

## **Board Structure Diversity and Corporate Innovation: Evidence from Australian Listed Firms**

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### **ABSTRACT**

This study investigates the nexus between board structure diversity and corporate innovation. Board structure diversity, known as demographic and cognitive, is measured by the gender, tenure, and nationality of directors in the boardroom. By using the sample of Australia's top 200 listed firms, the results endorsed that regional differences, particularly gender attributes, positively linked with preference in the investment of intangible resources. The robustness of the results is proved with the help of alternative proxy of intangible assets and the different most robust regression models. All study variables data is collected with the help of publically available annual reports at their respective website between 2008 and 2018. It is supported that the most recent updates to the principles and recommendations of the ASX Corporate Governance Council (referred to as "ASX CGC revisions") are effective economically. Innovation can be boosted significantly by increasing board structure diversity. Regulators and firms can use the findings to design rules and practices that promote the representation of women on corporate boards. The current study is the first one of its kind to examine the connection of foreign director presence on the board with gender diversity in Australia, a country with a low percentage of women serving on corporate boards and in senior managerial roles. In addition, there are no statutory mandates on board gender diversity and foreign director presence imposed by either legislation or governance policy. This paper provides new findings beyond confirming a positive association between board structure diversity and corporate innovation.

**Keywords:** Board structure diversity, gender diversity, presence of experience directors, presence of foreign directors; corporate innovation

## **1.INTRODUCTION**

In recent years, board structure diversity perspectives in the boardroom have become an essential topic of discussion in the corporate, academic, and regulatory sectors (Baker et al., 2020; Li & He, 2023; Beji et al., 2021). The composition of a company's board of directors can significantly impact various aspects of decision-making, including resource induction in the strategic matter, such as investment in research and development (R&D) initiatives and employee training. The current study helps to understand the driving forces behind the adoption of policies to allocate resources towards intangible assets in Australia's top 200 listed firms by examining the relationship between gender diversity, the presence of foreign directors, and directors' experience in the boardroom and their impact on a firm's knowledge assets, as measured by investment in intangible assets.

European countries, including Belgium, Finland, Iceland, Netherlands, and Norway, first introduced binding quotas about the presence of female directors on their corporate boards in early 2005 (Li & He, 2023). Norway secured prominent attention due to its mandatory policy of at least 40% female directors in publicly listed firms. Such trends influence the regulatory body in Australia (i.e., Australian Securities Exchange (ASX) Corporate Governance Council principles) and recommend a mandatory 30% female director presence in ASX's top 300 listed firms from January 2020 (Vafaei et al., 2021). The modern economy has shifted from a manufacturing-based model to a digital-based, knowledge-based one. As a result, knowledge is a source of value creation and ranks as the most influential factor in achieving and preserving a unique competitive position in the market (Caputo et al., 2019).

The firm's resource-based view (RBV) provides a theoretical foundation for examining the relationship between board diversity and knowledge assets. The RBV posits that a firm's investments in intangible assets are critical in securing a leading position in a competitive market (Barney, 1991). Therefore, understanding the factors contributing to developing knowledge assets is crucial for firms seeking to maintain a sustainable competitive advantage. This study contributes to the literature on RBV and provides insights for publically-listed firms seeking to enhance their performance through more considerable diversity in corporate boards.

Several studies have investigated the nexus between corporate governance indicators and investment in intangible assets. One key factor that impacts the investment in intangible assets is gender diversity on the corporate board

(Chen et al., 2018; Cheng & Groyberg, 2020). Gender diversity has been shown to positively affect the investment in intangible assets, as diverse boards bring different perspectives and experiences that lead to better decision-making (Eagly & Carli, 2007). Additionally, having a diverse board, including foreign directors, has positively affected the investment in intangible assets (Mahdi et al., 2011). Another critical factor that affects the investment in intangible assets is the experience of the directors. Experienced directors better understand the value of intangible assets and make such decisions to maintain the firm progress (Yuan & Wen, 2018). Investment in intangible assets shows the firm strategic commitment and makes the firm less risky in the slack financial period (Field & Mkrtchyan, 2017).

