Impact of Corporate Governance on Overinvestment and Underinvestment: An Examination of ASX Listed Companies*

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Abstract

Agency theory suggests that firm investments may deviate from their optimal level resulting in over or underinvestment. Using a sample of 1,035 Australian firms between 2005 and 2014 (7,392 firm-year observations), we investigate the impact of corporate governance on the investment efficiency of these firms. We find that better internal corporate governance improves the investment efficiency of the firm by mitigating both over and underinvestment. Our findings are robust to alternative investment inefficiency proxies, examining sub-components of corporate governance and controlling for potential endogeneity bias.

Keywords: Agency problem, investment inefficiency, overinvestment, underinvestment, corporate governance, Australia.

*Preliminary, please do not quote.

1. Introduction

In this paper, we aim to investigate whether corporate governance quality improves investment inefficiency by mitigating both overinvestment and underinvestment. The agency problem, as a result of conflict of interests between managers and shareholders, can lead managers to invest sub-optimally resulting in over or underinvestment. A wealth of literature has studied the role of corporate governance such as board composition, independent directors, risk management strategies and limitations on the power of the CEO to motivate managers to act in the best interest of shareholders and consequently minimise agency problems. While corporate governance has been studied extensively, and been the focus of numerous law and regulation changes around the globe, the evidence of its efficacy on mitigating over and underinvestment is limited.

Over and underinvestment is a cause of concern because inefficient investments affect firm performance, leading to a reduction of firm value and economic growth. While there is empirical evidence in literature that corporate governance can reduce some agency problems such as improving firm performance, reducing agency costs and dismissing poorly performing CEO's, the evidence is less clear on impact of corporate governance on direct estimates of investment inefficiency. Therefore, the aim of this study is to fill this gap in the literature by estimating the impact of corporate governance on more direct estimates of over and underinvestment for a sample of firms listed on the Australian Stock Exchange (ASX).

A few studies have considered the issue of the impact of corporate governance on sub-optimal investing. The primary study by Richardson (2006), which investigates 815 US in 2002, attempts to measure the impact of several corporate governance mechanisms on overinvestment using simple OLS regression. Richardson (2006) finds that, certain corporate governance mechanisms, especially activist shareholders and firms with Anti-Takeover II provisions (supermajority voting provisions & state of incorporation) mitigate overinvestment, while firms with Anti-Takeover I provisions (firms with staggered boards & poison pill) increase the level of overinvestment. Another study, using a US sample by Biddle et al., (2009) shows an association between corporate governance and investment inefficiency using the G-Index of Gompers et al., (2003). They conduct logistic regression and provide some evidence that G-Index mitigates overinvestment, while no significant association of G-Index with underinvestment was documented. More recently, Chen et al., (2015) studies the impact of corporate governance on both over and underinvestment on a sample of 865 Chinese firms

(3460 firm-year observations) between 2001 and 2004. Authors find that state ownership concentration is positively associate with overinvestment while the tradable shares (portion of shares not owned by the state that are tradable), the size of the supervisory board and leverage are negatively associated with overinvestment. Underinvesting companies were shown to have generally high state ownership concentration, with a larger board of directors and a greater proportion of outside directors. Chen et al., (2015) shows that leverage and the portion of tradable shares seems to mitigate the underinvestment problem.

In our study we consider Australia, which has a markedly different corporate governance and institutional environment compared to the US and China. Richardson (2006) and Biddle et al., (2009) who examine the US listed firms, consider anti-takeover defences which are often legal in other markets. However, in Australia it is legally prohibited to have anti-takeover defences such as poison pills, dual class recapitalisation and classified boards (Henry, 2010). Meanwhile, Chen et al., (2015) is set in the Chinese market which features markedly different corporate governance structures including two-tier board system and extensive state ownership. Australia has a one-tier board system where both executive and non-executive directors form a single board. A two-tier board consists of a separate executive board comprising of only executive directors and a supervisory board consisting of only non-executive independent directors. The supervisory board supervises the management board. Due to these major differences between corporate governance structure of these two countries, it is worth to investigate the impact of corporate governance on over and underinvestment and provide an evidence in a different setting.

In this study, we attempt to contribute to the literature by investigating the association between corporate governance and investment inefficiency (over and underinvestment) in Australia. To the best of our knowledge no similar research has been done in Australia. We estimate the impact of corporate governance on over and underinvestment using a sample of 7,392 firm-year observations (1,035 unique firms) between 2005 and 2014. First, we estimate the investment inefficiency using three models of Eisdorfer et al., (2013), Biddle et al., (2009) and Richardson (2006). Then we construct an aggregate corporate governance index following the Howarth-University of Newcastle Corporate Governance reports. These reports include the internal corporate governance components considered as best practiced CG Code[1] and recommended by the ASX Corporate Governance Principles & Recommendations, 2003 and

[1] See Appendix I: Horwath-University of Newcastle Corporate Governance report 2008.

2007. The Horwath corporate governance data covers the top ASX250 companies and is available until 2008. Therefore, we extend this index till 2014 by constructing an aggregate corporate index for all Australian companies (large cap, medium cap and small cap firms) employing a simplified Horwath index[2] as adopted by Ali et al., (2014). Therefore, our findings are generalizable to a wider range of firms.

We provide empirical evidence that corporate governance index is significantly and negatively associated with both overinvestment and underinvestment. We re-run our analysis on the alternative proxies of over and underinvestment and sub-components of corporate governance and find a consistent significant and negative association between corporate governance and estimates of over and underinvestment. We also run a two-stage least square (2SLS) instrumental variable approach to control for potential endogeneity and show that our findings are robust when we controlled for endogeneity.

The rest of the paper is organised as follows. In Section 2, we highlight the corporate governance environment in Australia and brief literature review. Section 3 contains our data and methodology. Section 4 reports our econometrics analysis. Section 5 concludes.

2. Corporate Governance environment in Australia & Background Literature

Australia is an interesting market to study as it has corporate governance attributes which makes it different than the US market where much of the studies to date has been done. First, the Australian corporate governance rules rely on a "comply or explain" regime whereas the US, has a more prescriptive approach. The ASX Corporate Governance Council released the first edition of the Principles of Good Corporate Governance and Best Practice Recommendation in 2003 and a revised version in 2007. These guidelines provide 30 recommendations to the Australian firms based on 8 principles[3] regarding best practiced internal corporate governance.

ASX listing rule 4.10.3 sets out as "if not why not approach". Under this rule, adherence to the recommendations is voluntary but has a mandatory disclosure regime (i.e. if not why not approach) requiring the companies to explain in their financial report the reasons for non-compliance of the recommendations. These guidelines were tightened after the Global Financial crisis of 2008. The revised edition of Principles of Good Corporate Governance and

[2]See Appendix II: Simplified Horwath Index adopted by Ali et al., (2014). Section 2 explains more about this simplified index.

[3] See Appendix III for 8 ASX principles regarding good corporate governance.

Best Practice Recommendation released in 2007 made it mandatory for S&P All Ordinaries index, i.e. top ASX500 companies, to establish an audit committee under listing rule 12.7. Moreover, under listing rule 12.8, it was made compulsory for S&P/ASX300 index companies to have an audit committee with its structure and composition compliant with ASX recommendations 4.2[4] and 4.3[5]. Revised rules also made it compulsory to establish remuneration committee for S&P/ASX300. If a company does not comply with any of these rules, then ASX listing rule 18.8 gives authority to the ASX to send a written warning to comply and subsequently terminate the company's listing if requirements are not met. Given the voluntary nature of corporate governance compliance law in Australia, for at least most of firms and for most of the corporate governance recommendations, we expect large variations in the corporate governance quality of Australian companies particularly in the medium cap and small cap firms.

Second, other mechanisms which can act as the alternative monitoring mechanisms maybe weaker in Australia compared to other countries. For instance, institutional ownership which acts as a powerful governance tool in monitoring of managers accounts for 40%-50% of total ASX market capitalisation (Hsu & Koh 2005) compared to 60%-75% of UK stock market (Webb et al., 2003) and 60% for the US stock market (Cornett et al., 2007). Additionally, the market for corporate control which acts as an effective external disciplinary force on the managers and is very active in the US, is less active in Australia. For example, from 2000-2005 tender offers in US accounts for 167% of total listed firms compared to 74% of listed firms in Australia (Tian & Twite, 2011). Therefore, role of corporate control in mitigating agency problems may be more limited in Australia and the role of the strength of internal corporate governance structure in reducing agency problems is more relevant (Pham et al., 2011).

Prior studies in Australia have attempted to investigate the role of corporate governance in several ways, such as examining the role of corporate governance in improving the firm performance. These studies mostly rely on individual components of corporate governance and have documented mixed findings similar to other countries. Studies have shown that the board independence improves firm value (Muth & Donaldson, 1998) deteriorates firm value (Kiel & Nicholson, 2003) or has no significant association (Cotter & Silvester, 2003; Bonn, 2004; Christensen et al., 2015). Additionally, Cotter & Silvester, (2003) investigates the impact of

[4] ASX recommendation 4.2 requires an audit committee should be composed of non-executive directors, with majority of independent directors and is chaired by an independent chair who is not the chair of the main board and should have at least 3 members.
[5] ASX recommendation 4.3 says that audit committee should have a formal charter.

independent audit and compensation committee and document no significant association between the independence of sub-committees and firm performance. Other studies investigating the impact of board size on firm performance also report inconsistent results. Kiel & Nicholson, (2003) show that the board size improves the firm value measured by Tobin's Q, while Bonn, (2004) documents the opposite findings with accounting or market based firm performance proxies. Similarly, Tian & Twite (2011) show that the independent boards and the small boards are effective in enhancing firm productivity. Wang & Oliver (2009) measure the impact of corporate governance on variance in stock returns (risk). They find that the executive directors enhance firm performance by reducing risk. This may also indicate that the executive directors reduce firm risk as a way in reducing their employment risk.

Several Australian studies argue that one possible channel through which effective corporate governance enhances firm performance is by dismissing CEO's in poorly performing firms. Therefore, the likelihood of CEO dismissal in poorly performing firms is high in firms with high corporate governance quality. An early study by Suchard et al., (2001) finds that the firms with independent boards are more likely to dismiss CEO's[6] due to poor firm performance compared to firms with non-independent boards. In a related study by Lau et al., (2009), using the forced CEO dismissals as a dependent variable, finds no such association. Additionally, Lau et al., (2009) finds that the larger boards increase the probability of forced CEO dismissals in poorly performing firms, in contrast to the view, that the large boards are usually ineffective due to communication and coordination issues.

Given such mixed findings from the prior literature, more recent Australian studies argue that endogeneity may have played a role in producing inconsistent results (Setia-Atmaja, 2009; Schultz et al., 2010; Pham et al., 2011). Setia-Atmaja (2009) argue that due to less active external corporate governance mechanisms in Australia, firms may employ alternative internal control mechanisms such as internal corporate governance, leverage or dividends. Hence, these mechanisms may be jointly determined endogenously. Setia-Atmaja (2009) controls for this potential endogeneity using 3SLS simultaneous equations and find that board independence improves firm performance. More recently Schultz et al., (2010) and Pham et al., (2011) show that none of the corporate governance components are significantly associated with any firm performance measures after controlling for endogeneity using dynamic GMM regressions.

[6] Suchard et al., (2001) include both forced and un-forced CEO dismissals in his study as a dependent variable.

Another possible explanation for these inconclusive findings is that, the firms can only get the benefit of agency problem reduction, if they comply with the overall CG code, rather than selecting individual CG components. There is a growing body of literature in Australia employing CG indexes, which generally present a more favourable picture on the effectiveness of corporate governance. Among, these indexes, the Henry (2008) index[7] is applied in limited studies while Horwath index[8] is well known and applied more widely in Australia. Henry (2008) investigates the compliance of Australian firms to his CG index between 1992 to 2002 (i.e. the period before ASX reforms 2003) and show that only the overall compliance with his CG Index improves firm value, while compliance with individual CG components does not improve firm value. A follow up study by Henry (2010) reports similar results about the effectiveness of the overall CG code in mitigating agency costs measured by discretionary expenses[9] and the asset utilisation ratio[10].

