Corporate governance and intellectual capital efficiency: empirical evidence from Palestine

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Abstract: This paper aims to examine the association between corporate governance (CG) and intellectual capital (IC) efficiency in the context of Palestine. The study sample consist 43 firms, which listed in Palestine Stock Exchange (PEX) over the period 2013 to 2022, totalling 430 observations. Utilising the value-added intellectual coefficient to measure IC – encompassing human, structural, and employed capital – and robust regression analysis through STATA software. Findings indicate a significant association between IC and both board gender diversity and board education, while board size and CEO duality appear associated. These insights offer practical guidance for regulatory bodies, management, and shareholders, especially serves the Capital Market Authority in supporting the implementation of the five-year financial technology strategy, as this study provides empirical evidence to support this initiative at the appropriate time. This novel research enhances understanding of CG's impact on IC in emerging markets, a relatively unexplored area in existing literature. In particular, to the authors' knowledge, this study is the first in Palestine that explore the association between IC and CG.

Keywords: corporate governance; intellectual capital efficiency; Palestine Stock Exchange; PEX; Palestine.

Reference to this paper should be made as follows: Abdelhaq, R., Salem, A., Rabaia, D., Jardaneh, L., Nour, A.I. and Al-Sartawi, A.M.A.M. (2025) 'Corporate governance and intellectual capital efficiency: empirical evidence from Palestine', *Int. J. Intellectual Property Management*, Vol. 15, No. 2, pp.180–203.

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1 Introduction

By the beginning of the 21st century, the expression 'knowledge is power' resonates profoundly (Holmes, 2020). Acknowledging knowledge as a critical organisational asset for competitive advantage has shifted the focus towards nurturing intellectual capital (IC) efficiency through systematic approaches to manage knowledge activities (Buallay, 2018; Al Momani et al., 2021a). Governing bodies, especially boards, are found to generate IC through their education, experience, and networks, effectively monitoring, advising, and contributing resources to promote value creation and stakeholder interests (Berezinets et al., 2016). For those reasons, several studies emphasised the need to understand the role of corporate governance (CG) in effectively engaging, defending, and maintaining the IC of the organisation's (Saruchi et al., 2019; Alqaraleh et al., 2020).

IC is an essential resource for value creation and competitive advantage in corporations, encompasses four dimensions: structural, human, social and psychological capital (Jaradat and Alzeer, 2020). Human resources form a critical component of a company's IC, emphasising the importance of creativity, talent, skills, expertise and innovation (Jaradat and Alzeer, 2020; Pasban and Nojedeh, 2016). The competitive edge in information technology derived from IC, sourced from employees, networks, and structures, underscores its fluctuating nature as a primary method for overcoming competitors (Jordão and de Almeida, 2017). While human resources hold significant intangible value for companies due to their knowledge, skills, and innovations, debates persist regarding whether employees' competence belongs to company assets (Guo and Chen, 2022). Structural capital, identified as organisational capital, is what remains within the company after employees depart, including non-tangible assets resulting from the company's creativity through research and development, such as patents, trademarks and distribution networks (Anwar and Siddiqui, 2020). Structural capital, interconnected with human capital, comprises assets that enhance intellectual performance and execution, including databases, organisation charts and reputation (Ahmed et al., 2020; Guo and Chen, 2022). Capital employed, representing financial resources required for effective business operation, is integral (Shahwan and Habib, 2020). It encompasses the total invested capital by the company in assets minus liabilities, defining the equity and debt utilised by the business (Okpe et al., 2022).

IC critical role in CG is evident, influencing a company's capabilities and resources, primarily managed by its board of directors (Borlea et al., 2017; Ciftci et al., 2019). Boards ensure improved decision-making by managers to increase shareholders' interest through efficient use of IC (Buallay and Hamdan, 2019). Governance structures, such as board characteristics, play a pivotal role in monitoring and serving the company, enhancing overall business outcomes (Shaukat et al., 2016). In Palestine, the implementation of CG began in 2009, aiming to enhance investment circumstances, activate financial market performance, expand it, and increase the competitiveness of the economy by boosting customers' confidence in companies and their ability to face risks. These rules are supervised by the Capital Market Authority (PCMA) and applied by public joint-stock companies (listed and non-listed) in the Palestine Stock Exchange (PEX), mortgage companies, financial leasing companies, and securities companies (National Corporate Governance Committee, 2009). In particular, Abualhassan et al. (2024) highlight the challenges faced by the Palestinian economy. Whereas, the country's status as an emerging country under occupation leads to high unemployment among skilled young people, causing uncertain emigrations seeking better work environments and higher wages (Jabarin et al., 2019; Mohammad et al., 2024). However, developing innovative solutions to attract and retain skilled labour is vital for the Palestinian economy's long-term success. From this perspective, effective governance should encourage the establishment of a stable and attractive work environment for skilled talents, fostering the utilisation and development of IC within companies. By achieving a balance and efficient utilisation of IC, companies can enhance their competitiveness, achieve sustainable growth, and foster innovation amid the challenging economic conditions facing the Palestinian economy (MAS, 2023).