Despite the potential benefits of investing in intangible assets, researchers lack consensus regarding the use of information disclosed about intangible assets in annual reports (KPMG, 2016). Some researchers argue that the information disclosed about intangible assets is insufficient for stakeholders to make informed decisions (Brown & Kimbrough, 2011), while others concluded that the information is useful and relevant (Cumming & Leung, 2021; Li & He, 2023; Vafaei et al., 2021).

Our research distils pertinent theoretical arguments and adds empirical support for corporate governance practices related to diversity and business innovation. In addition, the study responds to a current trend in the literature on corporate governance (Cumming & Leung, 2021; Hillman, 2015; Vafaei et al., 2021), emphasizing the value of board structure diversity in the boardroom and their involvement in corporate decision-making. The upshot calls for additional study on the role of board structure diversity with the preference for resource induction in intangible assets. The current research investigates the nexus between board diversity and corporate innovation using a multidimensional measure of diversity. Investment in intangible assets is a risky activity supervised by the directors. Boardroom diversity may significantly change the firms' decision-making. Regardless of the importance of board diversity in a firm, preference toward investment in intangible assets is less research (Li & He, 2023; Vafaei et al., 2021).

## **2. Literature Review**

In the early 1990s, firms listed on the ASX were the ones that were the first to implement reforms and disclose their CG practices. As a result, the ASX Corporate Practices and Conduct Manual was last updated in 2020. The boardroom diversity is the target audience for this revision, and its objective is to educate them on the fundamentals of an effective CG system. The essential demand of the company's shareholders, investors, and other stakeholders is that the board of directors (BOD) be well-structured and effective. The BOD of any company is the core element in the mechanism of internal CG structures. This core element must work well to lead the company's activities properly. The BOD of any company is the core element in the mechanism of internal CG structures. When the BOD does not have the necessary qualifications or cannot perform, the shareholders and other governing bodies need to pay close attention. The roles and responsibilities of the BOD in companies that are listed on the ASX are explicitly defined by CG frameworks. According to the guidance provided by the ASX Council (2020), the BOD is the company's custodian and is responsible for monitoring financial difficulties and reporting. The ASX CG council has issued some guidelines for an effective board component.

Another indicator of a robust CG system in any firm is the existence of a divide between the board of directors and the company's Chief Executive Officer (CEO). It is considered to be a weak monitoring system for the board when the same person serves as both the CEO and the chairwoman of the listed firm. Following the recommendation made in the Cadbury report, no member of the board or management should be allowed to establish unfettered control over the organization. As a result, any CG structures for top-level management should have a distinct separation of power and accountability. Previous research and publications demonstrated that the majority of publicly traded corporations solved the agency problem by finding a mechanism to divide the roles of CEO and Chairperson of the Board of Directors.

### **2.1 Resource-Based View**

The company's resources are the driving factor behind the majority of the company's recent financial success. Success is measured by the value of firm assets, whether tangible or intangible. These assets can lead an organization to achieve a competitive edge. A vast body of literature seeks to explain the part that tangible assets play in the expansion of a corporation; however, there is a pressing need to research the strategic function played by intangible assets. According to Kor & Leblebici (2005) theory of the RBV,

"even though the resource-based view provides us with these key insights about the importance of firms' resources for successful diversification, the literature fails to address how strategies related to management and development of human assets at the business level affect the success of diversification strategies at the corporate level,"

The introduction of resource-based theory as a method for measuring a company's competitive edge in any industry, particularly in industries dependent on knowledge-based economies. A company must use tangible and intangible assets to succeed; one cannot exist without the other. Specific indicators that contribute to the confirmation of the assets are referred to as strategic assets: (1) these means allow the company to realize the opportunity of business; (2) the resources are unusual; all other competitors can't gain such resources or even attaining them is hard, and (3) the business benefited from these resources. All of these factors will contribute to an increase in the value that the organization creates.

The resource-based theory is currently the dominant paradigm in the strategic management field. This theory, which is going to become increasingly common in all areas of business and economics, is known as the resource-based view. Most of the progress in resources-based theory may be attributed to the academics studying management sciences. Edith Penrose was the one who first presented it to the economics community in the year 1959 (Barney, 1991). In the early days of this theory, businesspeople or economists did not embrace it because it would require a heterogeneous industry. In a nutshell, business academics concluded that for a company to have a competitive edge in the market, the company must maintain and make efficient use of its unique resources. In conclusion, it can be stated that the resource-based theory has produced a new paradigm to describe the problematic issues in the operational management field (Hitt et al., 2016).