Studies applying the Horwath index as a proxy for corporate governance and measuring its impact on firm performance also provide mixed findings. Using one-year CG data of top ASX250 firm for 2001 Linden & Matolcsy (2004) run a univariate analysis to investigate firm performance in the contemporaneous year and following two years between firms with high CG and low CG quality. They do not find any evidence of high CG quality enhancing firm performance. However, more recently, another study using a larger sample of 550 firms with 3 years CG data from 2005-2008 documents a significant positive impact of CG quality on both firm value and financial performance (Baxter, 2014). A growing body of literature in Australia have shown the usefulness of the Horwath CG index in measuring the impact of CG on reducing agency problems. Beekes et al., (2015) shows that the better governed firms are more transparent and provide greater disclosures to the market in a timely fashion and also these firms also have low timeliness of price discovery. This indicates low information asymmetry and timely reflection of information in stock price. Chan et al., (2014) show that better governed firms also have high corporate social responsibility (CSR) standards, thus reflecting that these firms strive to improve firm image and maximise firm value by involving the firm in more CSR activities. Another study by Yarram (2015) document that the high CG

[7] See Henry (2008) study: Corporate Governance Structure and the Valuation of Australian Firms: Is There Value in Ticking the Boxes?
[8] See Appendix I: Horwath-University of Newcastle Corporate Governance report 2008.
[9] Discretionary expenses are SG&A expenses, which indicates the high managerial salaries and high perquisite expenses such as travel, rents etc.
[10] A low asset utilisation ratio represents unproductive managerial investment decisions such as empire building, managerial discretion in buying luxurious offices, buildings & vehicles for personal use.

quality is associated with greater likelihood of divided payments reducing free cash flows. Finally, Ali et al., (2016) document that CG quality enhances stock liquidity as measured by weighted quoted spread and the liquidity ratio. This increase in stock liquidity is channelled through a reduction in information asymmetry as argued by Beekes et al., (2015) and reduction in agency problems by limiting opportunistic activities of managers.

In this paper we construct an aggregate corporate governance index (*CG Index*) based on the simplified Horwath index as adopted by Ali et al., (2014)[11]. We extend it cross-sectionally for all listed Australian companies over a 10-year period (2005-2014). Thus, our findings are generalizable to a wider sample over more recent years. This simplified Horwath index is focussed on the objective governance attributes which can be empirically measured, resulting in 17 governance components (See Appendix II for simplified version). Of the 17 governance components, 3 are related to the board independence[12], CEO duality and board monitoring. The other 14 components measure structure, composition, size and monitoring of an audit, remuneration and nomination sub-committees. To construct the aggregate corporate governance index (*CG Index*) we operationalise all above 17 corporate governance components to create a binary-based index. An equal weight is applied to all the corporate governance components, therefore a score of 1 is allocated, if a firm meets a particular corporate governance criterion. and 0 otherwise. Hence, a firm meeting all the corporate governance criteria will get a score of 17.

We examine the overall development of the corporate governance structure of Australian firms in our sample over a sample period i.e. from 2005 to 2014. Table 1 Panel A & B reports the evolution of the yearly mean value of corporate governance components. There is a steady improvement in the corporate governance score (*CG Index*) and this improvement can be observed for all the CG components except for the audit committee (*Audit Com*) score, which slightly declined in 2014 and for *Board Meeting* showing a declining pattern over a sample period. To check whether these year-by-year improvement are statistically significant, we distribute our sample in two sub-samples, an early period (2005-2008)[13], which follows the release of the ASX CGC recommendations in 2003 and a late period (2009-2014). Column 7

[11] See Appendix II: Simplified Horwath Index adopted by Ali et al., (2014).
[12] See Appendix IV: Definition of Independent director according to ASX CGC Principles & Recommendation. Same principles are used as criteria by SIRCA in assigning the independence or non-independence of a director.
[13] First edition of ASX Corporate Governance Principles & Recommendations was released in 2003 therefore beginning few years are pre-adoption years hence firms were slowly adopting corporate governance recommendations. Therefore, we observe a 9% improvement in *CG Index* from 2005-2008 and 25% improvement in late adoption period from 2008-2014.

& 8 of Panel B Table 2 reports the results of *t*-test & Wilcoxen ranksum test. As can be seen, this improvement in corporate governance is statistically significant for all the CG components at the 1% level, except for the *Audit Com* where it is significant at 5% level and *Board Meetings* which is insignificant and thus indicates that it has not shown any improvement or decline. This increasing trend in the *CG Index* indicates that companies are gradually adopting the recommendations of ASX CGC in their corporate governance structure and the overall quality of internal corporate governance is improving in Australia.

[insert Table 1 here]

3. Data and Methodology

3.1. Data

We collect corporate governance data for Australian firms listed on the Australian Securities Exchange (ASX) from Securities Industry Research Centre of Asia-Pacific (SIRCA) for 10 years between 2005 and 2014. Any missing corporate governance information such as the board chairperson, the sub-committee chairperson was manually collected from the company annual reports. All the firm characteristics and investment data was sourced from Thomson Reuters DataStream (DS). Inclusion of a firm-year observation in our sample is dependent on its data being available from both SIRCA and DataStream (DS). We excluded all the Financial firms, defined as having an Industrial Classification Benchmark (ICB) code of 8000, due to their unique financing, capital structure and corporate governance environment. We also exclude all those directors from our corporate governance sample who were not in the board for most of the year and directors joining the company one month before the balance date with zero board meeting attendance[14]. To avoid measurement error arising due to the presence of outliers, we winsorize all the continuous variables which were at the 1st and 99th percentiles. The final sample consists of 1,035 unique firms with 7,392 firm-year observations.

Table 2 presents the descriptive statistics for the components of the investment and control variables for the whole sample. Investment spending in Panel A shows that that mean total investment (I_{TOTAL}) of Australian firms is 16.9% of their total assets base compared to the US firms which accounts for 14.14% (Biddle et al., 2009). Additionally, the median value of I_{TOTAL} is 7% which is lower than its mean indicating a considerable skewness in this variables.

[14] We assume that all directors who did not sit on the board for majority of the year and left company at least 7 months or before from the closing date or if have recently joined with the zero board meetings attendance do not bring anything to the board and they only result in increasing the board size.

Additionally, the average I_{NEW} (*CAPEX*) in Australia is 8.4% (10%) compared to 7.5% (7%) reported from the US sample (Richardson, 2006) and 7.2% (6.1%) from China (Chen et al., 2015). The higher I_{TOTAL}, I_{NEW} & *CAPEX* may be due to high growth opportunities available to Australian firms or as argued by Henry (2010) that Australian firms are generally overinvesting due to weak corporate governance. However, we do acknowledge that the higher mean of I_{NEW} (*CAPEX*) may also be driven by these variables being positively skewed, with median I_{NEW} (*CAPEX*) being equal to 3.1% (4%) and are therefore less than their respective mean estimates. In contrast, *Acquisitions* accounts for only 1.7% of average total assets in Australia compared to 2.5% in US firms (Richardson, 2006) and 4.4% from China (Chen et al., 2015). This may suggest market for external control in the form of corporate takeover is weaker in Australia which may also be a sign of weak external governance on managers.

Panel B of Table 1 gives summary statistic of the control variables. The mean *B/M* ratio is 0.765, which indicates a higher growth opportunities of Australian firms, and is interpreted as firms having a high market value compared to their book value of equity. In comparison to this Biddle et al., (2009) reports lower growth opportunities in US firms with a higher *B/M* ratio of 1.92. Australian firms in general are younger than US firms, 12.20 years compared to 19.13 years (Biddle et al., 2009). The average *Lev* is 20% of firm's capital structure and average *Cash* is 38% of total assets. Additionally, the Altman *Z Score,* a predictor of financial solvency, shows that Australian firms have a very low mean *Z Score* of 0.80 which indicates a high probability of financial distress in the future. The average *CFO*, *OC*, *Tang, CFO Vol* & *Sales Vol* are very similar and comparable to other studies from different countries (Biddle et a., 2009; Chen et al., 2011; Gomariz et al., 2014). The average *CFO* is -4.6% of average total assets indicating the Australian firms have negative cash flows. Composition of fixed assets 34.2% of total assets. Additionally, CFO Vol (Sales Vol) is 0.103 (0.145).

Panel C Table 1 provides information about the corporate governance characteristics of the entire sample. Overall the *CG Index* averages 8.124 out of a maximum 17 score. Further analysis of sub-components of the *CG Index* shows that mean (compliance%) of *Board Index, Audit Index, Rem Index, Nom Index* is 1.94 (64.5%), 3.16 (52.6%), 1.83 (45.8%), 1.19 (29.7%) respectively. These figures suggest that Australian firms, on average, meet over half elements of *Board* and *Audit Index*; however, more improvement needs to be done in improving the *Nom Index.* Further analysis of the individual CG components shows that *Board Ind* stands at 52% which is similar to the 53.8% reported from a comparable study from Australia (Henry 2010). Approximately 54% of the sample firms have an independent board chairperson in place with

87.6% of firm boards meeting six time or more in a year (*Board Meetings>=6*). *Audit Com* averages 80.2, meaning 80% of firms have an audit committee which is very high. Although the second edition of ASX CG Principles & Recommendations released in 2007 and made it mandatory for only the top ASX500 companies to have an audit committee. We observe more firms are increasingly complying, which may produce indirect pressure on other firms to establish audit committees. The mean of *Rem Com* & *Nom Com* is 65.1% & 41.7% respectively. Additionally, only 31.3%, 24% and 14.5% of the firms have fully independent audit, remuneration and nomination committees respectively.

[insert Table 2 here]

3.2.Measures of Investment Inefficiency

Investment inefficiency as a result of overinvestment and underinvestment is the key dependent variable in our study. We employ three proxies of over and underinvestment estimated from the recently developed investment inefficiency models developed by Eisdorfer et al., (2013) the industry adjusted investment model, Biddle et al., (2009) expected investment, and Richardson (2006), investment expenditure model. The basic intuition behind estimating over and underinvestment in these three models is similar. These models split the investments into discretionary and non-discretionary components by estimating the expected investments of the firms. In other words, actual investments greater or less than the non-discretionary expected investment is considered discretionary. If actual investment is higher than the non-discretionary component, we classify it as overinvestment and underinvestment if it is lower. The three investment inefficiency models and their estimation methods are explained in Appendix V.

3.3.Control Variables

We include several control variables from the existing literature which are known to influence the firm level investments. Appendix (VI) presents the definition of all the variables. These control variables include B/M ratio (*B/M*), Leverage (*Lev*), Cash (*Cash*), Age (*LnAge*), Size (*LnSize*), Cash flow (*CFO*), Dividend Yield (*DY*), Operating Cycle (*OC*), Tangibility (*Tang*), the Altman 1968 Z-score (*Z-Score*), a dummy for losses (*Loss*), Investment volatility (*Inv Vol*), Cash flow volatility (*CFO Vol*) and Sales volatility (*Sales Vol*) (Biddle et al., 2009; Henry 2010; Chen et al., 2011; Gomariz et al., 2014).

B/M is a proxy for growth opportunity and is measured as the ratio of the book value of equity to its market value. Firms with high growth opportunities are expected to invest more thus we

control for this variable. *Lev* is the leverage level in firm's capital structure measured as total debt scaled by the sum of total debt and equity of the firm. Firms with high levels of leverage could have financial constraints due to interest costs and debt repayment thus may underinvest (Myers, 1977). Firms with high levels of liquidity are associated with overinvestment of free cash flow. (e.g. Jensen, 1986 & Richardson, 2006) thus we control for this effect by controlling for *Cash*, operating cash flow (*CFO)*, operating cycle (*OC)*, dummy for firms making losses and the tangibility (*Tang)* of the firm. *Cash* is measured as the sum of cash and short term investments of the scaled with lagged total assets. *CFO* is estimated as cash flow after operations scaled with average total assets. Managers in the firms with higher *CFO* may have a higher tendency to overinvest, because utilisation of *CFO* may not have the monitoring that comes with the debt or capital market. Richardson (2006) also shows a positive association between *CFO* and overinvestment. *OC* represents firm operating cycle measured as sum of number of days' inventory held and accounts receivables days. We expect that firms with a low *OC* will have higher liquidity, thus we control for this effect. We take the natural log of *OC* consistent with Chen et al., (2011). Additionally, we control for the tangibility of the firm (*Tang*), measured as the ratio of fixed assets to its total assets. More tangible firms have higher pledgeable assets which may enable them to borrow more and invest more (Almeida & Campello, 2007). We also control for firm Age and Size. Larger and more mature firms are in different business cycles compared to younger firms and are likely to have lower growth opportunities and greater liquid cash which can be squandered in wasteful investment. We measure Age as the difference between current year and number of years a firm first appeared on DataStream. We take natural log of Age & Size to transform the skewed non-normal distribution of these variables. Additionally, we employ Dividend Yield (*DY*) as another control variable which controls for the dividend payment of the firm. Firms with high *DY* are expected to have low overinvestment because high dividend payments relative to price decreases the free cash flow of the firm. In addition, we also control for investment volatility[15] in order to ensure that we are not measuring the relation between "*overinvestment and underinvestment and investment volatility*" (Biddle et al., 2009). Investment volatility is measured as the standard deviation of total investment from t-3 to t-1. Moreover, we include the Z-score[16] based on Altman (1968) method to capture the risk of insolvency. We control for

[15] Very high one-time investment such as investment in an expensive machinery results in subsequent underinvestment. Investment volatility is therefore included to capture this effect.

[16] Altman (1968) Z-Score: $Z = 0.012 \times X_1 + 0.014 \times X_2 + 0.033 \times X_3 + 0.006 \times X_4 + 0.999 \times X_5$

Where, X_1 = working capital/total assets, X_2 = retained earnings/total assets, X_3=EBIT/total assets, X_4=MV of equity/BV of debt, X_5=sales/total assets.

cash flow volatility & sales volatility because it impacts on firm investments (Gomariz et al., 2014). Cash flow volatility & Sales volatility is measured as standard deviation of cash flow and sales from t-3 to t-1. Finally, we include industry and time dummies to control for any industry and time fixed effects. The industry dummy is based on level 1 Industrial Classification Benchmark (ICB) codes.

