Gadjah Mada International Journal of Business
September-December 2008, Vol. 10, No. 3, pp. 331–352

DOES BOARD SIZE REALLY MATTER?
Evidence from Australia

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This study examines the impact of board size of Australian firms on Tobin's Q. Agency theory suggests that there is an inverse relationship between board size and Tobin's Q (Yermack 1996; Eisenberg et al. 1998). The resource dependence argument, however, hypothesizes that larger boards can lead to higher performance as the CEO's need for advice is a function of the complexity of the organization (Pfeffer 1972; Klein 1998). Analyzing a panel data of 1,530 firm-year observations using random effects technique, this study finds a positive relationship between board size and Tobin's Q. The random effects regression results also reveal that the positive relationship between board size and Tobin's Q is driven by firm size as this positive relationship is only found in larger firm sample but not in the smaller firm sample. The overall results support the resource dependence argument.

Keywords: advisory role; agency theory; board size; firm performance; firm size

JEL classifications: G30, G34

Introduction

Corporations in most countries have boards of directors specifically responsible for representing shareholders' interests. Traditionally, the board has a legal responsibility for advising and monitoring management, and controlling companies on behalf of shareholders. Its fiduciary responsibility includes formulating corporate policy, approving strategic plans, authorizing major transactions and the sales of additional securities, declaring dividends, etc. Therefore, the board of directors can play a significant role in controlling agency problem, which is the heart of corporate governance, particularly in monitoring executives (Fama and Jensen 1983). The normative literature suggests that a board can monitor its firm more closely and take appropriate governance actions if it has enough independent directors to ensure effective monitoring (Jensen 1993).

Another characteristic perceived to influence a board's ability to monitor is the size of the board. There are two main reasons for this argument (i.e., agency theory argument). *First*, problems of communication and coordination increase as board size increases. Large boards can make coordination, communication, and decision-making more cumbersome compared to smaller boards (Jensen 1993). In addition, within larger boards, some directors tend to free-ride on the efforts of others (Lipton and Lorsch 1992). *Second*, the effectiveness of boards to control management or to resist CEO control decreases as board size increases. Jensen suggests that larger boards lead to less candid discussion of managerial performance and to greater control by the CEO.[1] Alternatively, the argument of the advisory role of the board (i.e., resource dependence argument) suggests that larger boards can lead to higher performance as the CEO's need for advice is a function of the complexity of the organization (Pfeffer 1972; Booth and Deli 1996; Klein 1998).

Most of empirical literature suggests that smaller boards are more effective in monitoring than larger board (e.g., Yermack 1996; Eisenberg et al. 1998; Mak and Kusnadi 2005). However, more recently, Coles et al. (2008) challenge the notion that limiting board size will enhance firm value. They find that Tobin's Q increases with board size for complex firms, and that complex firms tend to have larger boards.

This paper extends prior studies by examining Australian firms. Evidence on the relationship between board size and firm performance has been provided by Bonn et al. (2004), who study firms in 1999. However, major corporate collapses and scan-

[1] Lipton and Lorsch (1992) further argue that boards of eight or nine members are most effective in the U.S., while Jensen (1993) states that boards of more than seven or eight members function less effectively.

dals such as Ansett, OneTel and HIH, have intensified the issue of corporate governance in Australia since 2001. Australia also provides a unique opportunity for corporate governance research. Australia is a country converging from a network-oriented corporate governance system to a market-oriented system.[2] Prior work on this issue has focused on countries with a market-oriented system (e.g., Yermack 1996; Eisenberg et al. 1998) or countries with a network-oriented system (e.g., Conyon and Peck 1998; Beiner et al. 2004). Australia's listed market can be considered to be falling in between these two types of corporate governance systems (Dignam and Galanis 2004).[3] Accordingly, the results of this research serve as a reference for improving corporate governance in countries which are in transition from a network-oriented system to a market-oriented system.

Using a panel data on a sample of Australian publicly listed firms over the period 2000-2005, this study finds a positive relationship between board size and Tobin's Q. The results also reveal that the positive relationship between board size and Tobin's Q is driven by firm size. That is, this positive relationship is only found in the larger firm sample, but not in the smaller firm sample. The overall results support the resource dependence argument (Pfeffer 1972; Klein 1998).

The remainder of this paper is organized as follows: Section 2 provides a literature review. Section 3 describes the data and research methodology. Section 4 discusses the empirical results; Section 5 concludes my paper.

