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Board diversity and intellectual capital disclosure of Chinese-listed firms with Belt and Road Initiative projects

Belt and Road
Initiative
projects

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Abstract

Purpose – Chinese-listed firms with Belt and Road Initiatives (BRI) play a crucial role in advancing the outward investment policy of China. Board diversity can be vital, and intellectual capital disclosure (ICD) showing future earnings can build investor confidence in these firms. This study examines these two relationships in Chinese-listed firms with BRI projects during a predictable business outlook period (2019, pre-Covid period) and unpredictable business outlook period (2020, Covid period).

Design/methodology/approach – The study used least squares regression that analysed the target population comprising 79 listed Chinese firms with BRI projects in 2019 and 2020. The China Stock Market and Accounting Research (CSMAR) database provided board diversity data. Analysing annual reports using content analysis provided the ICD data, collected by following an established intellectual capital (IC) coding framework in the literature. After collecting board-related data, the study calculated the diversity between boards in firms (diversity of boards – DOB) using cluster analysis. The study estimated the diversity within each board (diversity in boards – DIB) using Blau's Index.

Findings – The findings indicate that in the predictable business outlook environment, DOB positively associates with ICD, and DIB negatively associates with ICD. In the unpredictable business outlook environment, the DIB and DOB interaction negatively associates with ICD, and DOB positively associates with ICD.

Research limitations/implications – The findings apply to Chinese-listed firms with BRI projects and further research is required to generalise findings beyond them. This study used annual reports to collect ICD, but a future study could examine BRI firms' social media and website disclosures. The attributes selected for board diversity dimensions can contribute to bounded findings, and future studies could expand the board diversity attributes included.

Practical implications – The findings provide insights into firms' board composition and structure associated with ICD.

Originality/value – This is one of the first studies providing empirical evidence about board diversity and ICD of Chinese-listed firms with BRI projects.

Keywords Belt and Road Initiative, Board diversity, Diversity of boards, Diversity in boards, Intellectual capital disclosure

Paper type Research paper

1. Introduction

China was a closed market economy until 1978. Since 1978, China has changed its foreign investment policy to attract investments into China. Since then, the country has built a

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strong manufacturing base that has raised its economic prosperity, increasing worldwide attention. In 2013, China unveiled an economic advancement for outward foreign investment to expand its trade relations. The trade relations contained two concepts: the Silk Belt Economic Road (trade by land) and the New Maritime Silk Road (trade by sea). They are together known as the Belt and Road Initiative (BRI). A primary objective is to sell its excess industrial production in the short run and infrastructure development in the long run. China has chosen six corridors to connect with other countries with BRI projects (Li *et al.*, 2022).

The chosen firms are the entire target population (from now on referred to as the BRI-listed firms) complied with the selection criterion that they implement Belt and Road Initiative projects (BRI, formerly known as One Belt One Road or OBOR for short). Since BRI-listed firms play a crucial role in China's outward foreign investment, the directors play a vital role in making decisions about internationalising firm activities (Rivas, 2012). There is empirical evidence available about United States and European firms' internalisation strategy (Rivas, 2012), but the Chinese situation remains largely unknown.

There are studies conducted on the relationship between board diversity and voluntary disclosure, corporate social disclosure (Hoang *et al.*, 2018; Khan *et al.*, 2019) and carbon disclosure (Lahyani, 2022). However, these studies focused on stakeholder-focused disclosure, whereas this study examines intellectual capital disclosure (ICD), which is shareholder-focused disclosure.

Strategic decisions stem from the identifiable competencies and capabilities of firms that demonstrate a relationship between innovative approaches and firm performance to shape their sustained competitive advantages (Helfat and Martin, 2014). Intangible resources are vital assets of firms in the contemporary knowledge-based society that yield dynamic capabilities and internal governance mechanisms (Teece, 2018). The intangibles unaccounted for on financial statements, collectively known as intellectual capital (IC), play a critical role in providing board diversity with value-creating resources to make decisions about future earnings value creation (Abeysekera and Guthrie, 2002; Al-Musalli and Ismail, 2012). This study aims to understand the role diversified boards play in disclosing IC. The research has shown that diverse boards favour voluntary disclosures (Rao and Tilt, 2016a), but this study specifically examines the association between diversity of boards and ICD in the context of Chinese BRI-listed firms with BRI projects. The paper focuses on both diversity in board (DIB) and diversity of board (DOB) aspects (Hafsi and Turgut, 2013).

To meet the aim of this paper, section two examines relevant literature, and section three is about theoretical frameworks; section four presents the research methodology and empirical regression models. Section five reports the results and discussion; the final section provides conclusions with research limitations and implications.

2. Literature review

Board members are diverse because of their differences in personal attributes. These are a director's gender, age, educational qualifications, and nationality. The collective outcome of these demographic differences constitutes the diversity in boards (DIB). Boards are also diverse because of the structural differences between boards. These include CEO-Chairperson duality (CEO duality), director ownership in firm, independent directors proportion, and board size; the collective product of structural differences is known as the diversity of boards (DOB) (Hafsi and Turgut, 2013; Hoang *et al.*, 2018).

2.1 Diversity of board (DOB) and voluntary disclosure

Studies have examined the effectiveness of individual structural board characteristics and show mixed findings. From an agency perspective, the CEO holding the chair role can lead to opportunistic behaviours enabling the individual to control and drive the corporate agenda and select board members. On the other hand, from a stewardship perspective, CEO duality leads to better operational and strategic decisions because there are fewer conflicts to deal with in decision-making (Abeysekera, 2010).

An independent director is one who is not a past or current executive and has no business relationship with the firm but can have ownership in it (Agrawal and Nasser, 2019). Independent directors are perceived to act in the firm's best interests, leading to increased stewardship. Their presence decreases managerial opportunism and can enhance voluntary disclosures (Rahman *et al.*, 2020). They can act in such ways as to maintain their good reputation (Cheng and Courtenay, 2006). However, the association of independent directors with ICD is mixed. Studies that found a positive relationship show that independent directors have more influence on board decisions as they are perceived as impartial and carry reputations (Garcia-Sanchez and Martinez-Ferrero, 2018; Vitolia *et al.*, 2020). Other studies found a negative or no relationship situation in which independent directors are not genuinely independent but are merely outside directors showing no association with voluntary disclosure (Barako *et al.*, 2006; Abdullah *et al.*, 2011). The indeterminate association of independent directors with voluntary disclosure can arise due to the degree of independence these directors have on the boards regarding firm voluntary disclosures (Nili, 2020). In real life, there is an interconnection between structural attributes and decision-making.

2.2 Diversity in board attributes (DIB) and voluntary disclosure

Studies have examined the effectiveness of individual attributes that constitute DIB, and the influence of gender on board members is widely studied (Boulouta, 2013; Krishnan and Parsons, 2008). Nadeem (2020) and Nicolò *et al.* (2021) reported that more female presence in the boardroom is associated with greater ICD. They explained that female directors are more diligent and proactive in firms, making more ICD. However, research also found no association between gender and voluntary disclosure, highlighting that corporate governance regulatory contexts can play a crucial role (Rahman *et al.*, 2019). The director's age is less well studied, possibly because of the difficulty in obtaining these data, as in some jurisdictions, it is not a requirement to disclose age. One study has reported director age has no significant influence on voluntary disclosure (Lahyani, 2022). In real-life decision-making situations, directors bring their demographic attributes as individuals, making it difficult to effectively relate those decisions without considering them together.

2.3 Diversity in board (DIB) diversity of board (DOB) as a composite index for voluntary disclosure

Hafsi and Turgut (2013) have pointed out that these individual diversity attributes can have an effect. Their study aggregated the board attributes under two diversity effects. The DIB index relates to demographic characteristics based on dissimilarities of board members within a given board. The DOB index relates to dissimilarities among firm boards due to differences in the structural attributes of board composition. Hoang *et al.* (2018) used this approach to examine the association between DIB and Corporate Social Responsibility Disclosure (CSD) and the association between DOB and CSD.

The two studies differ in their approach, where Hafsi and Turgut (2013) determined the relationship between each diversity attribute and diversity as constructs of corporate social performance. In contrast, Hoang *et al.* (2018) examined diversity as a construct concerning

corporate social disclosure. [Hafsi and Turgut \(2013\)](#) also examined the interaction effect of board diversities. Both studies found diversity in the board influences the outcome variable.

