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# Intellectual capital and firm's financial distress risk: Evidence from developed and developing countries

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## Abstract

**Objective:** This study aims to examine the effect of intellectual capital on financial distress risk in developed and developing countries.
**Design/Methods/Approach:** This study adopts a quantitative approach that focuses on investigating the effect of intellectual capital on the risk of financial distress by employing data from 266 companies listed on the India stock Exchange and 1164 companies listed on the Japan Stock Exchange during the period from 2017 to 2021. Panel data regression is employed to conduct the statistical analysis.
**Findings:** The results confirm that firms in developing and developed socioeconomic backgrounds with stronger intellectual capital are less likely to face financial distress. While the overall impact of intellectual capital on the risk of financial distress appears consistent, the magnitude of each category of intellectual capital varies depending on the economic circumstant. The influence of human capital efficiency in reducing financial distress risk is observed to be stronger in developed countries when comparing the value of the regression coefficient. In contrast, capital-employed efficiency has a greater impact on lowering financial distress risk in emerging nations.
**Originality:** This study uses the Adjusted VAIC (Value-Added Intellectual Coefficient) method, which incorporates research and development data in measuring structural capital, addressing criticisms faced by the original VAIC method. This study also explores the association between intellectual capital and the risk of financial distress, offering insights into the predictive value of intellectual capital indicators for identifying financially distressed companies. This research examines two countries with differing socioeconomic development and emphasizes intellectual capital's role in developing and developed economies. Additionally, utilizing the Z-Score measurement, adapted for emerging markets in the case of India, provides a comprehensive assessment of the financial distress risk.
**Practical/Policy implication:** Based on the results, managers should prioritize financial investments that impact the organization's resources, considering the influence of capital employed on intellectual capital. Although less influential, human capital remains significant, thereby emphasizing the importance of investing in employee development and fostering collaboration. While innovation capital may not exhibit statistical significance, creating an environment that supports innovation still holds considerable value.

**Keywords:** Bankruptcy, Financial distress, Intellectual capital

**JEL Classification: G33**

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## 1. Introduction

In today's knowledge-based economy, physical or tangible assets such as buildings, tools, and equipment, once believed to be the most critical assets within a company, are no longer as relevant. The sources of productivity and a business's ability to create value have shifted from tangible to intangible assets, also known as knowledge-based capital. Examples of knowledge-based resources include organizational knowledge, software, company-specific patents, designs, and skills. The importance of intellectual capital is heightened by the growth of globally operating companies that depend on knowledge, adapt swiftly to changes, and leverage advanced technology in the global economy (Petty & Guthrie, 2000). Stewart (1997) defines intellectual capital as "an intangible asset that organizations can utilize to generate value." However, the majority of intellectual capital academics concur that three dimensions hold particular dominance: human capital, structural capital, and customer capital (Chatterjee & Kar, 2018).

One way to measure intangible assets is by measuring intellectual capital (Petty & Guthrie, 2000). Academics generally concur on measuring intellectual capital through its components: human capital, structural capital, and capital efficiency. Despite its theoretical significance, the results often exhibit inconsistency, primarily due to a lack of standardized measurement (Pulic, 2004). Pulic (1988) developed a measurement called the Value-Added Intellectual Coefficient (VAIC) that assesses intellectual capital efficiency based on financial data. The added value serves as an indicator of business success by demonstrating the organization's capacity to generate value (Pulic, 2004). The VAIC model, developed by Pulic (1988), has become a widely utilized method in research and practice for measuring intellectual capital.(Nadeem et al., 2019). This study aims to contribute to the existing literature and enhance the precision of measuring Intellectual Capital. The paper employs the Adjusted VAIC method, which distinguishes itself from the more frequently employed VAIC method by incorporating research and development data in the measurement of structural capital. This adjusted method is utilized as a response to the criticisms encountered by the original VAIC method. The objective of this study is to assess the significance of intellectual capital in relation to a firm's likelihood of experiencing financial distress.

Intellectual capital plays a crucial role in enhancing a company's competitiveness and operational efficiency within a knowledge- and information-driven economy (Massaro et al., 2015). Multiple studies demonstrate that intellectual capital positively affects companies' financial performance and market value, serving as an indicator of their prospective financial performance. Moreover, intellectual capital can significantly influence a company's long-term financial well-being and credit rating (Guimón, 2005). Utilizing intellectual capital indicators can aid in predicting the probability of misclassifying a financially distressed company. Enhancing the assessment of a company's financial condition can minimize the misallocation of financial resources, consequently reducing economic value depletion and mitigating job losses (Berk et al., 2010). Considering intellectual capital as a factor makes it feasible to allocate financial resources to companies with the capability to manage and invest in their intellectual capital efficiently. With effective management, such companies can contribute to economic and social growth in a knowledge-based economy (Cenciarelli et al., 2018). Significant advancements have been made over the years in comprehending the risk of corporate bankruptcy. Altman (1968) pioneered in developing models that predict a company's likelihood of financial distress by incorporating accounting and market-based measurement approaches. Higher credit ratings lead to reduce borrowing costs, enhance company performance, and increase market value. These accomplishments can be realized through effective intellectual capital management (Dumay & Tull, 2007). In a study conducted by Altman et al. (2017), it was determined that the Z-score model outperforms hazard and market-based models as a predictor of the risk of financial distress.