[2] A network-oriented (insider) system is characterized by the relative unimportance of the securities market as a source of corporate finance. The main sources are banks, families, non-financial corporations and governments. The corporate shareholdings are more concentrated, and both shareholders and creditors are more actively involved in the control of the companies (e.g., Japan and Germany). A market-oriented (outsider) system is characterized by a securities market with dispersed shareholdings, where shareholders and companies interact on an 'arm's-length' basis, largely determined by market forces (e.g., U.S. and U.K.) (Dignam and Galanis 2004: 623).

[3] For example, in Australia, the market for corporate control is not as active as in the U.S. and, thereby, its effectiveness in imposing on boards the responsibility to monitor and take corrective actions is not as strong as in the U.S. (Suchard et al. 2001). The governance role of institutional investors in Australia is also less significant than that in the U.S. (Stapledon 2006; Bonn et al. 2004 and Craswell et al. 1997) suggest that incentive-based compensation plays a less important role in controlling agency problems among Australian firms. Australian corporate governance regulation is also relatively flexible in nature and is enshrined in recommendations (i.e., the 2003 ASX Corporate Governance Council Principles of Good Corporate Governance and Best Practice Recommendations). In contrast, the U.S. has made its reforms mandatory through legislation (i.e., the 2002 Sarbanes-Oxley Act).

Board Size and Firm Performance

A number of studies have attempted to examine whether board size has a significant impact on the effectiveness of board's monitoring. From an agency theory perspective, Jensen (1993) and Lipton and Lorsch (1992) suggest that large boards can be a less effective monitor than can small boards. Yermack (1996) examine this notion empirically and finds a negative relationship between Tobin's Q and board size for a sample of large U.S. firms. Eisenberg et al. (1998) replicate Yermack's study using a sample of small and medium-sized Finnish firms. They argue that studies of board-size effects in smaller firms are beneficial because the driving factors for board-size effects may be different in large and small public firms. For example, small and mid-sized firms are frequently more closely-held, so the impact of owner-manager agency problems on decisions affecting board size are less prevalent in this class of firms. The authors find evidence consistent with Yermack's findings, suggesting that problems in communication and coordination can be extended to smaller and mid-sized firms. A negative relationship between board size and firm value is also reported by Conyon and Peck (1998) who examine five European countries, and Mak and Kusnadi (2005) who study Singapore and Malaysia firms.

How do market participants view the argument that smaller boards monitor more effectively? Wu (2000) examine the evolution of board size over the 1991-1995 period in the U.S. The author finds that board size decreases on average over this period and this is partially caused by pressure from active large shareholders such as CALPERs.

These empirical findings raises a question: if large boards are destructive to firm value, why do they still exist? In addition, Hermalin and Weisbach (2003) raise the issue of whether an equilibrium phenomenon or out-of-equilibrium situation is being estimated. The interpretation has different implications for policy. For example, it is believed that board size is negatively related to firm performance. The out-of-equilibrium interpretation of this finding suggests that limits on board size should be encouraged. In contrast, an equilibrium interpretation implies that some other exogenous factors influence both board size and profitability, and as a result, such regulation is useless or even counterproductive.

Moreover, several non-U.S. empirical studies on this issue indicate that board size has an insignificant impact on firm performance. For examples, Beiner et al. (2004) who examine a sample of Swiss listed firms, and Bonn (2004) who studies large Australian firms. Therefore, the notion that smaller boards are a better monitor still needs further empirical evidence.

The advisory role of the board has received far less attention than their monitoring role. A number of literature, starting with Pfeffer (1972), suggests that boards are appointed to maximize the provision of important resources to the firm. Klein (1998), for instance, suggests that the CEO's need for advice is a function of the complexity of the organization. Moreover, Coles et al. (2008) argue that firms with greater advising requirements (such as those diversified across industries), firms that rely on debt financing, and larger firms are more likely to benefit from a larger board. They find that Tobin's Q increases with board size for complex firms (i.e., more diversified, larger, higher debt, and higher R&D firms), and that complex firms tend to have larger boards. The results, thus, challenge the notion that limiting board size will enhance firm value.

Therefore to test the relationship between board size and firm performance, the author propose the following null hypothesis:

Hypothesis 1: "Board size has an insignificant impact on firm performance in Australia."

Data and Research Method

Sample

This study examines annual panel data over a six-year period from 2000 to 2005, an important period in Australia that experienced vigorous debate of corporate governance with the redevelopment of the Corporate Law Economic Reform Program (Audit Reform and Corporate Disclosure) Bill in 2003 and the introduction of the ASX Corporate Governance Council Implementation Review Groups' principles on corporate governance in 2004. The sample comprises firms listed on the Australian Stock Exchange (ASX) on June 30, 1998 (i.e., 1,214 firms, including data from 1998 to 1999).[2] Financial firms (218 firms) are excluded because their dividend policies are influenced by government regulations (e.g., La Porta et al. 2000). The sample is further restricted to firms with annual reports available for 2000-2005 (i.e., 140 firms are excluded) and those firms that are eligible to pay dividends (i.e., 540 firms are excluded).[4] The final sample comprises 316 firms or 1,530 firm-year observations over a six-year period.