2.4 A case to examine the board diversity and ICD association

[Koutoupis et al. \(2022\)](#) reviewed the board diversity literature and concluded that studies have focused more on firm performance and less on voluntary disclosure in developed country settings. The exceptions are [Rao and Tilt \(2016b\)](#), which examined the association between board diversity and CSD with listed firms in Australia; [Hoang et al. \(2018\)](#), which investigated CSD with listed firms in Vietnam. Both studies found a positive association. [Juwita and Honggowati \(2022\)](#) examined sustainability disclosures of Indonesian-listed firms. They found no association between the before and during the COVID-19 periods, concluding that diverse boards had little impact during business resilience challenges.

So far, studies have only sparingly examined the effect of board diversity on ICD. The lack is more so with the need to understand the role of board diversity in the context of predictable and unpredictable business outlooks – such as the Covid-19 period. Further, [Wang \(2014\)](#) points out the deficiency of such studies in China, heightening the lack of understanding and the need for empirical contribution. Examining the relationship between board diversity and ICD in the context of two different business outlooks with Chinese-listed firms with BRI projects can bring a valuable understanding of those firms, Chinese policymakers, and the countries implementing BRI projects. As the BRI is an internationalising foreign investment plan of China, when those listed firms go international to operate, they have to adjust to various cultural and regional attributes and regulatory recommendations of the host nations, which might influence voluntary corporate disclosure. [Khatib et al. \(2021\)](#) pointed out that future studies need to consider the interactions of board-related attributes as the recent research ignores the interaction between them.

3. Theoretical frameworks and hypotheses development

3.1 Agency theory and diversity of boards (DOB)

[Hoang et al. \(2018\)](#) point out that the diversity of board aspect relates to directors fiduciary role, where directors monitor managerial actions undertaken to ensure that they align with shareholder interests. ICD are about value creation and directors can monitor whether managers disclose them to increase information transparency for shareholders.

[Figure 1](#) shows the theoretical constructs and operational variables that represent them. The two constructs are agency and firm effectiveness. The agency is operational as DOB and the firm effectiveness is operational as ICD. Agency theory posits that managerial staff carry

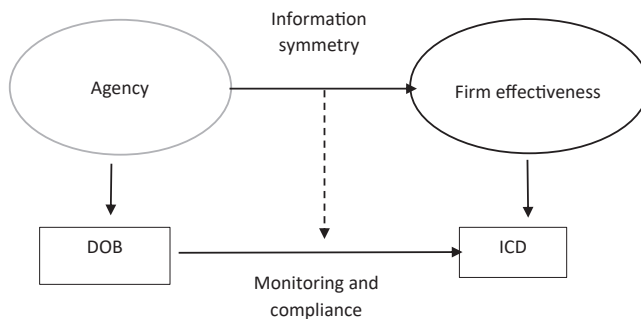


Figure 1.
Agency theory and
diversity of boards

Source(s): Authors elaboration

hidden characteristics to make welfare gains for them, which can result in organisational actions that lead to welfare losses to owners and investors. Research relating to agency theory has identified various tools and mechanisms to improve investor welfare through managerial decisions. These include providing incentives to increase firms' accounting and market values, and another is to bring independent directors above them who can monitor staff compliance with rules and regulations (Linder and Foss, 2015).

The board structure requires board members to oversee monitoring and compliance, leading to good governance. Studies show that firms board structures differ in board governance. Differences in the proportion of independent directors, the board size, CEO and chairperson being the same person or not (role duality), and independent directors taking active roles in remuneration, audit, compensation, and recruitment committees are examples. Good structural board compositions lead to better governing of the firm (Abeysekera, 2012; Petra, 2005). Different attributes of the board composition contribute variously towards it. For example, García-Sánchez and Martínez-Ferrero (2018) showed that independent directors support evidence-based voluntary disclosures contributing to enhanced disclosure accountability.

Well-governed firms have shown an association between structural board diversities and voluntary disclosures (Hoang *et al.*, 2018; Rao and Tilt, 2016a). Larger boards can replace skill deficiencies in firms to make a greater voluntary disclosure. They also can pay unequal attention to disclosure strategy (Abeysekera, 2010). Hoang *et al.* (2018) found that structural board diversity, measured as DOB, did not influence CSD and instead suggestively concluded as DOB may have had an indirect influence on CSD.

Good governance through DOB can help reduce information asymmetry with firms making voluntary disclosures about firm effectiveness through ICD, as explained by the agency theory as reducing agency costs (Hoang *et al.*, 2018). The investor-relevant disclosures, such as ICD, can help to correct firm mispricing valuation by shareholders and investors (Goebel, 2019). However, the Covid-19 crisis has broadened the monitoring and compliance aspect beyond agency's theoretical perspective focussing on reporting to investors. In a predictable value creation business outlook, firms organise the board structures to focus on monitoring and compliance to reduce such information misalignment towards investors. Based on this discussion, this study states the following hypothesis.

H1. DOB associates with ICD in a predictable business outlook environment (2019 year).

The Covid-19 pandemic challenged the board to become effective quickly because many firms across several industries settled for low revenue, profits, and losses. A strand of thought is that board structures are more rigid and take time to change, subject to how much firms are adaptable to change. Since DOB has a structural focus on monitoring and compliance, it is not practical to make sudden monitoring and compliance changes. The study expects that DOB on its own is unable to respond to the crisis condition being ineffective in assessing ICD as future earnings. However, in an unpredictable business outlook such as Covid-19, the DOB takes a broader focus on risk mitigation for society. For instance, DOB is likely to focus on monitoring and compliance on value chains, supplier chains, occupational health and safety; rather than to maximise investor returns (Paine, 2020). However, it is likely to maintain its valued strategic contribution. Therefore, this study states the following hypothesis.

H2. DOB associates with ICD in an unpredictable business outlook environment (2020 year).

3.2 Resource dependence theory and diversity in boards (DIB)

Directors also play an advisory role to the management and good governance. A diverse board membership can bring out diverse expertise and experiences to increase good governance (Hoang *et al.*, 2018; Lahyani, 2022).

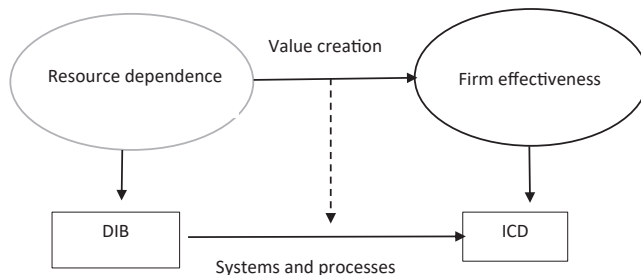
Figure 2 outlines the theoretical constructs and operational variables relating to the association between DIB and ICD. Resource Dependence Theory states that firms depend on their organisational environment to obtain resources. Mergers and acquisitions can become too expensive, ineffective, and even make it impossible to own resources because the anti-trust and unfair competition legislation can interfere with them by restricting such activities. A focal firm can avoid anti-trust legislation to obtain and share resources through alliances, joint ventures, outsourcing, and franchise arrangements with other firms (Carter *et al.*, 2010). A more innovative way of obtaining resources is to have a suite of diverse directors as knowledge resources to assist with increasing firm effectiveness (CSRC, 2006).

The resource dependence theory explains an enterprise's dependence on the external environment to obtain resources to increase effectiveness (Hoang *et al.*, 2018). Demographically diverse board members are a resource acquired by the firm for the strategic direction that can share various ideas, thoughts, and practices to make the best decisions to maximise value creation by controlling the uncertainties in the business environment (Hillman *et al.*, 2009). However, as pointed out in the literature review, studies have found mixed evidence about individual demographic attributes and voluntary disclosure. The point to note here is that diverse knowledge resources of directors become essential to meet marketplace competition and a positive association between DIB and ICD is expected because investors want to know about value creation through future earnings. However, BRI-listed firms do not have such market-based competition because the Chinese government awards BRI projects to selected firms chosen by the Chinese government. Based on the above discussion, and noting attributes have provided mixed results about the directional association, the study states the following hypothesis.

H3. DIB does not associate with ICD in a predictable business environment (2019 year).