3.4.Empirical Model

We estimate the following equation (1) and equation (2) to measure the impact of corporate governance on over and underinvestment respectively.

$$OverInv_{i,t} = \alpha_0 + \beta_1 CG_{i,t} + \sum \gamma_j Control_{j,i,t-1} + \phi IndFE_i + \varepsilon_{i,t} \quad (1)$$

$$UnderInv_{i,t} = \alpha_0 + \beta_1 CG_{i,t} + \sum \gamma_j Control_{j,i,t-1} + \phi IndFE_i + \varepsilon_{i,t} \quad (2)$$

Where *OverInv* denotes the estimates of overinvestment (*OverInv*^{E}, *OverInv*^{B}, *OverInv*^{R}) and *UnderInv* represents estimates of underinvestment (*UnderInv*^{E}, *UnderInv*^{B}, *UnderInv*^{R}) for the firm *i* at time *t*. The E, B and R superscript represents the investment inefficiency estimated from Eisdorfer et al., (2013), Biddle et al., (2009) and Richardson (2006) model respectively. For simplicity at interpretation we convert underinvestment estimates to absolute numbers by multiplying them with -1. *CG* represents the aggregate corporate governance score. *Control* denotes the set of control variables. *IndFE* is a dummy to control for the industry specific fixed effects of the firm *i*. ε captures the unexplained portion of this model.

We estimate equation 1 and 2 by employing the OLS regression with Petersen (2009) clustered standard errors at the firm level and year level. This estimation technique is robust for adjusting standard error for heteroscedasticity, serial and cross sectional correlation thus improving the accuracy of our results.

4. Results

4.1. Preliminary Analysis

To investigate the relationship between *CG Index* and investment inefficiency, we conduct correlation analysis between *CG Index*, *Invineff* and the control variables. The results are reported in Table 3. The correlations show that each estimate of *Invineff* is not very strongly correlated with the *CG Index,* ranging from -0.099 to -0.143. However, the negative sign may indicate the mitigating impact of CG on *Invineff*. The strongest correlation coeffecient is reported between 3 alternative proxies of *Invineff* i.e. between 0.628 to 0.963. On the whole,

we see that $Invineff^{E}$ and $Invineff^{B}$ are highly correlated (r= 0.963). $Invineff^{R}$ and $Invineff^{E}$ have a moderately high correlation (r=0.656). This suggests that these 3 models are capturing similar effects.

In terms of the *CG Index*, we observe a strong correlation between *CG Index* and *LnSize* with a correlation coeffecient of 0.646. This strong correlation may indicate a potential problem with multicollinearity. One way to deal with this problem is to avoid the inclusion of the correlated variable, however, exclusion of firm size may cause an omitted variable bias. To deal with this, we follow Singh & Davidson III (2003), we orthogonalise the *LnSize* on *CG Index*. This econometric technique separates the common variance of *CG Index* within firm size, thus we clean the CG effect from size. Finally, we observe *CG Index* is positively correlated with *Lev*, *LnAge*, *CFO*, *DY* and *Z Score*, indicating that better governed firms are older have more debt and cash flows, and they pay more in dividends. Also the positive correlation with *Z Score* implies that these firms have low bankruptcy risk. We also note a positive correlation of *CFO Vol* with *Cash*, with a correlation coeffecient of 0.296, and a negative correlation with *LnAge* and *LnSize* (r= -0.365 & -0.476). These correlations may indicate that smaller and younger firms have higher *CFO Vol*, hence, they maintain high cash levels to avoid the uncertainties arising due to *CFO Vol.* Another interesting trend is the positive correlation between *Z Score*, *CFO* and DY (r= 0.337 & 0.354) and negative correlation with *OC*, which may show that bankruptcy risk is lower in firms with high *CFO* and firms paying higher levels of dividends, while firms with high *OC* suggests liquidity constraints, which may indicate a high probability of financial distress.

[insert Table 3 here]

Table 4 Panel A presents the mean *CG Index* and mean of the *InvIneff* estimates distributed across two periods i.e. the early adoption period (a period with low average *CG Index*) and the late period (a period with higher average *CG Index*). Table 3 Panel A provides strong support for the hypothesis that the improvement in the *CG Index* between the two periods results in a significant decrease in *Invineff*. We observe that the mean level of $Invineff^{E}$, $OverInv^{E}$ & $UnderInv^{E}$ has decreased from 0.184, 0.282, 0.089 to 0.135, 0.208, 0.065, respectively. This decline is statistically significant at 1% level from both matched pairs t-test and Wilcoxen ranksum test. We interpret it, that as the CG improves across the two periods, the investments also get more efficient.

Table 4 Panel B presents the distribution of firms based on four quartiles[17] of CG Quality and the mean value of *Invineff* in each CG quartile. *CGQ1* is the lowest CG quality quartiles while *CGQ4* consists of the firms with highest CG quality. The table shows that firms belonging to *CGQ1* has the highest estimates of *Invineff, OverInv* & *UnderInv*, while firms in *CGQ4* have the lowest. As the CG quality improves and as the firm jumps from lower CG quartile to higher CG Quartile, the investments efficiency improves. As can be seen $OverInv^E$ *(*$UnderInv^E$*)*decrease from 0.312 (0.091) to 0.155 (0.059), as firm jumps from *CGQ1* to *CGQ4*. Similar trend can be seen when *InvIneff* is measured using a different method. This univariate analysis lends preliminary support to our hypothesis that increase in CG quality may reduce both over and underinvestment.

[insert Table 4 here]

We further test multiple pairwise tests of the differences between the different CG Quartiles. Table 5 presents the results for the test. As can be observed there is strong evidence of a significant difference in the level of *OverInv* & *UnderInv* among the different CG Quartiles. The mean $OverInv^E$ decreased by 0.054 (17.3%) as firm's CG improves from *CGQ1* to *CGQ2*. The difference in mean is statistically significant at the 1% level. Similarly, when a firm further improves its CG, the magnitude of the reduction in overinvestment gets more pronounced. The average of $OverInv^E$ decrease by 0.085 (27.2%) & 0.156 (50%) as the firm's CG improves from *CGQ1* to *CGQ2* & *CGQ3*, respectively. This decrease in mean is statistically significant at 1% level. Likewise, we see the same trend in the underinvestment sample. The average $UnderInv^E$ reduces by 0.015 (16.4%), 0.027 (29.7%) & 0.032 (35%) as CG increases from *CGQ1* to *CGQ2*, *CGQ3* & *CGQ4*, respectively. These differences are statistically significant at 1% level.

[insert Table 5 here]

4.2. Multivariate Analysis

We first examine whether the *CG Index* is related to overinvestment. Table 6 reports the results from equation 1 where we regress *CG Index* on estimates of overinvestment. The coeffecient of the *CG Index* in model (1) is negative and statistically significant at 1% level. This finding

[17] *CGQ1* includes firms with *CG Index* ranging from 0-4. *CGQ2* & *CGQ3* consists of firms with mid-range *CG Index* i.e. from 5-8 & 9-12 respectively. *CGQ4* is a quartile of firms with highest quality *CG Index* ranging from 13-17.

provides further support to our primary hypothesis that corporate governance quality mitigates overinvestment in the firm. To further check whether our results are robust and are not influenced by any single specific investment inefficiency model we re-run the regression analysis on equation 1 by including alternative proxies of overinvestment as our dependent variable. Column 3-5 reports the results for this analysis. We observe that the coeffecient of *CG Index* remains negative and significant at 1% level which further provides support to our hypothesis that better quality of corporate governance improves investment inefficiency by mitigating overinvestment. In model (3) we do not include those control variables which were used in estimating the $OverInvineff^{R}$ from Richardson (2006) investment expenditure model. However, in model (4) we re-include all the control variables. The coeffecient of *CG Index* still stays negative and strongly significant at 1% level even after re-inclusion of these control variables.

In terms of other control variables, we observe that *Lev* does have a negative impact on overinvestment which is in line with the findings of Chen et al., (2015) who find that leverage decreases overinvestment. We find this association significant only in model (4). Our results show some evidence that firms with liquid cash overinvest, albeit only in model (2) and model (4). Equally, the *Z Score*, has a negative relation with overinvestment but only for the Richardson (2006) model, suggesting a high risk of insolvency for overinvesting firms. We document a strong negative relationship between age, size and overinvestment, suggesting that older and larger firms have significantly better and more efficient investments. Furthermore, we find that firms that pay higher dividends (*DY*) appear to have lower overinvestment. This might be explained by the free cash flow hypothesis, according to which payment of dividends are associated with a reduction in free cash flows thus reduces the chance of manager squandering cash on negative NPV projects. Of note, the coeffecient on *Inv Vol* is positive and significant at the 1% level indicating that firms which overinvest in machinery or fixed assets subsequently underinvests. This may simply indicate a high investment in one year will result in a lower subsequent investment and may not be considered overinvestment. This association is persistently significant at 1% level across all the four regression models with strong coeffecient ranging from 0.031 to 0.096, which suggests that it is very important control variable.

With respect to the economic significance of the results, consider a firm with the median *CG Index* of 8 and median overinvestment estimate of 0.110 when measured by Eisdorfer et al., (2013) model and coeffecient of *CG Index* of -0.006 from model (1). A one point improvement

in the CG score will lead to a reduction in overinvestment by: (1) * (-0.006) = -0.006, which amounts to a 5.5% reduction in the median overinvestment.

[insert Table 6 here]

Next we investigate whether the *CG Index* also mitigates underinvestment. Results are reported in Table 7. The model (1) documents the results when $UnderInv^{E}$ is our dependent variable. We find that there is a significant negative relationship between *CG Index* and $UnderInv^{E}$. This relation is significant at the 1% level. Hence, we find support for our hypothesis that better governed firms also experience low underinvestment. Additionally, to further check the robustness of our results we re-run equation 2 on alternative estimates of underinvestment. As shown in column 3-5 of Table 7, the relation between *CG Index* and underinvestment stays consistently negative and statistically significant at 1% level. Also the coeffecients of the *CG Index* in all the models range between -0.001 to -0.002 and are quite similar, suggesting that different underinvestment estimates do not appear to change the results substantially. Thus, we find robust support for our hypothesis that corporate governance reduces underinvestment.

Further analysis of the control variables reveals a significant positive association with *Lev* and negative association with *Cash*, *OC* and *Tang*. These findings are in line with our predictions and indicate that financially constrained firms i.e. firms with high leverage, low liquid cash, high operating cycle and low tangible assets are more likely to suffer underinvestment. Low tangibility reduces the ability of a firm to obtain debt. Interestingly, with regards to *LnAge* and *LnSize*, we find that younger and larger firms have less underinvestment. The evidence for age is significant at 5% level only in model (2), and may be because older firms are at a mature stage of their business cycle, therefore underinvest or have fewer growth opportunities. In addition, we observe that *DY* does not have any significant impact on underinvestment. Similar to overinvesting firms, we find the negative relation between *Z Score* and underinvestment which shows a high probability of financial distress and potential agency problems within the underinvesting firms.

To gauge the economic significance of our results, consider a firm with median *CG Index* of 8 and median underinvestment as measured by Eisdorfer et al., (2013) model is 0.051 and coeffecient of *CG Index* of -0.002 from model (1). A one point improvement in CG score will enhance investment inefficiency by reducing underinvestment by: (1) * (-0.002) = -0.002, which amounts to a 3.9% reduction in underinvestment from the median level underinvestment.

[insert Table 7 here]

4.3.Endogeneity

In the earlier analysis we find a negative and significant association between the quality of corporate governance and investment inefficiency. However, one may raise concerns that the relationship between corporate governance and investment inefficiency is determined endogenously i.e. not only does corporate governance impact on investment inefficiency, but the causality may run in the opposite direction also. For example, firms may develop its corporate governance due to agency problems. Hence, we employ a two-stage least square (2SLS) approach to correct for any bias in the relationship between corporate governance and investment inefficiency association due to endogeneity. The earlier studies on corporate governance-investment inefficiency does not address this problem (Richardson 2006; Chen et al., 2015). Running a 2SLS regression requires identifying some valid instruments which should be correlated with corporate governance but uncorrelated with the error term (Liu et al., 2014). In other words, these instruments should not affect investment inefficiency except through corporate governance.

We identified two instruments which are correlated with corporate governance. Our first instrument is the dummy variable which takes the value of 1 for later part of our sample (i.e.2008-2014). Prommin et al., (2014) argue that the awareness of the importance of corporate governance among shareholders and corporate governance agencies has increased following the 2008 Global financial crisis. This has exerted pressure on firms to improve their corporate governance quality. Also, there was another small exogenous shock in Australia when the second edition of ASX Corporate Governance Principles & Recommendations was released in 2007 which made it mandatory for the S&P/All Ordinaries Index firms (i.e. ASX500) to have an audit committee and also for S&P/ASX300 firms to have a remuneration committee and an audit committee with its structure, composition and charter compliant with ASX CGC Recommendation 4.2. Thus, we assume that the corporate governance in our sample has risen significantly after 2008[18].