Model

Panel study methodology is utilized as it provides more robust information, more variability, less collinearity among variables, more degrees of freedom, and more efficiency (Baltagi, 1995). It also helps to control for unobserved firm heterogeneity.

The model to estimate the impact of board size on firm performance takes the following form:

[4] When a firm makes losses and has negative retained profits in a given year, it is legally unable to pay dividends (Section 254T, Australian Corporations Act 2001).

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1 \text{ Board size}_{it} + \beta_2 \text{Debt}_{it} + \beta_3 \text{Firm size}_{it} + \beta_4 \text{ Investment}_{it} + \beta_5 \text{ Profitability}_{it} + \beta_6 \text{ Lag- Profitability}_{it} + \beta_7 \text{ Firm age}_{it} + \beta_8 \text{ Blockholdings}_{it} + \beta_9 \text{ Business risk}_{it} +_{10} \text{ Industry}_{it} + \beta_{11\text{-}15} \text{ Year} + \varepsilon_{it} \quad \text{..........................(1)}$$

The subscripts *i* and *t* represent firm and year, respectively. The natural logarithm of Tobin's Q is used to measure firm performance (denoted as *Tobin's Q*). The actual definition of Tobin's Q is market value of the firm divided by the replacement cost of assets. However, as these replacement costs (the denominator) are not available in Australia, Tobin's Q is defined as the market value of equity plus the book value of all liabilities and preference shares scaled by total assets.[5] *Board size* is the key variable of interest. *Board size* is measured by the number of directors in the board. I also control for variables that potentially affect Tobin's Q, such as debt, firm size, investment, profitability, lag-profitability, firm age, blockholdings, and business risk.

Debt – Measured by book value of debt divided by assets. From agency theory perspective, in widely-held firms, debt can serve as a disciplining mechanism to contain agency problems between managers and dispersed shareholders by imposing fixed obligations on firm cash flows or by reducing free cash flows (Jensen and Meckling 1976; Jensen 1986). Therefore, a positive relationship between debt and firm performance is expected. In contrast, in closely-held firms, debt can allow controlling insiders to control more resources without diluting their voting rights and accordingly facilitate minority shareholders expropriation (Faccio et al. 2001). The governance role of debt in closely-held firms, therefore, depends upon the capital markets' effectiveness in containing its abuse. When capital market institutions are effective (i.e., corporate accounts are transparent and shareholders and creditor rights are well protected), higher debt levels may serve to mitigate agency problems between controlling and outside minority shareholders). Since Australia has a strong legal shareholder protection, debt is expected to have a positive impact on performance. Alternatively, from trade-off theory perspective, debt increases firm value as interest payments reduce taxes. However, higher debt will increase a firm's bankruptcy costs. Therefore, the firm should determine the optimal level of capital structure. A positive relationship between debt and firm value indicates that the firm is

[5] This proxy is highly correlated with the actual definition of Tobin's Q and has been widely used in U.S. studies (e.g., Loderer and Martin 1997; Demsetz and Villalonga 2001). In Australia, Craswell et al. (1997) also use the market-to-book (equity) ratio as a proxy for Tobin's Q.

using debt sub-optimally, while a negative relationship indicates that the firm is using too much debt.

Firm size– Measured by natural logarithm of total assets. From the agency theory perspective, agency problems and thus agency costs are expected to increase in larger firms (Barclay and Smith, 1995). Larger firms also tend to have fewer growth opportunities (Morck et al. 1988). Therefore, a negative relationship between *firm size* and *Tobin's Q* is expected. Alternatively, Demsetz and Lehn (1985) argue that large firms tend to have well established operations, and their performance is often better than small firms.

Investment – Measured by capital expenditure scaled by assets. Firms with lower investment tend to have fewer growth opportunities (Morck et al. 1988). Thus, a positive relationship between *investment* and *Tobin's Q* is expected.

Profitability – Measured by earnings after tax scaled by assets (ROA) and *Lag-Profitability* – Measured by previous year's ROA. On the basis of simple valuation model, it is reasonable to expect that accounting profitability (measured by return on assets) is positively related to Tobin's Q as profit is the main source of firm's cash flows and thus firm value (Beiner et al. 2004).