## **2.2 Hypothesis Development**

From the standpoint of RBV, having a diverse board can enhance the number of ideas and creativity and result in greater levels of innovation from the firm resources (Salancik & Pfeffer, 1978). The directors' decision-making process is heavily influenced by their prior experiences and their demographic and cognitive features. Boardroom diversity through experience and traits offers cognitive conflicts in the board decision-making process, which turn such differences into the development of creative ideas (Hambrick & Mason, 1984). In addition, different people in senior management have different points of view, and having a broad functional and educational background on

the executive team helps the team be more creative and innovative (Cumming & Leung, 2021).

According to the behavioral theory of the company, there is also a beneficial connection between diverse board membership and innovative business practices. It implies that the extent to which companies search for information and make decisions might impact those organizations' innovative capacity (Hambrick & Mason, 1984). Decisions can be influenced by the knowledge available inside the group making the decision, particularly when the search process is carried out by a homogenous group that concentrates solely on areas in which group members have past experience. On the other hand, groups with various types of knowledge will be able to generate a wider variety of ideas and information. In the identification phase, demographic and cognitive diversity on boards helps identify new innovative opportunities. Whereas in the development phase, it provides a greater variety of ideas and perspectives presented to search for and design solutions; and in the selection phase, it enables a more thorough evaluation of choices (Cumming & Leung, 2021; Hambrick & Mason, 1984; Salancik & Pfeffer, 1978).

This literature review highlights the importance of examining the impact of gender diversity, foreign directors, and directors' experience on innovation. Previous studies suggest a positive relationship between these factors and a firm's innovation level. However, further research is needed to understand the relationship between these factors and innovation in the Australian context. To address this gap, we propose to conduct a study that investigates the influence of gender diversity, foreign directors, and directors' experience on innovation in the Australian top 200 listed firms. By doing so, our study aims to contribute to the literature on the relationship between board diversity and innovation and provide insights for Australian firms seeking to enhance their innovation and performance. For example, Chen et al. 2018 examined the relationship between female representation on board directors and corporate innovation capabilities in US-based businesses between 1998 and 2006 and found that research is deficient in this context. However, some studies (Nguyen et al., 2020; Teruel & Segarra-Blasco, 2022) conclude that female involvement in firm ownership and workforce structures are positively associated with business innovation and that heterogeneous boards contribute more to firms' organizational innovation than boards with a male preponderance.

The role of foreign directors on boards has also been the subject of much research in recent years. Several studies have found a positive relationship between foreign directors on boards and various aspects of corporate performance, such as financial performance and innovation (Cumming & Leung, 2021; Li & He, 2023). For example, some studies found that firms with a higher proportion of foreign directors on their boards had higher innovation levels than those with lower proportions (Cheng & Groysberg, 2020). This can be explained by the knowledge-based view of the firm, which suggests that its knowledge assets are the key drivers of its competitive advantage (Grant, 1996). Foreign board directors can bring new perspectives and knowledge to a firm, enhancing its innovation and R&D capabilities. Similarly, a study by Abu et al. (2016) found that foreign board directors positively impacted a firm's financial performance.

*H1: There is a positive association between the presence of foreign directors in a board room and a firm preference to invest resources in intangible assets.*

Female and young directors must maintain different social networks to achieve their job and social resources. The impact of gender diversity on a firm's performance has been widely studied in recent years. Many studies have found a positive relationship between gender diversity in boards and various aspects of corporate performance, such as financial performance, risk management, and innovation. For example, some studies found that companies with higher levels of gender diversity on their boards were associated with higher levels of innovation (Cheng & Groysberg, 2020; Li & He, 2023). This can be explained by the resource-based theory, which posits that a firm's resources and capabilities are the primary drivers of its competitive advantage. Gender diversity in boards can be seen as a form of knowledge assets, which are valuable resources that can provide a firm with a competitive advantage in innovation (Barney, 1991). Another study by Sajjad and Rashid (2015) found that gender diversity on boards was positively related to the long-term financial growth of the company.