In the unpredictable Covid-19 business outlook, a typical firm requires quick responses with the help of diverse knowledge and skills that board members can bring to make decisions. A case study undertaken with HSBC has shown such imperatives are constrained by board members lack of preparation with remote working, open and alternative channels of communication (Sivaprasad and Mathew, 2021). In a questionnaire survey, Huber *et al.* (2021) found that directors increased collaboration between themselves and management, spent more time on board work, focused on resilience and implemented new processes. The survey found the most prominent drawback boards had at the start of the pandemic was a lack of board member interactions and discussions. The lack of interactions among board members could have diminished their sharing of knowledge resources. Therefore, the study states the following hypothesis.

H4. DIB does not associate with ICD in an unpredictable business environment (2020 year).



Source(s): Authors elaboration

Figure 2.
Resource dependence
theory and diversity in
boards

3.3 Resilience theory and the interacting role of board diversity (DIBDOB)

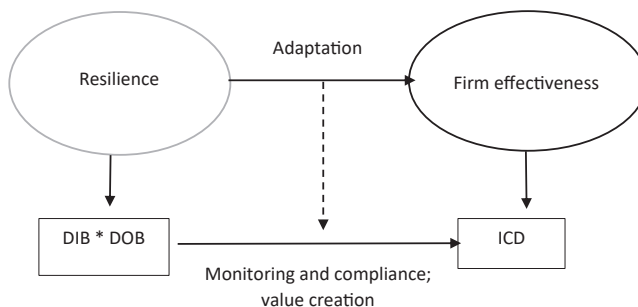
Figure 3 outlines the theoretical constructs and their representations of operational variables for the relationship between DIB and DOB interaction and ICD. Research on resilience has not entirely agreed on a uniform construct. Resilience-related research conducted with firms shows how firms respond to various adversities. These include threats, establishing reliability and employee strengths, and adopting business models and design principles that reduce supply chain vulnerability and disruption. Each research stream has conceptualised resilience differently, and within each stream, the context has influenced the conceptualisation. From a firm perspective, resilience enables an enterprise to respond quickly to unusual ways of doing business under duress, such as crises. These crises come under two categories: internal and external. Early research has focused on firms responding to internal crises such as technology. External crises, such as the global financial crisis that had a worldwide impact, have been occasional and unusual events that firms have had to respond to (Linnenluecke, 2017).

Corporate boardrooms facilitate firms' access to external resources in the outside environment (Song et al., 2020). Building an interacting role between board attributes is one way to increase the effectiveness of firm boards as diversity brings more perspectives, knowledge and experience into the boardroom, which enables the board to perform its commitments better (Malagila et al., 2021). In the same vein, the interaction of board diversity facilitates firms to remove ineffective management teams (Wellalage and Locke, 2013).

The DIB and DOB interaction can benefit firms by providing a competitive advantage to meet competition. Conceptually, board members interacting with each other increases the DIB focus. Diverse board structures can facilitate such interactions. A predictable business outlook is unnecessary for BRI-listed firms because they do not have to compete for BRI projects which are provided to them by the Chinese government. Based on these, the study states the following hypothesis.

H5. DIB and DOB interaction does not influence the ICD in a predictable business outlook (2019 year).

Factors influencing resilience are far from complete in the literature (Saad et al., 2021). However, this paper argues that resilience becomes vital in times of business outlook crisis. At times with predictable business outlooks, DIB focuses on value creation and DOB on monitoring and compliance. In an unpredictable business outlook such as Covid-19, the DIB typically becomes a vital knowledge resource to respond with a broader horizon of monitoring and compliance extended beyond the shareholder focus. However, DIB in BRI-listed firms does not have a value creation focus because BRI projects provide them with a



Source(s): Authors elaboration

Figure 3. Resilience theory and diversity of boards and diversity in boards interaction

definitive market share with which other firms cannot compete. Such interaction can negatively influence ICD because of the DIB lack of focus on value creation. On the other hand, DOB becomes vital to monitor risk and meet with compliance relating to the disrupted value chain, supply chain, and employee welfare such as during the Covid-19 period that extends their monitoring risks and compliance to include society (Paine, 2020). The importance is heightened because BRI-listed firms can get involved in technologies, equipment, and infrastructure projects where firm governance requires needs to harmonise with cultural, institutional, and political contexts of partner nations (Weng *et al.*, 2021), and to create a China-centric economic order (Palit and Bhogal, 2022). Based on these, the following hypothesis is stated.

H6. DIB and DOB interaction negatively influences the ICD in an unpredictable business outlook (2020 year).

4. Methodology

4.1 Firms selection

The target population, selected from the China Securities Index Co., Ltd (CSI), an authorised index provider sponsored by the Shanghai Stock Exchange and the Shenzhen Stock Exchange. The target population comprised 83 BRI-listed firms obtained from the CSI's website (www.csindex.com.cn) in 2019 (pre-Covid period) and 83 firms in 2020 (Covid period). They belong to industry categories of minerals, utilities, manufacturing, technology, and services. In the 2019 list, one of the listed firms, was involved in consolidation and reorganisations, and three firms had insufficient data. The final firm observations for 2019 became 79 firms. In 2020, three firms had inadequate data and we omitted one firm undergoing reorganisation. The final firm observations for 2020 was 79 firms.

4.2 Data collection

4.2.1 Dependent variable – ICD. Intellectual capital (IC) refers to knowledge-based resources that can create financial value for firms (Abeysekera, 2021). Empirical studies have investigated ICD using firms' annual reports, as they provide publicly signalled financial and non-financial values to investors (Abeysekera, 2010). Hence, this study examined firms' annual reports to obtain ICD.

The study used the content analysis research method to identify ICD in annual reports. Content analysis is an established research method applied in ICD studies and rigorously applied for text analysis (Salvi *et al.*, 2020). This study used a coding ICD framework comprising ICD items to obtain valid and reliable ICD data (Abeysekera, 2011). It used latent content analysis with as many synonyms of ICD items as possible to encompass more comprehensive ICD items. It captured them by the meanings assigned to each ICD item by counting the number of times each ICD item was disclosed. The study agreed on equivalent Chinese words for the English language coding framework because annual reports were in Chinese (Abeysekera, 2006).

After an initial screening of ICD items was established in the literature, the study verified their relevance to the Chinese context by asking selected Chinese executives to provide feedback. The study finalised ICD items in the coding framework as follows. The human capital dimension had 15 ICD items, the relational capital dimension had 14 ICD items, and the structural capital dimension had 15 ICD items. The study obtained a similar number of items from each dimension to equitably and sufficiently represent them. The framework had a total of 44 ICD items. Several weeks after extraction of the ICD data, the first author conducted the coding again and ensured that captured ICD items had a high degree of accuracy. [Table 1](#)

Table 1.
ICD coding framework

Human capital disclosure items	Relational capital disclosure items	Structural capital disclosure items
Employees' backgrounds	Supply chains/producers	Research and development
Employees' qualities/traits	Distribution channels	Patents
Career development	Partnerships	Proprietary technology
Employment assessment	Cooperation relations	Copyrights
Employment expenditures	Agreements/contracts	Trademarks
Motivation	Market shares	Databases
Bonus scheme	Customers/clients	Technological processes
Training programs	Customer services	Management processes
Promotion opportunities	Franchising agreements	Monitors/browsing
Educational background	Licensing agreements	Machines/equipment
Qualifications/certifications	Business collaboration	Information systems
Profession titles	Favourable contracts	Networking systems
Attitudes	Brand building	Management philosophy
Values	Quality standards	Corporate culture
Human resources		System integrating

Source(s): Authors work

shows the ICD items used for the content identified and classified by intellectual capital dimensions.

Guided by the literature, the study identified board diversity attributes and classified them as DOB and DIB (Hafsi and Turgut, 2013; Hoang *et al.*, 2018). The DOB is about the structural attributes, comprising board size, director independence, and board leadership duality (Hafsi and Turgut, 2013). The DIB is about the demographic attributes; comprising gender, age, degree backgrounds, and professional titles (Hoang *et al.*, 2018). An informal survey found them to be the two most suited to the Chinese business context. As there is no common consensus about the attributes that make up DIB and DOB, this study used the board attributes of Hafsi and Turgut (2013) to guide the make-up of DIB and DOB. They proposed several index compositions, including board size, director independence, and board leadership duality.

