Board Age Diversity and Firm Performance: Empirical Evidence from Thailand

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Review of Integrative Business & Economics Research

ABSTRACT

Drawing on the upper echelon theory and the resource dependency theory, this study aims to investigate the influence of board diversity on firm performance. While previous research has primarily focused on gender or nationality diversity, this study seeks to explore the implications of board age diversity on managing intellectual capital (IC) performance and enhancing financial performance. Moreover, there is a limited body of literature on the relationship between board age diversity and IC in Thailand. This study is the first to address this gap by analyzing data from agriculture and food companies listed on the Stock Exchange of Thailand (SET) between 2018 and 2022. IC performance is assessed using the Modified Value-Added Intellectual Coefficient (MVAIC) model, while financial performance is evaluated through accounting-based metrics such as return on assets (ROA) and return on equity (ROE), as well as the market-based measure of Tobin's Q. The findings indicate that board age diversity does not have a significant impact on firms' profitability, as measured by ROA and ROE. However, the analysis demonstrates a positive and significant impact of board age diversity on market value, and IC performance. This study contributes to a deeper understanding of the role of age diversity in enhancing a firm's intangible assets and market valuation.

Keywords: Board age diversity, intellectual capital, Thailand.

Received 7 February 2024 | Revised 13 August 2024 | Accepted 4 October 2024.

1. INTRODUCTION

Boards of directors (BODs) are responsible for determining a company's strategic direction, in addition to overall management and governance (Gardiner, 2024). To improve company performance, BODs play a crucial role in developing strategies, deciding on strategic options, and defining the company's vision, mission, and values (Kagzi and Guha, 2018). A critical issue for the corporate boards of listed companies is board composition. A corporate board is considered balanced when its members come from diverse backgrounds, enabling it to function more effectively (Hassan and Marimuthu, 2017). Diversity in corporate board members is one of the most promising and rapidly expanding fields of academic research and remains a top priority for public policy in many countries. However, despite significant debate on the benefits of board diversity on performance, the literature has not yet reached precise and definitive conclusions (Calabrese and Manello, 2021).

Diversity is commonly defined as the distribution of individual traits among individuals, with three distinct conceptualizations: separation, disparity, and variety (Harrison and Klein, 2007). Board diversity encompasses a blend of three spheres: existential (individual life choices), cognitive, and demographic. While the first two spheres can have a significant impact on corporate board composition, they are primarily statistically

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

unobservable (Calabrese and Manello, 2021) and are typically assessed through self-reported perceptions (Abbasi et al., 2023). Therefore, the primary focus of study remains observable demographic diversity such as gender, nationality, age, ethnicity, education, etc.

Diversity on the board indicates the breadth and depth of the board's judgments (Abdullah and Ismail, 2013). Academics and regulators have placed significant emphasis on gender diversity (e.g., Isola et al., 2020; Kabir et al., 2023) and ethnic diversity (e.g., Bin Khidmat et al., 2020; Issa et al., 2021), but other types of diversity tend to be overlooked (Arioglu, 2021; Janahi et al., 2023). For example, no rule or governance code emphasizes the value of age diversity on boards, even though it could have a significant impact (Janahi et al., 2023). PricewaterhouseCoopers (2017) compiled survey data indicating that a significant number of directors consider age diversity to be the most significant form of demographic diversity, surpassing even gender or ethnic diversity (Neukirchen et al., 2022). The increasing prevalence of age diversity in the workplace has led to more studies focusing on the organizational implications of age-diverse workforces (Li et al., 2021). Director age is crucial as it serves as an indicator of a director's decision-making process in the workplace and can also reflect the director's values. A variety of board members of different ages may be particularly crucial in countries that have experienced substantial changes within a relatively short period of time (Arioglu, 2021). Understanding the influence of age diversity among board members on performance is critical, as there is a notable trend towards actively promoting age-diverse composition on corporate boards (Gardiner, 2024).

The existing body of research on the influence of board age diversity shows contradictions, as some studies have documented a favorable correlation between board age diversity and various outcomes (e.g., Kagzi and Guha, 2018; Janahi et al., 2023). Conversely, other studies have reported an unfavorable association (e.g., Ali et al., 2014; Xu et al., 2022; Katsiampa et al., 2023). Furthermore, other researchers have observed that there is no significant correlation between age diversity on corporate boards and firm performance (e.g., Song et al., 2020; Bin Khidmat et al., 2020). According to relevant theories such as resource dependency theory, agency theory, information processing, problem-solving approaches, and prior research, it is reasonable to anticipate a correlation between age diversity and firm outcomes. However, the strength and direction of this association remain uncertain (Gardiner, 2024). In other words, further research is needed to determine whether diversity serves other purposes (Petersson and Wallin, 2017). Gardiner (2024, p.84) also mentioned that "the lack of a significant result—that is, a clear pattern of age diversity as either positive, negative, or curvilinear—is interesting and important to understand."

