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**Corporate Governance, Intellectual
Capital, and Bankruptcy Risk: Evidence
from Egyptian Stock Exchange.**

Dalia Morsy Mohammed Hassan Rasheed

Lecturer at Accounting Department

Faculty of Business, Alexandria University

Dalia.rasheed@alexu.edu.eg

Corporate Governance, Intellectual Capital, and bankruptcy risk: Evidence from Egyptian Stock Exchange.**Abstract**

Purpose – The purpose of this study is to examine the relationship between corporate governance and intellectual capital. It also investigates the impact of intellectual capital and corporate governance mechanisms on the bankruptcy risk of Egyptian companies listed on the EGX 100 index.

Design/methodology/approach– This study depended on a sample of 355 observations of 71 companies listed on the EGX 100 index during 2017-2021. The modified Altman Z Score model was used to measure bankruptcy risk, and the value-added intellectual coefficient (VAIC) model was used to measure intellectual capital. Corporate governance mechanisms, such as board characteristics and audit committee are presented as independent variables.

Findings – The findings suggest that board size, board meetings, and audit committee meetings have a significant positive effect on intellectual capital efficiency with its three components of human capital efficiency, structural capital efficiency, and capital employed efficiency. The results also show an insignificant influence of board independence and audit committee size on intellectual capital efficiency. Moreover, this study finds that companies with intellectual capital efficiency are less likely to go bankrupt. Furthermore, the results indicate that board size, independence, and meetings have a significant negative effect on bankruptcy risk. Thus, good corporate governance improves a company's financial health.

Originality/value – The results of this study contribute to the literature on intellectual capital and corporate governance in emerging markets, such as Egypt. This study also contributes to the bankruptcy risk literature. According to the researcher's knowledge, this study is the first to investigate the relationship among intellectual capital, corporate governance, and bankruptcy risk in the Egyptian stock exchange context.

Keywords Intellectual capital efficiency, Corporate governance, Bankruptcy risk, Signaling theory, Resource-based theory.

I. Introduction

Intellectual capital is a critical strategic asset for creating value and improving companies' competitive advantages by improving their creativity, innovation, and information technology (Jamei 2017; D'Amato 2021). Therefore, it has been recognized as an important strategic resource for determining company growth (Appuhami and Bhuyan 2015). Moreover, intellectual capital efficiency helps companies enhancing assets management, improving internal control, and reducing risk (Tran et al. 2020). Most researchers focused on the important role of intellectual capital in enhancing a company's value by creating new knowledge and exchanging knowledge (Appuhami and Bhuyan 2015; Buallay and Hamdan 2019; D'Amato 2021). Shahdadi et al. (2020) suggested that companies with intellectual capital efficiency have good risk management systems and are less likely to go bankrupt.

Additionally, according to previous studies, good corporate governance increases a company's ability to attract more intellectual capital (e.g., Jamei 2017; Buallay and Hamdan 2019). However, Corporate governance ensures that managerial decisions are made to increase the shareholders wealth through intellectual capital efficiency (Appuhami and Bhuyan 2015). As stated by (Oteng-Abayie et al. 2018), good corporate governance reduces agency problems, improves firm performance, and reduces financial distress. On the other hand, intellectual capital can enhance corporate governance by increasing managers' attention to structuring and formatting strategies and policies that reduce agency problems and protect financial reporting users (Musleh Al-Sartawi 2018). According to (Khan and Ali 2018) good corporate governance along with effective intellectual capital can improve a company's profitability, and sustainability and reduce its bankruptcy risk.

As corporate governance mechanisms play an imperative role in improving intellectual capital efficiency and reducing bankruptcy risk, few studies have investigated the link between corporate governance and intellectual capital. Furthermore, most studies

have focused on the impact of corporate governance or intellectual capital on firm performance (Dženopoljac et al. 2016; Nkundabanyanga 2016; Shahwan and Habib 2020). Hence, there are sparse studies examining the connection between corporate governance and intellectual capital efficiency and their impact on bankruptcy risk.

This study investigates the relationships between intellectual capital efficiency, corporate governance mechanisms, and bankruptcy risk. Accordingly, three issues are addressed. First, it tests whether corporate governance mechanisms, such as board characteristics and audit committee, enhance intellectual capital efficiency and its three proxies: human capital efficiency, structural capital efficiency, and capital employed efficiency. Second, it investigates whether intellectual capital efficiency improves bankruptcy risk predictions. Third, it examines whether corporate governance mechanisms enhance a company's ability to predict bankruptcy.

The current study uses the value-added intellectual coefficient (VAIC) model and its three components: human capital efficiency, structural capital efficiency, and capital employed efficiency, as proxies for intellectual capital. Further, it depends on corporate governance mechanisms such as board size, board independence, board meetings, audit committee size, and audit committee meetings. Additionally, it depends on the modified Altman Z Score model as a proxy for bankruptcy risk.

Based on a sample of 355 observations for 71 Egyptian companies listed on the EGX 100 index during the period from 2017 through 2021, the empirical results indicate a significant positive relationship between corporate governance and intellectual capital efficiency. Specifically, corporate governance mechanisms, such as board size, board meetings, and audit committee meetings, have a significant positive impact on intellectual capital efficiency. However, board independence and audit committee size have an insignificant impact on intellectual capital efficiency. Further, the results highlight that companies with good corporate governance are more profitable and less risky. Therefore, corporate

governance mechanisms improve a company's ability to predict bankruptcy. Finally, the results show that human capital efficiency, structural capital efficiency, and capital employed efficiency have a significant negative effect on bankruptcy risk. Therefore, companies with a high level of intellectual capital are less risky and are more able to predict bankruptcy.

This study contributes to the literature on intellectual capital, corporate governance, and bankruptcy risk, for which there is limited empirical research. Thus, the first contribution of this study is that it provides new evidence on the impact of corporate governance on intellectual capital efficiency, as well as the impact of intellectual capital and corporate governance on bankruptcy risk. Second, previous studies have examined the impact of intellectual capital or corporate governance on bankruptcy risk separately. Therefore, to the best of the researcher's knowledge, this study is the first to show the role of corporate governance mechanisms in enhancing intellectual capital efficiency and company bankruptcy prediction, as well as the role of intellectual capital efficiency in enhancing companies' financial health in the Egyptian stock exchange context.

Third, several studies on developed markets have investigated the relationship between intellectual capital, corporate governance, and bankruptcy risk. Consequently, this study fills this gap in the literature by examining the association between intellectual capital, corporate governance, and bankruptcy risk in emerging markets. Although most previous studies depended on the Altman Z score model developed by Altman (1968), this study depended on the modified Altman et al. (2005) Z Score model, which is the most powerful bankruptcy prediction model and can be used by different sectors and in emerging markets. Furthermore, few studies have examined the role of intellectual capital in predicting bankruptcy risk; therefore, the fourth contribution of this study is that it considers the importance of intellectual capital efficiency in enhancing a company's financial health. Finally, this study used the VAIC model with its three coefficients; human capital efficiency, structure capital efficiency, and capital employed

efficiency, as a proxy of intellectual capital efficiency and investigated its relationship with the Altman Z score model, which provides valuable contributions to the methodology.

The remainder of this paper is structured as follows. Section II presents the theoretical background of intellectual capital and corporate governance, the literature review, and hypotheses development. Section III contains the research methodology. While section IV reports the empirical results and discussion. Finally, Section V outlines the research conclusions, implications, and future research areas.

II. Theoretical background, literature review and hypotheses development.

• *Intellectual Capital.*

Intellectual capital is an intangible asset that includes technology, culture, reputation, and customer information that creates value added to companies, improves the management of their assets, reduces their risks, and improves their competitive power (Bakshani 2014; Shahdadi et al. 2020; Tran et al. 2020). It includes various types of assets, such as technology, knowledge, information, customer trust, trademarks, management skills, intellectual property, and the company's culture, learning, and experience, which can be used to create value for the company and sustain its competitive advantages (Petty and Guthrie 2000; Shahdadi et al. 2020; Tran et al. 2020). Therefore, it is an accumulation of all intangible resources that replace most tangible resources and enhance a company's performance (Petty and Guthrie 2000; Dalwai and Mohammadi 2020).