Numerous studies in the Western social and political context explore the link between CG and IC. However, research is lacking in transitional or emerging countries, where differences in market involvement, information efficiency, volatility and overall size exist (Buallay, 2018; Orazalin and Mahmood, 2019; Pillai and Al-Malkawi, 2018). Addressing this gap, this study investigates the CG and IC relationship in Palestine. Limited research is dedicated to examining the link between CG and IC in emerging countries. Nevertheless, in a similar way to Palestine's economy as its emerging economy. Furthermore, Nour et al. (2022a) examined the impact of CG mechanisms on IC in Jordan economy. Results revealed significant correlations between CG mechanisms and IC, with company size playing a role. In addition, Shahwan and Habib (2020) found no significant improvement in CG and IC practices' efficiency on the probability of financial distress for Egyptian Exchange companies, with efficiency scores indicating a negative association. Moreover, Dalwai and Mohammadi (2020) performed a study in Oman, revealed a significant association between board size, audit committee meetings, and IC efficiency in Oman's financial sector companies. Banks effectively leveraged efficiency, but limited support for agency and resource dependency theories.

In summary, these studies collectively contributed to understanding the complicated relationships between CG, IC, and various dimensions across different emerging economic contexts, providing valuable insights into the significance of IC and CG practices. Furthermore, PCMA in Palestine launched an initiative in 2021 named 'Ebtaker'. The initiative aims to enhance communication between PCMA and innovative Palestinians individual, for attracting talented and qualified people. This initiative continues for five years until 2025 (Palestinian Capital Market Authority, 2023).

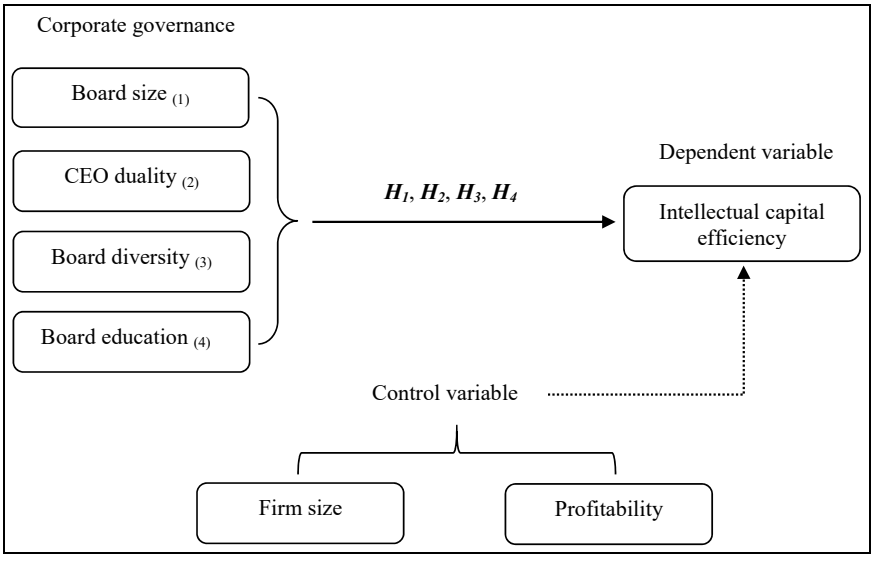
Therefore, this study provides empirical evidence to support this initiative at the appropriate time. In light of this, the current study aims to provide empirical evidence from Palestine regarding the association between CG and IC. It seeks to examine the relationship between IC and various CG elements. CG factors included board size, CEO duality, gender diversity, and education, in a comprehensive manner. The study contributing valuable insights to the understanding of IC and CG practices in the Palestinian context.

