals, $u_{i,t}$, from these regressions and use the absolute value of the residuals as a measure firm performance volatility.

To obtain ROA and Tobin's Q residuals, we follow Adams, Almeida, and Ferreira (2005) and Cheng (2008). We run panel regressions with ROA and Tobin's Q as the dependent variables: $ROA_{j,t}\ /\ Tobin's\ Q_{j,t} = \alpha + \beta\ X_{j,t} + \mu_{j,t}$ where $X_{j,t}$ is a set of variables explaining performance levels: board size, powerful CEO indicator, CEO tenure, CEO ownership, ROA[5],

[5] We exclude ROA as an independent variable from the ROA regression. We only include it in the Tobin's Q regression.

prior year ROA, book leverage, log of assets, capital expenditures/assets, firm age, and number of segments. Again, we use the absolute value of ROA and Tobin's Q residuals from these panel regressions to use as measures of variability in firm performance.

Table 3 presents the results of Glejser's heteroskedasticity 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 also choose to have a more concetrated board. Year fixed effects are also included. We note that we are unable to use firm fixed effects in our regressions because there is little time-series variation in our main variables of interest, the decomposed Rank and Span indexes. 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.[6]

The results suggest that firms with higher concentration of power within boards have higher variability in performance, even after controlling for board size and whether the CEO is powerful. The signs and magnitudes of other control variables are broadly consistent with prior studies. In terms of economic significance, a one standard deviation increase in the decomposed Rank index has a similar impact on firm performance variability as decreasing the number of firm segments by two.[7] 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). We cannot replicate Adams, Almeida, and Ferreira (2005)'s results that

[6] See Coles, Daniel, and Naveen (2008) for a similar argument.
[7] We standardize the decomposed Rank index and Span index and re-run the regressions in order to obtain the economic magnitudes. Results are untabulated.

powerful CEOs are associated with higher variability in monthly stock returns and annual ROA. 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 performance

The panel regressions utilize information from both cross-sectional and time-series data. To provide additional support for our hypothesis, we focus only on the effects of within-firm variability by using the standard deviation of monthly stock returns, annual ROA and Tobin's Q values from 1996 to 2011. As a result, there is only one observation per firm for the entire sample period. Firms with only one firm-year or one firm-month will be dropped because for these firms there are no standard deviation values. 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. We regress standard deviations values on the sample averages of our variables of interest, decomposed Rank and Span indexes, as well as other control variables. Industry fixed effects are included, but not year fixed effects since there is no longer a time dimension in this analysis.

The results, presented in Table 4, are broadly consistent with those 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 (t-stat 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 Robustness check

In this section, we follow Bernile, Bhagwat, and Yonker (forthcoming) and use another measure of firm performance volatility, annualized standard deviation of daily returns. Table 5 reports the results of regressions using this measure. The coefficients on the decomposed Rank index and decomposed Span index are both positive and statistically significant at the 1% level, which is consistent with our prior results.

4 Conclusions

In this paper, we provide some empirical evidence that higher concentration of power within boards is associated with higher variability in firm performance. This result holds for both across-firms and within-firm variability in performance, when performance is measured by daily stock returns, monthly stock returns, annual ROA, or annual Tobin's Q. The economic magnitude is large: the impact of a one standard deviation increase in boards' concentration of power is equivalent to reducing the number of firm segments by two or decreasing the size of the board by two members.

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, Almeida, and Ferreira, 2005; Cheng, 2008).