*H2: There is a positive association between the presence of female directors in a board room and a firm preference to invest resources in intangible assets.*

The impact of directors' experience on corporate performance has been widely studied in recent years. Many studies have found a positive relationship between directors' experience and various aspects of corporate performance, such as financial performance and innovation. For example, a study by Dalziel et al. (2011) found that firms with directors with more

experience in their fields had higher innovation levels than those with less experienced directors. The resource-based theory can also explain this, which suggests that a firm's resources and capabilities are the key drivers of its competitive advantage (Barney, 1991). Therefore, experienced directors can provide a firm with valuable knowledge and skills, enhancing its innovation capabilities. Similarly, a study by Feild and Mkrtchyan (2017) found that directors' experience positively affected a firm's financial performance.

*H3: There is a positive association between the presence of experienced directors in a board room and a firm preference to invest resources in intangible assets*

### **3. Research Methodology**

#### **3.1 Sample selection**

The target population of this study consists of the top 200 ASX-listed firms from 2008 to 2018. The maximum potential sample detail is given in Table 1 Panel A, representing 2,400 firm-year observations in total. However, due to missing information about the board structure variables and the non-availability of financial reports, the sample size reduces by up to 1527 firm-year observations. In addition, and precisely, we excluded the financial sector from the above sample size due to different regulations and less use of intangible assets management. Moreover, the final sample summary by each sector is shown in Table 1, Panel B. All the information on the study variables is collected from the published annual reports of the relevant companies. The measurement of the study variable is presented in Table 2. Three elements from the board structure diversity are selected (i.e., board diversity, known as the presence of foreign, female, and experienced directors). At the same time, the control variables are board independence, CEO duality, the board size, earnings per share, and profitability, measured through ROA and debt through leverage.

The dependent variable of the study innovation is measured through the investment in intangible assets other than goodwill. The resources that play a crucial part in producing value are often recognized as knowledge assets. The company's success depends on the endowment of resources, particularly knowledge assets, occasionally referred to as "intangibles," according to the resource-based view (Brown & Kimbrough, 2011). Nonaka and Takeuchi (1995) state that knowledge assets are the unique resources of a corporation that are necessary to generate value for the organization and that they are seen as the inputs, outputs, and moderators to generate value (Amin et al., 2018).



**Table 1 Summaries the sample selection procedure and sample description**

**Panel A: Overall Sample Selection**

Top 200 ASX listed firms	(2008-2018)	2,400
Less: Missing Corporate governance information and non-availability of firms' annual reports.		573
Less Financial sector firms		300
<b>Total sample</b>		<b>1,527</b>

**Panel B: Sample Description by Industry**

<b>Industry</b>	<b>Freq.</b>	<b>Percent</b>
Materials	380	24.89
Industrials	271	17.75
Consumer Discretionary	199	13.03
Energy	206	13.49
Real Estate	159	10.41
Health Care	91	5.96
Communication Services	58	3.80
Consumer Staples	82	5.37
Information Technology	58	3.80
Utilities	23	1.51
<b>Total</b>	<b>1527</b>	<b>100</b>

**Table 2 Variables measurements**

<b>Variables</b>	<b>Symbols</b>	<b>Description</b>
<b>Dependent</b>		
Innovation	KA	Total intangible assets, excluding goodwill divided by the firm's total assets (Feeny and Rogers, 2003).
	KA-2	Natural log of intangible assets.
<b>Independent</b>		
Regional diversity	BFD	The total number of foreign directors in the boardroom is divided by the total number of directors.
Gender diversity	BGD	The proportion of female directors on the board.
Board Expertise.	BED	An average number of years directors have served on the board.
<b>Control</b>		
Board independence	BIND	The proportion of independent directors on the board.
CEO duality	CEOD	The CEO and the chairman of the board are not the same person; score 1; otherwise, 0.
Board Size	BSIZE	Natural logarithm of the total number of board members.
Earnings per share	EPS	Net profit after tax divided by the total number of shares outstanding.
Return on assets	ROA	Net profit after tax divided by the total assets
Leverage	LEV	Total debts divided by the total assets