The upcoming sections of the article are structured as follows: Section 2 includes a literature review and hypotheses development, Section 3 outlines the methodology of the study, Section 4 presents the results, and Section 5 summarises the conclusions and offers recommendations.

2 Literature review and hypothesis development

This part discusses the theoretical framework of previous studies and theories that explain the association between CG and IC, in addition to developing appropriate hypotheses. In addition, Figure 1 shows the research framework.

Figure 1 Research framework



2.1 CG and IC

The integration of the perspective of the agency theory and resource dependency theory, as a theoretical framework presents valuable insights about the association between CG and IC efficiency. In the context of agency theory, Jensen and Meckling (1976) proposed that this framework elucidates how CG affects IC. They captured agency theory as an information asymmetry between ownership (principals) and management (agents). Principals carry the firm's risks because of their lack of management knowledge (Fama and Jensen, 1983). Briefly, CG frameworks are essential for keeping a focus on

management effectiveness and protecting the interests of shareholders (Pfeffer and Salancik, 1978). For ensuring effective oversight, CG facilitates the efficient utilisation of resources and provides guide strategic decisions aimed to create value for firm. This emphasis aligns with the notion that strong CG can enhance the efficiency of IC, as it directs resources toward value-creating activities (Asa'd et al., 2023; Al Momani et al., 2021b). Additionally, from resource-dependency-theory views, boards of directors play a critical role as intermediaries for the firm's access to external resources, as per the resource dependence hypothesis (Bussoli et al., 2023; Munir et al., 2020). Through these relationships, firms can obtain many resources that are needed to achieving strategic goals and improve the efficiency of their IC. Moreover, by establishing strong board relation with other firms, businesses may use outside resources to enhance their IC and become more competitive in the market. Furthermore, studies based on the resource dependence theory emphasise ensure the important of human resources to gaining a competitive advantage (Zahra and Pearce, 1989). Strong CG practices have the potential to improve human resource management, thus enhancing the company's IC. However, CG frameworks are essential because they prioritise the effective use of human resources and promote an innovative and talent-development culture, which all help to improve IC. In summary, agency theory and resource dependence theory both emphasise the critical role of CG is for controlling agency costs, gaining access to internal-external resources, and making the best use of human resources – all of which help firms to improve their IC. However, firms may use their IC to obtain a competitive advantages in the market by implementing efficient governance frameworks and strategic resource management (Tran et al., 2020; Widiatmoko et al., 2020).

In general, empirical evidence about the association between CG and IC is inconsistent. For instance, Achim et al. (2023) examine the effect of CG on IC in firms listed on the Bucharest Stock Exchange between 2016 and 2021. The study found a positive significant association between CG and IC, which helps firms to create wealth. Moreover, Buallay and Hamdan (2019) investigated the association between IC and CG Saudi stock exchanges, they found the firms with better CG demonstrated more efficient use of human and structural capital. Nevertheless, firms with lower levels of CG have less effectiveness in their capital. Furthermore, Sadiq et al. (2020) discovered the association between CG and IC in the firms on Pakistan and found a significant association between CG and IC. On the other side, Tran et al. (2020) measured CG by board size, board independence, board remuneration, CEO duality, and major shareholder holdings; they investigated the issue in emerging markets such as Vietnam and found a negative impact of CG on IC. Lari Dashtbayaz et al. (2020) examined the effect of board features and audit committee characteristics on IC. Finding an adverse association between the board's independence, financial expertise, and audit committee size with IC. However, Al-Sartawi (2018) found a weak and negative relationship between CG and IC in 274 firms in Gulf Cooperation Council countries. In addition, Appuhami and Bhuyan (2015) found insignificantly association between CG and IC in the context of Australian service firms. In the current paper, the association between the CG components, including board size, board tenure, board diversity, and board education and IC studied.