Previous studies have primarily focused on the relationship between board age diversity and performance in terms of financial performance, corporate social responsibility, and innovation, while overlooking the significance of intangibles such as intellectual capital (IC) performance. Surprisingly, no research has explored the connection between board age diversity and IC performance. I came across a similar study by Li et al. (2021) that examined the correlation between age-diverse workforces and intellectual capital (human and social capital) but was conducted in the context of employees rather than the BODs. Therefore, this study aims to expand on existing literature by investigating whether board age diversity influences firm performance in a developing country context. Drawing on resource dependence theory (RDT), upper echelon theory (UET), and various board diversity and firm performance studies, this research formulates hypotheses regarding the impact of board diversity on two performance aspects: financial performance (both accounting-based and

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

market-based measures) and IC performance. Additionally, the research examines the impact of other board diversity attributes, including gender, tenure, and education, on firm performance. Consequently, the study evaluates governance through the perspective of board demography, specifically focusing on the age diversity of agriculture and food firms in Thailand.

The rest of the paper is structured as follows: Section 2 provides an overview of the theoretical background, previous studies, and hypothesis development. Section 3 details the data set, variables measurement, model specification, and estimation techniques. Sections 4 and 5 present the study's results, discussion, and conclusion.

2. LITERATURE REVIEW

2.1 Theoretical Background

Several theories of diversity attempt to model the nature of the connection between diversity and outcomes. The theories used to explain the impact of board member age diversity on firm performance can be classified into two categories: optimistic and pessimistic. Optimistic theories view diversity positively, such as resource dependency theory, agency theory, upper echelons theory, information processing, and problem-solving approaches. Pessimistic theories, on the other hand, view diversity in a negative light, such as social identity theory, self-categorization theory, and similarity-attraction theory (Mannix and Neale, 2005; Kagzi and Guha, 2018). Among many theories establishing a positive relationship between board age diversity and firm performance, Resource Dependency Theory (RDT) is highly referred to in the literature (Gardiner, 2024). In contrast, the social identity theory was the most cited in the context of a negative relationship.

Resource Dependency Theory (RDT) by Pfeffer and Salancik (1978) is associated with providing resources to a firm, which are crucial for the firm's and the board's successful functioning. RDT claims that a firm's human resources can be successfully managed to achieve high performance and a competitive advantage. Age diversity is widely recognized as a significant attribute contributing to a broader range of viewpoints and specialized knowledge within the company board (Ali et al., 2014). Appointing board members from varied age groups enables the firm to acquire valuable resources, including expertise, skills, and connections with a broader range of external stakeholders. These resources can enhance the firm's growth and success (Gardiner, 2024). A company with a homogeneous board may exhibit inferior results due to its deficiency in the required blend of skills and expertise. This perspective is supported by prior research, which has indicated that the presence of age diversity on corporate boards positively impacts firm performance. For instance, Kagzi and Guha (2018) found that board age diversity positively influences firm performance in the context of KIFs in India. Sitthipongpanich and Piruna (2014) also discovered that age diversity positively relates to firm value. These results indicate that firms should have more diverse boards to improve performance.

The Upper Echelons Theory (UET), proposed by Hambrick and Mason (1984), highlights the significance of managers' beliefs, efforts, knowledge, and experience in determining organizational success (Bin Khidmat et al., 2020). The UET incorporates behavioral decision-making theories and organizational demography principles. The significance of corporate boards lies in their ability to contribute to organizational outcomes, including firm performance and strategy accomplishments. Corporate boards are relevant and can be utilized to achieve organizational goals such as business performance and strategic success. This theory describes how demographic and cognitive diversity influences

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

business performance. The UET concentrates on decision-makers' backgrounds and demographic traits. This is not because demographics are supposed to affect decisions. Instead, demographics assess unobservable aspects such as values, cognitive models, personality traits, and other psychological factors influencing top managers' perceptions of reality (Anessi-Pessina and Sicilia, 2020). Researchers have claimed that diverse boards make more efficient judgments than homogeneous boards (Hambrick and Mason 1984). Companies can attract, maintain, and achieve a competitive advantage from different skills by raising diversity within top management teams (Gelfand et al. 2004).

2.2 Age Diversity and Financial Performance

When it comes to age diversity, there are significant differences between older and younger individuals in terms of their interests, professional backgrounds, educational achievements, technological proficiency, and social connections. Consequently, a team with a diverse age range can combine various resources and enhance the organization's overall knowledge base and information processing capabilities (Harrison and Klein, 2007). Research also indicates that age-diverse groups are more likely to be innovative and adaptable due to their lower susceptibility to groupthink (Janis, 1972). This advantage stems from their ability to foster a wider range of perspectives, leading to more diverse and insightful discussions within the group. Ferrero-Ferrero et al. (2013) and Harrison and Klein (2007) argue that age diversity in a group contributes to a more balanced decision-making process, ultimately leading to improved corporate performance. Mahadeo et al. (2012) also support the argument for heterogeneity, along with Houle's (1990) perspective on the multitasking abilities of a mixed-age board. To enhance the effectiveness of a board, it is beneficial to have a diverse mix of directors across different age groups. This diversity facilitates the exchange of information and experience from older to younger members, promoting a more robust decision-making process (Katmon et al., 2019). The benefits of having a diverse age range in boardrooms appear to outweigh the drawbacks, which may include conflicts, communication challenges, ineffective collaboration, and biases against board members from different age groups (Arioglu, 2021).