Firm age – Measured by natural logarithm of the number of years since the firm's incorporation. Pham (2003) suggests that firm age affects Tobin's Q. Ritter (1991) shows that over-optimism is greater for younger firms, suggesting a negative relationship between *firm age* and *Tobin's Q*. Mikkelson et al. (1997) report that the number of years of operating history is a significant determinant of post-listing performance.

Blockholdings – Measured by aggregate fractional holdings of shareholders, holding at least five percent of the firm's shares. Agency theory suggests that large shareholders can play an important role in monitoring managers, and thus minimizing agency costs (Jensen and Meckling 1976). Therefore, firms that have large shareholders or those with higher ownership concentration may outperform other firms. However, Shleifer and Vishny (1997) remind us that large controlling shareholders may have an incentive and the ability to extract private benefits at the expense of minority shareholders, suggesting a negative relationship between ownership concentration and Tobin's Q. Empirical studies have produced mixed findings on the relationship between ownership concentration and firm performance. A positive relationship has been found by, for example, Mehran (1995) and Ang et al. (2000), whereas an insignificant relationship has been found by, for example, Demsetz and Lehn (1985) and Agrawal and Knoeber (1996).

Business risk – Measured by standard deviation of EBIT (earnings before interest and taxes) in the previous five years. It is widely believed that risk and return are positively related;

therefore, it is reasonable to expect that business risk is positively associated with firm performance. Alternatively, Demsetz and Lehn (1985) argue that low-risk firms tend to have well established operations, and their profitability and thus performance are often better than those of high-risk firms. Although the latter may have better growth potential, they incur comparatively more expenses in building up their businesses.

To address industry and time variations, the panel data regression can be extended to include fixed industry effects and fixed time effects; the former accounts for variation in dependent variables due to industry differences, while the latter removes secular effects among the independent variables. An industry dummy variable is used and takes the value of one if the firm is in an "opaque industry" (i.e., difficult to monitor) and zero if the firm is in a "transparent industry" (i.e., easy to monitor). This approach follows Zeckhauser and Pound (1990) and is appropriate as the focus of this study is the monitoring role of dividends. Zeckhauser and Pound classify their U.S. sample of 22 industries according to information and asset structure of the industry proxied by R&D scaled by sales. They assume that the higher the R&D intensity of firms in the industry, the more closed is the information structure, and the more difficult it would be to subject such firms to outside monitoring. Alternatively, dummy variables based on six-digit GICS industry classifications are used as a robustness check of this study. 20 dummy variables are used to represent 21 industry classifications in order to avoid perfect multicollinearity. Similarly, as the sample comprises six years of observations, five-year dummy variables are used in the second fixed effects model.

Results

Descriptive statistics for all variables used in the model is presented in Table 1.

The average number of directors in the board is six. The average blockholdings (i.e., shareholders with more than five per cent equity stake) are 44.6 percent, which suggests that Australian firms have relatively concentrated ownership.

Table 2a reports various Pearson product moment correlation coefficients among variables used in this study. It indicates that correlations among independent or firm characteristic variables are generally low. The maximum magnitude of the correlation coefficient among the independent variables is around 0.66 (i.e., the correlation between firm size and board size), suggesting that multicollinearity is not a potential threat when conducting multiple regression analyses. In addition, this study conducts multicollinearity test using variance inflation factor (VIF) method. Table 2b shows that all variables in Equation (1) have VIF less than 10 (i.e., between 1 and 2.4), indicating that multi-collinearity is not a big threat.

Table 1. **Descriptive Statistics**

Variable	Mean	Median	Std. Dev.	Min.	Max.
Tobin's Q	-0.022	-0.078	0.555	-1.724	2.759
Board size	6.08	6.00	2.10	3	15
Total debt / Assets	0.227	0.222	0.171	0	1.448
Total assets (A$ million)	1.15 b	1.12b	3.59b	0.9m	5.52b
Firm age	34.02	21.00	28.24	3	168
Capital expenditure/Assets	0.063	0.039	0.074	0	0.587
Net income/ Assets	0.055	0.053	0.103	-1.36	0.840
Lag (Net income/Assets)	0.039	0.037	0.138	-2.11	0.750
% of blockholdings	0.446	0.441	0.237	0	1
Number of observations	1530	1530	1530	1530	1530

* This indicates proportion of firms, rather than the mean proportion for associated variable.

The author also conducts tests on other classical assumptions for linear regression, such as normality, autocorrelation, and heteroskedasticity. The author uses the *Shapiro-Wilk W* statistic to test the normality of the residual in Equation (1). The author finds that the model barely fulfills the normality assumption at the conventional level (W= 0.96, p > 0.05). With regard to autocorrelation, The author uses the Wooldridge test for autocorrelation in panel data (Wooldridge 2002: 282-283), and finds first-order auto-correlation in the panel data (F = 108.80; p < 0.01). Finally, the author conduct the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity, and finds a relatively constant variance (Chi square = 2.54; p > 0.10).[6] Therefore, this study uses Huber-White Sandwich estimator (cluster) for variance to calculate pooled regression standard errors. This estimator provides robust standard errors in the presence of violations of regression model assumptions such as heteroskedasticity and serial correlation (Wooldridge 2002).