2.1.1 Board size and IC

A key component of CG is board size, which indicates the number of directories on the firm board. According to the agency theory, a large board can be detrimental to good

business functioning due to communication and coordination issues, as well as difficulty supervising and controlling the management (Jensen, 1993). This inefficiency extends to management decisions and IC efficiency, possibly leading to degraded firm value (Dalwai and Mohammadi, 2020). However, resource dependency theory discussed that the larger boards have more relations with external parties, resulting in increased access to more resources (Pfeffer and Salancik, 1978). The empirical results give an inconsistent view of the association between board size and IC. According to Kusi et al. (2018), bigger boards frequently comprise individuals with various experience, professional and educational backgrounds, and abilities that promote board proficiency. Thus, strengthening managers' monitoring and improving the firm's capacity to get more resources, such as IC (Catanzaro and Teyssier, 2021; Pratama and Innayah, 2021), which results in increased financial performance. Furthermore, Ali and Oudat (2021) found that increasing the board size has a negative impact on control, supervision, and judgements on IC, they suggest the smaller board are easier to make decisions than big boards. However, several studies found positive relationships between board size and IC (Hesniati, 2021; Nadeem, 2020). On the other hand, Tran et al. (2020) and Ali and Oudat (2021) found negative impacts of board size on IC. However, Appuhami and Bhuyan (2015) found an insignificant relationship between board size and IC. In alignment with these studies, the hypothesis is proposed:

H_1 Board size has a significant association with IC efficiency.

2.1.2 CEO duality and IC

CEO duality is a critical component of CG, which indicates where the CEO stands as the board's chairperson, a situation known as CEO tenure, influencing decision-making inside a firm (Finkelstein and D'aveni, 1994). According to Jensen (1993), CEO duality may undermine the board of directors as the CEO obtains greater authority, possibly affecting either the directors or other executives. Given the long-term relationships with directors, the researcher believed that the CEO's frequent position as chairperson might still have an impact. Nassirzadeh et al. (2023) confirm the capital market's sensitivity to changes in firm management. Changes in position may be considered as a strategy to match the firm with environmental changes, with leadership transitions possibly indicating directors' issues in performing tasks and boosting shareholder value. According to Bendig et al. (2018), CEO traits have an impact on all IC components. However, the changing landscape of CG systems may result in changes to the CEO's influence. The empirical results give an inconsistent view of the association between board tuner and IC. For example, Appuhami and Bhuyan (2015) revealed significant associations between CEO duality and IC. Also, Shahzad et al. (2023) revealed a significant positive nexus between CEO duality with IC efficiency. On the other hand, Aslam and Haron (2020) and Tran et al. (2020) showed negative associations between CEO duality with IC efficacy. However, some studies found insignificant association between CEO duality with IC as Martins et al. (2018). In alignment with these studies, the hypothesis is proposed:

H_2 CEO duality has a significant association with IC efficiency.

2.1.3 Board gender diversity and IC

The concept of board gender diversity refers to the nationality, ethnic background, gender and racial background (Zaid et al., 2020). Gender diversity is a key factor in shaping the composition of a board of directors. The inclusion of women improves the quality of decisions by introducing various perspectives, skills, values, and beliefs, as a whole, fair distribution of roles between genders (male, female) holds a large importance for any society (Chyu et al., 2021; Fernando et al., 2020). According to Ardito et al. (2021), women on boards may have a better understanding of client behaviour, needs, and potential for businesses to address those requirements. The upper-echelon theory suggests that gender diversity increases innovation by effective approaches and innovative decisions (Saeed et al., 2022), which lead to greater accumulation, and influence innovation in the structure of the capital. Thus, gender diversity retains qualities embodied in flexibility, adoption of innovation and information processing which aid businesses in developing plans on how companies include innovation in their goods or services (Javeed et al., 2022). Empirical evidence provided by Faccio et al. (2016) suggested that companies that have women CEOs are slower to make investment decisions which are reflected in a smaller amount of volatile earnings. A study by Nadeem et al. (2019) showed a strong positive relationship between the number of females on boards and IC. However, Aslam and Haron (2020) study reveals that gender diversity has a negative influence on IC in Islamic banks. On other hand, Yahaya and Tijani (2020) found that female directors do not influence IC, this result was supported by Ali et al. (2021) found that gender diversity is not a major factor affecting IC. In alignment with these studies, the hypothesis is proposed:

H_3 Board gender diversity has a significant association with IC efficiency.

