

The Impact of Board Size on Firm-Level Capital Investment Efficiency

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Abstract

The study aims to examine whether and how board structure is associated with firm-level capital investment efficiency. Specifically, I investigate whether the size of a firm's board is associated with the sensitivity of investments to the availability of internal funds. I hypothesize and find that board size is inversely related to investment-cash flow sensitivity. Larger boards seem to mitigate investment-cash flow sensitivity by reducing information asymmetry between managers and external capital providers. The study is important as it reveals that board structure influences the corporate investment policy, which is one of the most important firm economic decisions.

Keywords: board size, boards of directors, corporate governance, investment-cash flow sensitivity, corporate investment

1. Introduction

The purpose of this study is to investigate whether and how board structure is associated with corporate capital investment efficiency. Specifically, I examine whether board size is related to the elasticity of corporate investment to internal cash flows, which is a leading indicator of capital investment efficiency in finance literature. Corporate boards of directors play a crucial role in the corporate governance of firms. Corporate boards are one of the most significant internal governance mechanisms designed to protect shareholders' interests. Directors are charged with monitoring and advising top management. When the effectiveness of corporate boards is assessed, board structure is considered one of the most central factors (Monks & Minnow, 1995). Especially, board size is a vital factor that influences a board's efficacy (Jensen, 1993).

Empirical studies that examine the association between board size and its effectiveness present mixed results. On the one hand, it is argued larger boards are more effective than smaller boards in monitoring and advising top management. For example, larger boards are more likely to improve information transparency because they tend to establish various monitoring committees, allocate specific tasks, and have more directors with relevant knowledge in financial reporting process (Klein, 2002; Anderson et al., 2004; Beasley & Salterio, 2001). Furthermore, larger boards are more likely to lead to diversity in board members' experience and expertise (Firstenberg & Malkiel, 1994; Kiel & Nicholson, 2003) and include more outside or non-executive directors who are more independent (Jensen, 1993). Large boards have better access to resources such as business contacts, technologies, and raw materials (Zahra & Pearce, 1989; Booth & Deli, 1996; Kiel & Nicholson, 2003).

Consistent with these arguments favoring larger boards, empirical studies find larger boards improve firms' information environment (Upadhyay & Sriram, 2011), increase audit committee independence (Klein, 2002), and reduce earnings management (Xie et al., 2003; Peasnell et al., 2005; Larcker et al., 2007; García-Meca and Sánchez-Ballesta, 2009; Ghosh et al., 2010). Furthermore, board size is either positively related to corporate financial performance (Dalton, Daily, Johnson, & Ellstrand, 1999) or unrelated to firm performance (Wintoki, 2007) and inversely related to cost of capital (Anderson, Mansi and Reeb, 2004; Upadhyay and Sriram, 2011).

On the other hand, it is also argued companies are better off with smaller boards. Larger boards may exacerbate agency problems between managers and external capital providers (Lipton & Lorsch, 1992; Jensen, 1993) as well as coordination and communication problems (Jensen, 1993; Eisenberg, Sundgren, & Wells, 1998). It is easier for large boards to be controlled by CEO because of social loafing and free riding associated with large

groups (Jensen, 1993).

Supporting these arguments that smaller boards provide more effective governance, some empirical studies provide evidence that larger boards are related to lower firm performance (Yermack, 1996; Gertner & Kaplan, 1996; Eisenberg, Sundgren, & Wells, 1998; Denis & Sarin, 1999) and a higher expense ratio in the fund industry (Tufano & Sevick, 1997; Dann, Guercio, & Partch, 2000).

In this study, I examine the association between board size and investment-cash flow sensitivity. Firm-level investment decisions influence the whole economy as crucial determinants of economic productivity. Since Fazzari, Hubbard, and Petersen (1988), financial economics literature has investigated the determinants of the elasticity of corporate investment to internal cash flows. As factors affecting investment-cash flow sensitivity, prior studies have identified information asymmetry (Ascioglu, Hegde, & McDermott, 2008), accounting quality (Xie et al., 2003; Peasnell et al., 2005; Larcker et al., 2007; García-Meca & Sánchez-Ballesta, 2009; Ghosh et al., 2010), analyst following (Ağca & Mozumdar, 2008), institutional ownership (Ağca & Mozumdar, 2008), and managerial overconfidence (Malmendier & Tate, 2005). However, limited empirical research has addressed the effect of board structure on corporate investment decisions. I aim to fill this void by examining whether and how board size, which is a significant attribute of board effectiveness, is associated with investment-cash flow sensitivity. It is important to examine such an association given that board governance affects management investment decisions.