## 4. Results

### 4.1 Descriptive Statistics

Table 3 shows descriptive statistics for the dependent and independent variables as well as the control variables. The dependent variable, knowledge assets, has a mean of 0.19 and a standard deviation of 0.23. The result indicates that, on average, ASX 200 listed firms have almost 19% of intangible assets with respect to total assets. The minimum and maximum values are 0 and 0.57, respectively. Among the independent variables, foreign director in the boardroom has 1,527 observations with a mean of 41.50 and a standard deviation of 17.76. The minimum and maximum values for BFD are 0 and 69.39, respectively. At the same time, board gender diversity has 1,527 observations with a mean of 17.23 and a standard

deviation of 12.67. The minimum and maximum values for BGD are 0 and 71.43, respectively. Experience board members have 1,493 observations with a mean of 6.16 and a standard deviation of 3.08. The minimum and maximum values for BED are 0.25 and 21.31, respectively. The control variables include board independence with 1,523 observations, with a mean value of 66.88 and a standard deviation of 20.66. The minimum and maximum values for BID are 0 and 100, respectively. CEOD has 1,528 observations with a mean of -0.10 and a standard deviation of 0.29. The minimum and maximum values for CEOD are 0 and 1, respectively. The total number of directors is measured by board size, which has 1,527 observations with a mean of 2.00 and a standard deviation of 0.27. The minimum and maximum values for BSIZE are 3 and 15, respectively. EPS has 2,060 observations with a mean of 0.62 and a standard deviation of 3.72. The minimum and maximum values for earnings per share are -37.43 and 118.53, respectively. Profitability is measured by return on assets that has 2,123 observations with a mean of 0.03 and a standard deviation of 0.38. The minimum and maximum values for ROA are -13.06 and 1.61, respectively. Finally, debt to total assets is measured by leverage and has 2,127 observations with a mean of 0.22 and a standard deviation of 0.27. The minimum and maximum values for LEV are 0 and 1.89, respectively.

**Table 3. Descriptive statistics**

<b>Variable</b>	<b>Obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
<b>Dependent</b>					
KA	2,122	0.19	0.23	0	0.57
<b>Independent</b>					
BFD	1,527	41.50	17.76	0	69.39
BGD	1,527	17.23	12.67	0	71.43
BED	1,493	6.16	3.08	0.25	21.31
<b>Control</b>					
BID	1,523	66.88	20.66	0	100
CEOD	1,528	-0.10	0.29	0	1
BSIZE	1,527	2.00	0.27	3	15
EPS	2,060	0.62	3.72	-37.43	118.53
ROA	2,123	0.03	0.38	-13.06	1.61
LEV	2,127	0.22	0.27	0	1.89

Note: Definitions of all variables are presented in Table 2

Table 4 presents the correlation matrix of the variables used in the study, including the Variance Inflation Factor (VIF) scores. The VIF scores suggest that multicollinearity among the independent variables is not a concern. The correlation coefficients between knowledge assets measured by the intangible assets divided by total assets and the independent variables show weak to moderate relationships, with the strongest correlation between knowledge assets and board structure diversity with the presence of foreign directors ( $r = 0.064$ ,  $p < 0.05$ ). Among the control variables, board size and percentage of independent board members show the strongest positive correlation ( $r = 0.363$ ,  $p < 0.05$ ). Meanwhile, earning per share has the strongest positive correlation with a board size ( $r = 0.316$ ,  $p < 0.05$ ) and CEO ( $r = 0.160$ ,  $p < 0.05$ ). The correlation between knowledge assets and profitability is positive but weak ( $r = 0.063$ ,  $p < 0.05$ ). Contrary to expectations, the correlation between knowledge assets and leverage is positive but weak ( $r = 0.085$ ,  $p < 0.05$ ). These findings indicate that KA is weakly to moderately related to the model's independent and control variables, suggesting that the variables may have a modest effect on KA.

## **4.2 Regression Results**

The results in Table 5 suggest that the data support hypotheses H1 and H2. Specifically, H1 posits that more foreign directors in a boardroom increase the chances of investing in intangible assets. The regression results indicate that the number of foreign directors positively and significantly impacts investment in knowledge assets measured through total intangible assets excluding goodwill divided by the total assets ( $\beta=0.000866$ ,  $P<0.05$ ). This finding supports our hypothesis 1 and is consistent with resource-based theory, which suggests that a diverse board composition can bring different perspectives and knowledge to decision-making and ultimately result in better firm performance. This result is also consistent with agency theory, which posits that foreign directors can provide monitoring and control functions and mitigate agency problems. This finding is consistent with previous research that has shown that diverse boards, in terms of nationality and culture, are associated with more innovative and exploratory behavior (Cumming & Leung, 2021; Li & He, 2023; Vafaei et al., 2021).). Therefore, our study provides further evidence that foreign directors can play a vital role in promoting investment in knowledge assets and enhancing firm performance. H1 stated that a higher number of foreign directors in a boardroom increase the chances of investing in intangible assets. (Supported as shown in Table 5, column 1).