2.1.4 Board education and IC

Education is related to a person's educational qualifications and academic professions and is of countless importance in the labour market (Sidki et al., 2023). The academic qualifications and experiences of the board's members are important in terms of their awareness and perspective to innovate ideas and activities, which assists them in determining and assessing new opportunities, investments, and technologies to achieve high performance and therefore reach the companies' goals. Researchers found that CEOs control their corporations with a moderately personalised viewpoint based on their past experiences, motivations, and personal features, even when making decisions in an extremely competitive environment with limited corporate resources (Hambrick, 2007). Human capital theory points out the indications of training and education as an investment of capital; the development of knowledge, competence, and ongoing learning. However, Psacharopoulos and Woodhall (1985) approved that fast development in Asian countries comes as a result of high investment in the development of human capital. This perspective has been confirmed by the noticeable growth in social and economic environments observed, a part of the advantages of some oil-dependent nations have to offer. Furthermore, the theory primarily challenges the idea that firms strive to limit their expenditures on training and development, rather, it supports the idea that these indicators should be viewed as cost-effective activities, so this theory focuses on factors related to the CG in addition to the HR management factors of an entity (Oyewunmi et al., 2017). A study by Lajili et al. (2020) found a significant impact of CG on human resource

performance. Moreover, Oktaviana and Setiawan (2022) found that educational diversity of board members has a negative impact on IC. But, Al-Juaidi (2020) supported that the educational diversity of board members has a positive influence on IC. In alignment with these studies, the hypothesis is proposed:

H_4 Board education has a significant association with IC efficiency.

3 Research methodology

This study aims to determine the association between CG and IC. This study contains four hypotheses, namely the effect CG consisting of the board size, CEO duality, gender diversity, and board education, where IC consists of several variables, namely: human capital coefficient (HCE) for the firm, capital employed coefficient (CEE) for the firm, structured capital coefficient (SCE) for the firm and value-added intellectual capital (VAIC).

3.1 Study sample and data collection

This research examines the performance of companies listed on the PEX between 2013 and 2022. The study utilises a panel data approach and focuses on companies that were actively listed on the PEX during this period and had comprehensive and available data. Some companies either did not disclose their information years or were delisted from the stock exchange, so they were excluded from the sample. Companies with incomplete reports and outliers were also removed based on the exclusion criteria. The final sample consists of 43 companies, resulting in 430 firm-year observations. Data for the study were obtained from the publicly accessible annual reports of the selected companies, which were sourced from the PEX website. The statistical analysis, including the examination of associations between variables, was conducted using the STATA software programme. Appendix provides a concise summary of the study sample.

3.2 Variables measurements and proxies

3.2.1 Dependent variables

This study utilised the VAIC, a coefficient model developed by Pulic (1998). The VAIC is widely used by researchers to evaluate IC (Ali and Oudat, 2021; Nour and Momani, 2021). The justification for employing this model is its ability to measure the contribution of both (physical and financial) and intellectual resources (human, employed and structural) in generating value-added (VA) by the firm. The algebraic formula for VAIC comprises the sum of the efficiency value of working capital creation (physical and financial) and the three primary components of VAIC, namely human, structural and employee capital (Al-Juaidi, 2020).

$$VAIC = HCE + SCE + CEE$$

The formula for computing VA for the firm is $VA = OP + EC + DE + AE$. *VA* represents the sum of: operating profit (*OP*), employee cost (*EC*), depreciation expenses (*DP*) and amortisation expenses (*AE*) (Nour and Momani, 2021).

$$VA = OP + EC + DE + AE$$

HC is the primary and essential component of VAIC. Various classifications of VAIC have been proposed, but they all highlight HC as the central component (Nassirzadeh et al., 2023). However, Konno and Schillaci (2021) clarify HC, it refers to the amalgamation of competence, knowledge, skills, innovation, attitude, commitment, wisdom and experience. It encompasses the employee's competence, skills, experience and intellectual capability. Researchers such as Shahriari et al. (2022) assert that HC is a crucial resource for organisations aiming to gain a competitive edge in the ever-changing and unpredictable business landscape of today. HC encompasses the explicit and implicit knowledge, competencies, and capabilities of employees, which together form a framework of knowledge and skills required for specific tasks.

$$HCE = VA / HC; \textit{human capital}$$

Structured capital (SC) refers to the assets and resources that result from the previous performance of human capital, such as regulation, licenses, patents, reputation, standards and customer relationships (Bhattacharjee and Akter, 2022). It encompasses processes, systems, intellectual property, and other intangible assets that a company possesses. This capital is closely tied to the mechanisms and structure of the firm and supports optimal intellectual performance among employees, ultimately leading to improved organisational performance. In essence, structural capital encompasses anything within an organisation that facilitates the implementation of HC. Unlike HC and SC remains with the organisation even after employees depart. It includes databases, organisational charts, strategies, process guidelines, and other valuable resources for the company (Nassirzadeh et al., 2023).