This study seeks to contribute to the existing literature concerning the association between intellectual capital and the risk of financial distress. Specifically, it concentrates on two countries with contrasting socioeconomic statuses: India and Japan. Furthermore, this study employs the Adjusted VAIC method, which was developed by (Nadeem et al., 2019) and represents a more recent approach to measuring intellectual capital. The Adjusted VAIC method is an enhancement of the VAIC method initially proposed by Pulic (1988). India and Japan serve as intriguing case studies. As a developing country, India is presently prioritizing intellectual capital development as a catalyst for economic growth. India has also made significant investments in enhancing its human capital. However, India still faces certain challenges in the development of intellectual capital. The country still faces certain shortcomings, particularly in areas such as infrastructure, which can impede business growth and hinder the development of intellectual capital. Moreover, the education system encounters several challenges regarding quality and accessibility, particularly in rural areas.

Nonetheless, India's emphasis on developing intellectual capital has played a significant role in its economic growth and overall success. The country has witnessed notable advancements in recent years, and ongoing investments in education, research, development, and innovation are expected to fuel further growth and development in the future. Conversely, intellectual capital is highly esteemed in Japan and regarded as a pivotal driver of innovation and competitive advantage. The Japanese government and businesses have made substantial investments in education and training, research and development, and technology transfer to foster the development and utilization of intellectual capital. Moreover, Japan boasts numerous research and development centers and universities specializing in science and technology. The Japanese government has also implemented policies to support the development of intellectual capital, including provisions for patents and copyrights. Overall, Japan's emphasis on intellectual capital has served as a crucial catalyst for economic success and sustainable innovation. The selection of samples from India and Japan is based on the requirement of disclosing research and development costs in their financial statements, which is necessary for implementing the Adjusted VAIC method. India and Japan possess sufficient companies that disclose these variables, making them suitable representatives of developing and developed countries, respectively. This study employs the Z-Score measurement to assess the financial distress risk of companies. Specifically, a formula tailored for emerging markets is utilized, aligning with the focus of the research on India as a developing country. Additionally, separate manufacturing and non-manufacturing measurements are employed to calculate the Z-Scores of companies in Japan, accounting for the variations within each industry.

The remainder of this article is organized as follows: The Introduction presents the background information and identifies the research gap. The Literature Review and Hypothesis Development sections examine prior relevant studies to enhance the research foundation and formulate hypotheses. The Method section outlines this study's sampling and data processing methods. The Results and Discussion section presents the research findings and offers an interpretation. The Conclusion section summarizes the research, discusses the implications of the findings, acknowledges the limitations, and provides suggestions for future research.

## 2. Literature Review and Hypotheses Development

The Resource-Based View (RBV) model asserts that resources are vital to a firm's success. Resources can be classified into two categories: tangible and intangible. Intellectual capital falls under the category of intangible assets as it lacks a physical form (Rothaermel, 2021). Due to its intangible nature, intellectual capital is challenging for competitors to evaluate and imitate. Its uniqueness renders it one of the most crucial assets for enhancing firm performance (Nirino et al., 2022). Both tangible and intangible resources influence firm performance. In this resource-based economy, companies are encouraged to prioritize managing their intangible resources. Effective management of internal resources is necessary to ensure that they are valuable, rare, difficult to imitate, and systematically organized. When managed appropriately, these factors can contribute to the development of a sustainable competitive advantage for the company (Soewarno & Tjahjadi, 2020).