4.2.2 Independent variable: diversity-of-boards (DOB) index. These three structural attributes were then used in constructing a DOB index for each firm using the cluster analysis research method, as done in previous studies (Hafsi and Trugut, 2013; Hoang *et al.*, 2018). Cluster analysis helped identify those ICD items with high similarities, clustering them into distinct groups.

The dissimilarity of a DOB attribute refers to the distance measured. The distance (interpreted as dissimilarity or diversity) is measured by comparing an attribute to the same attribute in other firms. The distance measured represents the dissimilarity of each DOB attribute among firm boards in these firms. We then employed the outlier detection method to identify dissimilarity in the three DOB attributes in the study. We did that by comparing a given firm with an attribute to how far away it was from those of other firms with the same attribute. We did this for all three attributes separately.

The process of measuring DOB attribute dissimilarity followed three steps. First, the study identified the data type of the DOB attributes and then calculated the dissimilarity values of each attribute based on the dissimilarity formula for that data type. This study designated two data types: ratio (board size, director independence) and binary (CEO duality). Second, the study calculated the average value of the distance of these three DOB attributes in each board of firms. The distance value stands for the dissimilarity value of a firm board. Third, the study measured the distance of the three DOB attributes in a given firm board by corresponding to those of the remaining firm boards to measure the DOB value of that firm.

We then added the three distances of the three attributes to make up the DOB value of that firm. Table 2 shows the structural attributes used and the way they were measured.

4.2.3 *Independent variable: diversity-in-boards (DIB) index.* DIB is about the dissimilarities of two or more people (board members) in a group (board in a firm). The Blau's index quantifies the probability of such dissimilarity. Studies have applied Blau's Index to measure inequality and heterogeneity in sociological research (Blau, 1977, p. 276). This study analyses multiple board members' demographic attributes to determine these heterogeneities. These demographic attributes represent different categories of board member demography and the dissimilarity was computed using the following equation.

$$\text{Blau's Index} = 1 - \sum (P_i^2), \text{ where}$$

$I = 1, \dots, N$ possible categories.

P_i is the proportion of board members in an i th category.

In Blau's index, the value range is from 0 to 1. When the value in each attribute is closer to 1 that indicates the most distant DIB. Otherwise, a lower level of DIB is when the value is closer to 0.

After using Blau's index to measure attribute value representing dissimilarity, the study used the tercile method to construct a single composite DIB index (Hafsi and Turgut, 2013). The tercile method uses ordinal ranking of Blau's index measured diversity of each attribute classified into three different levels: assigned value 0 is for the first tercile, value 1 is for the second, value 2 is for the third (Hoang et al., 2018). The aggregate sum of all terciles reflects board diversity in each firm for the demographic attributes examined in the study. The larger DIB value signifies the greater diversity in boards. Table 3 shows the demographic attributes used in the study and the way they were measured to construct the DIB index.

4.2.4 *Control variables.* Studies have shown that firm size, return on assets (ROA), financial leverage, industry membership, and state ownership influence ICD and they are used as control variables in this study. The CSMAR database provided the data relating to the control variables.

Table 2.
Structural attributes
measurement of
DOB index

Diversity of board attributes	Measurements
Board size	The number of directors/mean value of the firm observations
Director independence	Measured as the percentage of directors that are not employees of the company
Board leadership duality	Assigned value one if the chairman also serves as the CEO; otherwise, assigned value 0
Source(s): Authors work	

Table 3.
Demographic attributes
measurement of
DIB index

Diversity in board attributes	Measurements
Gender	Using Blau's Index to calculate the gender diversity of male and female directors
Age	Using Blau's Index to calculate the age diversity of directors in a board in ratio scale
Educational background	Using Blau's index to calculate educational background with 6 sub-classifications: 1 = Technical secondary school and below, 2 = Associate degree, 3 = Bachelor, 4 = Master, 5 = PhD, 6 = Other (education announced in other form)
Profession title	Using Blau's Index to calculate professional backgrounds with several listed categories, such as economist, engineer, accountant, teacher, instructor, financial analyst, professor-level titles, researcher-level titles, and so forth
Source(s): Authors work	

Firm size (SIZE): Studies document the influence of firm size on ICD (Abeysekera, 2010; Bozzolan *et al.*, 2003). Based on prior studies, this study measured firm size as the natural logarithm of total assets (Anifowose *et al.*, 2017).

ROA: Studies have shown a positive association of profitability measured by ROA with ICD (Gilani and Safari, 2017). Return on assets is measured using the following equation: (Total Profit + Financial Expenses)/Total Assets). A negative value illustrates that some firms suffer losses.

Financial leverage (LEV): Financial leverage is using debt to buy more assets. Highly leveraged firms may face a severe financial dilemma of repaying debts as their operating cash flow may decline rapidly. Barako *et al.* (2006) find a positive association between leverage and voluntary disclosure, and White *et al.* (2007) have found a positive association between leverage and ICD. The study computed leverage using the following formula: (Net Profit + Income Tax Expenses + Financial Expenses)/(Net Profit + Income Tax Expenses).

Industry membership (IND): Literature has used binary variables to scale industry membership (Guo and Acar, 2005), and this study assigned value “1” for the manufacturing industry, otherwise setting the value “0”.

State ownership (STATE): Research has shown that state ownership positively associates with ICD (Firer and Williams, 2005). It is typical for the state to take ownership of Chinese-listed firms with strategic significance (Lin *et al.*, 2020).

4.2.5 Regression model equations. The study used the following two regression equations to test hypotheses for 2019 with predictable business outlook and for 2020 with an unpredictable business outlook as follows, where t represents year. They examined DOB and ICD, and DIB and ICD association, using the robust function to obtain unbiased standard errors under possible heteroscedasticity. This take care of any undue influence made by outlier data in the firms in estimating parameter values,

$$ICD_t = a + b_1DOB_t + c_1SIZE_t + c_2ROA_t + c_3LEV_t + c_4IND_t + c_5STATE_t + e$$

$$ICD_t = a + b_1DIB_t + c_1SIZE_t + c_2ROA_t + c_3LEV_t + c_4IND_t + c_5STATE_t + e$$

$$ICD_t = a + b_1DOB_t + b_2DIB_t + b_3DIBDOB_t + c_1SIZE_t + c_2ROA_t + c_3LEV_t + c_4IND_t + c_5STATE_t + e$$

5. Results and discussion

5.1 Descriptive analysis

Table 4 summarises the descriptive statistics. The descriptive statistics of 2019 and 2020, showing the number of observations, means, standard deviations, and minimum, median and maximum values. In 2019, the mean value of ICD is 301.86, the range is between 125 and 781, with large standard deviations indicating that firms differ in their ICD. In 2020, the mean value of ICD is 315.91. The range is from 11 to 863, meaning that the disparity of ICD is way wider in 2020 among firms. There has been more ICD in 2020 compared to 2019.

The DOB is higher than in the previous year, indicating that the firms have made structural differences to the board during the Covid-19 pandemic. In 2019, the DOB has a mean value of 0.21, ranging from 0.15 to 0.55. In 2020, the mean value of DOB is 0.26, and the range is between 0.18 and 0.54. DIB in 2019 has a mean value of 128.33, ranging from 56 to 249. In 2020, the mean value of DIB is 135.68. The DIB also has slightly increased during the Covid-19 period.