Table 3 presents the proportion of independent directors and board size across industries measured by four digit

[6]The Wooldridge test for autocorrelation in panel data is calculated based on the random effects (panel) estimation. The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity is calculated based on the OLS estimation. The results tests of classical assumptions for linear regression are not presented in order to preserve space, but they are available by emailing the author.

Table 2a. **Correlations**

	Tobin'sQ	**Board size**	**Debt**	**Firm size**	**Business risk**	**Firm Age**	**Block holdings**	**Profit-ability**	**Lag (Profit)**
Tobin's Q									
Board size	0.188 ***								
Debt	-0.010	0.108 ***							
Firm size	0.188 ***	0.668 ***	0.238 **						
Business risk	0.151 ***	0.351 ***	-0.021 ***	-0.147 ***					
Firm age	-0.049 **	0.231 ***	-0.041	0.229 ***	0.161 ***				
Blockholdings	-0.195 **	-0.123 **	-0.106 ***	0.048 ***	-0.198 ***	0.067			
Profitability	0.341 ***	-0.056	-0.227 ***	-0.032	0.023	0.006	-0.046		
Lag(Profit)	0.196 ***	0.019	-0.075 ***	0.090 ***	0.021	0.045 **	-0.018	-0.100 **	
Investment	0.191 ***	-0.026	-0.067 ***	-0.041	0.023	-0.058	-0.135 *	0.311 **	0.102 ***

Notes:

This table reports Pearson correlation coefficients for all variables in the regression models.***

*** Significant at the 0.01 level

** Significant at the 0.05 level

* Significant at the 0.10 level

Table 2b. **Variance Inflation Factors**

Variable	VIF
Board size	1.88
Debt	1.20
Firm size	2.41
Business risk	1.38
Firm age	1.10
Blockholdings	1.15
Profitability	1.14
Lag(Profitability)	1.15
Investment	1.05

GICS code. In Table 3, the statistical tests strongly indicate that board size is not identical across industries (i.e., *ANOVA = 9.94; p < 0.01* and *Kruskal Wallis = 157.68; p < 0.01)*. Several industries such as *foods and staples retailing*, *pharmaceutical and biotechnology*, and *transportation* have relatively larger boards. In contrast, several industries such as *real estate*, *capital goods*, *household and personal products*, and *consumer services* tend to have significantly smaller boards.

In addition, firms operating in transparent industries have significantly larger boards than firms in opaque industries (6.22 versus 5.89 directors). This difference is statistically significant at the conventional level (i.e., *t-statistic = 2.95; p < 0.01* and *Mann Whitney U test = -3.09; p < 0.01*). Therefore, it is important to control for industry effect in the analysis.

Table 4 shows the dynamics of board size and Tobin's Q. With respect to board structure, the statistical tests indicate strongly that board size of Australian firms are relatively stable over time (i.e., ANOVA = 9.94; p <0.01 and Kruskal-Wallis = 157.68; p < 0.01). With regard to Tobin's Q, the non-parametric test indicates that Australian firm performance is relatively unstable over time (i.e., Kruskal-Wallis = 157.68; p < 0.01), but parametric test indicates that it is relatively stable over time (i.e., ANOVA = 9.94; p <0.01).

Table 5 shows the relationship between board size and firm value of this study's sample without considering other variables that may also affect firm value.

The result seems not to support the notion that firms with larger boards tend to have lower values (Yermack 1996). Specifically, mean Tobin's Q increases until it reaches a maximum at a board size of eight, then decreases for a board size of nine. It increases again for a board size of 10, then decreases for larger board size. Therefore, an optimal board size of Australian listed firms is from eight to 10. This is consistent with Lipton and Lorsch (1992) who find that boards with eight or nine members are most effective in U.S. The result is not consistent with Mak and Kusnadi (2005) who find that boards of five members are most effective in Singapore and Malaysia. But this study's result, as