Financial distress can be attributed to failure, insolvency, bankruptcy, and default. It occurs when a firm consistently experiences underperforming investments or expenses that exceed its income (Al-Hadi et al., 2019). There are two types of financial distress: the inability to repay debt and restructuring measures to avoid bankruptcy (Andrade & Kaplan, 1998). Firms in distressed conditions experience several challenges, including a higher cost of capital, difficulty in accessing external funding, and a low credit score (Al-Hadi et al., 2019). Failure and restructuring are common outcomes of financial distress. A firm facing financial distress exhibits a diminished capacity to generate revenue and possesses debt surpassing its assets. Indicators of financial distress include an obligation yield lower than the risk-free rate and the inability to secure external funding (Gordon, 1971). The accounting approach is one of the methods that can be employed to measure financial distress (Altman et al., 2017). The accounting approach encompasses the Z-score as a significant component (Altman, 1968), O-score (Ohlson, 1980), and ZM-score (Zmijewski, 1984). Agarwal and Taffer (2008) demonstrated that, when utilizing international datasets, the Z-score model outperforms the hazard model and market price approach in predicting bankruptcy. Additionally, research conducted by Altman et al. (2017) confirmed the efficacy of the Z-score as a dependable predictor of bankruptcy risk. Accordingly, this study employed the Z-score accounting measure to assess the probability of financial distress. A higher Z-score value indicates a lower risk of encountering financial distress.

Intellectual capital is acknowledged as an exceedingly valuable intangible asset in the contemporary business landscape, particularly within the knowledge-based economy. It assumes a crucial role in propelling innovation, nurturing creativity, generating value, and enhancing company performance (Tayles et al., 2007). Previous research indicates that certain characteristics of firm-specific resources, including uniqueness, evaluability, sustainability, and capabilities, have a positive influence on firm performance (Backman et al., 2017). Resources can manifest in tangible or intangible assets, and intellectual property assets exemplify intangible resources that provide a sustainable competitive advantage through legal mechanisms for safeguarding property rights (Hoopes et al., 2003). Intellectual capital is vital in creating favorable conditions for sustainable competitive advantage and enhancing corporate performance. Companies with exceptional talent, capabilities, innovation, and human creativity can achieve and sustain a competitive edge. According to the resource-based view theory, the effective identification and management of company resources, including intellectual capital, significantly impact company performance. Although there is no universally accepted definition of intellectual capital, researchers agree that acknowledging and harnessing intellectual capital as a cornerstone for strategic innovation and profit generation enables companies to generate additional value (Sumedrea, 2013).

Pulic (1998) introduced the value-added intellectual coefficient (VAIC) method as a tool for measuring intellectual capital efficiency. This model incorporates the evaluation of human capital, structural capital, and capital employed. The VAIC model has been utilized in numerous previous studies as a metric for assessing intellectual capital. However, it has also faced criticism from Nadeem et al. (2019) and other researchers. In order to improve the VAIC model, Nadeem et al. (2019) proposed an adjusted Value-Added Intellectual Coefficient (A-VAIC) model. The significant modification in the A-VAIC model involves replacing structural capital with innovation capital derived from research and development (R&D) expenditure. The adjustment made by Nadeem et al. (2019) aims to incorporate the influence of innovation on the measurement of intellectual capital. In their study on the Adjusted VAIC, they discovered a substantial positive correlation between their refined measurement of intellectual capital, which includes Human capital efficiency, Innovation capital efficiency, Capital employed efficiency, and firm performance. This finding signifies that the Adjusted VAIC method effectively measures intellectual capital. In contrast, research conducted by Vishnu and Gupta (2014) indicates that research and development investment have no impact on Return on Assets (ROA).

While Nadeem et al. (2019) concentrated their research on financial performance, the present study aims to utilize the Adjusted VAIC method to measure Intellectual Capital and employ it as a predictor of a company's financial distress risk. In their reconstruction of the VAIC model, Nadeem et al. (2019) outlined three classifications: Human capital efficiency, Innovation capital efficiency, and Capital employed efficiency. Human capital efficiency pertains to the individual knowledge possessed by employees, enabling firms to seize opportunities and mitigate market threats. Higher intellectual capital positively impacts firm performance, leading to increased revenue. The human capital factor is widely considered the primary intangible asset of a firm (Soewarno & Tjahjadi, 2020). Innovation capital efficiency represents the principal distinction in this Adjusted VAIC model. Research and development (R&D) and intellectual property protection, including copyright, serve as pivotal sources of innovation. Investment in research and development plays a significant role in enhancing a firm's production efficiency and profitability (Nadeem et al., 2019). Capital-employed efficiency refers to a firm's endeavor and capability in effectively managing its assets. Numerous studies support the correlation between Intellectual Capital and financial distress (Cenciarelli et al., 2018; Shahwan & Habib, 2020). Enhancing the efficiency of Intellectual Capital can result in a decrease in a company's cost of debt and an increase in company value. Consequently, this contributes to the maintenance of the company's financial health stability (Dumay & Tull, 2007). Nadeem et al. (2016) emphasized the significance of including intellectual capital indicators as predictors in financial distress models. Conversely, Cenciarelli et al. (2018) concluded that Intellectual Capital has a negative effect on bankruptcy risk, suggesting that a higher level of Intellectual Capital can help mitigate the likelihood of bankruptcy.