5.2 Correlation analysis

Table 5 reveals that DOB has significant correlation with ICD ($r = 0.20$). DIB has negative correlation with ICD ($r = -0.27$), which indicates that structurally diverse boards positively

Table 4.
Descriptive statistics

VAR	n	2019 (pre COVID-19 period)					2020 (COVID-19 period)					
		Mean	SD	Min	Mdn	Max	n	Mean	SD	Min	Mdn	Max
Dependent												
ICD	79	301.86	127.12	125.00	283.00	781	79	315.91	135.09	11.00	286.00	863.00
Independent												
DOB	79	0.21	0.09	0.15	0.18	0.55	79	0.26	0.09	0.18	0.22	0.54
DIB	79	128.33	39.96	56.00	127.00	249.00	79	135.68	44.08	68.00	130.00	256.00
DIB*DOB	79	26.16	13.08	12.22	22.26	72.46	79	33.93	14.31	14.98	31.05	81.83
Control												
SIZE	79	24.87	1.58	21.30	24.97	28.64	79	24.98	1.59	21.12	25.05	28.54
ROA	79	0.04	0.04	-0.05	0.03	0.21	79	0.04	0.04	-0.14	0.03	0.20
LEV	79	5.79	2.78	0.66	5.01	17.93	79	5.23	2.84	-6.91	4.79	17.83
IND	79	0.34	0.48	0.00	0.00	1.00	79	0.34	0.48	0.00	0.00	1.00
STATE	79	0.05	0.13	0.00	0.00	0.77	79	0.04	0.10	0.00	0.00	0.55

Source(s): Authors work

Table 5.
Pairwise correlation matrix in 2019

	ICD	DOB	DIB	DIB*DOB	SIZE	ROA	LEV	IND	STATE
ICD	1								
DOB	0.20*	1							
DIB	-0.27**	-0.07	1						
DIB*DOB	-0.00	0.73***	0.59***	1					
SIZE	0.26**	-0.12	0.16	0.07	1				
ROA	-0.09	0.05	0.05	0.04	-0.08	1			
LEV	-0.07	0.01	-0.13	-0.08	-0.06	-0.35***	1		
IND	0.20*	0.23**	-0.05	0.18	-0.27**	-0.03	-0.05	1	
STATE	-0.03	0.02	0.08	0.06	0.05	0.04	-0.11	-0.05	1

Note(s): ***, **, * indicate significance at 0.01, 0.05 and 0.1

Source(s): Authors work

associate with ICD, demographically diverse boards negatively associate with ICD. The DIB and DOB interaction showed no association with ICD. For the control variables, SIZE has statistically significant relationship with ICD.

Table 6 shows the correlation between predictor variables and every combination of ICD variable in 2020. DIB and DOB show no significant correlation with ICD. In terms of control variables, SIZE shows a positive correlation with ICD.

Table 6.
Pairwise correlation matrix in 2020

	ICD	DOB	DIB	DIB*DOB	SIZE	ROA	LEV	IND	STATE
ICD	1								
DOB	0.16	1							
DIB	-0.13	-0.17	1						
DIB*DOB	-0.01	0.65***	0.61***	1					
SIZE	0.37***	-0.03	0.17	0.14	1				
ROA	-0.05	-0.28**	-0.09	-0.30***	0.02	1			
LEV	-0.08	0.16	-0.16	0.05	0.09	-0.19*	1		
IND	0.14	-0.05	-0.08	-0.07	-0.24**	-0.05	-0.20*	1	
STATE	-0.01				0.06	0.33***	0.32***	0.16	1

Note(s): ***, **, * indicate significance at 0.01, 0.05 and 0.1

Source(s): Authors work

5.3 Relationship between DOB and ICD

For the regression analysis, this study examines the variance inflation factor (VIF) and shows that the maximum VIF is 1.11, which is less than 10, showing that multicollinearity does not appear to be a concern in the empirical model (Farrar and Glauber, 1967).

Table 7 provides the results to test Hypothesis 1 (2019) and Hypothesis 2 (2020) using ICD as the dependent variable, where DOB is the independent variable. The 2019 result shows that the coefficient estimate of the DOB is significantly related to ICD (p -value = 0.05), which supports Hypothesis 1, suggesting that firms with more diverse structural board characteristics have a positive influence on ICD.

The findings are consistent with a prior study by Vitolla *et al.* (2020) that found that board diversity positively affects the quality of voluntary disclosure. Based on agency theory, firms with more diverse structural attributes of boards can appear to exercise their monitoring and compliance to reduce information asymmetry with ICD. Carter *et al.* (2010) and Hoang *et al.* (2018) explain this significant relationship as reducing agency conflicts and costs through voluntary disclosure.

The result of 2020 reveals that DOB does not significantly influence ICD (p -value of 0.21), which supports Hypothesis 2. The finding indicates that in an unpredictable business outlook (Cannella *et al.*, 2008), DOB on its own respond immediately with broader monitoring and compliance perspective to inform about ICD which represent value creation through future earnings and is consistent with the findings of Huber *et al.* (2021).

5.4 Relationship between DIB and ICD

Table 8 provides the results for the tests of Hypothesis 3 and 4 through ICD as the dependent variable and DIB as the independent variable. The results present that the coefficient estimate of DIB is significantly related to ICD (p -value = 0.00). The results are consistent with Nadeem (2020) that examined gender as a demographic attribute and found a negative relationship with ICD among listed firms in China. Based on resource dependence theory, board members are considered crucial resources linking between firms and external environments (Pfeffer and Salancik, 2003). Diverse boards have broader access to resources in approaching solutions to overcome challenges. However, this is not apparent, with a significant negative association between DIB and ICD. Eder (2019) explains that the Chinese government negotiates BRI projects with counterpart governments and then they are given

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > t $	Coeff	$P > t $
<i>Independent variable</i>				
DOB	278.92**	0.05	295.61	0.21
<i>Control variables</i>				
SIZE	27.27	0.00	38.44***	0.00
ROA	-303.70	0.30	-53.93	0.86
LEV	-3.63	0.36	-3.70	0.32
IND	64.20	0.04	71.03***	0.01
STATE	-38.88	0.54	-159.92	0.26
_CONS	-420.88	0.04	-715.90	0.01
R-SQUARED	0.19		0.24	
VIF	1.11		1.11	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors work

Table 7.
DOB and ICD

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > t $	Coeff	$P > t $
<i>Independent variable</i>				
DIB	-1.04***	0.00	-0.60	0.17
<i>Control variables</i>				
SIZE	30.15***	0.00	39.21***	0.00
ROA	-241.68	0.46	-268.77	0.37
LEV	-4.74	0.24	-4.28	0.23
IND	74.40***	0.01	62.47**	0.03
STATE	-15.37	0.75	-68.10	0.64
_CONS	-303.16	0.18	-569.35	0.03
R-SQUARED	0.26		0.24	
VIF	1.10		1.13	

Table 8.
DIB and ICD

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

to selected Chinese-listed firms. Therefore, DIB is not so focused on value creation as the Chinese government already sets it forth on their behalf.

The results present that the coefficient estimate of DIB is not significantly related to ICD (p -value = 0.17), which confirms H4. The finding is consistent with the prior study by [Juwita and Honggowati \(2022\)](#) that examined Indonesian-listed firms but found no influence of DIB on sustainability disclosures during the COVID-19 period. [Hoang et al. \(2018\)](#) study examined Vietnamese-listed firms with a domestic focus, which are about corporate social disclosure. The findings are inconsistent with [Hoang et al. \(2018\)](#) that found a positive association between BID and corporate social disclosure. This study notes that contradiction of results may have been because DIB must necessarily focus on voluntary disclosures to gain stakeholder support.

5.5 Relationship between DIB and DOB interaction and ICD

This study examines the regression models' variance inflation factor (VIF). Adding DIB*DOB, the maximum VIF is 7.81, less than 10. The multicollinearity doesn't threaten this model ([Farrar and Glauber, 1967](#)).

[Table 9](#) provides the results for the tests of Hypotheses 5 and 6. The results show that the coefficient estimate of DOB is positively and significantly related to ICD in 2019 with a predictable business outlook. The DIB and DOB interaction is negatively significant. The result indicates that DOB plays a dominant role in the predictable business outlook. It is possible that the Chinese government supervises BRI projects, and there is greater accountability in managing risk, ensuring compliance, and for ICD disclosure. However, DIB is not crucial as these Chinese-listed firms do not have to focus on the value creation aspect of the ICD, and the interaction between DIB and DOB adversely influenced ICD during the Covid-19 period.

In 2020, during the Covid-19 period, the BRI projects were subjected to an unpredictable business outlook. The focus shifted towards sustaining BRI projects. During the Covid-19 period, some countries questioned whether China was a power with responsibility which tested relationships. [Papageorgiou and de Melo \(2022\)](#) have shown that such framing differed significantly across countries regarding various landmark events in which China played a role.