Table 3. **Board Size by Industry**

GICS Code	INDUSTRY GROUP†	No	Board Size
	Transparent Industries		
1010	Energy	84	5.61
2020	Commercial services & Supplies	72	6.86
2030	Transportation	74	6.47
2510	Automobiles & components	44	5.90
2520	Consumer durables & apparels	35	5.77
2530	Consumer services	60	5.26
2540	Media	103	6.72
2550	Retailing	96	6.29
3010	Foods & staples retailing	30	9.06
3020	Food, beverage & tobacco	136	6.22
3030	Household & personal products	3	5.33
4040	Real estate††	125	5.26
5010	Telecommunication services	6	7.33
5010	Utilities	26	7.80
	Opaque Industries		
1510	Materials	309	5.76
2010	Capital Goods	195	5.72
3510	Health care equipment & services	68	6.69
3520	Pharmaceutical & biotechnology	10	6.90
4510	Software & services	30	6.10
4520	Tech. Hardware & equipment	21	6.28
4530	Semi conductor & equipment	3	5.00
	ANOVA†††		9.947 ***
	Kruskal-Wallis		157.68 ***

Continued from Table 3

GICS Code	INDUSTRY GROUP†	No	Board Size
	Transparent Industries	894	6.22
	Opaque Industries	636	5.89
	Difference		0.33
	t - statistic		2.959 ***
	Mann Whitney U test		-3.039 ***

† Excludes Banks (4010), Diversified Financials (4020) and Insurance (4030).

†† Includes only Real Estate Management and Development (GICS code 40401020).

††† Includes only industry groups having at least 10 observations. If all industry groups are included in the analysis, the ANOVA *F*-statistics for proportion of independent directors and board size are 4.692 and 8.684, respectively; and significant at the 0.01 level. In addition, Scheffe's post hoc tests were conducted to establish differences among industries.

*** Significant at the 0.01 level.

Table 4. **The Dynamics of Board Size and Tobin's Q by Time**

Variable	2000	2001	2002	2003	2004	2005	ANOVA	Kruskal Wallis
Board size	6.1358	6.1673	6.0480	6.0352	6.0651	6.0376	0.183	6.662
Tobin's Q	1.1471	1.1477	1.1538	1.0983	1.2245	1.2223	0.611	38.579***

*** Significant at the 0.01 level.

Table 5. **Tobin's Q and Board Size**

Board Size	Observations	Tobin's Q (mean)	Board Size	Observations	Tobin's Q (mean)
3	133	0.872	7	250	1.158
4	225	1.082	8	132	1.618
5	300	1.123	9	95	1.157
6	287	1.159	10	44	1.532
			>=11	53	1.248

well as Lipton and Lorsch's and Mak and Kusnadi's, should be interpreted carefully as they fail to control for other variables that potentially affect Tobin's Q.

Table 6 shows the pooled regression estimation for the relationship between board size and Tobin's Q. The author uses the Huber-White Sandwich estimator (cluster) for variance

Table 6. **Pooled Regression (Huber-White) Estimations of Board Size and Tobin's Q**

Variable	All Firms	Large Firms	Small Firms
Board size	0.046*** (2.86)	0.047** (2.29)	0.043** (2.16)
Debt	0.118 (1.02)	0.243 (1.22)	0.333*** (3.27)
Firm Size	0.009 (0.53)	-0.123*** (-3.44)	-0.131*** (-4.60)
Investment	1.073*** (4.66)	0.392 (1.09)	1.238*** (5.34)
Profitability	1.819*** (5.97)	2.119*** (3.51)	1.149*** (5.55)
Lag (Profitability)	0.400** (2.24)	2.119*** (3.51)	0.343*** (2.62)
Firm age	-0.081*** (-2.99)	-0.103*** (-3.11)	-0.049 (-1.32)
Blockholdings	-0.270*** (-2.76)	-0.220* (-1.78)	-0.225** (-2.17)
Business risk	0.000 (1.36)	0.001** (2.66)	0.006** (2.21)
Industry Dummy	-0.039 (-0.80)	-0.098 (-1.46)	-0.091 (-0.61)
Year Dummy	Included	Included	Included
Number of observations	1530	765	765
Adjusted R^2	0.238	0.275	0.231
F-test	13.43***	7.45***	8.92***

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level to calculate pooled regression standard errors. This estimator provides robust standard errors in the presence of violations of regression model assumptions such as heteroskedasticity and serial correlation (Wooldridge 2002). The technique is appropriate when panel data have a large number of subjects (i.e., firms), but a relatively small number of observations per subject.