Existing research provides evidence that intellectual capital plays a crucial role in determining the financial health of companies. Achieving long-term financial stability involves not only increasing equity but also effectively managing intangible assets, including intellectual capital. Lower debt costs can result in higher profitability and long-term value creation. Moreover, the maintenance of financial stability and the fulfillment of debt obligations can effectively mitigate credit risk, a factor that is beneficial to both investors and lenders. Hence, intellectual capital functions as a pivotal indicator for evaluating prospective financial performance. Companies endowed with significant intellectual capital are in a better position to generate future profits and meet their debt obligations. As a result, investors and lenders tend to allocate their resources to companies that possess substantial intellectual capital. These companies, characterized by long-term financial stability, are better equipped to create value and are less likely to encounter bankruptcy risks (Cenciarelli et al., 2018). Altman's (1968) model, which was developed using multiple discriminant analysis (MDA), is extensively utilized as a gauge for assessing financial distress. This model identifies accounting ratios that demonstrate robust predictive capability in determining the likelihood of corporate bankruptcy. The five variables considered as the most effective predictors are the ratio of working capital to total assets, the ratio of retained earnings to total assets, the ratio of earnings before interest and tax to total assets, the ratio of the market value of equity to the book value of debt, and the ratio of sales to total assets. The variables mentioned above, derived from MDA in Altman (1968), are assigned coefficients that are multiplied by each company's size. The aggregated outcomes produce a Z-score. Altman (1968) determined that companies with a Z-score below 1.81 are susceptible to bankruptcy risk, whereas those with a Z-score above 2.99 are deemed unlikely to face bankruptcy. Companies that fall within the range of 1.81 to 2.99 are considered to have a precarious financial position, often referred to as the 'gray area .'However, a Z-score below 1.1 indicates a higher risk of bankruptcy in non-manufacturing companies and companies operating in developing countries. In contrast, a Z-score above 2.6 indicates financial stability. Companies with a Z-score ranging from 1.1 to 2.6 are also classified within the 'gray area.'

## Hypothesis Development

This study proposes that intellectual capital, specifically human capital efficiency, innovation capital efficiency, and capital employed efficiency, has an impact on the risk of financial distress, as measured by the Altman Z-Score. Scholars contend that human capital plays a crucial role in shaping company performance, particularly when investments are allocated toward enhancing knowledge and skills rather than solely emphasizing educational attainment (Bendickson et al., 2017; Colombo & Grilli, 2005; Unger et al., 2011). Previous research indicates that companies possessing unique or tacit knowledge embedded within their human capital tend to attain elevated levels of success and productivity (Unger et al., 2011). Elevated levels of human capital exert a positive influence on company performance (Oh et al., 2015).

Intellectual capital encompasses distinct knowledge components, namely human capital (HC), structural capital (SC), and customer capital (CC). Choong (2008) defines intellectual capital as the collective investment in multiple domains, such as research and development (R&D), human resources, copyrights, and brand equity. It is widely recognized that intellectual capital encompasses three fundamental elements: human, structural, and relational capital. The structural capital component of intellectual capital pertains to distinctive production processes, copyrights, research and development (R&D) endeavors, and occasionally infrastructure facilities that enable employees to effectively leverage knowledge (Mehralian et al., 2013). In light of this definition, it is evident that SC encompasses investments in research and development (R&D), which serve as the primary sources of unique processes and copyrights. Moreover, investment in research and development (R&D) plays a crucial role in driving innovation, which has led to the alternative designation of structural capital (SC) as innovation capital (INVC) (Choong, 2008). Consequently, the revised VAIC model replaces the structural capital (SC) dimension with investments in research and development (R&D) and copyright. Previous studies conducted by Nimtrakoon (2015) and Vishnu & Gupta (2014), which expanded upon the original VAIC model, similarly substituted R&D costs for the structural capital (SC) component. The utilization of R&D costs as a measure of structural capital (SC) offers two advantages. Firstly, this investment represents SC, allowing the adjusted A-VAIC model to directly incorporate SC, in contrast to the original VAIC model, where SC is derived as the difference between value added (VA) and human capital (HC). Secondly, the inclusion of R&D and copyright investments in the A-VAIC model eliminates any overlap between value added (VA) and human capital (HC), as R&D becomes an independent variable within the model. This enables a more precise and independent evaluation of the contributions made by R&D and copyright investments to the overall efficiency of intellectual capital (Nadeem et al., 2019).

Ozkan et al. (2017) revealed that both capital employed efficiency (CEE) and human capital efficiency (HCE) exert a positive influence on financial performance, with CEE demonstrating a stronger impact compared to HCE. Furthermore, other studies suggest that organizational capital contributes to improved productivity and efficiency (Black & Lynch, 2005; Ray et al., 2013). According to Miles and Van Clieaf (2017), increased firm value is associated with intellectual capital. Furthermore, studies conducted by Bercovitz and Mitchell (2007) and Meyer et al. (2014) suggest that intellectual capital can lead to enhanced organizational performance.