Our second instrument is the median-industry *CG Index*. The logic behind this variable is that although inefficient investments, as a result of agency problems, may influence the corporate governance of the same firm, it is less likely to influence industry level corporate governance. Managers of the same firm may improve the corporate governance of their firm, but this should

[18] *CG Index* in our sample has improved by only 9.5% from 2005-2008 and 25% from 2008-2014. To further check the validation of our assumption we carry *t*-test and Wilcoxen ranksum test between the two sample periods (see Table 3, panel B). We find the that improvement of CG between the two periods is statistically significant.

have little influence in changing the corporate governance of other firms. Therefore, we expect that median-industry, *CG Index,* should act as a valid instrument because it affects the firm CG Index, however, it is unlikely to be related to a firm's inefficient investments. This instrument has been applied in previous studies. (Jiraporn et al., 2011; Liu et al., 2014; Ali et al., 2016).

Table 8 reports the results of the 2SLS regression on overinvestment. Column 2 reports the results of the first-stage of 2SLS regression for model (1). It is clear that both instruments are statistically significant at 1% level and strongly associated with *CG Index* with very significant coeffecients of 1.46 and 0.469. This observation provides initial evidence about the strong correlation of these two instruments. Next, we check the validity of these instruments. The F-stat value of these instruments is very high and statistically significant at the 1% level thus we reject the null hypothesis that our instruments are weak. The second important test to investigate the validity of our instrument is to check whether our instruments are correlated with the error term. The Sargan and Basmann chi-square values are very low and insignificant which implies that neither of the instruments are correlated with the error term.

Column (3) presents the results for second-stage 2SLS regression for model (1). The beta coeffecient of our instrumented *CG Index* is negative and significant at 1% level and has a greater magnitude compared to earlier OLS results suggesting that better corporate governance quality reduces overinvestment. Additionally, the results on control variables are virtually indistinguishable for the results reported in Table 6. Repetition of 2SLS analysis on alternative proxies of overinvestment gives us similar results from model (2) to (4). Hence, our overall results confirm that corporate governance improves investment inefficiency by mitigating overinvestment.

[insert Table 8 here]

We repeat the 2SLS regression on underinvestment and the results are reported in Table 9. We first begin analysing whether our instruments are valid. We find that model (1) does not pass the test. The Sargan and Basmann chi-square values are high and significant indicating the correlation of instruments with error term. However, model (2), model (3) and model (4) pass the instrument validation tests with significant high F-stats and insignificant Sargan and Bassmann chi-square values. Overall, the results of the second-stage 2SLS regression suggests that better corporate governance is negatively associated with underinvestment, consistent with our OLS results reported in Table 7. More specifically, we find a strong negative coeffecients

of *CG Index* for all models at 1% level with the exception model (2), which is significant at 10%. We conclude that superior quality of corporate governance does reduce underinvestment.

[insert Table 9 here]

4.4. Analysis of sub-components of corporate governance

So far we have shown the influence of overall corporate governance quality on over and underinvestment. In this section we investigate which sub-component of corporate governance affects over and underinvestment. We decompose the overall *CG Index* into its four sub-components namely: Board Index (*Board Index*), Audit Committee Index (*Audit Index*), Remuneration Committee Index (*Rem Index*) and Nomination Committee Index (*Nom Index*). Next, we check the influence of each CG sub-component has on over and underinvestment. We include each governance sub-component separately in the regression due to very strong multicollinearity among governance variables.

Table 10 Panel A presents the results for this analysis on overinvestment. We observe that all sub-components of governance are negatively associated with overinvestment at the 1% level except *Board Index* and *Audit Index* which are significant at 5% level. Likewise, Panel B documents the results for underinvestment shows the similar pattern. All governance sub-components are negative and significantly associated with underinvestment. We only show results for proxies of investment inefficiency estimated from Eisdorfer et al., (2013) model as results from other models produce similar results. Overall, these findings indicate that mitigation of over and underinvestment is not related to each single particular sub-component of corporate governance. It seems that the impact of corporate governance on over and underinvestment is more general and is related with all the sub-components.

[insert Table 10 here]

5. Conclusion

There is a scant evidence in the current body of literature regarding the effectiveness of corporate governance in improving investment inefficiency. Those few prior empirical studies investigating the association between corporate governance and investment inefficiency have mostly focussed in the US or China. These markets have a markedly different corporate governance structure and institutional settings compared to Australia.

Utilising a 10-year sample of Australian firms between 2005 and 2014, this study constructs a corporate governance index of Australian firms and tests its efficacy in improving investment inefficiency by mitigating both over and underinvestment. Our main findings provide strong evidence that high CG quality mitigates both over and underinvestment. We perform a number of robustness tests such as including alternative proxies of investment inefficiency, sub-components of corporate governance and applying two-least square (2SLS) regression to control for endogeneity. Overall, our findings remain broadly supportive that better corporate governance quality mitigates over and underinvestment.

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List of Appendices

Appendix I: Horwath corporate governance report 2008

1. Board of Directors
1.1 The most desirable outcome will be for a company to have: 1.1.1 A board with the majority of independent directors;
1.1.2 An independent chairperson; and
1.1.3 Met at least six times annually

1.2 The least desirable outcome will be for a company to have: 1.2.1 A board with no independent directors
1.2.2 The CEO as chairperson; and
1.2.3 Met less than six times annually.

2. Audit Committee
2.1 The most desirable outcome will be for a company to have an audit committee: 2.1.1 With all the members, including the chair, independent;
2.1.2 With a chair, who is not also the chair of the main board;
2.1.3 With at least one member with professional or educational accounting qualifications;
2.1.4 With at least three members;
2.1.5 That does not comprise the full board; and
2.1.6 That meets at least four times annually.

2.2 The least desirable outcome will be for a company not to have an audit committee

3. Remuneration Committee
3.1 The most desirable outcome will be for a company to have a remuneration committee:
3.1.1 With all the members, including the chair, independent;
3.1.2 With at least three members; and
3.1.3 That does not comprise the full board.

3.2 The least desirable outcome will be for a company not to have a remuneration committee.

4. Nomination Committee
4.1 The most desirable outcome will be for a company to have a nomination committee: 4.1.1 With all the members, including the chair, independent;
4.1.2 With at least three members; and
4.1.3 That does not comprise the full board

4.2 The least desirable outcome will be for a company not to have a nomination committee.

5. External Auditor Independence
5.1 Weighting is placed on the proportion of non-audit fees (relative to audit fees) paid by a client to their auditor, and the policy relating to the provision of non-audit services.

6. Code of Conduct and Other Policy Disclosures
6.1 A weighting is included for the quality of disclosures relating to the existence and substance of a company's: 6.1.1 Code of Conduct;
6.1.2 Policy on risk management;

6.1.3 Policy on share trading; and
6.1.4 Clarity of corporate governance disclosures

Appendix II: Simplified Horwath Corporate Governance Index

1. Board of Directors

1.1 A board with the majority of independent directors;
1.2 An independent chairperson; and
1.3 Met at least six times annually

2. Audit Committee

2.1 Company have an audit committee
2.2 With all the members, including the chair, independent;
2.4 With a chair, who is not also the chair of the main board;
2.5 With at least three members;
2.6 That does not comprise the full board; and
2.7 That meets at least four times annually.

3. Remuneration Committee

3.1 Company have a remuneration committee.
3.2 With all the members, including the chair, independent;
3.3 With at least three members; and
3.4 That does not comprise the full board.

4. Nomination Committee

4.1 Company have a nomination committee.
4.2 With all the members, including the chair, independent;
4.3 With at least three members; and
4.4 That does not comprise the full board

Appendix III: ASX Council (2007): 8 principles of ASX good corporate governance 2007.

- Principle 1: Lay solid foundations for management and oversight
- Principle 2: Structure the board to add value
- Principle 3: Promote ethical and responsible decision-making
- Principle 4: Safeguard integrity in financial reporting
- Principle 5: Make timely and balanced disclosure
- Principle 6: Respect the rights of shareholders
- Principle 7: Recognise and manage risk
- Principle 8: Remunerate fairly and responsibly

Appendix IV: ASX Council (2007): Box 2.3: Factors relevant to assessing the independence of a director

Examples of interests, positions, associations and relationships that might cause doubts about the independence of a director include if the director:

- is, or has been, employed in an executive capacity by the entity or any of its child entities and there has not been a period of at least three years between ceasing such employment and serving on the board;
- is, or has within the last three years been, a partner, director or senior employee of a provider of material professional services to the entity or any of its child entities;
- is, or has been within the last three years, in a material business relationship (eg as a supplier or customer) with the entity or any of its child entities, or an officer of, or otherwise associated with, someone with such a relationship;
- is a substantial security holder of the entity or an officer of, or otherwise associated with, a substantial security holder of the entity;
- has a material contractual relationship with the entity or its child entities other than as a director;
- has close family ties with any person who falls within any of the categories described above; or
- has been a director of the entity for such a period that his or her independence may have been compromised.

In each case, the materiality of the interest, position, association or relationship needs to be assessed to determine whether it might interfere, or might reasonably be seen to interfere, with the director's capacity to bring an independent judgement to bear on issues before the board and to act in the best interests of the entity and its security holders generally.

Appendix V: Investment Inefficiency Models

Eisdorfer et al., (2013) Industry Adjusted Investments

The Eisdorfer et al., (2013) model of industry adjusted investments measures the investment deviation of the firm by comparing the median industry level investments in a given year. This model is based on the assumption that the industry median investments are the expected investments of the firm. Therefore, the difference between the firm's actual investment and median industry investment in a given year represents overinvestment if actual investment is higher than the median industry investment and underinvestment if it is lower. We categorise industries based on level 1 Industrial Classification Benchmark (ICB) codes and then calculate median industry investments for a given year. Where median industry investment is the median of total investment (I_{TOTAL}) i.e. the sum of *CAPEX*, *Acquisitions*, R & D Expenses less *Sale of PPE*.

Biddle et al., (2009) Model for Expected Investment

Biddle et al., (2009) model for expected investments predicts the expected investments as a function of sales growth as shown in equation 1 below. Sales growth is considered a measure of the growth opportunities of the firm. Equation (i) predicts the expected (optimal) investments of the firm. Companies investments deviating from the expected level measured by its error term represents investment inefficiency. Companies investing at a higher rate than the expected levels according to sales growth (growth opportunity) have positive residuals thus represent overinvestment, while companies investing at a lower rate than expected have negative residuals representing underinvestment.

$$I_{TOTAL\,i,t} = \beta_0 + \beta_1\, Sales\ Growth_{i,t-1} + \varepsilon_{i,t} \quad \text{(i)}$$

We estimate equation (1) cross-sectionally for each year and for each industry based on level 1 Industrial Classification Benchmark (ICB) codes. Where I_{TOTAL} is the sum of *CAPEX*, *Acquisitions, R&D Expenses* less *Sale of PPE* of firm *i* at time *t*. All the investment variables are scaled with lagged total assets. *Sales Growth* is the annual percentage sales growth of the firm *i* in year *t-1*.

Richardson (2006) Investment Expenditure Model

Next we follow the extended investment expenditure model proposed by Richardson (2006). Richardson (2006) further splits the total investment *(I_{TOTAL})* of the firm in two components of

new investment *(I_{NEW})* and investment for maintenance *($I_{MAINTENANCE}$)* defined the capital expenditures required to maintain the assets of the firm, measured by depreciation & amortisation expenses. Hence component of new investment is gauged from equation (ii) below.

$$I_{NEW,i,t} = I_{TOTAL,i,t} - I_{MAINTENANCE,i,t} \quad \text{(ii)}$$

Following Richardson (2006) extended model, this component of new investment *(I_{NEW})* is then regressed on determinants of investments which includes firm growth opportunities, leverage, measure of liquidity, industrial affiliation and other factors known to determine firm investments as shown below in equation (iii).

$$I_{NEW,i,t} = \beta_0 + \beta_1 V/M_{i,t-1} + \beta_2 Lev_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 LnAge_{i,t-1} + \beta_5 LnSize_{i,t-1} + \beta_7 StockReturns_{t-1} + \beta_8 I_{NEW\ i,t-1} + \phi IndFE_i + \lambda YrFE + \varepsilon_{i,t} \quad \text{(iii)}$$

Similar to Biddle et al., (2009) the error term of this extended regression equation represents over and underinvestment depending on if a firm's new investments *(I_{NEW})* are higher or lower than the expected investments estimated from this model.

Where (*V/M)* is the Richardson (2006) measure of growth opportunity computed by taking the ratio of value of assets in place (*V*) to the market value or market capitalisation *(M)* of the firm. *V* is the book value of the firm reflected in its book value of equity and earnings, and is computed as:

$$V = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha r d$$

Where $\alpha = (\omega/1 + r - \omega)$

BV is the book value of common equity, d represents annual dividends, X is the operating income after depreciation. r=9.2% which is the long run average realised return on the Australian equities (ASX, 2015). ω represents abnormal earnings persistence parameter equal to 0.62 from the Ohlson (1995) model. Pairwise correlation coeffecient between Richardson (2006) growth opportunity measure (*V/P*) & simple *B/M* is 0.84 which suggests that other traditionally used proxies of growth opportunity are equally appropriate.