Furthermore, intellectual capital can be used to implement a company strategy and improve its performance, so it is a basis of competence and a resource of competitive advantage for the company (Kartika et al. 2021). It is a knowledge-based resource that contains capital employed (such as customers' and stakeholders' relationships), human capital (such as knowledge, experience, and skills), and structural capital (such as the working environment and company culture) (Suryani et al. 2018; Dalwai

and Mohammadi 2020; Kartika et al. 2021). These three components are key incentives for a company's performance (Bakshani 2014).

Human Capital signifies the employees' values that can be generated by the knowledge, experience, skills, competence, talents, and abilities of employees (Bakshani 2014; Mollabashi and Sendani 2014; Jamei 2017; Kartika et al. 2021). Consequently, it is the sum of leadership skills, employee professional knowledge, problem-solving abilities, and risk-taking (Petty and Guthrie 2000; Mollabashi and Sendani 2014). Additionally, human capital includes the creativity, culture, philosophy, and innovation power of the company, which can improve its performance and sustainability (Mollabashi and Sendani 2014; Braendle et al. 2017; Kartika et al. 2021).

Structural capital is an intangible infrastructure that belongs to company assets, such as patents, copyrights, trademarks, computer networks, databases, processes, software, strategies, organizational charts, knowledge, culture, philosophy, and other intellectual procedures, which support employee productivity and improve company value (Mollabashi and Sendani 2014; Jamei 2017; Kartika et al. 2021). It includes all of the non-human knowledge of an organization (Bakshani 2014; Jamei 2017). Hence, it can be divided into several categories, such as organizational structure and learning, corporate culture, information systems, and operational processes, that support companies in achieving their goals (Petty and Guthrie 2000; Mollabashi and Sendani 2014).

Capital employed or relational capital refers to an intellectual asset that includes a company's relationship with external parties, such as customers, suppliers, creditors, and the government (Bakshani 2014; Braendle et al. 2017; Jamei 2017; Kartika et al. 2021). The company should maintain its relationship with customers, suppliers, creditors, the government, and society, which has an impact on its profit (Jamei 2017; Kartika et al. 2021).

- ***Corporate governance.***

Corporate governance refers to a set of principles, rules, processes, regulations, and systems that control and manage the relationship between managers and investors in order to enhance a company's accountability, prosperity, and stakeholders' value (Puni and Anlesinya 2020; Iqbal and Masood 2022). Therefore, it implies the systems, processes, mechanisms, and structures that control and direct the company (Mensah and Adams 2014; Puni and Anlesinya 2020). Additionally, it involves rules that control the relationship between the company's managers, shareholders, employees, creditors, and internal and external stakeholders regarding their rights and obligations (Aboagye-Otchere et al. 2012; Kartika et al. 2021).

Furthermore, it has been raised due to agency problems because of the conflict of interest between managers and stakeholders (Dharmastuti and Wahyudi 2013). Accordingly, Iqbal and Masood (2022) defined it as a group of activities that controls the internal and external structures of the company and monitors managers' activities to reduce agency problems within a company. Consequently, corporate governance plays a primary role in reducing agency costs, creating long-term value, and enhancing the monitoring responsibility of board directors (Rezaee 2009). It provides trusted information about a company's growth, stability, and economic efficiency to the market (Jamei 2017; Iqbal and Masood 2022). Therefore, corporate governance is an important tool for improving efficiency, economic growth, and confidence and for creating value added (Jamei 2017).

It contains two types of mechanisms, internal and external, that coordinate the relationship between managers and principles (Sharma 2017). Companies use internal mechanisms to help managers create value for shareholders (Sharma 2017). Therefore, they include board size, diversity, independence, meetings, CEO duality, ownership concentration, capital and incentive structures, internal control system, and audit committees (Kohl and Schaeffers 2012; Ludwig and Sassen 2022). External mechanisms are created by the company's stakeholders for the company's operations with

associated parties (Sharma 2017). External mechanisms include auditors, market competition, selling policies, intermediaries, laws, and regulations (Dharmastuti and Wahyudi 2013; Sharma 2017).

- ***Corporate governance and intellectual capital.***

According to signaling theory, companies provide information to external parties to help them make decisions (Petty and Guthrie 2000; Suryani et al. 2018). This information can affect stock prices by triggering market reactions (Suryani et al. 2018). Therefore, annual reporting information can increase stock prices if it provides a positive signal of company performance (Petty and Guthrie 2000; Suryani et al. 2018). Conversely, if it provides a negative signal about a company performance, stock prices will be decreased (Suryani et al. 2018).

Resources-based theory explains that a competitive advantage improves financial performance and adds value to a company (Dalwai and Mohammadi 2020; Kartika et al. 2021). Competitive advantage can be obtained by employing and managing a company's current resources, which are structural, human, and capital employed (Dalwai and Mohammadi 2020; Kartika et al. 2021). Furthermore, resource dependence theory suggests that good corporate governance mechanisms, such as large size and a good diversity of board directors, many outside directors, and regular audit committee meetings, enhance companies' ability to generate valuable resources, such as human, structural, and capital employed (Shahwan and Fathalla 2020).

Good corporate governance improves a company's ability to attract talented employees, which in turn improves its performance (Tran et al. 2020). A good deal of previous research demonstrated a relationship between corporate governance and intellectual capital. For example, Braendle et al. (2017) surveyed 371 managers in public companies within the Gulf Cooperation Council to examine the impact of corporate governance and intellectual capital on company performance. The findings indicated that corporate governance mechanisms and human,

employed, and structured capital had a significant positive impact on company performance.

In addition, intellectual capital along with corporate governance are critical factors for a company's success, and they can improve companies' financial performance and value. In this line, Suryani et al. (2018) examined the impact of intellectual capital and corporate governance on company value and financial performance as intervening variables. Data were collected from the annual reports of financial companies listed on the Indonesian Stock Exchange in 2016. The results indicated a significantly positive impact of intellectual capital on financial performance and company value. Further, the findings demonstrated a significant positive effect of corporate governance on financial performance and an insignificant effect on company value. The results also showed that financial performance mediates the effects of intellectual capital and corporate governance on company value.

Likewise, Khan and Ali (2018) investigated the moderating effect of intellectual capital on the relationship between corporate governance and company performance. They used four-year panel data from 2012 through 2015, with 520 observations for a sample of 130 non-financial companies listed on the Pakistan Stock Exchange (PSX). The results pointed out a significant effect of intellectual capital on the relationship between board size, diversity, board financial expertise, CEO duality, and company performance. On the other side, Khan and Ali found an insignificant moderating effect of intellectual capital on the relationship between board independence and company performance. Further, the findings revealed a significant relationship between intellectual capital and board size, diversity, independence, and CEO duality.

Moreover, Buallay and Hamdan (2019) examined the moderating effect of firm size on the relationship between corporate governance and intellectual capital efficiency for a sample of 171 companies listed on the Saudi stock exchange with 498 observations between 2012 and 2014. They found that firm size

had a significant positive effect on the relationship between corporate governance and capital-employed efficiency. Further, they showed that human capital efficiency and structural capital efficiency were higher for firms with good corporate governance. However, capital-employed efficiency was higher for firms with a lower level of corporate governance.

Shahwan and Fathalla (2020) examined the mediating role of intellectual capital on the relationship between corporate governance and company performance. They applied the VAIC model and the corporate governance index to measure intellectual capital and corporate governance, respectively. Shahwan and Fathalla used a sample of 81 Egyptian companies with 405 observations for the period 2014-2018. The results indicated a significant positive impact of corporate governance on intellectual capital. Further, intellectual capital was found to mediate the relationship between corporate governance and company performance.

Similarly, intellectual capital and corporate governance can improve a company's ability to survive and stabilize. Kartika et al. (2021) explored the impact of intellectual capital and corporate governance on financial performance for a sample of 520 observations of 52 manufacturing companies listed on the Indonesia Stock Exchange during 2010-2019. The findings pointed out a significantly positive impact of good corporate governance and intellectual capital on financial performance.

However, some previous studies found an insignificant relationship between corporate governance mechanisms and intellectual capital. For example, a large number of directors may have a reverse effect on a company's goals by increasing costs and providing poor communication. Moreover, owning many shares by managers may affect a company's goals by increasing the managers' benefits. In this context, Jamei (2017) examined the relationship between corporate governance mechanisms, such as the number of board directors, non-duty members, managerial and institutional ownership, and intellectual capital. Jamei depended on 104 companies listed on the Tehran Stock Exchange during

2011-2015. He observed an insignificant effect of the number of directors, and managerial ownership on intellectual capital. He also found a significant positive relationship between the proportion of non-duty members, institutional ownership, and intellectual capital.