However, Gardner's (2024) systematic review revealed that the lack of evidence indicates a negative linear or non-significant relationship between financial performance and board member age diversity. In total, 21 analyses were conducted, with 33.3% of the studies showing a negative correlation, 23.8% indicating a positive association, 9.5% suggesting a curvilinear relationship, and 33.3% finding no significant link between the two variables. According to the similarity-attraction theory (Byrne, 1971), individuals are more likely to be attracted to those who are like them, leading to greater cohesion and social integration among similar individuals. When applied to board member age diversity, this theory suggests that older board members may be less inclined to connect with younger board members, resulting in reduced levels of connection and lower-quality social interactions. The self-categorizing theory (Turner 1982, 1985; Turner and Oakes, 1989) shares similarities with the similarity-attraction theory in its negative view of diversity. In essence, both theories highlight the potential negative impacts of board diversity on firm performance.

As discussed, empirical findings on age diversity and financial performance are inconclusive. The context above highlights the importance of the issues examined in this study. Determining whether age diversity positively or negatively influences financial outcomes offers valuable insights (Katsiampa et al., 2023). Based on the RDT and the UET discussed in Section 2.1, as well as previous research, there are compelling reasons to suggest that age diversity enhances performance. Therefore, the impact of age diversity and

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

financial performance, measured through return on assets (ROA), return on equity (ROE), and Tobin's Q (TBQ), is viewed positively as follows:

H1: Age diversity positively affects financial performance.

H1a-H3c: Age diversity positively affects ROA, ROE, and TBQ.

2.3 Age Diversity and Intellectual Capital Performance

The board of directors develops strategies and policies to gather, deploy, and manage resources in the best interests of all stakeholders (Asare et al., 2023). To maintain their competitive advantages, businesses must identify the competencies that contribute to them (Marr et al., 2004). Knowledge underpins competencies; organizations aiming to cultivate their competencies must recognize and manage their intangible assets, i.e., intellectual capital (Asare et al., 2023). Intellectual capital (IC) is an intangible and conceptual resource that organizations use to create value through the development of new processes for products and services. It is crucial to a firm's asset value (Ni et al., 2020). From an accounting perspective, IC should be disclosed in financial statements, like other assets of a firm entity. However, IC presents challenges in conceptualization, definition, measurement, and reporting within financial reports. The limited provisions of IC accounting standards have led professionals to assess IC using various models developed by researchers across different disciplines (Roslender et al., 2006; Ståhle et al., 2011; Xu and Li, 2019). Stewart (1997) defined IC as integrating experience, knowledge, information, skills, and learning capacity. Conversely, Edvinsson and Malone (1997) argued that IC is hidden between a firm's book and market valuations.

Despite varying definitions in the literature, IC is an intangible asset that can create significant value for businesses (Jardon and Martinez-Cobas, 2021). Given that IC comprises valuable organizational assets, management must prioritize its management. IC consists of human capital (HC), structural capital (SC), and relationship capital (RC). HC, recognized by firms as a core asset (Harjanto and Nurim, 2023), encompasses the attributes possessed by a company's personnel, including knowledge, competence, experience, commitment, and motivation. SC refers to all non-human knowledge resources within businesses related to information technology and organizational structure, leading to business intelligence (Alipour, 2012; Weqar et al., 2021). RC represents the value of a company's relationships with individuals and organizations directly or indirectly linked to the company's value creation. Existing literature demonstrates that effectively leveraging and managing IC performance enhances firm performance (e.g., Nimtrakoon, 2015; Xu and Li, 2019; Weqar et al., 2020). However, few scholars emphasize the role of board diversity in enhancing IC efficiency (e.g., Nadeem et al., 2019; Shahzad et al., 2020; Smriti and Das, 2021; Vetchagool, 2021). Surprisingly, there is no research examining the influence of board age diversity (or heterogeneity) on IC performance.

The primary benefit of age diversity is that individuals from different age groups can leverage knowledge and skills acquired from unique experiences to address the company's challenges. A study by Li et al. (2021) revealed a positive relationship between age diversity in the workplace and IC performance, indicating that age diversity positively impacts organizational performance by enhancing human and social capital. Drawing on the RDT and the UET and related research (as discussed in Section 2.1), it is reasonable to expect a positive impact of board age diversity on IC performance. Therefore, the following hypothesis is proposed.

H2: Age diversity positively affects IC performance.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

2.4 Board Diversity (gender, tenure, education) and Firm Performance

In addition to examining the diversity of board members in terms of age, the relationship between corporate board diversity in various dimensions (specifically gender, tenure, and education) and firm performance remains ambiguous. Several studies suggest that these aspects of diversity positively influence firm performance. For instance, Song et al. (2020) reported that gender diversity positively affected Tobin's Q. Similarly, Bin Khidmat (2020) found that gender and education diversity had a positive and significant effect on the performance of Chinese A-listed firms, based on both accounting and market measures. Research on the FTSE 100 Index demonstrated a significantly positive correlation between board tenure and ROE, indicating that tenure diversity can enhance firm performance by balancing innovation with stability (Roman et al., 2022). Furthermore, Smriti and Das (2021) and Vetchagool (2021) reported that higher gender diversity on boards positively impacted IC performance.