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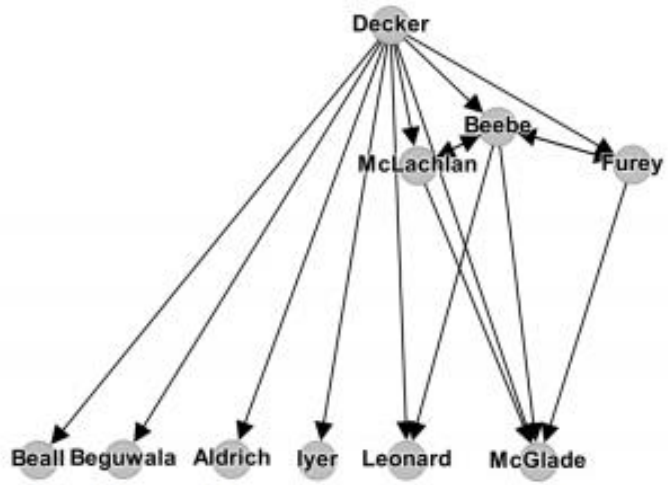
Appendix A – Definitions and sources of data used in this study

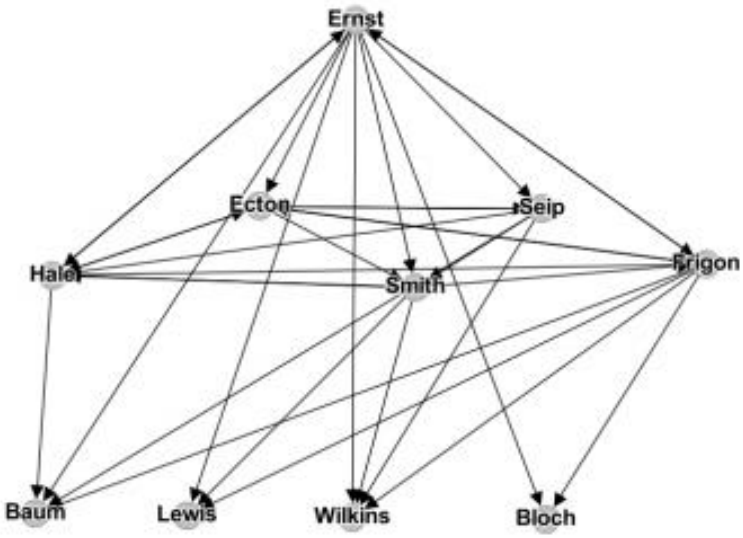
Variable	Definition	Source
Monthly stock returns	Variable RET in CRSP	CRSP
Return on Assets (ROA)	Operating Income/Assets (variable OIBDP/AT in Compustat)	Compustat
Tobin's Q	(Total assets – book value of equity + market value of equity) / Total Assets (AT - sum(SEQ, TXDB, ITCB, -PREF) + PRCC_C*CSHO)/AT	Compustat
Decomposed Rank index	Raw Rank index=$\sum_1^N rank\ share_i^2$, then decomposed into a component unrelated to board size	SEC proxy statements
Board size	Number of directors on the board	SEC proxy statements, also 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	Execucomp, SEC proxy statements, RiskMetrics/IRRC
CEO tenure	Current year minus year became CEO	Execucomp
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 (DLTT+DLC)/AT	Compustat
Log(Assets)	Natural log of total assets (AT)	Compustat
Capex/Assets	Capital expenditures/Total Assets CAPTX/AT	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

Figure 1 – Concentration of Power on Two Different Boards

The figures below show the power 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 B demonstrates a board with a highly decentralized organizational structure (i.e. H&R Block). Skyworks Solutions has a Rank index value of 0.1331 and a Span index value of 0.1648 whereas H&R Block has a Rank index of 0.1106 and a Span index value of 0.1207. Note that each board has 10 members. The highest node is the board chairman. The next tier below is comprised of committee chairs and the lowest tier includes non-chair directors.



Panel A. Centralized Board - Skyworks Solutions



Panel B. Decentralized Board - H&R Block

Figure 2: Illustration of Data on Committee Memberships

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.