Similarly, Musleh Al-Sartawi (2018) focused on the relationship between corporate governance and intellectual capital disclosure for a sample of 247 companies in the Gulf Cooperation Council in 2015. The results demonstrated a significant negative relationship between corporate governance levels and intellectual capital efficiency. Dalwai and Mohammadi (2020) explored the impact of board size, board independence, audit committee size, audit committee meetings, and ownership concentration on efficiency of the intellectual capital in Oman's financial sector companies. They depended on 151 firm-year observations of 31 financial companies listed on the Muscat Securities Market during the period 2012-2016. The results indicated a significant negative relationship between board independence and intellectual capital efficiency. Moreover, shareholder concentration and audit committee size were found to have insignificant impacts on intellectual capital. Further, the results demonstrated a significant positive relationship between board size, audit committee meetings, and intellectual capital.

Based on the modified value-added intellectual coefficient model (MVAIC), Tran et al. (2020) investigated the relationship between corporate governance and intellectual capital. They depended on a sample of 45 Vietnamese-listed companies with 348 observations during the period 2011-2018. The authors found that the size and independence of the board of directors, CEO duality, and holding more than 20% of outstanding shares by major shareholders had a significant negative effect on intellectual capital efficiency. Depending on panel data of services companies listed on the Pakistan stock exchange during the period 2016-2020, Shahzad et al. (2022) explored the effect of corporate governance on intellectual capital efficiency and the moderating role of profitability in this relationship. The authors found a

significant negative relationship between intellectual capital and board size, independence, and audit committee. Furthermore, the findings showed a significant positive effect of CEO duality on intellectual capital efficiency. Moreover, company profitability was found to moderate the relationship between intellectual capital efficiency and the audit committee.

Overall, previous studies have stated that a large number of the directors enhance external links and access resources (Dalwai and Mohammadi 2020). Moreover, board independence is more likely to choose strategies that improve intellectual capital (Khan and Ali 2018). The large size of the audit committee and its frequency of meetings are signs of increasing the efficiency of a company's intellectual capital (Shahwan and Fathalla 2020). Moreover, previous studies showed an unclear relationship between corporate governance mechanisms and intellectual capital efficiency. Some studies (Khan and Ali 2018; Buallay and Hamdan 2019; Shahwan and Fathalla 2020) found a significant positive relationship between corporate governance mechanisms and intellectual capital, while others (Dalwai and Mohammadi 2020; Tran et al. 2020; Shahzad et al. 2022) showed an insignificant or inverse relationship between corporate governance mechanisms and intellectual capital efficiency. Therefore, this study argues that board independence and size, audit committee size, and frequency of meetings improve the intellectual capital efficiency of listed companies in the Egyptian stock exchange. Accordingly, the first research hypothesis regarding the relationship between corporate governance mechanisms and intellectual capital efficiency is as follows:

H1: There is a significant positive relationship between corporate governance and intellectual capital efficiency.

H1a: There is a significant positive relationship between board size and intellectual capital efficiency.

H1b: There is a significant positive relationship between board independence and intellectual capital efficiency.

H1c: There is a significant positive relationship between board meeting and intellectual capital efficiency.

H1d: There is a significant positive relationship between audit committee size and intellectual capital efficiency.

H1e: There is a significant positive relationship between audit committee meetings and intellectual capital efficiency.

- ***Intellectual capital and bankruptcy risk.***

Bankruptcy refers to the failure and liquidity problems that occur when the company is unable to meet its obligations to creditors because of the drop in its profitability (Shahdadi et al. 2020). It is a process in which creditors depend on the judiciary to request claims from companies that are unable to fulfill their obligations (Shahdadi et al. 2020). Therefore, bankruptcy has detrimental effects on employees, managers, lenders, stakeholders, and society (Shahdadi et al. 2020). Many previous studies have demonstrated the impact of intellectual capital on bankruptcy risk. For example, Alwert et al. (2009) examined the impact of intellectual capital on financial analysts' valuation behavior. They found that intellectual capital reduced investors' and banks' risks and increased the evaluation of the company.

In the USA, Liu and Wong (2011) investigated the impact of intellectual capital on financing decisions for a sample of 12,743 firm-year observations from 1975 to 1999. They depended on three measures of financing decisions: market leverage, book leverage, and interest coverage ratios. They found a significant positive effect of intellectual capital on financing decisions. Intellectual capital was found to have a positive effect on interest coverage ratios, market leverage, and book leverage. Furthermore, the results indicated that the positive relationship between intellectual capital and financing decisions was stronger for high-tech companies than for non-high-tech companies.

In addition, intellectual capital plays an important role in enhancing the intelligent management of corporate liquidity and reducing the likelihood of bankruptcy. Mollabashi and Sendani (2014) examined the impact of intellectual capital on bankruptcy risk for a sample of 120 companies listed on the Tehran Stock Exchange for five years between 2008 and 2013. The results

indicated that the three types of intellectual capital; human capital, structural capital, and capital employed, are inversely related to the bankruptcy risk of companies listed on the Tehran Stock Exchange. Using survival analysis to predict bankruptcy, Bakshani (2014) examined the relationship between intellectual capital components and bankruptcy risk. He depended on a sample of 132 food and drink industrial companies listed on the Tehran Stock Exchange for the period 2004-2009. Bakshani found that the three components of intellectual capital were not suitable predictors of bankruptcy risk.

Companies with high levels of intellectual capital have more competitive advantages than their competitors. Akpinar (2017) studied the effects of companies' profitability, growth, size, liquidity, efficiency, dividend-paying, and intellectual capital on bankruptcy risk. Akpinar depended on a sample of 79 manufacturing companies listed on Borsa Istanbul, with 474 observations from 2010 through 2015. The results pointed out that a company's profitability, liquidity, efficiency, and intellectual capital reduced bankruptcy risk. Moreover, intellectual capital plays an important role in assessing a company's future solvency. In this line, Cenciarelli et al. (2018) explored the relationship between intellectual capital and bankruptcy risk prediction in the USA for a sample of 28,915 company-year observations during 1985-2015. The results pointed out that intellectual capital was associated with a lower probability of default in the future. Further, good intellectual capital performance was found to improve long-term financial performance and reduce the company's credit risk and cost of debt.

Shahwan and Habib (2020) assessed the influence of intellectual capital on financial distress for a sample of 51 companies listed on the Egyptian Stock Exchange during 2014-2016. They found a significant negative impact of intellectual capital on a company's financial distress because Egyptian listed companies failed to develop these three elements of intellectual capital. Conversely, Shahdadi et al. (2020) investigated the impact of intellectual capital on the liquidity of stocks and assets and the likelihood of

bankruptcy for a sample of 147 companies listed on the Tehran Stock Exchange during 2010-2017. The findings revealed a significant positive effect of intellectual capital on the liquidity of stocks and assets. Further, intellectual capital was found to have a significant negative effect on the likelihood of bankruptcy.

Depending on Altman-Z's score to measure bankruptcy risk, Dalwai and Salehi (2021) examined the impact of business strategy and intellectual capital on company performance and bankruptcy risk. They depended on a sample of 117 non-financial sector companies listed on the Muscat Securities Market, with 380 observations from 2015 through 2019. The results pointed out an insignificant impact of value-added intellectual capital on firm performance and financial solvency. Whereas employed capital efficiency was found to have a significant positive impact on firm performance. Further, structure capital efficiency had a significant positive impact on return on assets and financial solvency.

Furthermore, intellectual capital improves profitability and reduces financial risk. In the Italian context, D'Amato (2021) analyzed the relationship between intellectual capital and firm financial leverage, mediated by firm profitability and risk. D'Amato used a sample of 21,335 Italian companies during 2008–2017. He found that companies with a high level of intellectual capital were more profitable and riskier and had lower financial leverage than companies with a low level of intellectual capital. Further, the findings demonstrated that companies with a high level of intellectual capital, and higher profitability and risks have lower financial leverage.