Conversely, other studies have yielded conflicting results. Adams and Ferreira (2009) found that board gender diversity was associated with lower Tobin's Q and ROA. Tanikawa and Jung (2016) reported that tenure diversity had a negative and significant effect on ROE, while Khan et al. (2024) found an insignificant relationship between tenure diversity and firm performance in a study conducted in Pakistan. Mahadeo et al. (2012) and Ujunwa (2012) observed that boards with higher educational diversity negatively impacted firm performance. Similarly, Sitthipongpanich and Piruna (2014) indicated that diversity in educational levels led to lower firm value.

Based on the existing literature and the mixed evidence regarding the impact of board diversity on firm performance, this study is grounded on the theoretical supports regarding benefits from board diversity. The following hypotheses are formulated to explore the effects of gender, tenure, and education diversity on both financial and IC performance:

H3: Gender diversity positively affects financial performance.

H3a-H3c: Gender diversity positively affects ROA, ROE, and TBQ.

H4: Gender diversity positively affects IC performance.

H5: Tenure diversity positively affects financial performance.

H5a-H5c: Tenure diversity positively affects ROA, ROE, and TBQ.

H6: Tenure diversity positively affects IC performance.

H7: Education diversity positively affects financial performance.

H7a-H7c: Education diversity positively affects ROA, ROE, and TBQ.

H8: Education diversity positively affects IC performance.

3. METHODOLOGY

3.1 Sample Selection and Data Sources

This study focuses on agriculture and food companies in Thailand, which are recognized as long-standing sectors with significant implications for the country's population in terms of employment opportunities and cost of living (Pongpanich et al., 2017; Hatane et al., 2021). Moreover, Thailand's economy heavily relies on agricultural and food product exports,

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

making it a net exporter of agri-food commodities (Thammachote and Trochim, 2021). Due to the challenges in collecting information from private companies, this study was limited to companies listed on the Thai Stock Exchange (SET). Data was collected over a five-year period from 2018 to 2022 using the companies' websites and electronic databases such as SETSMART, Form 56-1, and Thomson Reuters. The initial sample consisted of 61 firms in the agricultural and food sectors. After excluding firms with missing variables, the analysis included a total of 45 firms, resulting in 225 firm-year observations.

3.2 Variable Measurement

3.2.1 Dependent Variable

This study utilizes four variables: return on assets (ROA), return on equity (ROE), Tobin's Q (TBQ), and IC performance to develop a suitable measure of firm performance. ROA represents a company's net profit ratio to its total assets for a specific fiscal year, while ROE indicates how efficiently a company utilizes shareholder equity to maximize earnings. TBQ, serving as a proxy for firms' market value, is calculated by the ratio of the market value of equity plus the book value of debt to the book value of total assets (Stulz, 1996; Loderer and Peyer, 2002).

ROA and ROE are fundamental backward-looking measurements determined using accounting standards to evaluate a company's financial profitability or productivity (Kapopoulos and Lazaretou, 2007). In contrast, TBQ is a predictive metric that assesses a company's future growth prospects by comparing its accounting (book) value to its intrinsic (market) value (Kapopoulos and Lazaretou, 2007). Utilizing both types of metrics should capture the dynamics of both past and future performance growth prospects (Boshnak, 2023).

Scholars commonly employ the value-added intellectual capital (VAIC) model to measure corporate IC performance in academic and practical studies (Xu and Wang, 2018). This model, developed by Ante Pulic (Pulic, 2000, 2004), surpasses previous methods of IC measurement. Many experts consider Pulic's VAIC the most appropriate because it utilizes data from the firm's performance rather than subjective measuring methods (Isola et al., 2020). Capital employed and intellectual capital (IC) are crucial assets for creating additional value within a company. The approach evaluates the effectiveness of a firm's intellectual capital alongside its physical and financial capital. The VAIC model, based on audited financial data (Appuhami, 2007), offers objectivity and verifiability, making it suitable for comparing cross-sectional data (Firer and Williams, 2003). This approach measures the efficiency of IC and its components using readily available secondary data. The model is simple to compute and implement, making it suitable for corporate managers and staff with prior knowledge of conventional accounting methods (Alipour, 2012). Furthermore, external stakeholders can easily assess a company's intangible assets using the VAIC model (Vishnu and Gupta, 2014; Shahzad et al., 2020).

However, the VAIC model does not account for RC; instead, this study employs the Modified Value-Added Intellectual Coefficient (MVAIC) model developed by Nazari and Herremans (2007), which has been used by previous researchers in IC studies (e.g., Nazari and Herremans, 2007; Nimtrakoon, 2015; Xu and Li, 2019; Smriti and Das, 2021). MVAIC is the sum of the firm's intangible and tangible assets, which include Capital Employed Efficiency (CEE), Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Relational Capital Efficiency (RCE). Thus, the MVAIC model is represented as follows: MVAIC = CEE + HCE + SCE + RCE; CEE = VA / CE; HCE = VA / HC; SCE = SC / VA; RCE = RC / VA; where VA is a company's value-added, calculated as total revenues

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

(OUTPUT) minus total expenses minus employee expenses (INPUT). Capital Employed (CE) refers to both physical and financial capital. Human Capital (HC) refers to all employee expenses. Structural Capital (SC) is the firm's internal resources derived by subtracting HC from VA. Finally, RC is calculated using marketing, selling, and advertising expenses.