This research posits that intellectual capital, encompassing human capital efficiency, innovation capital efficiency, and capital employed efficiency, influences the risk of financial distress as measured by the Altman Z-Score. Based on this premise, the following hypotheses are proposed:

**H1a**: Human Capital Efficiency has a significant and positive effect on Z-Score.
**H1b**: Structural Capital Efficiency has a significant and positive effect on Z-Score.
**H1c**: Capital Employed Efficiency has a significant and positive effect on Z-Score.

## 3. Method

### Subject

This research employs a quantitative approach using panel data regression. The study population comprises two countries, namely India and Japan, representing a developing and developed country, respectively. The regression analysis is conducted separately for each population. The data collection for this study spans five years, from 2017 to 2021. The sampling criteria include selecting public companies that have publicly disclosed their annual reports. Non-financial companies are excluded from the research due to their structural differences. Additionally, all selected companies must have comprehensive data for all the required variables. After applying the filtering criteria, 266 companies in India and 1164 companies in Japan meet the established criteria. The data for this research is collected from the Thomson Reuters Dataset.

### Measurement

Pulic (1998) introduced the value-added intellectual coefficient (VAIC) as a method for evaluating the efficiency of intellectual capital. However, the VAIC method has encountered criticism from scholars with respect to certain aspects, such as the utilization of overlapping variables and concerns regarding the measurement of structural capital efficiency (SCE) within the VAIC model. Scholars, including Ståhle et al. (2011) and Vishnu & Gupta (2014), contend that these concerns cast doubt on the justification and validity of the VAIC method. In the VAIC model, the measurement of structural capital typically involves subtracting personnel costs from value added (VA). However, according to Ståhle et al. (2011), considering operating profit plus depreciation and amortization as structural capital is deemed inaccurate since it is essentially proportional to the company's operating margin. Therefore, they assert that this measure cannot be accurately referred to as structural capital. The formula for A-VAIC is presented in Equation 1.

$$A - VAIC = \frac{VA}{HC} + \frac{VA}{INVC} + \frac{VA}{CE} \qquad (1)$$

The ratio VA/HC represents human capital efficiency (HCE), VA/INVC denotes innovation capital efficiency (INVCE), and VA/CE represents capital employed efficiency (CEE). The Adjusted-VAIC is a modification introduced by Nadeem et al. (2019) based on the original VAIC developed by Pulic (1988).

Compared to the market price approach and the hazard model, Z-Score is widely regarded as a superior measurement predictor of bankruptcy, particularly when utilizing an international dataset (Agarwal & Taffler, 2008). Altman et al. (2017) further support this argument in their research on utilizing accounting measurements to assess financial distress risk. They find that a higher Z-score indicates a lower risk of financial distress.

This research employs a formula designed specifically for emerging markets, as presented in Equation 2. The choice of this formula is informed by the fact that the research pertains to India, a developing country. Furthermore, it utilizes both manufacturing and non-manufacturing measurements in accordance with the industry of the companies under study. The Z-Scores of these companies in Japan are then measured, and the results are presented in Equations 3 and 4.

$$Z = 1.2\,\frac{(CA-CL)}{TA} + 1.4\frac{RE}{TA} + 3.3\frac{EBIT}{TA} + 0.6\frac{MV}{TL} + \frac{SAL}{TA} \tag{2}$$

$$Z = 6.56\,\frac{(CA-CL)}{TA} + 3.26\frac{RE}{TA} + 6.72\frac{EBIT}{TA} + 1.05\frac{MV}{TL} \tag{3}$$

$$Z = 3.25 + 6.56\,\frac{(CA-CL)}{TA} + 3.26\frac{RE}{TA} + 6.72\frac{EBIT}{TA} + 1.05\frac{MV}{TL} \tag{4}$$

In addition to the aforementioned variables, we included certain control variables in this study. Specifically, we controlled for firm size, measured by the log-transformed Total Assets. A higher asset size indicates that the firm is asset-based rather than service-based (De & Nagaraj, 2014). We also controlled for Leverage, measured as the total debt divided by total assets. Leverage is strongly correlated with a firm's credit rating, which reflects its creditworthiness. A firm with a high credit rating has a significantly lower chance of facing bankruptcy in the next 10 years (Verwijmeren & Derwall, 2010). In addition, we control for Return on Assets, which is calculated by dividing net income by total assets. We also include the Quick Ratio, measured as current assets minus inventory divided by current liabilities. Lastly, given that the research period encompasses pandemic years, we introduce a Covid control variable using a dummy to distinguish between Covid years (2020 and 2021) and non-Covid years.