On the one hand, China faltered in fostering friendships and partnerships with international powers. On the other hand, China used humanitarian approaches in specific endeavours to gain friendship with wider stakeholders ([Smith and Fallon, 2020](#)). During Covid-19, China's military and economic ambition and a contest with the US began to emerge, attempting to portray an international public perception. Their interaction became insufficient to respond with ICD to

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > t $	Coeff	$P > t $
<i>Independent variable</i>				
DOB	857.00**	0.05	1808.531**	0.05
DIB	0.101	0.90	2.667359	0.11
DIBDOB	-5.27	0.12	-13.26228**	0.05
<i>Control variables</i>				
SIZE	34.12618***	0.00	44.87562***	0.00
ROA	-332.8026	0.29	-163.1774	0.59
LEV	-5.361621	0.18	-1.327865	0.74
IND	71.34945**	0.02	81.84228***	0.00
STATE	-21.46161	0.66	-25.45352	0.87
_CONS	-577.8016	0.03	-1192.512	0.00
R-SQUARED	0.30		0.34	
VIF	7.81		7.68	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors work

Table 9.
DIB and DOB interaction and ICD

gain wider stakeholder acceptance because the DIB which contributes with diverse directors knowledge base was ill equipped to respond to international geo political conflicts, such DIB and DOB interaction adversely influenced informing about ICD, and not supporting the resilience theory. It is only through strategic board refocus of board structures relating to DOB that these firms respond to the situation. They included broadening the agency theory perspective with monitoring and compliance beneficial to a wider array of business partners that included customers, suppliers, and employees.

5.6 Additional analysis

The study sample is not significantly different from the Chinese firms in general. The study aimed to establish predictive rather than causal validity of variables. However, for comprehensiveness, it tested for various aspects of endogeneity (Hill *et al.*, 2021). The study conducted additional tests to ensure control variables have tolerable measurement errors (Abeysekera, 2010, 2011; Vitolla *et al.*, 2020). It also examined the accuracy of standard errors because the target population was small (Mooney, 2008). Findings showed largely consistent results with the primary model. The details are in the supplementary materials deposited in the data repository (doi: 10.6084/m9.figshare.22644295).

6. Conclusion

6.1 Concluding remarks

The study makes the following three contributions. First, there is a literature shortage examining the association between board diversity and ICD. The study aimed to contribute to such understanding. Second, the study investigated the Chinese BRI-listed firms that play a crucial role in advancing China's foreign direct investment policy. In that, the board plays a pivotal role, and ICD are an important disclosure to inform about the future earnings of these firms. Third, this study also examined the interaction effect of DIB and DOB on ICD, not examined in the previous literature.

Table 10 summarises the results that show the DOB has played a crucial role during both predictable (pre Covid-19, 2019) and unpredictable (Covid-19, 2020) business outlook periods. However, during the Covid-19 period, the interaction effect of DIB and

DOB became more critical for ICD. We outline the theoretical and managerial-policy implications next.

6.2 Theoretical implications

The results showed that DOB played a crucial role in a predictable business outlook period, typically meeting the monitoring and compliance aspects required from a board structure with an investor focus, firm behaviour that typified agency theory perspective. However, in the unpredictable business outlook period, the monitoring and compliance was not primarily aimed at satisfying the investor-led wealth maximisation proposition. It became evident that BRI-listed firms thought more broadly about monitoring and compliance to include a wider stakeholder group, a firm behaviour that broadened the typified agency theory perspective. These included customers, suppliers, and employees, to minimise risk relating to the value chain, supply chain, and employee welfare (Paine, 2020).

Firms depend on external resources such as diverse board members to bring various skills and competencies to direct the firms strategically. However, the findings showed that DIB was negatively associated with ICD, and in the presence of DIB and DOB interaction, DIB did not associate with ICD. Results show that BRI-listed firms do not require such diverse skills and competencies as they are in a monopolistic situation and do not have to compete for projects. Instead they are allocated to them by the Chinese government. In that sense, this study points out that resource dependence theory becomes applicable when perfect or near-perfect competition exists.

6.3 Managerial and policy implications

BRI-listed firms come under constant challenges as they play a political role of establishing the legitimacy of the Chinese leadership and the Chinese Community Party across the world (Eder, 2019). The findings reveal that boards must interact with policies and procedures and respond to changes with revised board structures. Hence, board members at a strategic level and managers at a managerial level play a fiduciary and political role. International development market is inherently monopolistic, BRI-listed firms has a crucial role to play in establishing China-centric economic order as a major provider of infrastructure development that has embraced projects of high costs and scale (Palit and Bhogal, 2022).

6.4 Limitations and future research

This study has four limitations which proposes future research. First, the study used a target population which is a small number of firms to investigate board diversity in the Chinese context and restricted the number of variables that could be investigated while maintaining model parsimony. Second, the study investigated two years separately to provide a perspective of contrasting business outlooks. A future study could extend the time horizon beyond the Covid-19 period because Covid-19 has made lasting changes to business. The world view of BRI-listed firms among key partner countries that have adopted BRI

	2019 ICD	2019 ICD	2019 ICD	2020 ICD	2020 ICD	2020 ICD
DOB		+**	+**			+**
DIB	(-)***		-			
DIBDOB			-			(-)**

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors work

Table 10.
Association between
ICD and board
diversity

projects for their development also has changed. The study used specific DIB and DOB attributes that can define the results. Future studies can expand on those attributes that constitute DIB and DOB for ICD practices. Third, the study used a quantitative approach; future research can use research methods (quantitative and/or qualitative) triangulation to obtain a deeper understanding of the same research questions or broaden the set of investigated research questions (Gibson, 2017). Fourth, findings are generalisable to Chinese-listed firms with BRI only. Findings are generalisable to Chinese-listed firms with BRI only. A study can compare Chinese listed firms with BRI and non-BRI to investigate whether BRI privileged status as a condition influence the relationship between board diversity and ICD.

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Further reading

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Supplementary Material

Additional analysis (continued)

This supplementary material discusses two aspects of the Additional Analysis section in the journal paper: the suspected presence of endogeneity in the primary models and the accuracy of standard errors. The study supports them with empirical evidence obtained by analysing the data.

Before we discuss these, the findings of the main model are as follows. [Table A1](#) shows the main model results for 2019 (predictable business outlook) and 2020 (unpredictable business outlook) years for DOB effect on ICD. DOB significantly influenced ICD in 2019 but not in the 2020 year. The variable of interest parameter estimates in 2019 is highlighted in blue; in 2020 is highlighted in green; and the replacement variable is highlighted in turquoise.

[Table A2](#) shows the effect of DIB on ICD in the 2019 and 2020 year. DIB had a significant impact on ICD in 2019 but not in 2020.

[Table A3](#) shows that DIBDOB interaction significantly influences the ICD in an unpredictable business outlook. Because the interaction variable is significant, the DOB variable, although significant was not analysed. However, the variable had no impact on a predictable business outlook (2019).

(1) Endogeneity

The variables of interest in the study are the Board in Diversity (BID), Board of Diversity (BOD), and the interaction of BID and BOD (DIBDOB). The study tested its independent (associational) variables are also exogenous (causal) variables, and conducted the analysis separately for the 2019 and 2020 years.

Endogeneity is a situation where it cannot establish that the independent variable causes the effect on the dependent variable. There are four reasons for it. They are: 1. Erroneous sample selection,

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P> t $	Coeff	$P> t $
<i>Independent variable</i>				
DOB	203.48**	0.04	227.30	0.24
<i>Control variables</i>				
SIZE	19.97***	0.00	27.14***	0.00
ROA	-282.62	0.18	-89.18	0.71
LEV	-2.85	0.34	-3.42	0.24
IND	65.08***	0.01	58.93***	0.01
STATE	-13.25	0.79	-111.82	0.23
_CONS	-333.61	0.03	-522.35	0.01
R-SQUARED	0.20		0.22	
VIF	1.11		1.11	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors work

Table A1.
DOB and ICD
(main model)

Table A2.
DIB and ICD
(main model)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P> t $	Coeff	$P> t $
<i>Independent variable</i>				
DIB	-0.86***	0.00	-0.49	0.15
<i>Control variables</i>				
SIZE	22.47***	0.00	27.83***	0.00
ROA	-235.37	0.33	-257.81	0.26
LEV	-3.83	0.18	-3.96	0.15
IND	72.37***	0.00	52.02**	0.03
STATE	5.67	0.89	-36.72	0.69
_CONS	-242.82	0.14	-406.78	0.03
R-SQUARED	0.28		0.22	
VIF	1.10		1.13	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

Table A3.
DIB and DOB
interaction and ICD
(main model)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P> t $	Coeff	$P> t $
<i>Independent variable</i>				
DOB	438.23	0.22	1342.47*	0.10
DIB	-0.37	0.60	1.92	0.18
DIBDOB	-2.23	0.44	-9.82*	0.10
<i>Control variables</i>				
SIZE	24.36***	0.00	32.03***	0.00
ROA	-285.69	0.18	-177.61	0.44
LEV	-4.19	0.15	-1.78	0.55
IND	67.96***	0.01	66.42***	0.00
STATE	1.18	0.98	-5.53	0.96
_CONS	-378.68	0.07	-869.43	0.01
R-SQUARED	0.31		0.32	
VIF	7.81		7.68	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

2. Simultaneous effects between independent and dependent variables, 3. Omitted variables, and 4. Measurement errors in variables (Wooldridge, 2010). Correlations among variables do not imply causality for inferences, but causality can imply correlation (Liang and Yang, 2021).