I posit that board size is inversely associated with investment-cash flow sensitivity through the avenue of information asymmetry between managers and external suppliers of capital. Larger boards are likely to improve investment efficiency by reducing information asymmetry. Board size is negatively related to information asymmetry between managers and outside capital providers (Beasley & Salterio, 2001; Klein, 2002; Anderson et al., 2004). Larger boards reduce information asymmetry because they form various monitoring committees, allocate specific tasks, and have more directors with relevant expertise in financial reporting (Klein, 2002; Anderson et al., 2004; Beasley & Salterio, 2001). By reducing information asymmetry between managers and external capital providers, larger boards are expected to decrease the wedge between the cost of internal funds and that of external funds. This reduction in the cost wedge is expected to be manifested in lower sensitivity of investment to internal cash flows.

Information asymmetry problems between managers and external capital providers increase the sensitivity of investment to internal cash flows (Ascioglu, Hegde, & McDermott, 2008). When managers are better informed than shareholders about their firm's prospects, shareholders require a premium for new equity issues because there are adverse selection problems. The premium for new equity issues makes the cost of external funds higher than that of internal funds. Then, companies are likely to rely more on internal funds for their investment outlays, leading to higher sensitivity of investment to internally generated cash flows.

For the period of 2006-2011, I run the OLS regression to empirically test the hypothesis that larger boards are related to lower investment-cash flow sensitivity. Consistent with the hypothesis, results suggest larger boards are likely to reduce investment-cash flow sensitivity presumably by decreasing information asymmetry between managers and external capital providers. As a supplemental analysis, leverage, which is a proxy for capital constraints, is included in the main regression as a control variable. Additionally, instead of the number of directors on the board, which is used to measure board size in the main regression, natural logarithm of board size is used in the estimation. The results are robust to these supplemental analyses.

The study contributes to extant knowledge in several ways. First, the study contributes to the literature that examines board effectiveness by demonstrating board structure influences the corporate investment policy, which is one of the most important firm economic decisions. Although board effectiveness has been extensively studied, few studies reveal that the size of a firm's board is associated with firm investment decisions. Second, the study contributes to the stream of corporate finance literature examining the determinants of capital investment efficiency by identifying an additional determinant. It provides evidence that the internal governance mechanism relates to variation in corporate investment policies. By finding a link between the size of boards and capital investment efficiency, the paper proposes that board structure may be a crucial indicator of board effectiveness that can influence firm investment decisions.

The paper proceeds as follows. The next section reviews studies related to the current paper followed by hypothesis development. Research design and descriptive statistics are discussed in the fourth and fifth sections, respectively. The sixth section presents results while the seventh section contains additional analyses. The last section concludes the paper.

2. Literature Reivew

Two strands of research relate to this study. The first strand of research explores how board size affects board effectiveness. Empirical studies that examine the association between board size and its effectiveness present mixed results. Some studies show larger boards are more effective than smaller boards in monitoring and advising top management. In contrast, some studies show companies are better off with smaller boards. The second strand of research examines the determinants of firms' investment-cash flow sensitivity. As factors affecting the sensitivity, prior studies have identified information asymmetry, accounting quality, analyst following, institutional ownership, and managerial overconfidence.

2.1 Board Size

Corporate governance is designed to lessen agency conflicts between managers and shareholders caused by the separation of ownership and control in corporations. Corporate boards are the key internal governance mechanisms designed to alleviate agency problems. Boards of directors monitor and advise top management to guard shareholders' interests. For example, directors oversee the financial reporting process, grant important firm decisions such as launching major investment projects, and decide managers' compensation. When the effectiveness of corporate boards is assessed, board structure is considered one of the most central factors (Monks & Minnow, 1995). Especially, board size is a vital factor that influences a board's efficacy (Jensen, 1993).