Table 1. Variable Operational Definitions

| Variable | Indicator | Item | Source |
|---|---|---|---|
| Financial Distress | ZSCORE | Altman Z-Score | Altman et al., 2017 |
| Intellectual Capital | HCE | Human Capital Efficiency | Nadeem et al., 2019 |
| | INVCE | Innovation Capital Efficiency | |
| | CEE | Capital Employed Efficiency | |
| Firm Size | SIZE | Total Assets | Al-Hadi et al., 2019 |
| Leverage | LEV | Short Term Debt, Long Term Debt, Total Assets | |
| Return on Assets | ROA | Net Income, Total Assets | |
| Quick Ratio | QUICK | Current Assets, Inventory, Current Liabilities | |
| Covid-19 | COVID | Dummy Variable with "1" representing COVID year | Athayah et al., 2022 |

**Regression Analysis**

This research utilizes a panel data regression model to investigate the relationship between Intellectual Capital Performance and the Financial Distress Risk of companies. The regression model is presented in Equation 5.

$$\mathrm{ZSCORE_{it}} = \beta_0 + \beta_1 HCE_{it} + \beta_2 INVCE_{it} + \beta_3 CEE_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 ROA_{it} + \beta_7 QUICK_{it} + \beta_8 COVID_{it} \tag{5}$$

## 4. Result and Discussion

### *4.1. Descriptive Statistics*

The descriptive analysis results of the variables in this study are summarized in Table 2. For the variable ZSCORE, the mean value for India is 12.670, with a standard deviation of 10.110, whereas, for Japan, the mean value is 5.5850, with a standard deviation of 6.8064. Regarding the variable HCE, India exhibits a mean value of 6.8778 with a standard deviation of 89.8719, whereas Japan shows a mean value of 2.5585 with a standard deviation of 9.1400. As for the variable INVCE, India has a mean value of 662.6942 with a standard deviation of 7750.7320, while Japan has a mean value of 91.9521 with a standard deviation of 961.7734. The variable CEE has a mean value of 0.2391 with a standard deviation of 0.1459 for India and a mean value of 0.1180 with a standard deviation of 0.0885 for Japan.

Regarding SIZE, India exhibits a mean value of 20.0493 with a standard deviation of 1.6669, while Japan shows a mean value of 20.4047 with a standard deviation of 1.5996. As for the variable LEV, India has a mean value of 0.1905 with a standard deviation of 0.1580, while Japan has a mean value of 0.1676 with a standard deviation of 0.1475. Regarding

ROA, India exhibits a mean value of 0.0741 with a standard deviation of 0.0849, whereas Japan shows a mean value of 0.0366 with a standard deviation of 0.0591. As for the variable QUICK, India has a mean value of 1.3239 with a standard deviation of 1.7684, while Japan has a mean value of 1.9203 with a standard deviation of 1.4226. Finally, it is worth noting that both India and Japan demonstrate an identical mean value of 0.4000 for the variable COVID. The standard deviation for India is 0.4900, while Japan's is 0.4899.

Table 2. Descriptive Statistics

| Variable | India | | Japan | |
|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** |
| Dependent Variables | | | | |
| ZSCORE | 12.6701 | 10.1100 | 5.5850 | 6.8064 |
| Independent Variables | | | | |
| HCE | 6.8778 | 89.8719 | 2.5585 | 9.1400 |
| INVCE | 662.6942 | 7750.7320 | 91.9521 | 961.7734 |
| CEE | 0.2391 | 0.1459 | 0.1180 | 0.0885 |
| Control Variable | | | | |
| SIZE | 20.0493 | 1.6669 | 20.4047 | 1.5996 |
| LEV | 0.1905 | 0.1580 | 0.1676 | 0.1475 |
| ROA | 0.0741 | 0.0849 | 0.0366 | 0.0591 |
| QUICK | 1.3239 | 1.7684 | 1.9203 | 1.4226 |
| COVID | 0.4000 | 0.4900 | 0.4000 | 0.4899 |

### *4.2. Regression Analysis*

Panel data regression with random effects is employed to assess the impact of HCE, INVCE, and CEE on the firm's financial distress risk, measured using Altman Z-Score. The regression results are presented in Table 3. As shown in Table 3, the random effect model applied to the regression of firms in India yields an adjusted R-squared value of 0.403110. This value indicates that the independent variables in this study collectively account for 40.31% of the variation in the company's Z-Score. In comparison, the remaining 59.69% is attributed to other variables not included in the model. On the other hand, Japan exhibits an adjusted R-squared value of 0.239823. This value indicates that the independent variables in this study account for 23.98% of the variation in the company's Z-Score, while the remaining 76.02% is explained by other variables not included in the model.