1.1 Sample selection

Erroneous sample selection occurs when a non-random sample is selected to represent the population (Hill et al., 2021). This study chose the entire target population, and there cannot be a sample selection bias on that count.

1.2 Reverse causality

A simultaneity effect can occur where intellectual capital disclosure (ICD) can cause an impact on DIB, DOB, and DIBDOB. The disclosures do not choose the directors. Although it is methodologically possible, it is theoretically improbable because directors decide what to disclose (Hill et al., 2021).

1.3 Omitted variable bias

The omitted variables can have a randomised effect when observed firms are the target population. Then the omitted variables cannot systematically enter into the empirical model. However, this study conducted an omitted variable analysis for conservativeness. The study followed the following steps. First, it ran the ordinary least squares (OLS) regression. Second, it selected each independent variable (DIB, DOB, and DIBDOB) one at a time, chose it as the dependent variable, and ran OLS without the ICD. Third, it calculated the predicted residual of the second OLS regression. Fourth, it ran an OLS regression with ICD as a dependent variable, the independent variable of interest (DIB, DOB, or DIBDOB), including the computed predicted residual on that regression. Fifth, it investigated whether the residual was significant. When the residual was statistically significant, it concluded that the OLS model had an omitted variable included in the error term that can influence the variable investigated in the model. OLS regression equation set for DIB_t endogeneity test for DIB_t, DOB_t, and DIBDOB_t was as follows.

Equation set for DIB_t endogeneity test.

$$\begin{aligned} \text{DIB}_t &= a + b1\text{DOB}_t + b3\text{DIBDOB}_t + c1\text{SIZE}_t + c2\text{ROA}_t + c3\text{LEV}_t + c4\text{IND}_t \\ &+ c5\text{STATE}_t + e \\ &\text{predict residualDIB}_t, \text{res} \\ \text{ICD}_t &= \text{DIB}_t + \text{residualDIB}_t \end{aligned}$$

Equation set for DOB_t endogeneity test.

$$\begin{aligned} \text{DOB}_t &= a + b2\text{DIB}_t + b3\text{DIBDOB}_t + c1\text{SIZE}_t + c2\text{ROA}_t + c3\text{LEV}_t + c4\text{IND}_t \\ &+ c5\text{STATE}_t + e \\ &\text{predict residualDOB}_t, \text{res} \\ \text{ICD}_t &= \text{DOB}_t + \text{residualDOB}_t \end{aligned}$$

Equation set for DIBDOB_t endogeneity test.

$$\begin{aligned} \text{DIBDOB}_t &= a + b1\text{DOB}_t + b2\text{DIB}_t + c1\text{SIZE}_t + c2\text{ROA}_t + c3\text{LEV}_t + c4\text{IND}_t \\ &+ c5\text{STATE}_t + e \\ &\text{predict residualDIBDOB}_t, \text{res} \\ \text{ICD}_t &= \text{DOB}_t + \text{residualDIBDOB}_t \end{aligned}$$

After running these OLS regression models, the study found no omitted variable bias for independent variables (DIB, DOB, or DIBDOB) in 2019. In 2020, the study found no omitted variable with DOB and DIBDOB, but there was suspected omitted variable bias with DIB (p-value = 0.044). In 2020, in the primary OLS regression model that included the interaction variable, results showed that the DOB and DIBDOB variables were statistically significant (Table A8).

Although DIB was not significant in the main model (see Tables A6–A8), the study chose to conduct endogeneity for the 2020 year DIB variable with firm age as an instrumental variable. Firm age can influence governance, but firm age has not shown an effect on ICD (Bianchini *et al.*, 2018). The study replaced the suspected endogenous DIB variable with firm age and conducted limited information maximum likelihood regression. The study chose limited maximum likelihood regression because it is a small number of firm observations. The regression model output was not statistically significant. As a conservative measure, the findings interpret DIB associates with ICD.

1.4 Measurement errors

Measurement errors can enter the model in various ways. If the measurement error is related to residual in the model, then that can create endogeneity. The study conducted endogeneity tests for the independent variables. Hence regarding the control variables, the study used replacement variables. It replaced ROA with ROE, leverage with debt ratio, and total assets with total revenue. We tested the replacement variables one at a time to detect any measurement errors. The variable of interest parameter estimates in 2019 is highlighted in blue; in 2020 is highlighted in green; and the replacement variable is highlighted in turquoise.

1.4.1 ROA replaced with ROE

The additional analysis replaced ROA in the principal model with ROE measured as the main model's net profit/average balance of shareholders' equity (Vitolla *et al.*, 2020). Table A4 reports the results DIB variable with the ICD variable, and model results are consistent with the main model.

Table A5 reports the results of DIB with ICD, and model results are consistent with the main model.

Table A6 reports the DOB variable with the ICD variable, and model results are consistent with the main model.

Variable	ICD (2019)		ICD (2020)	
	Coeff	P> t	Coeff	P> t
<i>Independent variable</i>				
DIB	-1.03***	0.00	-0.60	0.17
<i>Control variables</i>				
SIZE	31.24***	0.00	40.29***	0.00
ROE	-95.62	0.60	-194.24	0.18
LEV	-4.15	0.28	-3.57	0.31
IND	74.91***	0.01	61.39**	0.03
STATE	-14.94	0.76	-47.68	0.73
_CONS	-335.23	0.12	-595.59	0.02
R-SQUARED	0.26		0.24	
VIF	1.08		1.12	

Table A4.
DIB and ICD (ROA replaced with ROE)

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

Variable	ICD (2019)		ICD (2020)	
	Coeff	P> t	Coeff	P> t
<i>Independent variable</i>				
DOB	266.06	0.05	291.49	0.20
<i>Control variables</i>				
SIZE	28.52	0.00	39.35	0.00
ROE	-100.57	0.56	-149.20	0.32
LEV	-2.74	0.48	-3.65	0.35
IND	65.57	0.03	69.10	0.01
STATE	-38.06	0.54	-155.05	0.26
_CONS	-458.31	0.02	-728.20	0.00
R-SQUARED	0.19		0.25	
VIF	1.09		1.07	

Table A5.
DOB and ICD (ROA replaced with ROE)

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

Table A6.
DIB and DOB
interaction and ICD
(ROA replaced
with ROE)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > t $	Coeff	$P > t $
<i>Independent variable</i>				
DOB	792.94	0.06	1821.17	0.05
DIB	0.01	0.10	2.67	0.11
DIBDOB	-4.83	0.16	-13.32	0.05
<i>Control variables</i>				
SIZE	35.17	0.00	46.01	0.00
ROE	-96.23	0.57	-182.66	0.22
LEV	-4.29	0.27	-1.00	0.80
IND	72.32	0.02	80.22	0.00
STATE	-20.66	0.66	-10.84	0.94
_CONS	-601.40	0.02	-1216.85	0.00
R-SQUARED	0.30		0.35	
VIF	7.70		7.66	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors work

Table A6 reports the DIB, DOB, and DIBDOB variables with the ICD variable, and model results are consistent with the main model.

1.4.2 LEVERAGE replaced with DEBT RATIO

The study replaced leverage with debt ratio measured as Total Liabilities/Total Assets in the principal model (Abeyssekera, 2011). The study cross-checked results using debt ratio instead of financial leverage, which were quite similar.