In conclusion, most previous studies suggested an inverse relationship between intellectual capital and bankruptcy risk. They demonstrated that intellectual capital is an indicator of a company's financial health, which depends on its ability to manage intangible assets. Given that, companies with a high level of intellectual capital can cover their obligations and improve their future performance. Consequently, investors and creditors prefer to allocate their resources to companies with good intellectual capital. Therefore, companies with good intellectual capital can

meet their debts, enhance their financial position, create value-added, and reduce their bankruptcy risk. Based on these arguments, this study suggests that companies with efficient intellectual capital are less likely to face bankruptcy. Thus, the second research hypothesis is as follows:

H2: There is a significant negative relationship between intellectual capital efficiency and bankruptcy risk.

H2a: There is a significant negative relationship between human capital efficiency and bankruptcy risk.

H2b: There is a significant negative relationship between Structural capital efficiency and bankruptcy risk.

H2c: There is a significant negative relationship between capital employed efficiency and bankruptcy risk.

- ***Corporate Governance and bankruptcy risk.***

Bankruptcy is the consequence of financial distress, which happens when the company defaults its financial commitments. Companies try to restructure their assets and liabilities to avoid bankruptcy and financial distress. Recent studies have found that corporate governance mechanisms can improve a firm's ability to predict bankruptcy. For example, Fich and Slezak (2008) studied the effect of corporate governance characteristics on a company's ability to predict and avoid bankruptcy for a sample of 781 USA companies from 1992 to 2000. The results indicated that a large number of directors, the more independent directors, and the large ownership of inside directors have a significant negative effect on bankruptcy risk.

Companies with good governance are less likely to suffer financial distress. In this context, Hui and Jing-Jing (2008) examined the relationship between corporate governance mechanisms and financial distress costs for a sample of 193 companies listed on the Shanghai Stock Exchange during the period 2000-2006. The results demonstrated a significant negative impact of board independence and the proportion of companies' shares owned by the state on the costs of financial distress.

Furthermore, CEO duality and ownership concentration were found to have an insignificant impact on financial distress costs.

Depending on the internal mechanisms of corporate governance, Mokarami and Motefares (2013) assessed the impact of board size, CEO dual position, and replacement on a company's bankruptcy risk. They depended on a sample of 76 companies listed on the Tehran Stock Exchange (TSE) during 2001-2009. The findings indicated a significant positive relationship between CEO replacements and bankruptcy risk. Further, the results revealed an insignificant relationship between board size, CEO dual position, and bankruptcy risk.

Similarly, Khabir and Vatanparast (2016) evaluated the impact of corporate governance indices on bankruptcy risk for a sample of 81 companies listed on the Tehran Stock Exchange from 2009 through 2013. The results showed a significant negative impact of government ownership, managers ownership, majority ownership, and financial leverage on bankruptcy risk. Further, board size and institutional ownership were found to have an insignificant impact on bankruptcy risk. Conversely, Darrat et al. (2016) studied the impact of corporate governance on bankruptcy risk for a sample of 217 USA bankrupt companies during 1996-2006. The results documented that the large number of directors reduced bankruptcy risk. These results also suggested that the proportion of inside directors is negatively associated with bankruptcy risk.

Shahwan and Habib (2020) found an insignificant negative impact of the board of directors' structure, ownership structure, shareholders' rights, and investor relations on companies' financial distress. In contrast, Annisa (2021) examined the effects of corporate governance, third-party funds, and asset growth on profitability and bankruptcy risk for Islamic Banking listed on the Indonesian stock exchange. The results showed a significant positive effect of corporate governance, assets growth, and third-party funds on profitability. Further, the results also showed a significant negative impact of corporate governance, assets growth, and third-party funds on bankruptcy risk. Further,

Handriani et al. (2021) explored the effect of board size, board independence, and institutional ownership on financial distress for a sample of nine manufacturing companies listed on the Indonesia Stock Exchange with 300 observations during the period 2010-2018. They found that institutional ownership and board independence have a significant positive impact on avoiding financial distress. However, board size was found to have an insignificant positive effect on financial distress.

In the Sri Lankan context, Uduwalage (2021) investigated the relationship between corporate governance mechanisms and a company's financial distress for a sample of 205 non-financial companies listed on the Colombo Stock Exchange in 2012. Uduwalage found that board size, board independence, board ownership, institutional ownership, and non-institutional ownership concentration enhanced a company's prediction of financial distress. Similarly, Safrida et al. (2021) tested the effect of corporate governance on bankruptcy prediction for a sample of 20 companies listed on the Indonesia Stock Exchange for the period 2016-2020. The results demonstrated a significant positive effect of the board of directors, board of commissioners, independent commissioners, and audit committee on the prediction of bankruptcy. The results also revealed a significant negative influence of Institutional ownership and managerial ownership on bankruptcy prediction.

By developing a corporate governance index, Iqbal and Masood (2022) provided empirical evidence of the relationship between corporate governance and bankruptcy prediction for 30 sugar sector companies listed on the Pakistan Stock Exchange during 2008-2018. Their findings showed a significant positive relationship between corporate governance and bankruptcy prediction when measured by the Working Capital/Total Asset ratio. Moreover, the findings showed a significant negative relationship between corporate governance and bankruptcy prediction measured by retained earnings/ total asset, earnings before interest and taxes/ total assets, sales/ total assets, and cash flow/total debt ratios.

Overall, the aforementioned studies, on one hand, have provided mixed results regarding the relationship between corporate governance mechanisms and bankruptcy risk. Some studies (Mokarami and Motefares 2013; Handriani et al. 2021) found an insignificant negative impact of board size and CEO duality on bankruptcy risk. On the other hand, most studies have found a significant negative effect of corporate governance mechanisms on bankruptcy risk. Therefore, most studies agreed that good corporate governance practices reduce agency costs, and problems, and enhance a company's financial health and its ability to predict bankruptcy. Based on these arguments, good practices of corporate governance are expected to improve a company's prediction of financial distress and reduce its possibility of going bankrupt. Accordingly, this study examines the relationship between corporate governance and bankruptcy risk in the Egyptian environment, using the following hypothesis:

H3: There is a significant negative relationship between corporate governance and bankruptcy risk.

H3a: There is a significant negative relationship between board size and bankruptcy risk.

H3b: There is a significant negative relationship between board independence and bankruptcy risk.

H3c: There is a significant negative relationship between board meeting and bankruptcy risk.

H3d: There is a significant negative relationship between audit committee size and bankruptcy risk.

H3e: There is a significant negative relationship between audit committee meetings and bankruptcy risk.

III. Research Methodology

- *Sample selection*

This study uses Egyptian companies listed on the EGX 100 to investigate the relationship between intellectual capital, corporate governance, and bankruptcy risk. Hence, the initial sample comprises 100 listed companies over a five-year period, from 2017 to 2021. The sample excluded 18 companies due to the

unavailability of their annual reporting, board of directors reports or corporate governance reports during the study period. In addition, six companies were eliminated because their financial statements were presented in a foreign currency. Moreover, the study sample excluded five companies listed on the Egyptian Stock Exchange after 2017. The data used in this study were collected from annual reports and companies' websites. The companies used in the sample were selected on the basis of their data availability. Consequently, the final sample consists of 71 companies with 355 observations.

- *Variable measurements*

Independent variables: This study examines the impact of corporate governance and intellectual capital on bankruptcy risk. Accordingly, the first independent variable in this study is intellectual capital. Most previous studies (Dženopoljac et al. 2016; Shahwan and Habib 2020; Dalwai and Salehi 2021) have used the value-added intellectual coefficient (VAIC) model developed by (Pulic 1998, 2000, 2003, 2004) as a useful method to assess intellectual capital efficiency. It is a measurement for providing statistical comparable results within department and across sectors (Dalwai and Salehi 2021). The (VAIC) model measures intellectual capital as the total of structural capital efficiency (STVA), human capital efficiency (VAHU), and capital employed efficiency (VACA) (D'Amato 2021). Accordingly, this model provides information about the efficiency of companies' intangible assets, which are human capital (skills and knowledge), structural capital (patents, databases, and networks), and capital employed (relationships with customers and suppliers) (Public 2003; Stähle et al. 2011). The (VAIC) model is a valuable and reliable measurement for intellectual capital because it is calculated based on financial reporting information (Clarke et al. 2011; D'Amato 2021). According to Pulic (2003, 2004) The (VAIC) model can be calculated using the following steps.

Step 1: Calculating the value-added (VA), which is the net value created by the company during the year. It is the sum of operating profit, total employees' costs, depreciation, and amortization expenses

(Cenciarelli et al. 2018). Therefore, the value-added can be calculated as follows (Shahwan and Fathalla 2020):

$$VA_{i,t} = OP_{i,t} + EC_{i,t} + D_{i,t} + A_{i,t}$$

Whereas:

$OP_{i,t}$ is the operating profit for the company (i), and year (t).