Prior research has examined how board size, which is an important attribute of board structure, affects overall board effectiveness. There are two opposing theories that explain how board size affects firms' board effectiveness. On the one hand, it is argued larger boards are more effective than smaller boards in monitoring managerial activities because of the following reasons. First, larger boards lead to greater information transparency. Larger boards tend to have more directors with relevant knowledge and expertise in financial reporting (Beasley & Salterio, 2001). They are more likely to challenge auditors on contentious financial reporting issues (Firstenberg & Malkiel, 1994). By establishing a variety of monitoring committees and distributing specific tasks, a larger board facilitates greater discussion on corporate matters, which, in turn, results in greater information transparency (Klein, 2002; Anderson et al., 2004). Second, larger boards lead to diversity in industry experience, education, opinions, expertise, and skills (Firstenberg and Malkiel, 1994; Kiel & Nicholson, 2003). This diversity in experience is likely to help board members to more effectively monitor and advise management (Zahra & Pearce, 1989). Third, larger boards have a higher possibility of including more outside or non-executive directors who are more independent (Jensen, 1993). Board independence enhances board effectiveness. For instance, independent directors are likely to decrease earnings management (Klein, 2002; Bowen et al., 2008) and financial fraud (Beasley, 1996; Dechow et al., 1996). Lastly, larger boards have better access to resources such as business contacts, technologies, and raw materials (Zahra & Pearce, 1989; Booth & Deli, 1996; Kiel and Nicholson, 2003).

On the other hand, it is also argued companies are better off with smaller boards. It is easier for large boards to be controlled by CEO because of social loafing and free riding associated with large groups (Jensen, 1993). Moreover, coordination and communication problems are likely to exacerbate as boards get larger (Jensen, 1993; Eisenberg et al., 1998). Poorer coordination and communication may worsen agency problems between managers and external investors, thereby allowing managers to maximize their private benefits (Lipton & Lorsch, 1992; Jensen, 1993).

The empirical evidence on the relation between board size and its effectiveness is mixed. A number of studies indicate larger boards are more effective than smaller boards in monitoring and advising managers. For example, Upadhyay and Sriram (2011) show that firms with larger boards exhibit greater information transparency and enjoy a lower cost of capital. They argue larger boards have more resources to monitor managerial performance than smaller boards do. Larger boards would deliberate vital corporate decisions more expansively and demand that managers release important issues to the stakeholders. To measure information transparency, Upadhyay and Sriram (2011) use bid-ask spread, analysts' forecast error, share turnover, and analyst following. They find the positive relationship between board size and information transparency, concluding investors seem to perceive larger boards as contributing to a better information environment. Additionally, they document board size reduces cost of capital by enhancing information transparency.

Cheng (2008) demonstrates that larger boards decrease the variability of accruals. The variability of accruals has a positive relationship with information asymmetry between managers and external capital providers (Jayaraman, 2008). Accordingly, larger boards reduce information asymmetry by mitigating the variability of accruals. Moreover, Klein (2002) finds a positive relationship between board size and audit committee independence.

Klein (2002) indicates that larger boards are more likely to establish several monitoring committees and allocate specific tasks, thereby leading to greater information transparency.

Firms with larger boards are less likely to engage in earnings management (Xie et al., 2003; Peasnell et al., 2005; Larcker et al., 2007; García-Meca & Sánchez-Ballesta, 2009; Ghosh et al., 2010). That is, larger boards seem to be more effective in monitoring the corporate financial accounting process than smaller boards. Xie et al. (2003) argue that firms with a larger board are able to reduce earnings management because they may bring a greater number of experienced directors to a board. Ghosh et al. (2010) uses three measures to proxy for earnings management: discretionary accruals, absolute values of special items, and deferred tax expense. Their findings of greater earnings management for smaller boards are consistent among these three measures. García-Meca and Sánchez-Ballesta (2009) show that board size decreases earnings management by conducting a meta-analysis. They find the negative relationship between board size and discretionary accruals. They reason that larger boards are more likely to delegate responsibilities to board committee member than are smaller boards. The formation of subcommittees of large boards is likely to supply superior monitoring (Klein, 2002).