3.2.2 Independent Variable

Diversity is broadly defined as the dispersion of one or more unique characteristics among individuals. It can be further categorised into three distinct conceptualisations: separation, disparity, and variety (Harrison and Klein, 2007). According to Harrison and Klein (2007), heterogeneity in categorical qualities should be referred to as 'variety' and is most accurately assessed using the Blau Index (Blau, 1977), which is defined as $1 - \Sigma (Pi)^2$, where P*i* represents the proportion of board members belonging to each category on the board. In the equation above, P*i* represents the proportion of board members in the i^{th} category of a given attribute, and k indicates the number of categories in each attribute. The Blau index is calculated by dividing each category by its theoretical maximum value ((k - 1)/k). This study builds on the work of Sirinuch et al. (2017), who divided the age of boards of Thai firms listed on the Stock Exchange into four cohorts: 1) under 30 years old, 2) 31-45 years old, 3) 46-60 years old, and 4) beyond 60 years old. When the board is evenly divided into four cohorts, the Blau index runs from 0 to 0.75. The higher the index, the more diverse (in terms of age) the board of directors is (Petersson and Wallin, 2017). In other words, diversity as variety is at its lowest when all individuals belong to the same group and at its maximum when all individuals are represented in various groups (Harrison and Klein, 2007). This measurement also aligns with relevant studies (e.g., Kagzi and Guha, 2018; Li et al., 2021; Neukirchen et al., 2022). To test the result's robustness, the study also estimated AD using the dummy variable, which assumes the value "1" if the average age of the board of directors is less than 60 years and "0" otherwise. Other aspects of board diversity, namely gender diversity, tenure diversity, and education diversity, are also measured using the Blau Index.

3.2.3 Control Variables

Control variables for this study were selected based on prior research on board diversity and firm performance (e.g., Kagzi and Guha, 2018; Smriti and Das, 2021; Asare et al., 2023; Janahi et al., 2023). The study includes controls for other aspects of board diversity such as board size, average board age, and proportion of independent directors. Furthermore, firm attributes such as age, size, and leverage are included as control variables in this framework, as outlined in Table 1.

3.3 Empirical Model

To analyze the impact of board diversity (age, gender, tenure, and education) on firm performance indicators, four econometric models are constructed for each of the two performance class measures. The models are represented by equations (1) to (4).

Financial performance:

Accounting-based performance model

$$\text{Model (1, 2): ROA, ROE} = \alpha + \beta_1 \text{AD}_{it} + \beta_2 \text{GD}_{it} + \beta_3 \text{TD}_{it} + \beta_4 \text{ED}_{it} + \beta_5 \text{BS}_{it} + \beta_6 \text{BI}_{it} + \beta_7 \text{AA}_{it} + \beta_8 \text{Size}_{it} + \beta_9 \text{Age}_{it} + \beta_{10} \text{Lev}_{it} + \varepsilon_{it}$$

Market-based performance model

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

$$\text{Model 3: TBQ} = \alpha + \beta_1 \text{AD}_{it} + \beta_2 \text{GD}_{it} + \beta_3 \text{TD}_{it} + \beta_4 \text{ED}_{it} + \beta_5 \text{BS}_{it} + \beta_6 \text{BI}_{it} + \beta_7 \text{AA}_{it} + \beta_8 \text{Size}_{it} + \beta_9 \text{Age}_{it} + \beta_{10} \text{Lev}_{it} + \varepsilon_{it}$$

Intellectual capital performance:

$$\text{Model 4: MVAIC} = \alpha + \beta_1 \text{AD}_{it} + \beta_2 \text{GD}_{it} + \beta_3 \text{TD}_{it} + \beta_4 \text{ED}_{it} + \beta_5 \text{BS}_{it} + \beta_6 \text{BI}_{it} + \beta_7 \text{AA}_{it} + \beta_8 \text{Size}_{it} + \beta_9 \text{Age}_{it} + \beta_{10} \text{Lev}_{it} + \varepsilon_{it}$$

Table 1: Definition of variables and measurement.

Acronym	Variable used	Measurement
Independent variable		
AD	Age diversity	Measured through two different proxies: 1) The Blau index is calculated as the percentage of board directors in each category (less than 30 years, 31-45 years old, 46-60 years old, and older than 60 years old) 2) The dummy variable assumes the value "1" if the average age of the board of directors less than 60 years, and "0" otherwise
GD	Gender diversity	The Blau index is calculated as the percentage of board directors in each category (male and female)
TD	Tenure diversity	The Blau index is calculated as the percentage of board directors in each category (less than 3 years, 4-6 years, 7-9 years, and more than 9 years)
ED	Education diversity	The Blau index is calculated as the percentage of board directors in each category (below bachelor's degree, bachelor's degree, master's degree, and doctoral degree)
Dependent variable		
MVAIC	IC performance	Measured through the MVAIC model
ROA	Return on asset	Ratio of net profit to total reported assets
ROE	Return on equity	Ratio of net profit to total shareholder's equity
TBQ	Tobin's Q	Ratio of the market value of equity, plus the book value of debt to the book value of total assets
Control variables		
Board specific control variable		
BS	Board size	The total number of members of board directors
BI	Independent board	Proportion of independent directors
AA	Average age	The average age of all board directors
Firm-specific control variable		
Size	Firm size	Natural logarithm of total assets at year-end
Age	Firm age	The total years of the firm's existence
Lev	Leverage	Total debt divided by total asset