H2 proposes that a higher number of female directors in a boardroom increases the chances of investment in intangible assets, in line with resource-based theory, which suggests that a diverse workforce can provide a firm with unique resources and capabilities. The regression coefficient for the variable board gender diversity is  $\beta = 0.00253$ , which is significant at level  $P < 0.01$  in Table 5, column 1, indicating a positive and statistically significant relationship between the number of female directors and the firm's knowledge assets. This result supports our hypothesis 2 and suggests that more female directors in a boardroom are associated with increased investment in intangible assets. This finding is consistent with previous studies that indicate that women directors are more likely to promote knowledge creation and sharing within organizations (Aslam et al., 2021; Chen et al., 2018; Vafaei et al., 2021 ). H2 stated that the higher number of female directors in a boardroom increases the chances of investment in intangible assets. (Supported as per Table 5, column 1).

Our study found that the number of experienced directors (BED) did not significantly impact investment in intangible assets. The regression coefficient for the variable BID is  $\beta = 0.000323$ , which is insignificant at level  $P > 0.1$  shown in Table 5, column 1. This finding contradicts our hypothesis 3, which proposed that a higher number of experienced directors in a boardroom increases the chances of investment in intangible assets. However, this result is consistent with the RBV theory, which suggests that the impact of board characteristics on firm performance is not always straightforward and can be influenced by other factors.

According to the RBV theory, board composition is just one of many factors that can impact firm performance. Its effect can be influenced by factors such as CEO characteristics and environmental factors (Hambrick & Mason, 1984). For example, the CEO's leadership style and ability to manage the board may be more critical in determining the impact of board composition on firm performance. Moreover, external environmental factors such as industry competition, regulatory changes, and technological advancements may also play a crucial role in shaping the relationship between board composition and firm performance. This result is inconsistent with prior research that found experienced directors on the board positively impact firm performance. For example, Baysinger and Hoskisson (1990) and Yermack (1996) found that experienced directors can provide valuable resources and expertise to the firm, ultimately leading to better performance. However, our findings suggest that the impact of experienced directors on investment in intangible assets may be more complex than in previous research.

**Table 4. Correlation**

	VIF	KA	BFD	BGD	BED	BID	CEOD	BSIZE	ROA	EPS	LEV
<b>KA</b>		1									
<b>BFD</b>	3.3	0.064*	1								
<b>BGD</b>	2.85	0.115*	0.600*	1							
<b>BED</b>	1.12	0.088*	-0.165*	-0.140*	1						
<b>BID</b>	1.21	-0.034	0.328*	0.263*	-0.199*	1					
<b>CEOD</b>	1.09	-0.007	0.143*	0.113*	-0.206*	0.170*	1				
<b>BSIZE</b>	1.34	-0.017	0.363*	0.224*	-0.029	0.153*	0.136*	1			
<b>ROA</b>	1.24	0.063*	0.029	0.051*	0.153*	-0.077*	-0.056*	-0.074*	1		
<b>EPS</b>	1.34	-0.050*	0.203*	0.142*	0.101*	0.160*	0.013	0.316*	0.286*	1	
<b>LEV</b>	1.09	0.085*	0.076*	0.018	-0.046	-0.034	0.080*	0.177*	-0.289*	-0.022	1