Other variables include *Lev,* which is leverage ratio computed as the total short term and long term debt scaled by sum of total debt and book value (BV) of equity. *Cash* is defined as the sum of cash holdings and short term investments scaled by lagged total assets. *LnAge* is the natural logarithm of difference in the current year and number of years the firm has appeared

on Thomson Reuters DataStream. *LnSize* is the natural logarithm of total assets of the firm. *Stock Returns* represent the percentage change in MV of the firm one year prior to investment. Finally, dummy for industry based on level 1 Industrial Classification Benchmark codes (ICB) and year is created to capture industry fixed effects and year effects. All the investment variables are scaled by the average total assets of the firm.

Appendix VI: Variables Definition

Dependent Variables	
$Invineff^{E}$	=absolute estimate of investment inefficiency from Eisdorfer et al., (2013) model.
$OverInv^{E}$	=estimates of overinvestment from Eisdorfer et al., (2013) model.
$UnderInv^{E}$	=estimates of underinvestment from Eisdorfer et al., (2013) model. Estimates multiplied with -1.
$Invineff^{B}$	=absolute estimate of investment inefficiency from Biddle et al., (2009) model.
$OverInv^{B}$	=estimates of overinvestment from Biddle et al., (2009) model.
$UnderInv^{B}$	=estimates of underinvestment from Biddle et al., (2009) model. Estimates multiplied with -1.
$Invineff^{R}$	=absolute estimate of investment inefficiency from Richardson (2006) model.
$OverInv^{R}$	=estimates of overinvestment from Richardson (2006) model.
$UnderInv^{R}$	=estimates of underinvestment from Richardson (2006) model. Estimates multiplied with -1.

Independent Variables (Governance Variables)	
CG Index	Binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17).
Board Index	Binary-based index representing the governance strength of board. Score range (0-3).
Audit Index	Audit sub-committee score measuring the governance strength of audit sub-committee. Score range (0-6).
Rem Index	Remuneration sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4).
Nom Index	Nomination sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4).

Investment Variables	
I_{Total}	=represents total investments of the firm which is sum of CAPEX, Acquisitions, R&D Expenses less Sale of PPE scaled by lagged total assets.
I_{New}	=represents new investment of the firms computed as I_{Total} less depreciation & amortisation expenses scaled by average total assets.

Control Variables & Others	
Sales Growth	=annual percentage sales growth.
Lev	=sum of short term and long term debt scaled by sum of total debt and BV of common equity.
Cash	=sum of cash holdings and short term investments scaled by lagged total assets

LnAge	=natural logarithm of difference between the number of years firm first appear on Thomson Reuters Datastream & current year.
LnSize	=natural logarithm of total assets.
Stock Returns	=annual percentage change in market value of the firm.
B/M	=ratio of book value of common equity to its market value.
CFO	=cash flow after operations scaled with average total assets.
DY	=dividend per share as a percentage of share price.
OC	=(account receivable days + inventories days held). Natural log of operating cycle is taken.
Tang	=ratio of fixed assets to total assets.
Z Score	=computed based on Altman (1968) paper.
Inv Vol	=standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets.
CFO Vol	=standard deviation of *CFO* from t-3 to t-1. Numerator deflated with average total assets.
Sales Vol	=standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets.
Losses	=dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise.
IndFE	=control for Industry fixed effects, captured by creating industry dummies based on level 1 Industrial Classification benchmark codes.

List of Tables

Table 1

Development of corporate governance components from 2005-2014 and statistical test of difference between early period and late period.

Panel A: Annual mean values of corporate governance components from 2005-2011.

	2005	2006	2007	2008	2009	2010	2011
CG Index	6.929	7.298	7.455	7.586	7.917	8.225	8.598
Board Index	1.805	1.817	1.869	1.911	1.956	1.961	1.985
Audit Index	2.735	2.884	2.954	3.044	3.092	3.161	3.322
Rem Index	1.518	1.628	1.649	1.622	1.727	1.857	1.937
Nom Index	0.872	0.969	0.983	1.009	1.141	1.247	1.354
Board Ind	0.433	0.453	0.466	0.500	0.521	0.526	0.558
Chair Ind	0.480	0.494	0.523	0.545	0.553	0.557	0.549
Board Meetings>=6	0.892	0.870	0.879	0.866	0.882	0.878	0.879
Audit Com	0.773	0.777	0.794	0.814	0.810	0.799	0.805
Audit Com Ind	0.240	0.259	0.277	0.284	0.302	0.309	0.348
Audit Com Chair not board chairman	0.372	0.437	0.423	0.467	0.493	0.528	0.567
Audit Com Members>=3	0.542	0.578	0.606	0.623	0.633	0.636	0.652
Audit Com mem DCFB	0.481	0.513	0.544	0.545	0.553	0.570	0.602
Audit Com Meetings>=4	0.327	0.320	0.310	0.310	0.302	0.318	0.347
Rem Com	0.583	0.615	0.631	0.614	0.629	0.655	0.657
Rem Com Ind	0.168	0.178	0.208	0.183	0.225	0.245	0.260
Rem Com Members>=3	0.407	0.437	0.430	0.438	0.460	0.502	0.527
Rem Com DCFB	0.359	0.398	0.381	0.387	0.413	0.454	0.493
Nom Com	0.329	0.362	0.359	0.369	0.402	0.434	0.457
Nom Com Ind	0.083	0.092	0.105	0.101	0.128	0.147	0.190
Nom Com Members>=3	0.245	0.280	0.277	0.288	0.323	0.353	0.372
Nom Com DCFB	0.214	0.235	0.242	0.252	0.288	0.312	0.335

Panel B: Annual mean values corporate governance components from 2012-2014 and statistical test of difference between early period and late period.

	2012	2013	2014	Early period 2004-2008	Late period 2009-2014	*t*-statistic	Wilcoxon *z*
CG Index	8.886	9.127	9.480	7.320	8.672	11.49***	11.34***
Board Index	2.018	2.033	2.023	1.851	1.994	6.25***	6.44***
Audit Index	3.359	3.524	3.607	2.906	3.332	8.79***	9.30***
Rem Index	2.097	2.140	2.244	1.605	1.989	10.56***	10.57***
Nom Index	1.412	1.429	1.607	0.959	1.356	11.07***	10.58***
Board Ind	0.567	0.587	0.608	0.463	0.559	8.13***	8.10***
Chair Ind	0.573	0.565	0.558	0.511	0.559	4.09***	4.08***
Board Meetings>=6	0.878	0.882	0.857	0.877	0.876	0.075	0.07

Table 1 ***(continued)***

	2012	2013	2014	Early period 2004-2008	Late period 2009-2014	*t*-statistic	Wilcoxon *z*
Audit Com	0.808	0.825	0.816	0.790	0.810	2.15**	2.15**
Audit Com Ind	0.352	0.381	0.392	0.265	0.345	7.30***	7.28***
Audit Com Chair not board chairman	0.560	0.613	0.655	0.425	0.566	12.04***	11.93***
Audit Com Members>=3	0.668	0.687	0.698	0.588	0.661	6.41***	6.39***
Audit Com mem DCFB	0.615	0.635	0.642	0.521	0.601	6.82***	6.80***
Audit Com Meetings>=4	0.355	0.383	0.404	0.317	0.349	2.90***	2.90***
Rem Com	0.697	0.716	0.723	0.611	0.677	5.88***	5.87***
Rem Com Ind	0.305	0.311	0.338	0.184	0.278	9.36***	9.30***
Rem Com Members>=3	0.558	0.571	0.610	0.428	0.535	9.07***	9.02***
Rem Com DCFB	0.537	0.541	0.573	0.382	0.499	10.00***	9.93***
Nom Com	0.478	0.482	0.523	0.355	0.460	9.07***	9.02***
Nom Com Ind	0.196	0.197	0.224	0.095	0.178	10.01***	9.94***
Nom Com Members>=3	0.384	0.393	0.451	0.273	0.377	9.40***	9.34***
Nom Com DCFB	0.355	0.358	0.409	0.236	0.340	9.69***	9.63***

Notes:

* significant at 10%; ** significant at 5%; *** significant at 1%

Table reports the mean values of corporate governance every year. Also it shows mean value of corporate governance between two periods in early adoption period i.e. from 2004-2008 and late adoption period i.e. from 2009-2014. Last two columns report statistical tests of differences. *CG Index* measures strength of corporate governance. It's a binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17). *Board Index* is Binary-based index representing the governance strength of board. Score range (0-3). *Audit Index* is Audit sub-committee score measuring the governance strength of audit sub-committee. Score range (0-6). *Rem Index* Remuneration sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4). *Nom Index* Nomination sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4). *Board Ind* measured board independence. Takes value of 1 if board members are greater than or equal to 50% and 0 otherwise. *Chair Ind* measures independence of board chairman. Takes value of 1 if chairman independent and 0 otherwise. *Board Meetings>=6* indicator variable if annual board meetings are greater than or equal to 6. *Audit Com* is an indicator variable of company has an audit committee. *Audit Com Ind* indicator variable if audit committee has fully independent members. *Audit Com Chair not board chairman* indicator variable of audit committee chairman is independent and not the chairman of the board. *Audit Com Members>=3* indicator variable coded as 1 if audit committee members greater than or equal to 3. *Audit Com mem DCFB* indicator variable coded as 1 if audit committee members are greater than 3 but less than the full board. *Audit Com Meetings>=4* indicator variable coded as 1 if audit committee meets more than or equal to 4 times a year. *Rem Com* is an indicator variable of company has a remuneration committee. *Rem Com Ind* indicator variable if remuneration committee has fully independent members. *Rem Com Members>=3* indicator variable coded as 1 if remuneration committee members greater than or equal to 3. *Rem Com DCFB* indicator variable coded as 1 if remuneration committee members are greater than 3 but less than the full board. *Nom Com* is an indicator variable of company has a nomination committee. *Nom Com Ind* indicator variable if nomination committee has fully independent members. *Nom Com Members>=3* indicator variable coded as 1 if nomination committee members greater than or equal to 3. *Nom Com DCFB* indicator variable coded as 1 if nomination committee members are greater than 3 but less than the full board.

Table 2
Descriptive statistics of components of investment, control variables and components of corporate governance.

Variable	N	Mean	Median	Std Dev.	Min	Max
Panel A: Descriptive statistics of the components of Investment.						
I_{TOTAL}	7392	0.169	0.070	0.307	-0.356	1.925
I_{NEW}	7392	0.084	0.031	0.182	-0.465	0.818
CAPEX	7392	0.100	0.040	0.142	0.000	0.748
Acquisitions	7392	0.017	0.000	0.059	-0.010	0.393
RD Expenses	7392	0.017	0.000	0.066	0.000	0.448
Sales of PPE	7392	0.017	0.000	0.062	0.000	0.461
$I_{MAINTENANCE}$	7392	0.036	0.022	0.043	0.000	0.229
Panel B: Descriptive statistics of control variables.						
B/M	7392	0.765	0.535	0.806	-0.854	4.454
Lev	7392	0.201	0.075	0.283	0.000	1.716
Cash	7392	0.380	0.155	0.696	0.000	4.903
Age	7392	12.204	11.000	7.669	1.000	40.000
LnSize	7392	11.079	10.923	2.158	6.418	16.464
CFO	7350	-0.046	0.005	0.288	-1.426	0.498
DY	7392	1.667	0.000	2.688	0.000	11.760
OC	7168	4.987	4.787	1.249	2.303	9.436
Tang	7379	0.342	0.280	0.292	0.000	0.951
Z Score	7385	0.800	0.574	0.863	-0.688	4.177
Inv Vol	7292	0.195	0.068	0.392	0.001	2.789
CFO Vol	7281	0.103	0.056	0.139	0.003	0.860
Sales Vol	7284	0.145	0.071	0.206	0.001	1.206
Losses	7392	0.523	1.000	0.500	0.000	1.000
Panel C: Descriptive statistics of the components of corporate governance.						
CG Index	7392	8.124	8.000	5.009	0.000	17.000
Board Index	7392	1.936	2.000	0.972	0.000	3.000
Audit Index	7392	3.159	3.000	2.061	0.000	6.000
Rem Index	7392	1.833	2.000	1.548	0.000	4.000
Nom Index	7392	1.195	0.000	1.527	0.000	4.000
Board Ind	7392	0.520	1.000	0.500	0.000	1.000
Chair Ind	7392	0.539	1.000	0.498	0.000	1.000
Board Meetings>=6	7392	0.876	1.000	0.329	0.000	1.000
Audit Com	7392	0.802	1.000	0.399	0.000	1.000
Audit Com Ind	7392	0.313	0.000	0.464	0.000	1.000
Audit Com Chair not board chairman	7392	0.509	1.000	0.500	0.000	1.000
Audit Com Members>=3	7392	0.631	1.000	0.483	0.000	1.000
Audit Com mem DCFB	7392	0.568	1.000	0.495	0.000	1.000
Audit Com Meetings>=4	7392	0.336	0.000	0.472	0.000	1.000
Rem Com	7392	0.651	1.000	0.477	0.000	1.000
Rem Com Ind	7392	0.240	0.000	0.427	0.000	1.000
Rem Com Members>=3	7392	0.491	0.000	0.500	0.000	1.000
Rem Com DCFB	7392	0.451	0.000	0.498	0.000	1.000
Nom Com	7392	0.417	0.000	0.493	0.000	1.000
Nom Com Ind	7392	0.145	0.000	0.352	0.000	1.000
Nom Com Members>=3	7392	0.335	0.000	0.472	0.000	1.000
Nom Com DCFB	7392	0.298	0.000	0.457	0.000	1.000