4. RESULTS

4.1. Descriptive Statistics

Table 2 presents the descriptive statistics of variables included in the primary analyses. The sample comprises 225 firm-year observations from 45 companies. The average age of directors is 60.44 years, with a range of 43-72 years between 2018-2022 in the Agro and Food Industry. The standard deviation of directors' age is 5.034, indicating a lack of age diversity. Directors in the sample firms are older compared to those in existing literature; for instance, non-financial firms listed on the SET had an average age of 55 years with a range of 40-70 years in 2001-2005 (Sitthipongpanich and Piruna, 2013), and Malaysian listed firms

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

had an average age of 58 years with a range of 45-72 years in 2009–2013 (Hassan and Marimuthu, 2017). The average Blau's index (AD), a proxy for board age diversity, is 0.46, with a range from 0 to 0.74, similar to Sirinuch et al. (2017) mean age diversity index (0.49) for all Thai listed firms in the 2015 fiscal year. Among the four cohorts, directors older than 60 years constitute 57.99%, and there are no directors in the youngest cohort (under 30). Considering these board patterns, agriculture and food boards exhibit relatively low diversity.

The percentage of female directors on the board is approximately 25%, ranging from 0% to 63%. The gender diversity index (GD) is 0.332, the tenure diversity index (TD) is 0.463, and the education diversity index (ED) is 0.533. The MVAIC values for the sample firms range from -9.180 to 16.220, with a mean of 3.238. Among the four components of MVAIC, HCE has the highest average at 2.242, followed by RCE at 0.696, SCE at 0.395, and CEE at 0.273. The average values for ROA and ROE are 6.307 and 6.909, respectively, while TBQ has an average value of 2.038. The mean board size (BS) is 10.880, with a range from 10 to 21 directors, which is comparable to the findings of Isola et al. (2020) who reported a mean board size of 9.16 among GCC countries. The mean firm size and age are 16.426 and 36.622, respectively. The average leverage ratio is 0.422.

Table 2 Descriptive statistics of the variables

Variables	Observation	Min	Max	Mean	S.D.
Dependent variables					
ROA	225	-29.620	28.459	6.307	8.244
ROE	225	-40.140	38.060	6.909	12.616
TBQ	225	0.160	12.600	2.038	2.698
MVAIC	225	-9.180	16.220	3.238	3.002
Independent variables					
AD	225	0.000	0.740	0.464	0.127
GD	225	0.000	0.500	0.332	0.142
TD	225	0.000	0.740	0.463	0.211
ED	225	0.198	0.741	0.533	0.125
Control variables					
BS	225	21	10	10.880	2.629
BI	225	0.143	0.714	0.379	0.086
AA	225	43	72	60.440	5.038
Size	225	13.798	20.451	16.426	1.304
Age	225	7	60	36.622	11.765
Lev	225	0.070	2.520	0.422	0.242

4.2 Correlation Analysis

The correlation matrix results indicate a strong positive correlation (r = 0.924) between return on assets (ROA) and return on equity (ROE). These findings do not pose any problems for regression analysis, as both variables are used as dependent variables. The explanatory variables in this study show no signs of multicollinearity, with all values below 0.60. Additionally, the variance inflation factor (VIF) analysis confirms that there are no issues with multicollinearity (Hair et al., 2010; Kline, 2005).

4.3 Main Analyses and Hypotheses Testing

The research utilized the Hausman test to determine whether to use the random or fixed effects method. Given the statistically significant difference in coefficient estimations

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between the fixed and random effects methods (p-value<0.05), this study adopted the fixed effects method to test all hypotheses. The comprehensive summary statistics of all variables used to examine the effect of board diversity on firm performance are presented in Table 3.

In models 1-2, an analysis of accounting-based performance indicators in this study reveals no statistically significant association between AD and ROA (-7.448, p-value > 0.10) as well as ROE (-11.827, p-value > 0.10). Consequently, the first two hypotheses (H1a and H1b) are not supported. The findings do not provide evidence to support the hypotheses that increasing board age diversity enhances financial performance. These results are consistent with the conclusions drawn by Gardiner (2024), who conducted a comprehensive quantitative research analysis over the past 26 years on the relationship between board member age diversity and firm outcomes in developed and developing economies. Most researchers did not observe a statistically significant correlation between board age diversity and firm performance. Gardiner (2024) also stated that "age diversity is not a robust or consistent predictor of a firm's financial performance." In the context of an insignificant association, Bin Khidmat et al. (2020) on Chinese companies found an insignificant effect of age diversity on ROA, where age diversity was measured through the ratio of young members under 50 to total board members. The result aligns with the findings of Okon Akpan (2014), who found no evidence to support that director between the ages of 25 and 45 affect firm performance (measured by turnover). However, the current study's findings contradict previous research, which found either a significant positive relationship between age diversity and performance (e.g., Sitthipongpanich and Piruna, 2014; Kagzi and Guha, 2018; Neukirchen et al., 2022) or a significant negative relationship (e.g., Ali et al., 2014; Xu, Fernando, and Schneible, 2022).