Table A7 reports the results DIB variable with the ICD variable, and model results are consistent with the main model.

Table A8 reports the results DOB variable with the ICD variable, and model results are consistent with the main model.

Table A9 reports the DIB, DOB, and DIBDOB variables with the ICD variable, and model results are consistent with the main model.

1.4.2 TOTAL ASSETS replaced with TOTAL REVENUE

Findings showed consistent results with the primary model. The study replaced firm size with total operating revenue measured as Operating Revenue + Net Interest Income + Premiums Earned + Net

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > t $	Coeff	$P > t $
<i>Independent variable</i>				
DIB	-0.86	0.00	-0.46	0.23
<i>Control variables</i>				
SIZE	14.05	0.12	20.66	0.03
ROA	255.40	0.25	232.33	0.31
DEBT RATIO	331.02	0.00	373.64	0.00
IND	72.33	0.01	62.48	0.02
STATE	-0.90	0.99	-62.24	0.67
_CONS	-154.21	0.46	-372.55	0.10
R-SQUARED	0.36		0.36	
VIF	1.23		1.26	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors work

Table A7.
DIB and ICD
(LEVERAGE replaced
with DEBT RATIO)

Table A8.
DOB and ICD
(LEVERAGE replaced
with DEBTRATIO)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P> t $	Coeff	$P> t $
<i>Independent variable</i>				
DOB	200.49	0.15	251.11	0.28
<i>Control variables</i>				
SIZE	10.56	0.17	20.10	0.03
ROA	202.93	0.31	405.67	0.12
DEBTRATIO	347.04	0.00	373.78	0.00
IND	64.37	0.03	68.88	0.01
STATE	-21.33	0.74	-135.65	0.34
_CONS	-222.26	0.23	-490.58	0.03
R-SQUARED	0.31		0.36	
VIF	1.24		1.24	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

Table A9.
DIB and DOB
interaction and ICD
(LEVERAGE replaced
with DEBT RATIO)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P> t $	Coeff	$P> t $
<i>Independent variable</i>				
DOB	734.92	0.09	1770.63	0.04
DIB	0.17	0.83	2.73	0.07
DIBDOB	-4.81	0.15	-13.17	0.04
<i>Control variables</i>				
SIZE	18.56	0.03	26.90	0.01
ROA	170.10	0.36	264.85	0.29
DEBT RATIO	312.83	0.00	359.96	0.00
IND	72.05	0.01	77.63	0.00
STATE	-4.59	0.93	-20.88	0.89
_CONS	-409.10	0.10	-966.57	0.01
R-SQUARED	0.38		0.46	
VIF	7.89		7.37	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

Fees and Commissions Income + Income from Other Operations in the primary model (Abeysekera, 2010). The results are as follows.

Table A10 reports the DIB variable with ICD variable results, and model results are consistent with the main model.

Table A11 reports the results DOB variable with the ICD variable, and model results are consistent with the main model.

Table A12 reports the DIB, DOB, and DIBDOB variables with the ICD variable, and model results are consistent with the main model.

(2) Standard errors

The study selected the entire population of listed firms in China with OBOR projects. Hence, the sampling error and observation of firm selection causing bias do not apply (Nayak, 2010). However, smaller samples can provide broader standard errors, making the calculated statistics distant from their actual value. The study used the robust standard error function in the OLS models. However, that function does not conduct a resampling iteration procedure to calculate standard errors. The study used bootstrapping to confirm standard error accuracy further and estimate more precisely (Guan, 2003). It was an additional statistical procedure setting 1,000 bootstrap replications (Mooney, 2008).

Variable	ICD (2019)			ICD (2020)		
	Coeff		$P> t $	Coeff		$P> t $
<i>Independent variable</i>						
DIB	-0.87		0.01	-0.44		0.34
<i>Control variables</i>						
TOTALREVENUE	1.03e-11		0.84	8.96e-11		0.16
ROA	-390.68		0.27	-131.78		0.65
LEV	-6.28		0.13	-1.93		0.66
IND	49.34		0.11	47.52		0.13
STATE	-4.15		0.95	56.58		0.69
_CONS	447.25		0.00	359.89		0.00
R-SQUARED	0.13			0.10		
VIF	1.09			1.14		

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors work

Table A10.
DIB and ICD (TOTAL ASSETS replaced with TOTAL REVENUE)

Variable	ICD (2019)			ICD (2020)		
	Coeff		$P> t $	Coeff		$P> t $
<i>Independent variable</i>						
DOB	253.63		0.02	263.19		0.29
<i>Control variables</i>						
TOTALREVENUE	1.37e-11		0.77	8.99e-11		0.15
ROA	-430.10		0.18	50.78		0.87
LEV	-5.13		0.21	-1.64		0.71
IND	42.73		0.19	54.78		0.06
STATE	-24.23		0.72	-14.86		0.91
_CONS	280.85		0.00	225.23		0.00
R-SQUARED	0.09			0.11		
VIF	1.10			1.11		

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors' work

Table A11.
DOB and ICD (TOTAL ASSETS replaced with TOTAL REVENUE)

[Table A13](#) reports the results DIB variable with ICD variable, and model results are consistent with the main model.

[Table A14](#) reports the results DOB variable with ICD variable, and model results are consistent with the main model.

[Table A15](#) reports the DIB, DOB, and DIBDOB variables with the ICD variable, and model results are consistent with the main model.

Table A12.
DIB and DOB
interaction and ICD
(TOTAL ASSETS
replaced with TOTAL
REVENUE)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > t $	Coeff	$P > t $
<i>Independent variable</i>				
DOB	92.36	0.84	1460.93	0.17
DIB	-1.10	0.26	2.17	0.25
DIBDOB	1.21	0.76	-10.48	0.19
<i>Control variables</i>				
TOTAL REVENUE	1.09e-11	0.83	1.05e-10	0.11
ROA	-413.56	0.22	-9.30	0.98
LEV	-6.53	0.11	0.74	0.87
IND	38.25	0.24	62.50	0.03
STATE	-9.96	0.88	103.22	0.49
_CONS	432.04	0.00	-38.91	0.89
R-SQUARED	0.16		0.16	
VIF	7.01		7.61	

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors' work

Table A13.
DIB and ICD (with
bootstrapping)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > z $	Coeff	$P > z $
<i>Independent variable</i>				
DIB	-1.03***	0.00	-0.60	0.16
<i>Control variables</i>				
SIZE	30.15***	0.00	39.21***	0.00
ROA	-241.68	0.52	-268.77	0.44
LEV	-4.74	0.29	-4.28	0.34
IND	74.40***	0.01	62.47**	0.03
STATE	-15.37	0.81	-68.10	0.68
_CONS	-303.15	0.19	-569.35	0.02
R-SQUARED	0.26		0.24	
VIF				

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1
Source(s): Authors' work

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > z $	Coeff	$P > z $
<i>Independent variable</i>				
DOB	278.92	0.08	295.61	0.23
<i>Control variables</i>				
SIZE	27.27	0.00	38.44	0.00
ROA	-303.70	0.36	-53.94	0.88
LEV	-3.63	0.43	-3.70	0.43
IND	64.20	0.04	71.03	0.01
STATE	-38.88	0.66	-159.92	0.32
_CONS	-420.88	0.05	-715.90	0.00
R-SQUARED	0.19		0.24	
VIF				

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors' work

Table A14.
DOB and ICD (with bootstrapping)

Variable	ICD (2019)		ICD (2020)	
	Coeff	$P > z $	Coeff	$P > z $
<i>Independent variable</i>				
DOB	857.00	0.16	1808.53*	0.07
DIB	0.10	0.92	2.67	0.14
DIBDOB	-5.27	0.26	-13.26*	0.08
<i>Control variables</i>				
SIZE	34.13***	0.00	44.88***	0.00
ROA	-332.80	0.32	-163.18	0.65
LEV	-5.36	0.23	-1.33	0.78
IND	71.35***	0.02	81.84***	0.00
STATE	-21.46	0.76	-25.45	0.88
_CONS	-577.80	0.04	-1192.51	0.00
R-SQUARED	0.30		0.34	
VIF				

Note(s): ***, **, * denote significance levels at 0.01, 0.05 and 0.1

Source(s): Authors' work

Table A15.
DIB and DOB interaction and ICD (with bootstrapping)

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