Notes:
Sample consists of 7392 firm-year observations from 2005-2014. Investment and control variables data collected from Thomson Reuters Datastream (DS) and corporate governance data collected from Securities Industry Research Centre of Asia-Pacific (SIRCA).
I_{Total} represents total investments of the firm which is sum of *CAPEX, Acquisitions, R&D Expenses* less *Sale of PPE* scaled by lagged total assets. I_{New} represents new investment of the firms computed as I_{Total} less depreciation & amortisation expenses. $I_{MAINTENANCE}$ measures the investment required for maintenance of assets and is measured by depreciation & amortisation expenses.
B/M measures book to market ratio of the firm measured as the ratio of BV of common equity to firm's market value. *Lev* denotes firms leverage which is the sum of long term and short term debt scaled with sum of total debt and BV of common equity. *Cash* measures sum of total cash and short term investments scaled with lagged total assets. *Age* shows number of years since firm appears on Thomson Reuters Datastream. *LnSize* represents firm size measured by taking natural log of total assets. *CFO* measures cash flow after operations scaled with average total assets. *DY* dividend per share as a percentage of share price. *OC* shows operating cycle measured as: account receivable days + inventories days held). Natural log of operating cycle is taken. *Tang* represents tangibility of firm calculated as ratio of fixed assets to total assets. *Z Score* shows firm's bankruptcy risk computed following Altman (1968) paper. *Inv Vol* is standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets. *CFO Vol* is standard deviation of *CFO* from t-3 to t-1. *Sales Vol* is standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets. *Losses* dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise.
CG Index measures strength of corporate governance. It's a binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17). *Board Index* is Binary-based index representing the governance strength of board. Score range (0-3). *Audit Index* is Audit sub-committee score measuring the governance strength of audit sub-committee. Score range (0-6). *Rem Index* Remuneration sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4). *Nom Index* Nomination sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4).
Table 2 ***(continued)***

Board Ind measured board independence. Takes value of 1 if board members are greater than or equal to 50% and 0 otherwise. *Chair Ind* measures independence of board chairman. Takes value of 1 if chairman independent and 0 otherwise. *Board Meetings>=6* indicator variable if annual board meetings are greater than or equal to 6. *Audit Com* is an indicator variable of company has an audit committee. *Audit Com Ind* indicator variable if audit committee has fully independent members. *Audit Com Chair not board chairman* indicator variable of audit committee chairman is independent and not the chairman of the board. *Audit Com Members>=3* indicator variable coded as 1 if audit committee members greater than or equal to 3. *Audit Com mem DCFB* indicator variable coded as 1 if audit committee members are greater than 3 but less than the full board. *Audit Com Meetings>=4* indicator variable coded as 1 if audit committee meets more than or equal to 4 times a year. *Rem Com* is an indicator variable of company has a remuneration committee. *Rem Com Ind* indicator variable if remuneration committee has fully independent members. *Rem Com Members>=3* indicator variable coded as 1 if remuneration committee members greater than or equal to 3. *Rem Com DCFB* indicator variable coded as 1 if remuneration committee members are greater than 3 but less than the full board. *Nom Com* is an indicator variable of company has a nomination committee. *Nom Com Ind* indicator variable if nomination committee has fully independent members. *Nom Com Members>=3* indicator variable coded as 1 if nomination committee members greater than or equal to 3. *Nom Com DCFB* indicator variable coded as 1 if nomination committee members are greater than 3 but less than the full board.

Table 3

Pair-wise correlation coeffecients for the independent and dependent variables for the complete sample from 2005-2014.

	CG Index	*Invineff*^{E}	*Invineff*^{B}	*Invineff*^{R}	*B/M*	*Lev*	*Cash*	*LnAge*	*LnSize*	*CFO*	*DY*	*OC*	*Tang*	*Z Score*	*Inv Vol*	*CFO Vol*	*Sales Vol*
CG Index	1.000																
Invineff^{E}	-0.099	1.000															
Invineff^{B}	-0.101	0.963	1.000														
Invineff^{R}	-0.143	0.656	0.628	1.000													
B/M	0.017	-0.183	-0.176	-0.170	1.000												
Lev	0.133	-0.082	-0.080	-0.053	-0.108	1.000											
Cash	-0.146	0.169	0.198	0.173	-0.164	-0.223	1.000										
LnAge	0.021	-0.115	-0.113	-0.083	0.114	0.052	-0.122	1.000									
LnSize	0.646	-0.228	-0.224	-0.229	0.125	0.225	-0.197	0.119	1.000								
CFO	0.314	-0.199	-0.180	-0.193	0.166	0.054	-0.222	0.044	0.540	1.000							
DY	0.340	-0.173	-0.183	-0.191	0.004	0.149	-0.206	0.039	0.435	0.374	1.000						
OC	-0.207	0.081	0.065	0.067	0.033	-0.093	0.029	0.074	-0.226	-0.293	-0.237	1.000					
Tang	-0.040	0.033	0.040	0.022	0.105	0.009	-0.153	0.055	0.137	0.128	-0.157	0.085	1.000				
Z Score	0.181	-0.122	-0.124	-0.151	-0.046	0.083	-0.108	-0.039	0.184	0.337	0.354	-0.366	-0.231	1.000			
Inv Vol	-0.061	0.186	0.216	0.173	-0.051	-0.027	0.234	-0.091	-0.054	-0.0837	-0.148	0.075	0.128	-0.156	1.000		
CFO Vol	-0.189	0.176	0.187	0.172	-0.207	-0.050	0.296	-0.049	-0.365	-0.476	-0.191	0.033	-0.157	-0.093	0.212	1.000	
Sales Vol	0.0007	-0.019	0.011	0.006	-0.098	0.116	0.026	-0.044	-0.069	0.043	0.045	-0.202	-0.204	0.327	0.031	0.305	1.000

Notes:

CG Index measures strength of corporate governance. It's a binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17). *Invineff*^{E} is the absolute measure of investment inefficiency estimated from Eisdorfer et al., (2013) model. *Invineff*^{B} is the absolute measure of investment inefficiency estimated from Biddle et al., (2009) model. *Invineff*^{R} is the absolute measure of investment inefficiency estimated from Richardson (2006) model.

B/M measures book to market ratio of the firm measured as the ratio of BV of common equity to firm's market value. *Lev* denotes firms leverage which is the sum of long term and short term debt scaled with sum of total debt and BV of common equity. *Cash* measures sum of total cash and short term investments scaled with lagged total assets. *LnAge* shows natural log of number of years since firm appears on Thomson Reuters Datastream. *LnSize* represents firm size measured by taking natural log of total assets. *CFO* measures cash flow after operations scaled with average total assets. *DY* dividend per share as a percentage of share price. *OC* shows operating cycle measured as: account receivable days + inventories days held). Natural log of operating cycle is taken. *Tang* represents tangibility of firm calculated as ratio of fixed assets to total assets. *Z Score* shows firm's bankruptcy risk computed following Altman (1968) paper. *Inv Vol* is standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets. *CFO Vol* is standard deviation of *CFO* from t-3 to t-1. *Sales Vol* is standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets. *Losses* dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise.

Table 4
Comparison between corporate governance and estimates of investment inefficiency.

Panel A: Comparison between corporate governance and investment inefficiency in early adoption and late adoption period.

Period	CG Index	$Invineff^{E}$	$OverInv^{E}$	$UnderInv^{E}$	$Invineff^{B}$	$OverInv^{B}$	$UnderInv^{B}$	$Invineff^{R}$	$OverInv^{R}$	$UnderInv^{R}$
Early Period 2004-2008	7.320	0.184	0.282	0.089	0.205	0.316	0.075	0.113	0.137	0.096
Late Period 2009-2014	8.672	0.135	0.208	0.065	0.151	0.254	0.070	0.090	0.103	0.080
t-stat	11.49***	7.80***	6.39***	8.90***	7.97***	5.00***	2.24**	8.14***	6.66***	5.27***
Wilcoxen *z*	11.34***	12.01***	8.19***	10.83***	7.56***	6.41***	0.66	9.90***	7.52***	6.86***

Panel B: Comparison between corporate governance and investment inefficiency across the quality of corporate governance groups.

CG Quartiles	N	$Invineff^{E}$	$OverInv^{E}$	$UnderInv^{E}$	$Invineff^{B}$	$OverInv^{B}$	$UnderInv^{B}$	$Invineff^{R}$	$OverInv^{R}$	$UnderInv^{R}$
CGQ1	2188	0.185	0.312	0.091	0.205	0.339	0.083	0.121	0.150	0.103
CGQ2	1649	0.164	0.257	0.076	0.185	0.299	0.076	0.104	0.124	0.090
CGQ3	1882	0.153	0.227	0.064	0.172	0.279	0.065	0.092	0.110	0.078
CGQ4	1673	0.110	0.155	0.059	0.121	0.190	0.061	0.074	0.082	0.067
f-stat		26.16***	33.04***	30.95***	29.28***	24.82***	20.03***	51.85***	34.21***	27.77***

Notes:
* significant at 10%; ** significant at 5%; *** significant at 1%
CG Index measures strength of corporate governance. It's a binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17). $Invineff^{E}$ is the absolute measure of investment inefficiency estimated from Eisdorfer et al., (2013) model. $OverInv^{E}$ represents the estimated overinvestment from Eisdorfer et al., (2013) model. $UnderInv^{E}$ represents estimates of underinvestment estimated from Eisdorfer et al., (2013). Estimates are multiplied with -1. $Invineff^{B}$ is the absolute measure of investment inefficiency estimated from Biddle et al., (2009) model. $OverInv^{B}$ represents the estimated overinvestment from Biddle et al., (2009) model. $UnderInv^{B}$ represents estimates of underinvestment estimated from Biddle et al., (2009). Estimates are multiplied with -1. $Invineff^{R}$ is the absolute measure of investment inefficiency estimated from Richardson (2006) model. $OverInv^{R}$ represents the estimated overinvestment from Richardson (2006) model. $UnderInv^{R}$ represents estimates of underinvestment estimated from Richardson (2006). Estimates are multiplied with -1.
CGQ1 includes firms with *CG Index* ranging from 0-4. *CGQ2* & *CGQ3* consists of firms with mid-range *CG Index* i.e. from 5-8 & 9-12 respectively. *CGQ4* is a quartile of firms with highest quality *CG Index* ranging from 13-17.

Table 5
Multiple pair-wise Bonferroni comparison test of difference on mean estimates of investment inefficiency across CG quality.

	OverInv^{E}		
	CGQ1	*CGQ2*	*CGQ3*
CGQ2	-0.054***		
CGQ3	-0.085***	-0.030	
CGQ4	-0.156***	-0.102***	-0.072***

	UnderInv^{E}		
	CGQ1	*CGQ2*	*CGQ3*
CGQ2	-0.015***		
CGQ3	-0.027***	-0.0124**	
CGQ4	-0.032***	-0.017***	-0.005

	OverInv^{B}		
	CGQ1	*CGQ2*	*CGQ3*
CGQ2	-0.040		
CGQ3	-0.060***	-0.020	
CGQ4	-0.148***	-0.109***	-0.089***

	UnderInv^{B}		
	CGQ1	*CGQ2*	*CGQ3*
CGQ2	-0.007		
CGQ3	-0.018***	-0.011***	
CGQ4	-0.021***	-0.014***	-0.003

	OverInv^{R}		
	CGQ1	*CGQ2*	*CGQ3*
CGQ2	-0.027***		
CGQ3	-0.041***	-0.014	
CGQ4	-0.068***	-0.042***	-0.027***

	UnderInv^{R}		
	CGQ1	*CGQ2*	*CGQ3*
CGQ2	-0.013***		
CGQ3	-0.025***	-0.012**	
CGQ4	-0.036***	-0.023***	-0.011

Notes:
* significant at 10%; ** significant at 5%; *** significant at 1%
Table reports the statistical test of differences between the means of estimates of investment inefficiency belonging to different quartiles of corporate governance. Reported values are the difference between the means of estimates of investment inefficiency.
OverInv^{E} represents the estimated overinvestment from Eisdorfer et al., (2013) model. *UnderInv^{E}* represents estimates of underinvestment estimated from Eisdorfer et al., (2013). Estimates are multiplied with -1. *OverInv^{B}* represents the estimated overinvestment from Biddle et al., (2009) model. *UnderInv^{B}* represents estimates of underinvestment estimated from Biddle et al., (2009). Estimates are multiplied with -1. *OverInv^{R}* represents the estimated overinvestment from Richardson (2006) model. *UnderInv^{E}* represents estimates of underinvestment estimated from Richardson (2006). Estimates are multiplied with -1.
CGQ1 includes firms with *CG Index* ranging from 0-4. *CGQ2* & *CGQ3* consists of firms with mid-range *CG Index* i.e. from 5-8 & 9-12 respectively. *CGQ4* is a quartile of firms with highest quality *CG Index* ranging from 13-17.