In Model 3, the impact of age diversity on TBQ is statistically significant at a 10% level (3.079, p-value<0.10), confirming Hypothesis H1c. The results show a positive correlation between increasing age diversity and firm value, aligning with previous studies (Sitthipongpanich and Piruna, 2013; Kagzi and Guha, 2018) but contradicting Song et al.'s (2020) findings that age diversity has no significant effect on Tobin's Q in publicly traded US lodging firms. Model 4 examines the non-financial performance, specifically IC performance. A significant positive impact is observed between AD and MVAIC, supporting H2 (6.924, p-value<0.01). Increasing in age diversity enhances IC performance. This outcome is consistent with Li et al.'s (2021) findings that age-diverse workforces are linked to enhanced human and social capital. Janahi et al. (2023) also proposed that age-diverse boards are more effective in monitoring managerial decision-making.

In terms of other aspects of board diversity, namely gender, tenure, and education (Models 1-3), there is no significant impact on ROA, ROE, and TBQ. Therefore, hypotheses H3a-H3b, H5a-H5c, and H7a-H7c are not supported. The findings do not provide evidence to support the hypothesis that increasing board diversity enhances financial performance. Only gender diversity is found to significantly impact TBQ at the 10% level (2.212, p-value<0.10), confirming Hypothesis H3c. Model 4 demonstrates the impact of gender diversity (GD) and tenure diversity (TD) on MVAIC. High IC performance is associated with increasing levels of gender and tenure diversity in boardrooms. Consequently, hypotheses H4 and H6 are supported. These findings are consistent with previous research

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(e.g., Nadeem et al., 2019; Shahzad et al., 2020; Smriti and Das, 2021; Vetchagool, 2021), which has shown a positive impact of gender diversity on IC performance.

The impact of tenure diversity on IC performance is also supported by Resource Dependency Theory (RDT) and Upper Echelons Theory (UET), as a mix of experienced and newer board members combines institutional knowledge with fresh perspectives, enhancing strategic decision-making. However, there is no statistically significant impact of education diversity (ED) on IC performance. Consequently, hypothesis H8 is not supported.

Table 3: The effect of board diversity on ROA, ROE, TBQ, and MVAIC

	ROA	**ROE**	**TBQ**	**MVAIC**
Model summary	**Model 1**	**Model 2**	**Model 3**	**Model 4**
R^2	0.621	0.597	0.393	0.469
Adjusted R^2	0.504	0.472	0.200	0.304
F-statistic	5.289***	4.771***	2.042***	2.846***
Durbin–Watson	1.780	1.833	2.423	2.384
Constant	16.182 (1.169)	51.549** (2.358)	0.773 (0.086)	-14.300** (-2.395)
AD	-7.448 (-1.110)	-11.827 (-1.117)	3.079* (1.756)	6.924*** (3.199)
GD	-4.317 (-0.860)	-9.597 (-1.211)	2.212* (1.683)	6.296** (2.177)
TD	4.057 (0.739)	10.403 (1.200)	0.255 (0.177)	4.814** (2.034)
ED	2.977 (0.324)	-4.734 (-0.326)	0.458 (0.190)	1.971 (0.497)
BS	-0.541 (-1.332)	-0.777 (-1.211)	-0.020 (-0.184)	-0.357** (-2.035)
BI	-19.523* (-1.786)	-33.072* (-1.916)	-3.916 (-1.370)	-12.320*** (-2.613)
AA	-0.985 (-1.009)	-0.679 (-0.440)	-0.202 (-0.792)	0.040 (0.096)
Size	-0.315 (-0.623)	-1.209 (-1.515)	0.313** (2.365)	0.859*** (3.944)
Age	0.312 (0.983)	0.096 (0.192)	0.220 (0.987)	0.131 (0.958)
Lev	-2.326 (-0.989)	-3.458 (-0.931)	0.226 (0.366)	-1.317 (-1.298)

Notes: The t-values are in parentheses. The asterisks indicate statistical significance at the following levels: *p < 0.10; **p < 0.05; ***p < 0.01.

Notably, there is an inverse correlation between board independence and firm performance, as indicated by ROA, ROE, and MVAIC. This aligns with previous studies by Al-Musali and Ismail (2015) and Asare et al. (2023), suggesting that boards with lower levels of independence are more likely to drive policies and actions that enhance company performance. The presence of controlling shareholders in the selection of independent directors may impede the selection of truly independent directors (Al-Musali and Ismail, 2015). Firm size is one of the firm-specific control variables that show a significant link to MVAIC and TBQ at a 1 and 5 percent level of significance, respectively. Consistent with prior research, this study indicates that the size of agricultural and food companies significantly influences their firm value and IC performance. However, there was no statistically significant correlation observed between firm age, leverage, and firm performance. These findings suggest that firm performance is not strongly influenced by firm characteristics such as age and leverage.