Anderson, Mansi and Reeb (2004) find an inverse association between board size and the cost of debt, suggesting that, from creditors' perspectives, larger boards are better monitors. That is, creditors consider financial reporting prepared by firms with larger boards more reliable. Upadhyay (2015) also finds firms with larger boards enjoy a higher credit rating and a lower realized cost of debt.

Some studies find that board size is affected by firm variables, including Tobin's Q, size, and profitability (Lehn et al., 2004; Boone et al., 2007; Coles et al., 2008). Prior studies that show board size has a negative impact on firm performance have been greatly condemned for not addressing endogeneity issues because firm performance has a negative impact on board size (Wintoki, 2007). In order to control for endogeneity problems, Wintoki (2007) uses generalized method of moments (GMM) estimator and finds no significant association between board size and firm performance. Coles et al. (2008) find that, for the sample of complex firms with a high leverage, larger boards result in higher Tobin's Q. They suggest complex firms require a larger board because the larger board is better in monitoring and advising complex firms than a smaller board. Dalton, Daily, Johnson, and Ellstrand (1999) find that larger boards lead to better financial performance in a meta-analysis. Chaganti, Mahajan, and Sharma (1985) find an inverse relationship between board size and the rate of bankruptcy.

However, not all studies agree with the view that larger boards are better monitors of managerial activities. For example, some studies indicate that larger boards are related to lower firm performance because of higher coordination costs and process losses (Yermack, 1996; Gertner & Kaplan, 1996; Eisenberg, Sundgren, & Wells, 1998; Denis & Sarin, 1999). Yermack (1996) shows the negative association between board size and Tobin's Q. Gertner and Kaplan (1996) indicate that smaller board sizes are preferred because of coordination costs and free rider problems innate in large boards. Furthermore, smaller boards tend to have a lower expense ratio in the fund industry (Tufano & Sevick, 1997; Dann, Guercio, & Partch, 2000).

2.2 Investment-Cash Flow Sensitivity

In a "perfect" Modigliani and Miller (1958) world, corporate investment decisions are driven by investment opportunities regardless of financing choices. Hence, there would be no association between corporate investment spending and internally generated cash flows in perfect financial markets. In reality, however, capital markets are imperfect and internal and external financing are not perfect substitutes. In imperfect capital markets, the cost of external funds is greater than that of internal funds because potential moral hazard problems and costly monitoring of managerial actions lead to a higher rate of return charged by external capital providers (Jensen & Meckling, 1976).

One theory that explains the wedge between the cost of external capital and that of internal funds is informational asymmetry model (Myers, 1984; Myers & Majluf, 1984). Managers have superior information about their firm's prospects compared with shareholders. Because of adverse selection problems, shareholders require a premium for new equity issues, making the cost of external funds higher than that of internal funds. As a result, companies are likely to rely more on internally generated funds for their investment outlays, making their investment-cash flow sensitivity higher. In sum, greater informational asymmetry between managers and external capital suppliers results in higher investment-cash flow sensitivity.

A number of factors affecting investment-cash flow sensitivity have been identified by empirical studies. Fazzari, Hubbard, and Petersen (1988) are the first to study the relationship between corporate investment and internal funds availability. They argue and find that financially constrained firms have higher investment-cash flow sensitivity because it is harder for them to obtain external financing. Because of the difficulty to get external financing, they tend to rely more on internal funds. On the contrary, Kaplan and Zingales (1997) find by using

the same sample of Fazzari et al. (1988) that financially constrained firms exhibit lower investment-cash flow sensitivity. They argue high managerial risk aversion in financially constrained firms leads to underinvestment.

Ascioglu, Hegde, and McDermott (2008) document that firms with high information asymmetry between firms and investors exhibit higher elasticity of investment to cash flows because information asymmetry is a main reason for financial constraints and higher external financing costs. Biddle and Hillary (2006) find the negative relationship between accounting quality and investment-cash flow sensitivity. They reason that higher quality accounting decreases information asymmetry between managers and outside suppliers of capital and, hence, improves investment efficiency. They use four measures to proxy for accounting quality: earnings aggressiveness, loss avoidance, earnings smoothing, and timeliness.