Table 6
Petersen (2009) OLS regression for corporate governance and overinvestment.

	Model (1) $OverInv^{E}$	Model (2) $OverInv^{B}$	Model (3) $OverInv^{R}$	Model (4) $OverInv^{R}$
CG Index	-0.006	-0.006	-0.002	-0.003
	(3.54)***	(3.46)***	(4.36)***	(6.13)***
B/M	-0.086	-0.111		-0.024
	(6.48)***	(6.35)***		(7.23)***
Lev	-0.016	-0.048		-0.018
	(0.72)	(1.64)		(2.85)***
Cash	0.025	0.030		0.017
	(1.58)	(1.81)*		(3.07)***
LnAge	-0.035	-0.036		-0.011
	(3.77)***	(4.68)***		(3.30)***
LnSize	-0.040	-0.048		-0.011
	(-5.65)***	(-5.94)***		(4.76)***
CFO	-0.165	-0.106	-0.064	-0.042
	(3.21)***	(2.24)**	(4.28)***	(2.94)***
DY	-0.003	-0.007	-0.003	-0.002
	(1.10)	(2.17)**	(3.18)***	(2.37)**
OC	-0.004	-0.009	-0.003	-0.003
	(0.77)	(1.55)	(1.75)*	(1.66)*
Tang	-0.025	-0.028	-0.025	-0.008
	(0.69)	(0.78)	(1.84)*	(0.66)
Z Score	-0.010	-0.013	-0.005	-0.008
	(1.02)	(1.07)	(1.78)*	(2.83)***
Inv Vol	0.070	0.096	0.031	0.023
	(3.55)***	(6.36)***	(3.76)***	(3.02)***
CFO Vol	0.170	0.117	0.067	0.011
	(2.20)**	(1.71)*	(2.64)***	(0.40)
Sales Vol	-0.076	-0.008	-0.005	-0.009
	(2.43)**	(0.26)	(0.30)	(0.56)
Losses	-0.059	-0.059	-0.007	-0.013
	(4.07)***	(4.41)***	(1.14)	(1.93)*
Constant	Included	Included	Included	Included
Industry FE	Yes	Yes	Yes	Yes
Firm/Year Cluster	Yes	Yes	Yes	Yes
Observations	3501	3386	3024	3024
F-stat	961.73***	9.82***	167.01***	20.70***
Centred R-Square	21.67%	19.62%	13.49%	18.07%

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
CG Index measures strength of corporate governance. It's a binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17). $OverInv^{E}$ represents the estimated overinvestment from Eisdorfer et al., (2013) model. $OverInv^{B}$ represents the estimated overinvestment from Biddle et al., (2009) model. $OverInv^{R}$ represents the estimated overinvestment from Richardson (2006) model.
B/M measures book to market ratio of the firm measured as the ratio of BV of common equity to firm's market value. *Lev* denotes firms leverage which is the sum of long term and short term debt scaled with sum of total debt and BV of common equity. *Cash* measures sum of total cash and short term investments scaled with lagged total assets. *LnAge* shows natural log of number of years since firm appears on Thomson Reuters Datastream. *LnSize* represents firm size measured by taking natural log of total assets. *CFO* measures cash flow after operations scaled with average total assets. *DY* dividend per share as a percentage of share price. *OC* shows operating cycle measured as: account receivable days + inventories days held). Natural log of operating cycle is taken. *Tang* represents tangibility of firm calculated as ratio of fixed assets to total assets. *Z Score* shows firm's bankruptcy risk computed following Altman (1968) paper. *Inv Vol* is standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets. *CFO Vol* is standard deviation of *CFO* from t-3 to t-1. *Sales Vol* is standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets. *Losses* dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise. *Industry FE* controls for industry fixed effects based on level 1 codes of Industrial Classification Benchmark (ICB).

Table 7
Petersen (2009) OLS regression for corporate governance and underinvestment.

	Model (1) $UnderInv^{E}$	Model (2) $UnderInv^{B}$	Model (3) $UnderInv^{R}$	Model (4) $UnderInv^{R}$
CG Index	-0.002	-0.001	-0.001	-0.002
	(4.20)***	(4.43)***	(2.60)***	(4.11)***
B/M	-0.006	-0.001		-0.014
	(3.14)***	(0.64)		(9.90)***
Lev	0.016	0.016		0.024
	(2.69)***	(2.23)**		(2.22)**
Cash	-0.006	-0.009		0.010
	(2.66)***	(3.15)***		(5.38)***
LnAge	-0.000	0.004		-0.003
	(0.08)	(2.38)**		(1.55)
LnSize	-0.002	-0.002		-0.003
	(-2.26)***	(-0.068)*		(2.51)**
CFO	-0.012	-0.003	-0.013	0.004
	(2.06)**	(0.77)	(2.35)**	(0.68)
DY	-0.001	-0.001	-0.001	-0.000
	(1.55)	(1.27)	(0.75)	(0.50)
OC	-0.002	-0.001	-0.004	-0.003
	(2.28)**	(0.96)	(3.16)***	(2.47)**
Tang	-0.022	-0.025	-0.005	0.004
	(4.68)***	(5.60)***	(1.04)	(0.80)
Z Score	-0.002	-0.003	-0.004	-0.006
	(1.42)	(2.04)**	(3.58)***	(5.92)***
Inv Vol	0.004	0.009	0.037	0.032
	(1.15)	(3.03)***	(18.74)***	(13.34)***
CFO Vol	-0.019	-0.007	0.051	0.030
	(1.84)*	(0.76)	(2.82)***	(1.68)*
Sales Vol	0.006	0.014	0.020	0.016
	(1.34)	(2.68)***	(2.55)**	(2.33)**
Losses	0.004	0.008	0.015	0.016
	(1.52)	(2.53)**	(4.34)***	(4.78)***
Constant	Included	Included	Included	Included
Industry FE	Yes	Yes	Yes	Yes
Firm/Year Cluster	Yes	Yes	Yes	Yes
Observations	3493	3652	4014	4014
F-Stat	162.26***	3.91***	79.98***	39.36***
Centred R-Square	14.33%	4.75%	10.88%	13.28%

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
CG Index measures strength of corporate governance. It's a binary-based governance index score based on total of 17 CG components based on simplified Horwath index. Score range (0-17). $UnderInv^{E}$ represents estimates of underinvestment estimated from Eisdorfer et al., (2013). Estimates are multiplied with -1. $UnderInv^{B}$ represents estimates of underinvestment estimated from Biddle et al., (2009). Estimates are multiplied with -1. $UnderInv^{R}$ represents estimates of underinvestment estimated from Richardson (2006). Estimates are multiplied with -1.
B/M measures book to market ratio of the firm measured as the ratio of BV of common equity to firm's market value. *Lev* denotes firms leverage which is the sum of long term and short term debt scaled with sum of total debt and BV of common equity. *Cash* measures sum of total cash and short term investments scaled with lagged total assets. *LnAge* shows natural log of number of years since firm appears on Thomson Reuters Datastream. *LnSize* represents firm size measured by taking natural log of total assets. *CFO* measures cash flow after operations scaled with average total assets. *DY* dividend per share as a percentage of share price. *OC* shows operating cycle measured as: account receivable days + inventories days held). Natural log of operating cycle is taken. *Tang* represents tangibility of firm calculated as ratio of fixed assets to total assets. *Z Score* shows firm's bankruptcy risk computed following Altman (1968) paper. *Inv Vol* is standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets. *CFO Vol* is standard deviation of *CFO* from t-3 to t-1. *Sales Vol* is standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets. *Losses* dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise. *Industry FE* controls for industry fixed effects based on level 1 codes of Industrial Classification Benchmark (ICB).

Table 8
Two-stage least square (2SLS) regression for corporate governance and overinvestment.

	Model (1) *OverInv^E*		Model (2) *OverInv^B*		Model (3) *OverInv^R*		Model (4) *OverInv^R*	
	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
Instrument 1	1.46		1.556		1.282		1.409	
	(9.37)***		(10.09)***		(7.31)***		(8.09)***	
Instrument 2	0.469		0.362		0.488		0.407	
	(8.13)***		(6.41)***		(8.12)***		(6.63)***	
CG Index		-0.028		-0.028		-0.016		-0.008
(instrumented)		(4.41)***		(4.00)***		(5.29)***		(2.56)**
B/M	-0.196	-0.090	-0.319	-0.113			-0.217	-0.026
	(1.58)	(9.60)***	(2.25)**	(9.78)***			(2.14)**	(8.76)***
Lev	2.205	0.015	1.888	-0.021			1.048	-0.021
	(7.61)***	(0.53)	(6.43)***	(0.75)			(3.80)***	(2.24)**
Cash	.168	0.036	0.206	0.041			-0.058	0.018
	(1.47)	(4.13)***	(2.00)**	(4.84)***			(0.41)	(4.17)***
LnAge	0.361	-0.023	0.257	-0.025			0.287	-0.009
	(3.68)***	(2.82)***	(2.53)**	(2.95)***			(2.54)**	(2.40)**
LnSize	-0.992	-0.061	-1.078	-0.068			-0.758	-0.015
	(18.75)***	(8.23)***	(19.79)***	(7.82)***			(13.48)***	(5.41)***
CFO	2.917	-0.069	2.707	-0.019	1.141	-0.042	2.583	-0.022
	(7.91)***	(2.11)**	(7.48)***	(0.55)	(2.72)***	(2.95)***	(6.14)***	(1.53)
DY	0.214	-0.000	0.207	-0.005	0.226	-0.002	0.284	-0.002
	(5.89)***	(0.12)	(4.90)***	(1.27)	(6.14)***	(1.16)	(7.84)***	(1.28)
OC	-0.345	-0.009	-0.296	-0.012	-0.268	-0.007	-0.316	-0.003
	(5.39)***	(1.57)	(4.75)***	(2.07)**	(3.73)***	(2.55)**	(4.50)***	(1.47)
Tang	1.35	0.059	1.671	0.073	0.066	-0.029	0.480	-0.002
	(4.26)***	(2.61)***	(5.31)***	(2.92)***	(0.20)	(2.74)***	(1.43)	(0.18)
Z Score	-0.334	-0.025	-0.190	-0.023	-0.008	-0.010	-0.085	-0.012
	(3.15)***	(3.03)***	(1.65)*	(2.40)**	(0.06)	(2.63)***	(0.74)	(3.55)***
Inv Vol	0.286	0.078	0.201	0.102	0.164	0.036	0.344	0.026
	(1.57)	(5.57)***	(1.17)	(7.14)***	(0.74)	(4.92)***	(1.57)	(3.83)***
CFO Vol	-3.039	0.118	-3.618	0.055	-1.718	0.050	-2.764	-0.001
	(4.50)***	(2.13)**	(5.72)***	(0.96)	(2.23)**	(1.90)*	(3.60)***	(0.04)
Sales Vol	-1.705	-0.120	-1.544	-0.047	-1.557	-0.031	-2.162	-0.020
	(3.95)***	(3.43)***	(3.65)***	(1.27)	(3.13)***	(1.82)*	(4.44)***	(1.23)
Losses	-2.371	-0.106	-3.025	-0.119	-1.981	-0.034	-2.359	-0.025
	(11.18)***	(4.61)***	(13.98)***	(4.22)***	-(8.8)***	(3.41)***	(10.51)***	(2.50)**
Constant	Included	Included	Included	Included	Included	Included	Included	Included
F-test (instrument)	74.22***		69.68***		59.63***		53.33***	
Partial R^2	4.09%		3.97%		3.81%		3.43%	
Sargan chi^2	1.12		1.03		4.02**		3.54*	
Basmann chi^2	1.11		1.02		4.01**		3.52*	
Observations	3501	3501	3386	3386	3024	3024	3024	3024

Absolute value of t & z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Instrument 1 represents the dummy variable takes the value of 1 after the year 2008 and 0 otherwise. *Instrument 2* denotes the industrial-median *CG Index. CG Index (instrumented)* is the estimate of instrumented *CG Index* obtained from 1st stage of 2SLS regression. *OverInv^E* represents the estimated overinvestment from Eisdorfer et al., (2013) model. *OverInv^B* represents the estimated overinvestment from Biddle et al., (2009) model. *OverInv^R* represents the estimated overinvestment from Richardson (2006) model.
B/M measures book to market ratio of the firm measured as the ratio of BV of common equity to firm's market value. *Lev* denotes firms leverage which is the sum of long term and short term debt scaled with sum of total debt and BV of common equity. *Cash* measures sum of total cash and short term investments scaled with lagged total assets. *LnAge* shows natural log of number of years since firm appears on Thomson Reuters Datastream. *LnSize* represents firm size measured by taking natural log of total assets. *CFO* measures cash flow after operations scaled with average total assets. *DY* dividend per share as a percentage of share price. *OC* shows operating cycle measured as: account receivable days + inventories days held). Natural log of operating cycle is taken. *Tang* represents tangibility of firm calculated as ratio of fixed assets to total assets. *Z Score* shows firm's bankruptcy risk computed following Altman (1968) paper. *Inv Vol* is standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets. *CFO Vol* is standard deviation of *CFO* from t-3 to t-1. *Sales Vol* is standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets. *Losses* dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise.