Column 1 of Table 6 shows the regression estimation for all firms. The coefficient on board size is positive and significant at the conventional level (*coefficient = 0.046, $p < 0.01$*). This suggests that larger boards lead to higher values, and this does not support Hypothesis 1. This is consistent with Coles et al. (2008), and challenges the notion that limiting board size will enhance firm value. With regard to control variables, coefficients on *investments*, *profitability*, and *lag (profitability)* are positive and significant at the conventional level, suggesting that firms with higher investment and profitability are valued higher by market participants. This is consistent with Morck et al. (1988) and Beiner et al. (2004). In addition, coefficients on *firm age* and *blockholdings* are negative and significant at the conventional level, indicating that younger firms and firms with lower ownership concentration outperform other firms. Result for firm age is consistent with Ritter (1991), showing that over-optimism is greater for younger firms. Result for blockholdings is consistent with the notion that large shareholders may expropriate minority shareholders, lowering the market value of the firm (Shleifer and Vishny 1997).

There is an argument that due to limited budget or less complexity, smaller firms tend to have fewer directors in the boards. Larger firms are also likely to have more external contracting relationships and, thus, require larger boards (Pfeffer 1972; Booth and Deli 1996; Coles 2008). In our sample, board size is positively correlated with firm size (coefficient of correlation = 0.668, see Table 2a). To examine whether firm size has an impact on the result shown in column 1, this study divides sample equally into larger and smaller firms based on total assets, and re-estimates random effects regressions for those subsamples.

The results presented in columns 2 and 3 of Table 6 reveal that the positive relationship between board size and Tobin's Q is not driven by firm size. The coefficient on *board size* for large firm sample remains positive and significant in large (*coefficient = 0.047, $p < 0.05$*) and small firms (*coefficient = 0.043, $p < 0.05$*).

Pooled data regressions, however, do not consider the possibility that a spurious relationship exists between independent and dependent variables due to the lack of inclusion of unmeasured explanatory variables that affect firm behavior. This may result in biased estimates. The panel data method addresses the unobserved omitted variable bias by modeling a different intercept for each cross-sectional unit. Two techniques can be used to incorporate different intercepts in the model (see Kennedy 2003: 303-307). First, the impact of unobserved variables on the dependent variable can be accommodated by introducing a different intercept for each cross-sectional unit (i.e., firm). This can be achieved by modeling a dummy variable for each firm (and omit the intercept), which results in a fixed effects estimator (referred to as fixed effects regression). The fixed effects model, however, has two major drawbacks: (1) by implicitly including a substantial number of dummy variables, the degrees of freedom of the model are reduced significantly, and (2) the transformation involved in this estimation process eliminates all explanatory variables that do not vary within an individual (i.e., a time-invariant variable such as gender).

An alternative method is to treat different intercepts for each subject randomly, thereby including the intercept as a component of the error term (referred to as the random effects regression). This method is designed to overcome the two drawbacks of the fixed effects model. The procedure views the different intercepts as having been drawn from a pool of possible intercepts. Thus, they can be considered random (and usually assumed to be normally distributed) and part of the error term. As a result, the specification has an overall intercept, a set of explanatory variables, and a composite error term. The latter consists of two parts: the random intercept term, which measures the extent to which this individual's intercept differs from the overall intercept, and the traditional random error, which indicates random deviation for a firm in a certain time period. The random effects model does not reduce the degrees of freedom, and thus produces a more efficient estimator of the slope coefficients than does the fixed effects model. In addition, the transformation used for the random effects estimation procedure does not eliminate time-invariant explanatory variables. Therefore, this study uses random effects regression to estimate Equation (1).

Table 7 shows the random effects regression estimation for the relationship between board size and Tobin's Q. Column 1 of Table 7 shows the regression estimation for all firms. Consistent with the analysis of pooled (Huber-White) regressions presented in column 1 of Table 6, there appears a significant positive impact of board size on Tobin's Q, suggesting that larger boards lead to higher values (*coefficient* = *0.021*, $p < 0.01$). This is consistent with Coles et al. (2008), and challenges the notion that limiting board size will enhance firm value. As such, the result does not support Hypothesis 1. With regard to control variables, Tobin's Q seems to be positively related to *investments*, *profitability*, and *lag (profitability)*, and negatively associated with *firm age* and *blockholdings*. As such, the results are consistent with the analysis of pooled regressions presented in column 1 of Table 6.

Table 7. **Random Effects Regression Estimations of Board Size and Tobin's Q**

Variable	All Firms	Large Firms	Small Firms
Board size	0.021**	(3.52)	0.014
	(2.41)	0.034***	(1.13)
Debt	0.048	0.011	0.376***
	(0.53)	(0.08)	(3.55)
Firm Size	0.003	-0.053**	-0.119***
	(0.23)	(-2.19)	(-4.99)
Investment	0.969***	0.594***	1.091***
	(6.68)	(2.65)	(6.35)
Profitability	1.025***	1.165***	0.616***
	(9.61)	(7.61)	(5.09)
Lag (Profitability)	0.188***	0.544***	0.161**
	(2.65)	(3.80)	(2.02)
Firm age	-0.006**	-0.078***	-0.044
	(-2.15)	(-1.96)	(-1.22)
Blockholdings	-0.145**	-0.227***	-0.158*
	(-2.10)	(-2.56)	(-1.80)
Business risk	0.000	0.000**	0.005*
	(1.49)	(2.08)	(1.67)
Industry Dummy	-0.044	-0.098	-0.076
	(-0.89)	(-1.46)	(-1.38)
Year Dummy	Included	Included	Included
Number of observations	1530	765	765
Adjusted R^2	0.221	0.224	0.204
Wald Chi-Square	260.73***	143.11***	127.27***