$EC_{i,t}$ is the employee costs for the company (i), and year (t).

$D_{i,t}$ is the depreciation expenses for the company (i), and year (t).

$A_{i,t}$ is the amortization expenses for the company (i), and year (t).

Step 2: Calculating structural capital efficiency, human capital efficiency, and capital employed efficiency.

$$HCE_{i,t} = VA_{i,t} / HC_{i,t}$$

Whereas:

$HCE_{i,t}$ is the human capital efficiency for the company (i), and year (t).

$VA_{i,t}$ is the value added for the company (i), and year (t).

$HC_{i,t}$ is the total salaries and wages for the company (i), and year (t).

$$SCE_{i,t} = SC_{i,t} / VA_{i,t}$$

Whereas:

$SCE_{i,t}$ is the structural capital efficiency for the company (i), and year (t).

$VA_{i,t}$ is the value added for the company (i), and year (t).

$SC_{i,t}$ is the structural capital for the company (i), and year (t).

$SC_{i,t} = VA_{i,t} - HC_{i,t}$

$$CEE_{i,t} = VA_{i,t} + CE_{i,t}$$

Whereas:

$CEE_{i,t}$ is the capital employed efficiency for the company (i), and year (t).

$VA_{i,t}$ is the value added for the company (i), and year (t).

$CE_{i,t}$ is the capital employed for the company (i), and year (t).

$CE = \text{total assets} - \text{total debts}$.

Step 3: calculating value added intellectual capital.

$$VAIC_{i,t} = HCE_{i,t} + SCE_{i,t} + CE_{i,t}$$

The other independent variable in this study is corporate governance, which is measured using internal corporate governance mechanisms such as board size, board independence, board meetings, audit committee size, and audit committee

meetings. Board size is measured by the number of directors (Dalwai and Salehi 2021). Board independence is measured by the ratio of independent non-executive directors to the total number of directors (Appuhami and Bhuyan 2015). Whereas board meetings are measured by the number of board meetings held during the year (Dalwai and Salehi 2021). Audit committee size is measured by the number of committee members (Li et al. 2012). While the audit committee meetings are measured by the number of the audit committee meetings held during the year (Li et al. 2012; Dalwai and Salehi 2021).

Dependent variable: This study examines the impact of intellectual capital and corporate governance on bankruptcy risk. Accordingly, the first objective of this study is to examine the relationship between corporate governance and intellectual capital efficiency. Therefore, the first dependent variable of this study is intellectual capital efficiency. The second and third objectives of this study are to examine the impact of corporate governance and intellectual capital on bankruptcy risk. Thus, the second dependent variable of this study is bankruptcy risk, which is measured by the modified Altman Z Score model proposed by Altman (2005), which can be used to evaluate a company's financial distress (Anwar and Hasnu 2016). It is suitable for manufacturing and non-manufacturing companies as well as for companies operating in emerging countries (Altman 2005). The model has three interpreting values, so if a Z-score is equal to or greater than 5.85, the company is classified as financially healthy (El Khoury and Al Beaino 2014; Cooper and Uzun 2019). When the Z-score is below 4.15, the company is in a bankruptcy area (El Khoury and Al Beaino 2014; Cooper and Uzun 2019). A Z-score between 4.15 and 5.85, means that the company has a possibility of bankruptcy (El Khoury and Al Beaino 2014; Cooper and Uzun 2019). The three Z-score values can be estimated using the following model (Shahwan and Habib 2020):

$$Z\text{-score} = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

Whereas:

X1 refers to working capital/total assets.

X2 refers to retained earnings/total assets.

X3 refers to earnings before interest and taxes/total assets.

X4 refers to market value equity/book value of total debt.

Control variables: To analyze the impact of intellectual capital and corporate governance on bankruptcy risk, firm size, firm age, and leverage were employed as control variables. Previous studies showed that firm size, age, and leverage are critical factors affecting intellectual capital, corporate governance, and bankruptcy risk (Shahwan and Fathalla 2020; Dalwai and Mohammadi 2020; Dalwai et al. 2021). Firm size is measured by the natural logarithm of total assets (Shahwan and Fathalla 2020; Dalwai and Salehi 2021). Firm age is measured by the number of years the company has been listed on the Egyptian Exchange (EGX) (Dalwai and Mohammadi 2020). Firm leverage is measured as the ratio of total debt to total assets (Shahwan and Fathalla 2020).

Research model

The relationship between intellectual capital efficiency, corporate governance mechanisms, and bankruptcy risk is tested using the following regression models:

The relationship between intellectual capital efficiency and corporate governance mechanisms is examined using model 1.

$$ICE_{i,t} = \beta_0 + \beta_1 BSIZE_{i,t} + \beta_2 BIND_{i,t} + \beta_3 BMEET_{i,t} + \beta_4 AUDSIZE_{i,t} + \beta_5 AUDMEET_{i,t} + \beta_6 CompanySize_{i,t} + \beta_7 CompanyAge_{i,t} + \beta_8 Leverage_{i,t} + \varepsilon_{i,t} \quad (1)$$

The impact of intellectual capital efficiency on bankruptcy risk is expressed using model 2.

$$Z-Score_{i,t} = \beta_0 + \beta_1 ICE_{i,t} + \beta_2 HCE_{i,t} + \beta_3 SCE_{i,t} + \beta_4 CEE_{i,t} + \beta_5 CompanySize_{i,t} + \beta_6 CompanyAge_{i,t} + \beta_7 Leverage_{i,t} + \varepsilon_{i,t} \quad (2)$$

The relationship between corporate governance mechanisms and bankruptcy risk is tested using model 3.

$$Z\text{-Score}_{i,t} = \beta_0 + \beta_1 \text{BSIZE}_{i,t} + \beta_2 \text{BIND}_{i,t} + \beta_3 \text{BMEET}_{i,t} + \beta_4 \text{AUDSIZE}_{i,t} + \beta_5 \text{AUDMEET}_{i,t} + \beta_6 \text{CompanySize}_{i,t} + \beta_7 \text{CompanyAge}_{i,t} + \beta_8 \text{Leverage}_{i,t} + \varepsilon_{i,t} \quad (3)$$

whereas:

β_0 =Intercept of each regression model.

$\beta_1, \beta_2, \beta_3, \beta_4,$ and β_5 =Regression coefficient of independent variables.

$\text{ICE}_{i,t}$ is the intellectual capital efficiency of company (i) at year (t).

$\text{CG}_{i,t}$ is the corporate governance of company (i) at year (t).

$Z\text{-Score}_{i,t}$ is the bankruptcy risk of company (i) at year (t).

$\text{BSIZE}_{i,t}$ is the board size of company (i) at year (t).

$\text{BIND}_{i,t}$ is the board independence of company (i) at year (t).

$\text{BMEET}_{i,t}$ is the board meetings of company (i) at year (t).

$\text{AUDSIZE}_{i,t}$ is the audit committee size of company (i) at year (t).

$\text{AUDMEET}_{i,t}$ is the audit committee meetings of company (i) at year (t).

$\text{HCE}_{i,t}$ is human capital efficiency of company (i) at year (t).

$\text{SCE}_{i,t}$ is the structural capital efficiency of company (i) at year (t).

$\text{CEE}_{i,t}$ is the capital employed efficiency of company (i) at year (t).

$\text{CompanySize}_{i,t}$ is the company size at year (t).

$\text{CompanyAge}_{i,t}$ is the company age at year (t).

$\text{Leverage}_{i,t}$ is the company leverage at year (t).

$\varepsilon_{i,t}$ is the error coefficient.

IV. Results and discussion

Table 1 presents the descriptive statistics for the dependent, independent, and control variables. Panel A provides descriptive statistics for the independent variables. The average VAIC is 36.1373, and ranges from 7.31 to 141.23, with a standard deviation of 20.71990. The average HCE is 7.7356, with a minimum of .13 and a maximum of 95.93. The average SCE is .8057 and runs from .02 to 8.78. The average CEE is 27.5985, with a minimum of 3.54 and a maximum of 82.96. The board size consists of nine members, on average, and ranges from 3 to 21 members. The board meetings are, on average, eight meetings, with a minimum of two meetings and a maximum of 41 meetings. Board independence includes seven non-executive directors, on average, and ranges from one director to 15 directors. Moreover,

the audit committee consists of four auditors, on average, and runs from two to eight members. The audit committee meetings are five, on average, with a minimum of one meeting and a maximum of 23 meetings. Panel B shows the descriptive statistics of the dependent variables. The bankruptcy Z score is, on average, 10.837, suggesting that EGX 100 companies are financially healthy. Panel C presents the descriptive statistics of the control variables. The company size, company age, and leverage are, on average, 12.0398, 18.68, and .1806, respectively.