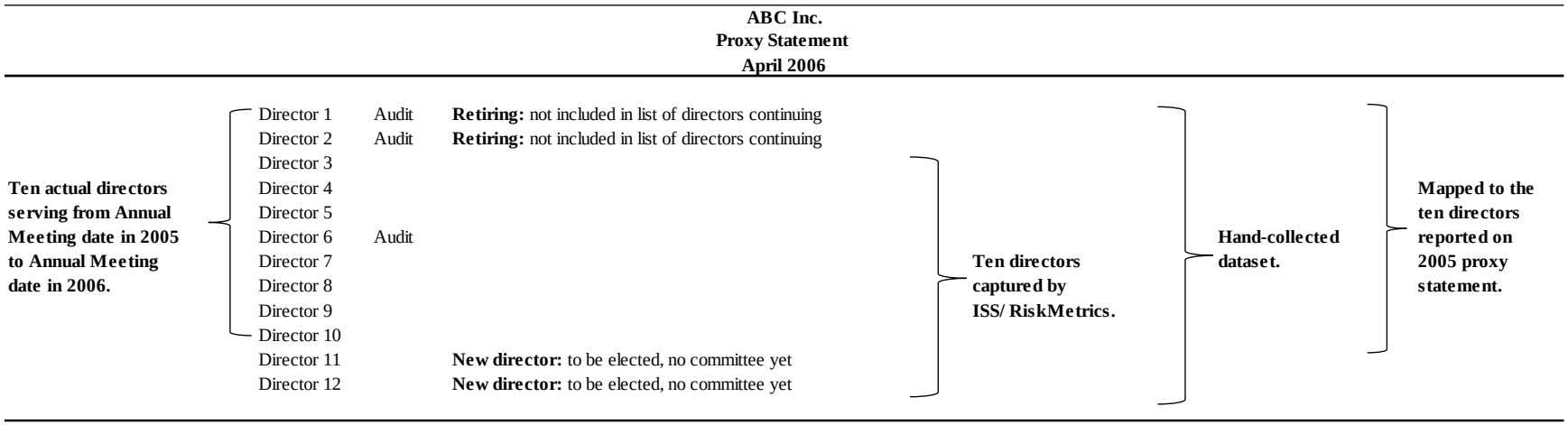


Table 1: Example Calculation of the Rank and Span Indexes

The table below demonstrates how the Rank and Span indexes are computed using the board of directors for Skyworks Solutions presented in Figure 1. The slate of directors is obtained from the 2005 proxy statement and the committee information is obtained 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.

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

All variable definitions and sources are described in Table 1.

Variables	Number of obs	Mean	Std. Dev.	Min	25th Percentile	Median	75th Percentile	Max
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
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
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 (% of outstanding shares)	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 Glejser's (1969) heteroskedasticity tests on 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.

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 is the standard deviation of monthly stock returns, column 2 is the standard deviation of ROA, and column 3 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.

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 – Annualized standard deviation of daily returns as a measure of variability

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 is the standard deviation of monthly stock returns, column 2 is the standard deviation of ROA, and column 3 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.

Dependent Variable	Annualized std. dev. of daily returns	Annualized std. dev. of daily returns
Decomposed Rank index	0.668	
	(7.8)***	
Decomposed Rank index		0.381
		(7.0)***
Board size	-0.007	-0.008
	(-9.9)***	(-11.1)***
CEO is powerful	0.006	0.007
	(1.9)*	(1.9)*
CEO tenure	-0.000	-0.000
	(-0.7)	(-0.6)
CEO ownership	-0.085	-0.084
	(-3.8)***	(-3.7)***
ROA	-0.424	-0.427
	(-13.0)***	(-13.1)***
ROA (prior year)	-0.173	-0.172
	(-5.6)***	(-5.6)***
Book leverage	0.054	0.052
	(4.8)***	(4.6)***
Log(Assets)	-0.025	-0.024
	(-20.5)***	(-19.7)***
Capex/Assets	0.316	0.320
	(9.5)***	(9.6)***
Firm age	-0.001	-0.001
	(-14.9)***	(-14.4)***
Number of segments	-0.007	-0.007
	(-4.5)***	(-4.4)***
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	14,786	14,786
R-squared	0.528	0.527