Ağca and Mozumdar (2008) demonstrate that the investment-cash flow sensitivity is inversely related to both institutional ownership and analyst following, which are factors associated with capital market imperfections. They hypothesize that firms with institutional ownership have more information reflected into prices because institutions act on information. Consequently, the information asymmetry between firms and outside capital providers is decreased and, in turn, the cost wedge between internal funds and external funds is decreased. This reduction in the cost wedge lowers the sensitivity of corporate investment to internal funds availability. Furthermore, they hypothesize that higher analyst coverage leads to lower information asymmetries, thereby reducing the sensitivity of investment to internal funds.

Attig, Cleary, Ghoul, and Guedhami (2011) document that the presence of institutional investors with long-term investment horizons lowers the investment-cash flow sensitivity because they alleviate information asymmetry and agency problems. Malmendier and Tate (2005) find managerial overconfidence increases investment-cash flow sensitivity. They contend that overconfident managers overinvest when they have high level of internal funds availability because overconfident CEOs overestimate the returns to their investment projects.

3. Hypothesis Development

One of the most significant responsibilities of a corporate board is ensuring that managers present reliable information to shareholders. Prior literature suggests that, compared with smaller boards, larger boards are more likely to reduce information asymmetry problems between managers and investors. By establishing a variety of monitoring committees and distributing specific tasks, a larger board facilitates greater discussion on corporate matters, which, in turn, results in greater information transparency (Klein, 2002; Anderson et al., 2004). Larger boards tend to have more directors with relevant knowledge and expertise in financial reporting (Beasley & Salterio, 2001) and challenge auditors on contentious financial reporting issues (Firstenberg & Malkiel, 1994). Upadhyay and Sriram (2011) argue that larger boards have more resources to monitor managerial performance than smaller boards do. Thus, they are likely to deliberate vital corporate decisions more expansively and demand that managers release important issues to the stakeholders. Xie et al. (2003) argue that firms with a larger board may bring a greater number of experienced directors to a board and, thereby, are able to reduce earnings management.

Empirical studies support these arguments that larger boards tend to reduce information asymmetry problems between managers and external capital suppliers. Upadhyay and Sriram (2011) show that firms with larger boards exhibit greater information transparency and enjoy a lower cost of capital due to better information transparency, concluding investors seem to perceive larger boards as contributing to a better information environment. Furthermore, firms with larger boards are less likely to engage in earnings management (Xie et al., 2003; Peasnell et al., 2005; Larcker et al., 2007; García-Meca & Sánchez-Ballesta, 2009; Ghosh et al., 2010). That is, larger boards seem to be more effective in monitoring the corporate financial reporting process. In addition, Klein (2002) finds a positive relationship between board size and audit committee independence.

Information asymmetry problems between managers and external capital providers increase the sensitivity of investment expenditures to fluctuations in internal funds (Ascioglu, Hegde, & McDermott, 2008). When managers have superior information about their firm's prospects than shareholders, shareholders require a premium for new equity issues because there are adverse selection problems. Then, companies are likely to rely more on internal funds for investment expenditures, leading to higher sensitivity of investment to internally generated cash flows.

Empirical studies support that information asymmetry problems increase investment-cash flow sensitivity (Ascioglu, Hegde, & McDermott, 2008; Biddle & Hillary, 2006; Ağca & Mozumdar, 2008; Attig, Cleary, Ghoul, & Guedhami, 2011). Higher quality accounting decreases information asymmetry between managers and outside suppliers of capital, thereby enhancing investment efficiency (Biddle & Hillary, 2006). Both institutional ownership and analyst following reduce the sensitivity of investment to internal funds by lowering information

asymmetries (Ağca & Mozumdar, 2008). The presence of institutional investors with long-term investment horizons lowers the investment-cash flow sensitivity because they alleviate information asymmetry and agency problems (Attig, Cleary, Ghoul, & Guedhami, 2011).