In Table 3, when examining the results for Indian firms, Human Capital Efficiency (HCE) demonstrates statistical significance, suggesting that it significantly impacts the firm's financial distress risk as measured by the Z-score. Similarly, when analyzing the results for Japanese firms, HCE exhibits statistical significance, indicating its significant influence on financial distress risk. This result indicates that the hypothesis (H1a) is accepted in both sample countries. In knowledge-based economies, human capital is anticipated to influence a firm's competencies and efficiency throughout its business processes, thereby reducing the risk of the firm facing financial distress situations. This finding aligns with the human capital theory. This result aligns with previous research (Nadeem et al., 2019; Soewarno & Tjahjadi, 2020), which also significantly affected Human Capital Efficiency. The regression coefficient suggests that human capital has a more pronounced impact in Japan compared to its influence in India, implying that developed nations attribute greater significance to human capital.

For Innovation Capital Efficiency (INVCE), the regression results yield statistically insignificant results in India and Japan. This indicates that innovation, as measured by the amount spent on research and development costs, does not significantly affect a firm's risk of facing financial distress. These results indicate that the Hypothesis (H1b) is rejected in India and Japan. According to the resource-based view, a firm must possess valuable, rare, difficult to imitate, and systematically organized resources to maintain sustainability. This research does not align with the resource-based theory, as higher research and development investments were not found to lead to better products, which would subsequently contribute to sustainability and a lower risk of facing financial distress situations. However, according to the findings of this research, higher investment in research and development did not result in a lower chance of facing financial distress. Previous research done by (Bayraktaroglu et al., 2019; Vishnu & Gupta, 2014) supports these findings. However, this result contradicts the findings of previous studies (Nadeem et al., 2019; Soewarno & Tjahjadi, 2020), which reported significant results. Upon closer examination of the regression coefficients, it becomes evident that both countries display negligible values, indicating that innovation plays a minor role in both developed and developing nations.

Regarding Capital Employed Efficiency (CEE), the results from the regression analysis show significant effects for both India and Japan. These findings indicate that CEE, measured by the amount of firm total assets, impacts the firm's financial distress risk. These results also imply that the Hypothesis (H1c) is accepted in India and Japan. This finding aligns with previous research (Nadeem et al., 2019; Soewarno & Tjahjadi, 2020), which similarly reported that Capital Employed Efficiency has a significant effect. The analysis of regression coefficients indicates that India has a greater impact than Japan, suggesting that Capital Employed Efficiency holds more significance in a developing country compared to a developed one.

Table 3. Regression results

| Dependent Variable | Z-Score | |
|---|---|---|
| | India | Japan |
| HCE | 0.003** (0.001) | 0.019** (0.009) |
| INVCE | 0.001ns (0.001) | 0.001ns (0.001) |
| CEE | 34.928*** (2.078) | 11.888*** (1.556) |
| SIZE | 0.632*** (0.235) | -0.136* (0.070) |
| LEV | -19.011*** (1.824) | -3.336*** (0.773) |
| ROA | -27.112*** (2.549) | 6.832*** (2.077) |
| QUICK | 1.646*** (0.154) | 2.373*** (0.074) |
| COVID | 1.480*** (0.233) | -1.190*** (0.119) |
| Adjusted R-Squared | 0.403110 | 0.239828 |
| F-Stat | 113.1926 | 230.4807 |
| Durbin Watson | 1.115982 | 1.294367 |
| Observation | 1330 | 5820 |

Note(s): Coefficient (Std. Error) | ***: statistically significant at the level <0.01; ** : statistically significant at the level <0.05; * : statistically significant at the level <0.1; ns : not significant

### *4.3. Result and Discussion*

This study hypothesizes that Intellectual Capital, as measured using the Adjusted VAIC method consisting of Human Capital Efficiency, Innovation Capital Efficiency, and Capital Employed Efficiency individually, has a positive and significant influence on a company's Financial Distress Risk. Financial Distress Risk is measured using the Altman Z-Score, where companies with higher Z-scores are expected to have a lower risk of bankruptcy. The data processing results indicate positive and significant correlations between human capital efficiency and capital employed efficiency with the company's Z-score. However, innovation capital efficiency does not have a significant effect on the Z-Score value.

The results pertaining to the relationship between the variables, human capital efficiency and capital employed efficiency, which both exhibit a significant effect on the company's financial distress risk, are consistent with previous research conducted by (Cenciarelli et al., 2018; Shahwan & Habib, 2020). Meanwhile, the innovation capital efficiency variable, which does not exhibit a significant effect on the company, contradicts the research conducted by (Nadeem et al., 2019). Their study demonstrated that innovation capital efficiency has a positive and significant effect on company performance, as measured by ROA and ROE. However, another study (Soewarno & Tjahjadi, 2020) found that the innovation capital efficiency variable has a significant effect on ROA but does not show significant effects on ROE, ATO, and PBV.