Table 1. Descriptive statistics of variables

Variables	Obs	Mean	Min	Max	SD
Panel A: Independent Variables					
VAIC	355	36.1373	7.31	141.23	20.71990
HCE	355	7.7356	.13	95.93	10.84947
SCE	355	.8057	.02	8.78	.60364
CEE	355	27.5985	3.54	82.96	17.90798
BSIZE	355	9	3	21	2.998
BIND	355	7	1	15	3.011
BMEET	355	8	2	41	5.229
AUDSIZE	355	4	2	8	1.234
AUDMEET	355	5	1	23	2.785
Panel B: Dependent Variables					
Bankruptcy Z-Score	355	10.837	5.0236	19.9725	4.07586
Panel C: Control Variables					
Company Size	355	12.0398	8.470	20.430	3.16320
Company Age	355	18.68	2	41	8.631
Leverage	355	.1806	0.05	.810	.12454

Table 2 presents the Pearson correlation coefficient between the dependent, independent, and control variables. The VAIC is significantly and positively correlated with its three proxies, HCE, SCE, and CEE, with correlation coefficients of .502, .568, and .850, respectively. Moreover, VAIC is significantly and positively correlated with corporate governance variables of BSIZE, BIND, BMEET, and AUDMEET, with correlation coefficients of .608, .460, .108, and .111, respectively. In contrast, VAIC is insignificantly positively correlated with AUDSIZE, with a correlation coefficient of .036. The results of this study suggest that strong corporate governance mechanisms improve intellectual capital efficiency of Egyptian companies. These findings are consistent with those of previous studies (Khan and Ali 2018; Dalwai and Mohammadi 2020; Shahwan and Fathalla 2020).

Furthermore, the bankruptcy risk Z-score is significantly and negatively correlated with the VAIC with its three components: HCE, SCE, and CEE, with correlation coefficients of -.416, -.159, -.245, and -.382, respectively. These results indicate that higher intellectual capital efficiency reduces a company's possibility of going bankrupt. These findings are consistent with those of previous studies (Shahwan and Habib 2020; Shahdadi et al. 2020). Additionally, the bankruptcy risk Z-score is significantly and negatively correlated with the corporate governance proxies of BSIZE, BMEET, and AUDSIZE, with correlation coefficients of -.288, -.119, and -.142, respectively. These findings reveal that companies with good corporate governance mechanisms are less likely to go bankrupt. These results are consistent with those of previous studies (Darrat et al. 2016; Annisa 2021; Safrida et al. 2021). Conversely, there is an insignificant negative correlation between the bankruptcy risk Z-score and both BIND, and AUDMEET, with correlation coefficients of -.038, and -.054, respectively.

According to the control variables, the results indicate a significant positive correlation between company size and CEE, AUDSIZE, AUDMEET, whereas the correlation coefficients are .179, .161, and .179, respectively. Company age is significantly and positively correlated with BSIZE, BIND, BMEET, AUDSIZE, AUDMEET, and company size, with correlation coefficients of .209, .169, .573, .229, .504, and .265, respectively. Company leverage is significantly and negatively correlated with VAIC, HCE, BSIZE, BIND, and company size, with correlation coefficients of -.203, -.256, -.209, -.126, and -.137, respectively.

Table 2. Pearson coefficient correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) VAIC	1												
(2) HCE	.502**	1											
(3) SCE	.568**	.282**	1										
(4) CEE	.850**	.248**	.464**	1									
(5) BSIZE	.608**	.170**	.346**	.599**	1								
(6) BIND	.460**	.138**	.401**	.248**	.772**	1							
(7) BMEET	.108***	.031	.122**	.753**	.064	.146**	1						
(8) AUDSIZE	.036	.106**	.082	.610**	.238**	.242**	.133**	1					
(9) AUDMEET	.111**	.077	.234**	.106**	.246**	.103	.388**	.128***	1				
(10) Z-Score	-.416**	-.159**	-.245**	-.382**	-.288**	-.119*	-.038	-.142**	-.054	1			
(11) Company Size	.021	.096	.024	.179**	.103	.034	.023	.161**	.179**	-.023	1		
(12) Company Age	.013	.015	.065	.022	.229**	.169**	.573**	.229**	.504**	-.034	.265**	1	
(13) Leverage	-.203**	-.256**	-.015	-.016	-.209**	-.126**	-.012	-.028	-.003	.029	-.137**	-.076	1

Note(s): This table shows the Pearson correlation coefficients between the independent, dependent, and control variables of this study. VAIC is a proxy for intellectual capital efficiency. HCE is human capital efficiency. SCE is structural capital efficiency. CEE is capital employed efficiency. BSIZE is a board size measured by the number of directors. BIND is board independence measured as a percentage of independent non-executive directors to total directors. BMEET is board meetings measured as the number of board meetings during the year. AUDSIZE is the audit committee size measured by the number of members. AUDMEET is audit committee meetings measured by the number of meetings during the year. Z-score is a proxy for bankruptcy risk. Company size denotes the natural logarithm of total assets. Company age denotes the number of years the company was listed on EGX. Leverage is total debt to total equity. ***and ** denote significant at the 0.01 and 0.05 levels, respectively.

Table 3 presents the ordinary least squares regression model results for the relationship between corporate governance mechanisms; BSIZE, BIND, BMEET, AUDSIZE, and AUDMEET, and intellectual capital efficiency for 355 observations. Results H1a, H1b, H1c, H1d, and H1e are for the effect of corporate governance variables, with control variables; company size, age, and leverage, on the VAIC. The table contains the t-statistics, coefficients, and level of significance for each variable.

Board size (BSIZE) is found to have a significant positive impact on VAIC at the 1% significance level. The coefficient is 2.979, with a positive T-value of 19.066. The F-value is 98.602, and statistically significant at the 1% level, with an adjusted R² of 52%. This highlights that a large number of board directors can improve the efficiency of intellectual capital. These results support H1a, and they are consistent with those of previous studies (Musleh Al-Sartawi 2018; Buallay and Hamdan 2019; Dalwai and Mohammadi 2020).

Board independence has an insignificant positive effect on VAIC, with a coefficient of .553, and a positive T-value of 1.676. Therefore, board independence has no implication on the efficiency of intellectual capital for Egyptian companies. These findings on board independence are inconsistent with those of previous studies (Buallay and Hamdanm 2019; Tran et al. 2020). Thus, H1b is not supported.

Board Meetings are found to have a significant positive impact on VAIC at a level of 0.05; the coefficient is .476, with a positive T-value of 2.489. Moreover, the model is statistically significant with an F-value of 22.217, and an adjusted R^2 of 19.4%. These results support H1c and suggest that the more board meetings during the year, the higher the investment in intellectual capital. These findings are also consistent with those of previous studies (Buallay and Hamdanm 2019; Shahwan and Fathalla 2020).

Audit committee size has an insignificant positive influence on VAIC, with a coefficient of .693, and a positive T-value of .824., thereby lending no support to hypothesis H1d. These results are also inconsistent with those of Shahwan and Fathalla (2020), who found a significant positive association between audit committee size and intellectual capital efficiency. However, these findings are consistent with those of previous studies (Dalwai and Mohammadi 2020; Shahzad et al. 2022), suggesting that audit committee size does not improve intellectual capital efficiency.

Furthermore, audit committee meetings are found to have a significant positive impact on VAIC, with a coefficient of .721, at a level of 0.05, and a positive T-value of 2.024. The model is statistically significant with an F-value of 21.672, P-value less than .01, and an adjusted R^2 of 18.9%. These findings confirm the prediction of H1e, more audit committee meetings during the year increase investment in human, structural capitals, and capital employed, which improves the efficiency of intellectual capital. These results support H1e, and they are consistent with the results of previous studies (Buallay and Hamdan 2019; Dalwai and Mohammadi 2020). Regarding control variables, company age and leverage explain the variation in intellectual capital

efficiency. Older companies are more likely to invest in intellectual capital and have higher intellectual capital efficiency.