Following prior studies, I expect board size to be inversely related to investment-cash flow sensitivity through the avenue of information asymmetry. Larger boards are likely to mitigate investment-cash flow sensitivity by reducing information asymmetry between managers and external capital providers. Compared with smaller boards, larger boards are expected to be better in reducing information asymmetry because they form various monitoring committees, allocate specific tasks, and have more directors with relevant expertise in financial reporting (Klein, 2002; Anderson et al., 2004; Beasley & Salterio, 2001). By reducing information asymmetry problems between managers and external capital suppliers, larger boards are expected to decrease the wedge between the cost of internal funds and that of external funds. This reduction in the cost wedge is expected to be manifested in lower sensitivity of investment to the availability of internally generated funds. Accordingly, my hypothesis is as follows.

Hypothesis: Board size is negatively related to investment-cash flow sensitivity.

4. Research Design

I empirically test whether board size is inversely associated with investment-cash flow sensitivity by estimating the following OLS investment model:

$$Investment = \beta_0 + \beta_1 CFO * BoardSize + \beta_2 CFO + \beta_3 BoardSize + \beta_4 LnTA + \beta_5 MTB + \beta_6 PPE + \beta_7 DivDummy + \varepsilon \quad (1)$$

where:

Investment = capital expenditures / total assets

CFO = cash flow from operations / total assets

BoardSize = the number of directors on the board

LnTA = natural logarithm of total assets

MTB = market-to-book ratio = (book value of total assets + market value of equity - book value of equity) / book value of total assets

PPE = PPE / total assets

DivDummy = 1 if firm pays dividend, =0 otherwise

Consistent with previous research, I measure firm investment decisions by using scaled capital expenditures (Beatty, 2009; Attig, Cleary, Ghoul, & Guedhami, 2012). Board size is measured by the number of directors on the board. CFO is cash flow from operations divided by total assets. I control for firm characteristics that are known to affect investment expenditures as follows: firm size (LnTA), growth opportunity (MTB), tangibility (PPE), and internal funding (DivDummy) (Biddle et al., 2009; Agrawal & Nasser, 2012).

The main variable of interest is the interaction term between CFO (cash flow from operations) and BoardSize (the number of directors on the board) in the equation. The coefficient on CFO * BoardSize (β_1) is expected to be significantly negative, supporting the hypothesis that board size is inversely related to investment-cash flow sensitivity. If firms' investments are sensitive to internal cash flows as shown in previous literature, I expect the coefficient on CFO (β_2) to be positive. The coefficient on LnTA is expected to be positive as larger firms have better access to external capital markets. MTB is predicted to have a positive coefficient as firms with high growth opportunities tend to increase investment. The coefficient on DivDummy is predicted to be negative. Firms that pay dividends may not have adequate internal funding, which can force firms to forgo positive net present value projects.

For the purpose of mitigating the effect of outliers, I winsorize the variables at the 1% and 99% level. Furthermore, I estimate the equation with firm and year fixed effects in order to mitigate omitted variable problems and potential endogeneity problems. Standard errors at the firm level are clustered.

5. Sample and Descriptive Statistics

I use Compustat and Risk Metrics Directors (currently ISS) for firm variables and board size for the period of 2006-2011. The Risk Metrics Directors database collects its data from corporate proxy statements, covering S&P 1500 firms. Financial firms (SIC codes 6000-6999) and utilities (SIC codes 4000-4949) are excluded as a board's role in these regulated firms can be limited. For 1,253 unique firms, the number of firm-year observation is 7,320. Table 1 shows the summary statistics of my sample, including mean, standard deviation, median, and first/third

quartile. As shown in previous studies (Upadhyay, 2015), an average board size is about 9. Table 2 displays Pearson correlation among variables. Correlation coefficients in bold are significant at 5% level.