**Note:** \*Show significance at the level of 0.05. Definitions of all variables are presented in Table 2

**Table 5 Regression results**

VARIABLES	(1)	(2)	(3)	(4)
	KA-1	KA-2	KA-1	KA-1
BFD	0.000866** (0.000395)	0.00699* (0.00398)	0.000883** (0.000381)	0.000866*** (0.000268)
BGD	0.00253*** (0.000871)	0.0298*** (0.00769)	0.00260*** (0.000849)	0.00253*** (0.000533)
BED	0.000323 (0.00177)	0.0429 (0.0265)	0.000502 (0.00167)	0.000323 (0.00147)
BID	0.000260 (0.000221)	0.00559** (0.00236)	0.000223 (0.000221)	0.000260 (0.000159)
CEOD	0.0262* (0.0136)	0.0517 (0.212)	0.0264** (0.0132)	0.0262** (0.0108)
BSIZE	0.0319* (0.0185)	0.976*** (0.318)	0.0261 (0.0177)	0.0319** (0.0158)
ROA	-0.0357 (0.0225)	-0.179 (0.799)	-0.0265 (0.0219)	-0.0357 (0.0223)
EPS	0.0109*** (0.00392)	0.0881 (0.0644)	0.00928** (0.00388)	0.0109*** (0.00371)
LEV	0.0803* (0.0441)	0.981* (0.541)	0.0836* (0.0440)	0.0803*** (0.0220)
Constant	0.0920** (0.0440)	9.808*** (0.733)	0.124*** (0.0430)	0.0920** (0.0361)
Observations	1,479	1,238	1,479	1,479
R-squared	0.056	0.127	0.055	0.910
Number of Company	175	154	175	

Note: Please see Table 2 for variables definitions \*\*\*, \*\*, and \* indicate statistical significance at 1, 5, and 10% levels, respectively. The figures in parentheses are the robust standard errors.

### **4.3 Robustness Check**

Moreover, Table 5, column 2 shows the results of the alternate proxy of knowledge assets through the natural log of intangible assets. Column 3 in Table 5 shows the regression results of knowledge assets (e.g., measured through intangible assets-goodwill/total assets) examined with random effects with robust standard error. Finally, column 4 in Table 5 shows the robust check regression results cluster at the firm level.

Regarding the robustness checks, the results using the natural log of intangible assets as an alternate proxy for knowledge assets (KA-2) were consistent with the primary analysis (KA-1). Moreover, the results using random effects with robust standard errors (KA-1) and clustering at the firm level (KA-1) were also consistent with the primary analysis. This suggests that our results are robust to different specifications and model assumptions. In summary, our study contributes to the literature on corporate governance and knowledge asset investment by providing empirical evidence of the impact of board characteristics on firm investment in knowledge assets. Our results highlight the importance of having a diverse board composition, specifically with foreign directors, in promoting investment in intangible assets. However, our study also suggests that gender diversity significantly impacts knowledge asset investment. Further research is needed to explore these relationships in different contexts and to investigate other potential determinants of knowledge asset investment.

### **5. Conclusion**

In conclusion, this study provides empirical evidence of the impact of board diversity on firm investment in intangible assets. The findings suggest that more foreign directors in the boardroom are associated with increased investment in intangible assets, supporting the resource-based theory and agency theory. The study also found that more female directors are associated with increased investment in intangible assets, consistent with the resource-based theory. However, the study found no significant impact of experienced directors on investment in intangible assets, which is not consistent with the RBV. These findings have several implications for practice. First, firms can benefit from having a diverse board composition, particularly with foreign directors, in promoting investment in knowledge assets. This can lead to better firm performance and a competitive advantage in the market. Second, the study highlights the importance of gender diversity in the boardroom, as it can enhance investment in intangible assets, which are critical for the firm's long-term success.

The study has some limitations that suggest avenues for future research. First, the study only examines the impact of board characteristics on investment in knowledge assets, and it does not examine the mechanisms through which this relationship occurs. Further research is needed to understand how board diversity affects investment in knowledge assets. Second, the study only focuses on listed firms in a particular country like Australia, and the results may not be generalizable to other countries or non-listed firms. Future research can explore the relationship between board characteristics and knowledge asset investment in different contexts.

Finally, the study's results should be interpreted cautiously due to the possibility of endogeneity bias and omitted variable bias. Furthermore, the study cannot establish causality due to the possibility of reverse causality and omitted variable bias. Further research using longitudinal data or natural experiments can help establish causality and provide stronger evidence of the relationship between board characteristics and knowledge asset investment. In summary, this study contributes to the literature on corporate governance and knowledge asset investment by providing empirical evidence of the impact of board characteristics on firm investment in knowledge assets. The findings highlight the importance of having a diverse board composition, particularly with foreign directors, in promoting investment in knowledge assets. Future research can build on these findings to examine how board diversity affects investment in knowledge assets and examine the relationship in different contexts.



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