Eventually, the results of table 3 provide evidence that some corporate governance mechanisms, such as board size, board meetings and audit committee meetings improve intellectual capital efficiency through enhancing its three components; human capital efficiency, structural capital efficiency and capital employed efficiency. On the contrary, board independence and audit committee size have an insignificant positive effect on intellectual capital efficiency; consequently, H1 is partially supported.

Table 3. OLS regression results of corporate governance and intellectual capital

Independent variables	H1a VAIC	H1b VAIC	H1c VAIC	H1d VAIC	H1e VAIC
Constant					
T-value	5.006	2.204	3.934	3.865	4.274
Coefficient	37.828***	27.445***	25.602***	28.126***	27.419***
BSize					
T-value	19.066				
Coefficient	2.979***				
BIND					
T-value		1.676			
Coefficient		.553			
BMEET					
T-value			2.489		
Coefficient			.476**		
AUDSIZE					
T-value				.824	
Coefficient				.693	
AUDMEET					
T-value					2.024
Coefficient					.721**
Company size					
T-value	.182	1.717	1.529	1.362	1.810
Coefficient	.163	1.401	1.247	1.357	1.468
Company age					
T-value	1.363	7.431	8.002	7.383	7.970
Coefficient	.127	.807***	.845***	.818***	.840***
Leverage					
T-value	-3.280	-3.524	-3.794	-3.688	-3.706
Coefficient	-7.937 ***	-11.225***	-12.020***	-11.650***	-11.647***
Adjusted R ²	.524	.185	.194	.181	.189
F-statistics	98.602***	21.008***	22.217***	20.619***	21.672***
Observations	355	355	355	355	355

Note(s): This table presents the OLS regression results of corporate governance mechanisms, board size, board independence, board meetings, audit committee size, and audit committee members, and control variables, company size, age, and leverage, on intellectual capital efficiency measured by the sum of HCE+SCE+CEE, from 2017 to 2021. Statistical significance is denoted as ***P-value<0.01, and ** P-value<0.05.

Table 4 presents the ordinary least squares regression results for the relationship between intellectual capital and bankruptcy risk. Columns 1,2,3 and 4 represent the results of the effect of intellectual capital with its three variables, HCE, SCE, and CEE, and the control variables, company size, company age, and leverage, on the dependent variable (bankruptcy risk). The results in column 1 show that VAIC has a significant negative effect on bankruptcy risk. The coefficient is -.083 at the 1% level, with a negative t-value of -8.572. The model is statistically significant with an F-value of 18.460, and an adjusted R² of 32%. These findings support hypothesis H2. These results indicate that companies with higher VAIC are less likely to go bankrupt. These findings are consistent with results reported in the previous studies (Mollabashi and Sendani 2014; Akpinar 2017; Shahwan and Habib 2020; Shahdadi et al. 2020).

HCE reports a significant negative impact on Z-score; the model is statistically significant at a level of .01, with an F- statistic of 15.153, adjusted R² of 23%, t-value of -6.582, and a coefficient of -.132. These results support hypothesis H2a, and suggest that the higher the investments in employees, the lower is the probability of bankruptcy. These findings are consistent with previous studies that reported bankruptcy risk to be negatively explained by human capital efficiency (Cenciarelli et al. 2018; Shahwan and Habib 2020; D'Amato 2021).

Furthermore, the results in column 3 indicate a significant negative effect of structural capital efficiency on bankruptcy risk. The coefficient is, -1.333, significant at the 1% level, with a t-value of -4.560. The model is also significant at the 1% level, with an F-statistic of 31.861, and an adjusted R² of 26%. These results support hypothesis H2b and indicate that companies with higher structural capital efficiency have a significantly lower probability of going bankrupt. These findings are consistent with the results for Oman's companies (Dalwai and Salehi 2021), Turkish companies (Akpinar 2017), and US companies (Cenciarelli et al. 2018).

Column 4 displays the regression of capital employed efficiency with control variables on bankruptcy risk. CEE has a significant negative effect on bankruptcy risk; the coefficient, at a level of 1%, is -.069, with a T-value of -6.544. The model is also statistically significant at the 1% level, with an F-

statistic of 39.211, and an adjusted R² of 30%. These findings support hypothesis H2c and suggest that companies that have good relationships with customers, suppliers, creditors, and the government are less risky. This is consistent with the findings for Oman's companies (Dalwai and Salehi 2021), Iran companies (Shahdadi et al. 2020), and US companies (Cenciarelli et al. 2018). However, company size and age have a significant negative relationship with bankruptcy risk, suggesting that larger and older companies are less likely to go bankrupt. Leverage has a significantly positive relationship with bankruptcy risk, suggesting that companies with higher debt are riskier.

Table 4. OLS regression results of intellectual capital and bankruptcy risk

Independent variables	H ¹ Z-Score	H2a Z-Score	H2b Z-Score	H2c Z-Score
Constant				
T-value	8.079	6.996	7.113	17.124
Coefficient	10.648***	8.792***	8.428***	13.554***
VAIC				
T-value	-8.572			
Coefficient	-.083***			
HCE				
T-value		-6.582		
Coefficient		-.132***		
SCE				
T-value			-4.560	
Coefficient			-1.333***	
CEE				
T-value				-6.544
Coefficient				-.069***
Company size				
T-value	-.431	-1.818	-1.123	-5.844
Coefficient	-.077	-.303*	-.174	-.588***
Company age				
T-value	-.095	-2.971	-2.815	-.501
Coefficient	-.002	-.065***	-.057***	-.010
Leverage				
T-value	8.801	.686	8.301	8.953
Coefficient	5.171***	.447	5.139***	5.308***
Adjusted R ²	.318	.226	.259	.302
F-statistics	18.460***	15.153***	31.861***	39.211***
Observations	355	355	355	355
Note(s): This table presents the OLS regression results of intellectual capital efficiency with its three variables (human capital efficiency, structural capital efficiency, and capital employed efficiency), and control variables (company size, age, and leverage) on bankruptcy risk measured by the modified Altman Z Score model from 2017 to 2021. The Statistical significance is denoted as ***P-value<0.01, ** P-value<0.05, and * P-value<0.1.				

Table 5 summarizes the results of ordinary least square regression that investigate the impact of corporate governance mechanisms on bankruptcy risk. The results indicate a significant negative impact of board size on bankruptcy risk; the coefficient at a level of 1% is $-.498$, with a t-value of -11.270 . The model is statistically significant at a level of 1% with an F-statistic of 50.787 and an adjusted R^2 of 36%. Accordingly, H3a is supported. The significant negative influence of board size on bankruptcy risk is in line with previous evidence (Fich and Slezak 2008; Darrat et al. 2016; Handriani et al. 2021). They point out that a large number of board directors increases the company's ability to predict bankruptcy and reduces its possibility of going bankrupt. However, these findings are inconsistent with the results of Mokarami and Motefares (2013), Khabir and Vatanparast (2016), and Handriani et al. (2021), who found an insignificant influence of board size on a company's bankruptcy risk.

Board independence has a significant negative effect on bankruptcy risk, with a coefficient of $-.179$, at a level of 1%, and a t-value of -2.935 . The model is also statistically significant at a level of 1% with an F-statistic of 28.666 , and an adjusted R^2 of 24%. Consequently, hypothesis H3b is confirmed, suggesting that the large number of non-executive directors in board members improves a company's ability to predict bankruptcy. These results are consistent with the findings of Hui and Jing-Jing (2008), Fich and Slezak (2008), Uduwalage (2021), and Handriani et al. (2021) who stated that board independence improves the bankruptcy prediction of a company and reduces the probability of financial distress.

Regarding the board meetings, the results show a significant negative influence of board meetings on bankruptcy risk. The model is statistically significant at a level of 1% with an F-statistic of 20.050 , a coefficient of $-.291$, a t-value of -7.916 , and an adjusted R^2 of 18%. These results confirm hypothesis H3c and suggest that the more board of directors' meetings during the year, the more financially healthy the company will be. These results are consistent with those of previous studies (Annisa 2021; Iqbal and Masood 2022).