Table 9
Two-stage least square (2SLS) regression for corporate governance and underinvestment.

	Model (1) *UnderInv^E*		Model (2) *UnderInv^B*		Model (3) *UnderInv^R*		Model (4) *UnderInv^R*	
	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
Instrument 1	1.524		1.514		1.339		1.574	
	(9.25)***		(9.20)***		(8.74)***		(10.61)***	
Instrument 2	-0.020		0.091		0.189		0.053	
	(0.37)		(1.67)*		(3.67)***		(1.05)	
CG Index		-0.012		-0.003		-0.010		-0.006
(instrumented)		(5.29)***		(1.71)*		(4.16)***		(2.81)***
B/M	0.150	-0.006	0.155	-0.000			0.126	-0.015
	(1.74)*	(3.09)***	(1.87)*	(0.07)			(1.37)	(7.04)***
Lev	1.800	0.018	1.983	0.018			2.638	0.028
	(6.62)***	(2.61)***	(7.30)***	(3.20)***			(9.28)***	(3.42)***
Cash	-0.099	-0.002	-0.206	-0.009			0.141	0.011
	(0.74)	(0.86)	(1.29)	(3.31)***			(1.31)	(4.58)***
LnAge	-0.204	-0.002	-0.079	0.004			-0.140	-0.004
	(1.73)*	(0.76)	(0.70)	(2.21)**			(1.38)	(1.61)
LnSize	-0.778	-0.010	-0.712	-0.003			-0.996	-0.008
	(14.62)***	(4.55)***	(13.79)***	(1.89)*			(19.90)***	(3.28)***
CFO	3.136	0.021	2.954	0.001	1.887	0.008	3.315	0.021
	(8.22)***	(1.93)*	(7.50)***	(0.18)	(5.49)***	(0.82)	(9.82)***	(2.09)**
DY	0.386	0.001	0.377	-0.000	0.273	0.001	0.323	0.000
	(11.83)***	(1.22)	(12.53)***	(0.10)	(8.12)***	(0.91)	(10.04)***	(0.12)
OC	-0.313	-0.003	-0.354	-0.000	-0.365	-0.007	-0.326	-0.004
	(4.74)***	(2.00)**	(5.25)***	(0.28)	(5.76)***	(4.04)***	(5.38)***	(2.61)***
Tang	0.316	0.011	0.039	-0.019	0.336	0.001	1.032	0.016
	(1.09)	(1.83)*	(0.13)	(4.19)***	(1.23)	(0.23)	(3.80)***	(2.65)***
Z Score	-0.101	-0.006	-0.134	-0.003	-0.180	-0.008	-0.244	-0.009
	(0.99)	(2.71)***	(1.38)	(1.68)*	(1.81)*	(3.54)***	(2.57)**	(4.40)***
Inv Vol	0.342	0.012	0.597	0.011	0.337	0.042	0.400	0.036
	(1.49)	(2.49)**	(2.37)**	(2.55)**	(1.76)*	(9.41)***	(2.15)**	(8.52)***
CFO Vol	-3.683	-0.054	-3.674	-0.013	-2.861	0.031	-4.016	0.016
	(5.33)***	(3.19)***	(4.93)***	(0.96)	(4.53)***	(1.97)**	(6.51)***	(1.03)
Sales Vol	-0.799	-0.013	-1.031	0.012	-0.134	0.011	-0.579	0.008
	(2.00)**	(1.42)	(2.55)**	(1.81)*	(0.35)	(1.32)	(1.59)	(1.00)
Losses	-2.211	-0.014	-1.845	0.006	-1.683	0.003	-2.210	0.009
	(11.08)***	(2.20)**	(9.43)***	(1.42)	(8.62)***	(0.54)	(11.71)***	(1.53)
Constant	Included	Included	Included	Included	Included	Included	Included	Included
F-test (instrument)	43.11***		43.07***		43.41***		56.4***	
Partial R^2	2.42%		2.31%		2.12%		2.75%	
Sargan chi^2	46.06***		0.910		0.086		0.05	
Basmann chi^2	46.45***		0.906		0.085		0.05	
Observations	3493	3493	3652	3652	4014	4014	4014	4014

Absolute value of t & z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Instrument 1 represents the dummy variable takes the value of 1 after the year 2008 and 0 otherwise. *Instrument 2* denotes the industrial-median *CG Index. CG Index (instrumented)* is the estimate of instrumented *CG Index* obtained from 1st stage of 2SLS regression. *UnderInv^E* represents estimates of underinvestment estimated from Eisdorfer et al., (2013). Estimates are multiplied with -1. *UnderInv^B* represents estimates of underinvestment estimated from Biddle et al., (2009). Estimates are multiplied with -1. *UnderInv^R* represents estimates of underinvestment estimated from Richardson (2006). Estimates are multiplied with -1.
B/M measures book to market ratio of the firm measured as the ratio of BV of common equity to firm's market value. *Lev* denotes firms leverage which is the sum of long term and short term debt scaled with sum of total debt and BV of common equity. *Cash* measures sum of total cash and short term investments scaled with lagged total assets. *LnAge* shows natural log of number of years since firm appears on Thomson Reuters Datastream. *LnSize* represents firm size measured by taking natural log of total assets. *CFO* measures cash flow after operations scaled with average total assets. *DY* dividend per share as a percentage of share price. *OC* shows operating cycle measured as: account receivable days + inventories days held). Natural log of operating cycle is taken. *Tang* represents tangibility of firm calculated as ratio of fixed assets to total assets. *Z Score* shows firm's bankruptcy risk computed following Altman (1968) paper. *Inv Vol* is standard deviation of I_{Total} from t-3 to t-1. Numerator deflated with average total assets. *CFO Vol* is standard deviation of *CFO* from t-3 to t-1. *Sales Vol* is standard deviation of *Sales* from t-3 to t-1. Numerator deflated with average total assets. *Losses* dummy that takes a value of 1 if firm's net income before extraordinary items is negative and 0 otherwise.

Table 10
Petersen (2009) OLS regression for sub-components of corporate governance and investment inefficiency.

Panel A: Regression for sub-components of corporate governance and overinvestment.

	Model (1) $OverInv^E$	Model (2) $OverInv^E$	Model (3) $OverInv^E$	Model (4) $OverInv^E$
Board Index	-0.012			
	(2.12)**			
Audit Index		-0.010		
		(2.15)**		
Rem Index			-0.015	
			(3.75)***	
Nom Index				-0.014
				(3.21)***
Control Variables	Included	Included	Included	Included
Constant	Included	Included	Included	Included
Industry FE	Yes	Yes	Yes	Yes
Firm/Year Cluster	Yes	Yes	Yes	Yes
Observations	3501	3501	3501	3501
F-Stat	23.65***	30.40***	147.85***	22.08***
Centred R-Square	21.31%	21.47%	21.56%	21.56%

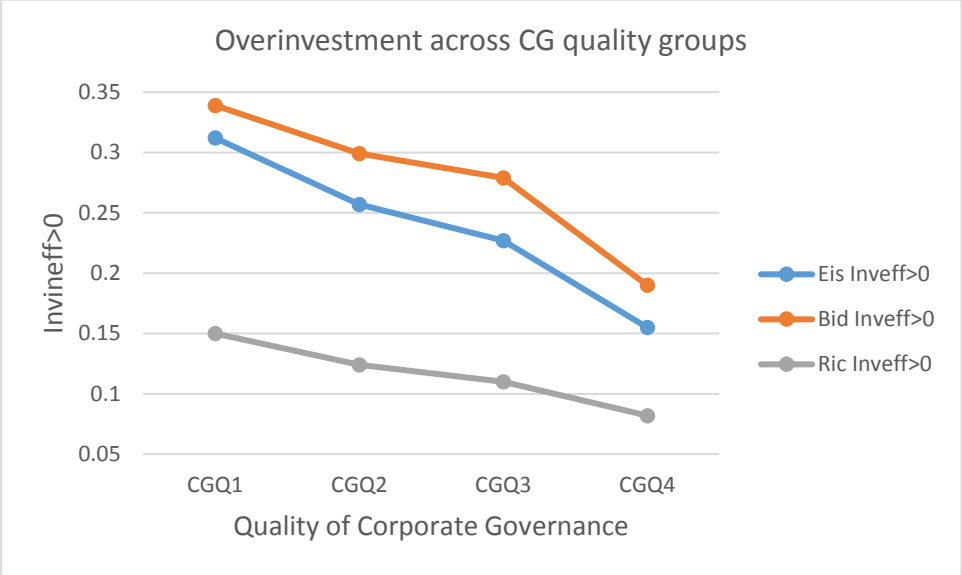
Panel B: Regression for sub-components of corporate governance and underinvestment.

	Model (1) $UnderInv^E$	Model (2) $UnderInv^E$	Model (3) $UnderInv^E$	Model (4) $UnderInv^E$
Board Index	-0.003			
	(1.96)**			
Audit Index		-0.003		
		(4.71)***		
Rem Index			-0.007	
			(4.99)***	
Nom Index				-0.004
				(3.29)***
Control Variables	Included	Included	Included	Included
Constant	Included	Included	Included	Included
Industry FE	Yes	Yes	Yes	Yes
Firm/Year Cluster	Yes	Yes	Yes	Yes
Observations	3493	3493	3493	3493
F-Stat	31.41***	51.22***	145.78***	44.21***
Centred R-Square	13.48%	14.10%	14.51%	13.84%

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Board Index is binary-based index representing the governance strength of board. Score range (0-3). *Audit Index* is Audit sub-committee score measuring the governance strength of audit sub-committee. Score range (0-6). *Rem Index* Remuneration sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4). *Nom Index* Nomination sub-committee score measuring the governance strength of remuneration sub-committee. Score range (0-4). $OverInv^E$ represents the estimated overinvestment from Eisdorfer et al., (2013) model. $UnderInv^E$ represents estimates of underinvestment estimated from Eisdorfer et al., (2013). *Control Variables* indicate set of all control variables applied in previous regressions. *Industry FE* controls for industry fixed effects based on level 1 codes of Industrial Classification Benchmark (ICB).

List of Figures

Panel A: Overinvestment across corporate governance quality groups.



Panel B: Underinvestment across corporate governance quality groups.

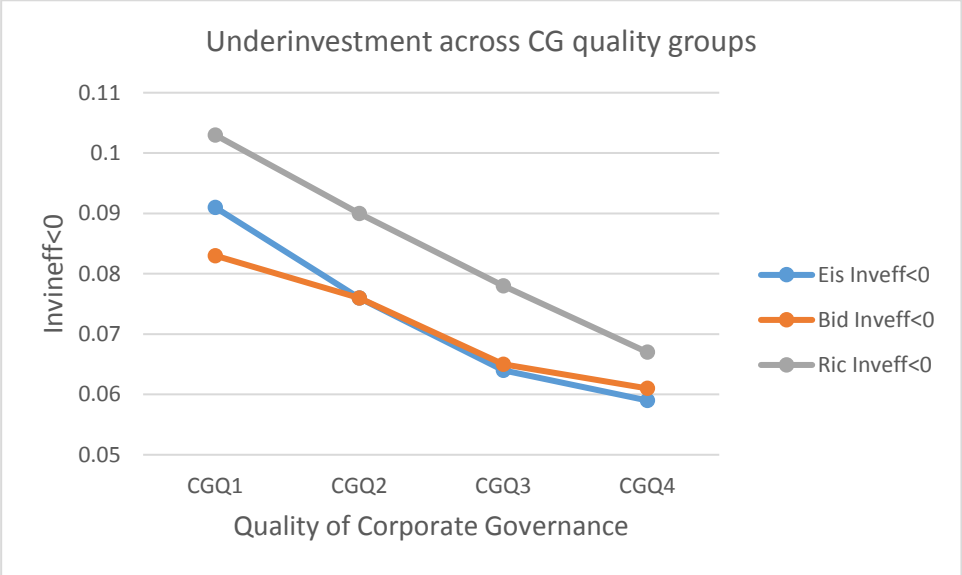


Fig. 1. Investment inefficiency across corporate governance quality groups.