Robustness analyses (not reported here for brevity but available upon request) were conducted using an alternative proxy for Age Diversity (AD), defined as a dummy variable ("1" if the average age of the board of directors is less than 60 years, and "0" otherwise).

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These analyses confirm the main results of the hypothesis testing. Additional analyses demonstrate a positive and significant impact of age diversity on firm value (p-value < 0.10) and IC performance (p-value < 0.01), but not on firm profitability (p-value > 0.10). Similarly, for other aspects of board diversity and control variables, the results are consistent with those presented in Table 3.

5. DISCUSSION AND CONCLUSION

This study investigates the impact of board diversity on financial performance and IC performance in the agricultural and food industry. The analysis utilizes a panel data set of 45 Thai-listed firms from 2018 to 2022, employing the fixed-effects estimation approach. The findings indicate that a broader range of age groups represented on boards of directors has a positive impact on firms' value and IC. The study shows that a diverse board of directors can enhance a firm's efficiency by leveraging their expertise and abilities. These findings are consistent with the resource dependence theory (RDT) and upper echelon theory (UET), which view diversity positively and argue that it contributes to performance by providing additional resources, human capital, or stimulating debate (Gardiner, 2024). Therefore, the results of this study contribute valuable insights to existing theories on board age diversity. However, the study does not provide evidence to support hypotheses regarding the impact of board age diversity on financial performance, as measured by ROA and ROE. In certain firm contexts, RDT and UET may not fully explain the mechanisms of board diversity and financial performance, especially in terms of accounting-based measures.

The lack of a significant impact of board age diversity on ROA and ROE can be explained by the different types of performance measurements used. Intellectual capital serves as an intermediate form of performance measurement based on value-added, which includes intangible assets and physical capital efficiency, and is considered a value-creating aspect of age diversity (Li et al., 2021). In contrast, ROA is a more distal financial performance measure (Ali et al., 2014; Richard et al., 2007). The resources provided by age diversity, such as improved decision-making and diverse external linkages, may take time to manifest in financial (tangible) performance (Ali et al., 2014).

In summary, the impact of board diversity, particularly age diversity, on firm performance remains inconclusive, as the findings deviate from theoretical predictions. It appears that a firm's market value and intellectual capital success, rather than its financial profitability, are more suitable indicators of the benefits of age diversity. In addition, the results suggest that specific types of diversity (age, gender, and tenure) positively influence particular aspects of firm performance, with IC performance being most positively influenced by diversity variables. Thus, while board diversity enhances a firm's value, its impact on profitability may not be as apparent.

This study addresses crucial gaps in literature by strengthening the business case for board-age diversity. It provides the first evidence of a positive impact of board age diversity on firm value and IC performance. Previous research on board age diversity did not explore the impact on both financial and non-financial outcomes. This evidence supports the growing calls for more diverse boards and underscores the significance of age diversity (Xu et al., 2022; Janahi et al., 2023). While the influence of board age diversity on profitability may not be statistically significant, this study emphasizes the importance of increasing age diversity in the boardroom. Age diversity emerges as a stronger predictor of firm value and

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IC performance. Age diversity brings diverse perspectives, better representation of stakeholders, reduces groupthink, fosters innovation and creativity, and promotes inclusivity in the workplace. Embracing age diversity and including members from various age groups can lead to more successful and effective boards. However, it is essential to remember that age diversity alone does not guarantee board performance. A combination of individuals with the necessary knowledge, experience, and skills is crucial for making prudent decisions and guiding the organization to success.

According to Ahuja and Ahuja (2012), firms with superior IC performance are more likely to succeed, while those with inferior IC performance need to enhance their performance. Chatterjee et al. (2022) found significant evidence that increasing HC, SC, and RC could enhance a firm's performance and influence competitive advantage. Similarly, Mutiarni et al. (2023) discovered that implementing Islamic human capital and Islamic social capital improved the performance of Islamic cooperatives in Indonesia. This underscores the importance for businesses to prioritize board-age diversity to enhance IC performance, leading to improved financial performance and sustainable competitive advantage (Chatterjee et al., 2022). Therefore, firms aiming to improve their market valuation and intellectual capital efficiency should prioritize age and gender diversity in board composition. At the same time, they should ensure that board size remains manageable and that independent directors are well-integrated with firm-specific knowledge to optimize decision-making and performance outcomes.

The study's limitations include focusing on Thai-listed companies in the agricultural and food industry, which may limit the generalizability of the findings. Future research could explore different industries or cross-country samples to enhance the study's applicability. Investigating the mediation effect of IC performance on the relationship between board age diversity and financial performance would be an interesting avenue for further research. Additionally, investigating the dynamics of how different forms of diversity interact with each other to impact firm performance could provide more comprehensive insights. Future studies could incorporate moderators or mediators to explore the relationship between board diversity and firm performance.

ACKNOWLEDGMENTS

The author is grateful for the financial support received from the Faculty of Business Administration and Accountancy, Khon Kaen University, under grant number 005/2566. Additionally, I would like to thank the anonymous reviewers for their insightful comments and helpful suggestions.

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