Audit committee size and meetings have an insignificant negative effect on bankruptcy risk. Therefore, they have no implications for improving a company's ability to predict bankruptcy. The results of audit committee size and meetings are inconsistent with those of Safrida et al. (2021), Annisa (2021), and Iqbal and Masood (2022), who found a significant negative effect of audit committee size and meetings on bankruptcy risk. These results do not support hypotheses H3d and H3e. Regarding the control variables, company age and leverage provide support in explaining the variation in bankruptcy risk. Older companies and those with lower debt are less likely to go bankrupt.

The results of table 5 suggest that the many board directors, the large number of non-executive directors in the board, and the more board meeting during the year, the more financial healthy the companies will be, and the less possibility of going bankrupt. However, the results do not provide support to hypotheses H3d and H3e, suggesting that audit committee size and meetings do not enhance the companies' ability of predicting bankruptcy. Accordingly, H3 is partially supported.

Table 5. OLS regression results of corporate governance and bankruptcy risk

Independent variables	H ^a VAIC	H ^b VAIC	H ^c VAIC	H ^d VAIC	H ^e VAIC
Constant					
T-value	10.433	6.580	8.558	6.185	6.249
Coefficient	11.265***	8.345***	11.277***	8.126***	7.769***
BSIZE					
T-value	-11.270				
Coefficient	-.498***				
BIND					
T-value		-2.935			
Coefficient		-.179***			
BMEET					
T-value			-7.916		
Coefficient			-.291***		
AUDSIZE					
T-value				-1.568	
Coefficient				-.227	
AUDMEET					
T-value					-1.425
Coefficient					-.099
Company size					
T-value	-1.105	-1.204	-.893	-1.217	-1.392
Coefficient	-.150	-.189	-.147	-.194	-.220
Company age					
T-value	-1.958	-2.763	-3.829	-2.839	-3.206
Coefficient	-.035**	-.057***	-.081***	-.060***	-.066***
Leverage					
T-value	6.222	8.857	.028	8.983	9.095
Coefficient	3.538***	5.495***	.062	5.613***	5.680***
Adjusted R ²	.360	.240	.178	.220	.219
F-statistics	50.787***	28.666***	20.050***	25.958***	25.820***
Observations	355	355	355	355	355

Note(s): This table presents the OLS regression results of corporate governance mechanisms, board size, board independence, board meetings, audit committee size, and audit committee members, and control variables, company size, age, and leverage, on bankruptcy risk measured by the modified Altman Z Score model, from 2017 to 2021. The statistical significance is denoted as ***P-value<0.01, and ** P-value<0.05.

VI. Conclusion

Intellectual capital is the most effective tool for knowledge value creation. It is also a source of competitive advantages. Additionally, corporate governance mechanisms have a greater influence on the efficiency of intellectual capital and stakeholders' value creativity. Therefore, this study examined the effect of corporate governance mechanisms of board size, board independence, board meetings, audit committee size, and audit committee meetings on the IC efficiency. It also examined the role of intellectual capital efficiency in enhancing a company's ability to predict bankruptcy and improving its financial health. Moreover, it analyzed the effect of corporate governance mechanisms on bankruptcy risk.

Three hypotheses were developed based on signaling theory, resources-based theory, and previous studies on intellectual capital and corporate governance. Based on the data collected from 355 company-year observations for 71 Egyptian companies listed on the EGX 100 index from 2017 through 2021, the results indicated that corporate governance mechanisms of board size, board meetings, and audit committee meetings have a significant positive influence on VAIC with its three variables: HCE, SCE, and CEE. This is consistent with the results of previous studies (Musleh Al-Sartawi 2018; Buallay and Hamdan 2019; Dalwai and Mohammadi 2020; Shahwan and Fathalla 2020). Furthermore, this study reported an insignificant influence of board independence and audit committee size on intellectual capital efficiency. This is inconsistent with the results of previous studies (Buallay and Hamdanm 2019; Tran et al. 2020).

Regarding the relationship between intellectual capital efficiency and bankruptcy risk, the results indicated a significant negative influence of VAIC and its three proxies, HCE, SCE and CEE, on bankruptcy risk. This suggests that companies with higher intellectual capital efficiency are financially healthy and less likely to go bankrupt. This is consistent with the findings reported by the previous studies (Mollabashi and Sendani 2014; Akpinar 2017; Shahwan and Habib 2020; Shahdadi et al. 2020).

Furthermore, the results related to the relationship between corporate governance and bankruptcy risk showed a significant negative effect of the corporate governance mechanisms of board size, board independence, and board meetings on bankruptcy risk. This indicates that the larger the number of board members, the more non-executive directors, and the more meetings of board directors during the year, the more financially healthy the company will be. This finding is consistent with the results of previous studies (Fich and Slezak 2008; Darrat et al. 2016; Handriani et al. 2021; Uduwalage 2021; Iqbal and Masood 2022). On the other hand, the results showed an insignificant negative influence of audit committee size and audit committee meetings on bankruptcy risk. This is inconsistent with the results of previous studies (Safrida et al. 2021; Annisa 2021; Iqbal and Masood 2022).

This study contributes to the literature on intellectual capital efficiency, corporate governance mechanisms, and bankruptcy risk. The relationship between intellectual capital and bankruptcy risk, or corporate governance mechanisms and bankruptcy risk has been debated in the literature. To the best of the researcher's knowledge, the influence of intellectual capital and corporate governance on bankruptcy risk is wholly absent. Therefore, this study is the first to investigate the effects of corporate governance mechanisms and intellectual capital efficiency on bankruptcy risk.

The results of this study have implications for theory, investors, regulators, and managers. From a theoretical viewpoint, this study contributes to the literature on intellectual capital and corporate governance by providing new evidence on the relationship between corporate governance and intellectual capital and explaining their role in reducing companies' financial distress. Corporate governance mechanisms play a significant role in improving IC efficiency. A larger board of directors, more board meetings and audit committee meetings

during the year increase the efficiency of intellectual capital. These are also important for enhancing a company's bankruptcy prediction ability. On the other hand, intellectual capital efficiency improves a company's financial health. The effective use of a company's intangible resources reduces the possibility of bankruptcy.

From a practical viewpoint, investors are aware of the importance of intellectual capital efficiency in ensuring the stability of a company's financial health and reducing its risk. Therefore, predicting bankruptcy helps investors identify desirable investment opportunities. The Egyptian stock exchange needs to increase managers, shareholders, and creditors' awareness of the importance of intellectual capital in creating value-added and competitive advantages. Accordingly, improving a company's ability to predict bankruptcy helps managers take appropriate action in a timely manner. Managers of companies also need to focus on the efficient use of the company's resources to reduce its leverage and financial distress and improve its performance. This study depended on publicly listed companies on the EGX 100; hence, the study's results can be extended to other companies listed on the EGX or countries with similar regulatory settings.

The findings of this study should be interpreted considering a few limitations. **First**, this study relied on data only from Egyptian companies listed on the EGX 100; therefore, the generalizability of its results is restricted to companies listed on the EGX 100 index only. Future research can examine this relationship on a different sample or in other emerging markets to verify the relationship between corporate governance, intellectual capital, and bankruptcy risk. **Second**, this study covered a limited number of years; thereby, future research should cover a different sample size with different durations. **Third**, intellectual capital is measured using the VAIC model, which is a quantitative measure that does not consider all intellectual capital

efficiency forms. Future research could measure intellectual capital using other methods, such as surveys or content analysis. **Fourth**, this study depended on a few corporate governance mechanisms, such as board size, independence, meetings, audit committee size, and audit committee meetings. Other mechanisms could have a better effect on intellectual capital efficiency and bankruptcy risk. Future research can examine the relationship between corporate governance and intellectual capital, or the relationship between corporate governance and bankruptcy risk, depending on other corporate governance mechanisms, such as board diversity, CEO duality, and board financial expertise.

Fifth, this study used the modified Altman Z Score model proposed by Altman et al. (2005) as a measure of bankruptcy risk. Future research can depend on the Altman Z-score proposed by Altman (1968, 1995) or the actual probability of bankruptcy to examine the relationship between intellectual capital or corporate governance and bankruptcy risk, and to ensure the strength of the results. **Finally**, this study depended on some control variables, such as company size, age, and leverage, the influence of corporate governance or intellectual capital on bankruptcy risk can be controlled by additional variables, such as industry type, firm growth, or liquidity. Future research can examine the relationship between intellectual capital, corporate governance, and bankruptcy risk, depending on other control variables to guarantee the robustness of the results.

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