No statistically significant difference was observed in the results for the three independent variables, namely Human Capital Efficiency, Innovation Capital Efficiency, and Capital Employed Efficiency, between the two countries. Notably, all three variables demonstrate analogous outcomes across the two countries. There is a notable difference when examining the control variable. In India, firm size exhibits a positive relationship with financial distress risk, whereas, in Japan, it demonstrates a negative relationship. Furthermore, the significance levels differ significantly, with the relationship in India being significant at the 1% level, while in Japan, it is only significant at the 10% level. The Return on Assets (ROA) exhibits a distinct relationship between the two countries, with India experiencing a negative impact on financial distress risk, while Japan shows a positive association. Both relationships are statistically significant at the 1% level. Furthermore, COVID-19 has differing effects on the financial distress risk of the two countries, with Japan experiencing a negative impact and India experiencing a positive impact. Again, both impacts are statistically significant at the 1% level.

## 5. Conclusion

This study aims to contribute to the existing literature by investigating the impact of intellectual capital on financial distress risk in two countries with distinct socioeconomic backgrounds. This research analyzes India, a developing country, and Japan, a developed nation. Through panel data regression analysis, the findings confirm that intellectual capital significantly influences the financial distress risk of firms in both developing and developed countries. Both countries exhibit positive results regarding the relationship between intellectual capital and financial distress. As hypothesized, capital employed significantly influences a firm's likelihood of experiencing financial distress. A firm with higher capital employed demonstrates a higher Z-score value, consequently reducing the probability of encountering financial distress. While human capital exhibits a comparatively lower influence than capital employed, it still plays a noteworthy role in impacting a firm's probability of facing financial distress. A firm with superior human capital would yield a higher Z-score value, consequently reducing the probability of encountering financial distress. While there exists a hypothesis that is not supported, this study offers novel and in-depth insights into the individual components of intellectual capital, namely human capital efficiency, research and development capital, and capital employed efficiency, and their impact on a firm's risk of facing financial distress. Further research is required to measure each element accurately, as the results display inconsistencies with prior literature.

This research contributes to expanding the theory of Intellectual Capital to encompass the risk of companies experiencing financial distress. This study investigates intellectual capital within two distinct socioeconomic conditions: developing and developed. The primary objective of this research is to examine the influence of intellectual capital on the occurrence of financial distress in both India, a developing country, and Japan, a developed country. To measure financial distress, the Z-Score approach is employed as the chosen method in this study.

According to the findings of this research, managers should prioritize financial investments that directly impact the organization's financial resources, as capital employed exerts the strongest influence on intellectual capital. Despite human capital having a comparatively lower influence, it still maintains statistical significance, underscoring the importance of investing in activities that enhance employees' knowledge, skills, and capabilities. Encouraging collaboration and knowledge sharing maximizes existing knowledge and expertise. Although innovation capital is statistically insignificant, managers can still foster an environment that encourages creativity by providing the necessary resources, incentives, and support for generating and implementing new ideas. Performance evaluation and incentive systems should align with the factors influencing intellectual capital, emphasizing financial metrics related to capital employed and measures of human capital development and collaboration. Strategic planning should align with financial goals, leveraging resources effectively and considering the development and utilization of human capital to achieve sustained competitive advantage and foster innovation.

This research study has certain limitations that need to be addressed to enhance its effectiveness. Firstly, the analysis focused on examining the effect of intellectual capital on financial distress risk in public companies of India and Japan, chosen as representatives of developing and developed nations, respectively. However, it is essential to acknowledge that this research only encompasses the period from 2017 to 2021 and relies solely on secondary data published by the companies. Another limitation of this study is the restriction of the sample and company data to public companies, which may offer a partial representation of the entire business landscape. Furthermore, it is crucial for future research to enhance the sample size by including more countries as representatives of both emerging and developed nations. Additionally, the completeness of the required financial data should be enhanced to ensure a more accurate representation of each country. To improve the effectiveness of this research, future studies should also concentrate on refining the measurement of each variable essential for this investigation. Furthermore, considering the utilization of primary data could be advantageous. Researchers can achieve a more comprehensive and nuanced understanding of the relationship between intellectual capital and financial distress risk by incorporating primary data collection methods, such as surveys or interviews.

### Author Contribution

Author 1: conceptualization, writing original draft, data curation, formal analysis, investigation, methodology. Author 2: review and editing, writing review and editing, supervision, validation, visualization.

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### Conflict of Interest

The authors assert that the research was carried out without involvement in commercial or financial relationships that could be perceived as potential conflicts of interest.

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