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level

To examine whether firm size has an impact on the result shown in column 1, this study divides sample equally into larger and smaller firms based on total assets, and re-estimates random effects regressions for those subsamples. The results presented in columns 2 and 3 of Table 7 reveal that the positive relationship between board size and Tobin's Q is driven by larger firms. The coefficient on *board size* for large firm sample remains positive and significant (*coefficient = 0.034, p < 0.01*). The coefficient on board size for small firm sample, however, is positive but insignificant at the conventional level (*coefficient = 0.014, p > 0.10*). In addition, for large firm sample, the author find that Tobin's Q is negatively related to *firm size*, *firm age*, and *ownership concentration*, and positively related to *investment*, *profitability*, *lag (profitability)*, and *business risk*. This is consistent with the analysis of all firm sample, except for *firm size* and *business risk*, that is, for all firm sample, both variables are statistically insignificant but become significant for large sample firms. It seems that, among large sample firms, smaller and riskier firms outperform other firms. In small firm sample, Tobin's Q is negatively related to *firm size* and *ownership concentration*, and positively related to *debt*, *investment*, *profitability*, *lag (profitability)* and *business risk*. This is consistent with the analysis of all firm sample, except for *debt* and *business risk*. It seems that smaller firms with lower debt and higher risk outperform other firms.

Several analyses were conducted as robustness tests. *First*, our sample and data are potentially contaminated by Australia's 2003 corporate governance reforms since our data begin in 2000. To examine whether our results are sensitive to this reform, the author divide the data into two groups (2000-2003 and 2004-2005) and examine for any differences. The results are similar to those reported, except that the positive impact of family control on debt becomes less significant in the 2004-2005 group.

Second, test the sensitivity of our findings to the presence of outliers and influential observations by truncating the largest one to five percent probability levels for each tail of the distribution for the model variables. In general, the results are not substantially different from earlier analyses.

Third, reestimate Equation (1) using log nature board size (*ln board size*) instead of *board size* to increase the normality of board size variable. The author still get a positive relationship between board size and firm performance.

Finally, a six-digit Global Industry Classification Standard (GICS) is used to control for industry differences instead of a dummy variable for transparent versus opaque sector. Although some industry observations prove relatively small, the results are similar to those reported in Table 6. So, different industries do not change my findings.

Conclusion

This study examines the impact of board size of Australian firms on Tobin's Q. There have been two conflicting arguments on the relationship between firm performance and board size. On the one hand, agency theory suggests that there is an inverse relationship between board size and Tobin's Q (Yermack 1996; Eisenberg et al. 1998). Earlier empirical evidence in several countries generally supports this argument. On the other hand, the resource dependence argument hypothesizes that larger boards can lead to higher performance as the CEO's need for advice is a function of the complexity of the organization (Pfeffer 1972; Klein 1998). Using a panel data of 1,530 firm-year observations, the univariate analysis indicates that an optimal board size of Australian listed firms is from eight to 10, which is above the sample average of six directors. Consistently, controlling for variables that potentially affect Tobin's Q, the multivariate analysis finds that larger boards lead to higher Tobin's Q, especially among larger firms. Therefore, my findings provide support for the resource dependence argument. These findings justify initiatives to encourage more directors in boards who could provide advice for CEOs, especially in large and complex firms.

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Appendix
Variable Description

Primary Variables	
Board Size	The number of directors on the board
Tobin's Q	The natural log of market to book value of assets ratio
Control Variables	
Debt	The book value of debt divided by assets
Firm Size	The natural logarithm of total assets
Business Risk	The standard deviation of EBIT in the previous five years
Blockholdings	The aggregate ownership of shareholders holding 5% or more equity
Investment	Capital expenditure scaled by assets
Firm Age	The natural logarithm of the number of years since the firm's incorporation
Profitability	Earnings after tax scaled by assets (ROA)
Lag (Profitability)	Previous year's ROA
Industry	A dummy variable, based on two digit GICS codes, which equals one for "opaque industries" and zero for "transparent industries"