Table 1. Descriptive statistics of regression variables

Variable	Obs.	Mean	Std Dev	First quartile	Median	Third quartile
Investment	7320	0.05	0.06	0.02	0.03	0.06
BoardSize	7320	8.9	2.14	7	9	10
CFO	7320	0.12	0.08	0.07	0.11	0.16
LnTA	7320	7.48	1.59	6.36	7.36	8.49
MTB	7320	1.62	1.08	0.91	1.3	1.96
PPE	7320	0.49	0.37	0.2	0.38	0.72
DivDummy	7320	0.51	0.5	0	1	1

Table 2. Pearson correlation among variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)Investment	1						
(2)BoardSize	-0.059	1					
(3)CFO	0.283	-0.030	1				
(4)LnTA	0.000	0.593	-0.025	1			
(5)MTB	0.032	-0.124	0.434	-0.215	1		
(6)PPE	0.613	0.098	0.171	0.110	-0.168	1	
(7)DivDummy	-0.008	0.338	0.048	0.345	-0.087	0.210	1

6. Results

In Table 3, I estimate the OLS regression to test the hypothesis that board size is inversely related to investment-cash flow sensitivity. The dependent variable is capital expenditures divided by total assets. The main variable of interest is the interaction term between CFO (cash flow from operations) and BoardSize (the number of directors on the board). Consistent with my hypothesis, the coefficient on the interaction term between cash flows from operations and board size (β_1) is significantly negative at the 1 percent level. This result suggests the negative association between board size and the sensitivity of investment to internal cash flows. Larger boards seem to reduce the sensitivity of investment spending to cash flows presumably by decreasing information asymmetry between managers and external capital providers. In addition, in accordance with previous studies (Ascioglu et al., 2008; Attig et al., 2012), the coefficient on CFO (β_2) is significantly positive at the 1 percent level, confirming firm investments are sensitive to internal cash flows.

In general, control variables are signed as expected. Firm size has a positive impact on the investment. Market-to-book ratio is significantly associated with investment in a positive direction, implying that firms with higher growth opportunities tend to increase investment. Dividends have a negative impact on the investment.

7. Supplemental Analyses

I conduct several supplemental analyses. First, it is possible investment-cash flow sensitivity is affected by capital constraints (John, Litov, & Yeung, 2008). Therefore, I attempt to control for this possibility by including firms' leverage, which is a proxy for capital constraints, in the main regression (Biddle, Callhan, Hong, & Knowles, 2015). The coefficient on leverage is significantly negative because firms with high level of leverage may have debt overhang and underinvestment problem. The main results hold after controlling for capital constraints (Table 4). Second, instead of BoardSize (the number of directors on the board), natural logarithm of BoardSize is used (Upadhyay, 2015). The main results remain valid when LnBordSize is used (Table 5).

Table 3. Board size and investment-cash flow sensitivity (dependent variable: capital expenditures)

	Coef.	p-value
CFO*BoardSize	-0.015	0.008
CFO	0.249	0.000
BoardSize	-0.001	0.225
LnTA	0.002	0.014
MTB	0.003	0.006
PPE	0.100	0.000
DivDummy	-0.015	0.000
N	7320	
R ²	0.462	

Table 4. Leverage as a control variable (dependent variable: capital expenditures)

	Coef.	p-value
CFO*BoardSize	-0.015	0.007
CFO	0.248	0.000
BoardSize	-0.001	0.256
LnTA	0.002	0.004
MTB	0.003	0.007
PPE	0.101	0.000
DivDummy	-0.015	0.000
LEVERAGE	-0.010	0.028
N	7320	
R ²	0.463	

Table 5. LnBoardSize as an independent variable (dependent variable: capital expenditures)

	Coef.	p-value
CFO*LnBoardSize	-0.127	0.012
CFO	0.393	0.002
LnBoardSize	-0.009	0.156
LnTA	0.002	0.010
MTB	0.003	0.007
PPE	0.100	0.000
DivDummy	-0.015	0.000
N	7320	
R ²	0.463	

8. Conclusion

This study examines whether board size is associated with the the sensitivity of investments to the availability of internal funds. Corporate boards are one of the most important internal governance mechanisms designed to protect shareholders' interests. When the effectiveness of corporate boards is assessed, board structure is considered one of the most central factors (Monks & Minnow, 1995). In particular, board size is a crucial factor affecting board effectiveness.

In the current study, I posit board size inversely affects investment-cash flow sensitivity through the avenue of information asymmetry. The results confirm the hypothesis and remain valid after supplemental analyses are conducted. Larger boards appear to improve investment efficiency by decreasing information asymmetry between managers and external capital providers. This study is important as it reveals that board structure influences the corporate investment policy, which is one of the most important firm economic decisions.

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