$$SCE = VA / SC; SC = VA - HC; \textit{structured capital}$$

CE refers to the ability to establish strong relationships with stakeholders, including customers, suppliers, investors, government, and society as a whole. It encompasses both the current value of the organisation and the potential future value of its relationships. This includes assets like trademarks, market share, customer information and customer relations (Nassirzadeh et al., 2023). Numerous studies on VAIC have also considered this classification. The interrelationship between these components demonstrates that they are all grounded in (IC).

$$CEE = VA / CE; \textit{VA capital employed}.$$

3.2.2 Independent and control variables

This study consists of four independent variables namely, board size, board tenure, board gender diversity and board education. In addition, this study has two control variables, firm size and firm profitability. Table 1 represents the measurements of the variables for dependent, independent and control variables.

Table 1 Variables measurements

Variable	*Measurement*	*Abbreviations*	*Studies*
Dependent variable			
Intellectual capital efficiency	Measured by VAIC equations, where *VAIC = CEE + HCE + SCE*		Nour and Momani (2021)
Human capital	*VA / HC*; human capital coefficient for firm	*HCE*	Al Momani et al. (2021c), Nassirzadeh et al. (2023)
Capital employed	*VA / CE*; *VA* capital employed coefficient for firm	*CEE*	Nadeem et al. (2019), Ahmad Sharabati et al. (2016)
Structured capital	*VA / SC*; structured capital for the firm.	*SCE*	Ali and Oudat (2021)
Dependent variables (CG indicators)			
Board size	Number of directors in the board	*BSIZE*	Elfeky (2017), Mardawi et al. (2024)
CEO duality	If CEO and chairman roles are separated then 1, otherwise (0)	*CEODUL*	Freitas Cardoso et al. (2019), Yasser and Al Mamun (2016)
Board gender	The number of females divided by board size	*BGIVE*	Nadeem (2020), Nour et al. (2023)
Education	The number of directories who have MA or PhD divided by board size	*BEDU*	Guney et al. (2020)
Control variables (firms features)			
Firm size	Natural logarithm of total asset	*FSIZE*	Al-Sartawi (2015), Basalat et al. (2023)
Profitability	Net profit divided by total asset	*PROFIT*	Jalal et al. (2023), Nour et al. (2022b)

3.3 Empirical models

To investigate the association between CG and IC, a multiple regression econometric equation formulated:

$$VAIC_{it} = \alpha + \beta_1 BSIZE_{it} + \beta_2 CEODUL_{it} + \beta_3 BGIVE_{it} + \beta_4 BEDU_{it} + \beta_5 FSIZE_{it} + \beta_6 PROFIT_{it} + \varepsilon$$

The following models were derived from the first model, explaining the elements of VAIC separately; the first sub-model is Model (I):

$$CEE_{it} = \alpha + \beta_1 BSIZE_{it} + \beta_2 CEODUL_{it} + \beta_3 BGIVE_{it} + \beta_4 BEDU_{it} + \beta_5 FSIZE_{it} + \beta_6 PROFIT_{it} + \varepsilon$$

The second sub-model is Model (II):

$$HCE_{it} = \alpha + \beta_1 BSIZE_{it} + \beta_2 CEODUL_{it} + \beta_3 BGIVE_{it} + \beta_4 BEDU_{it} + \beta_5 FSIZE_{it} + \beta_6 PROFIT_{it} + \varepsilon$$

The third sub-model is Model (III)

$$SCE_{it} = \alpha + \beta_1 BSIZE_{it} + \beta_2 CEODUL_{it} + \beta_3 BGIVE_{it} + \beta_4 BEDU_{it} + \beta_5 FSIZE_{it} + \beta_6 PROFIT_{it} + \varepsilon$$

where α is the intercept, β_1 to β_6 the regression coefficients, i is the firm, t represents the year and ε is the error term.

4 Empirical results

This part contains a discussion of the most important results, such as the descriptive analysis and normality, heteroskedasticity, correlation matrix, multicollinearity and robust test results.

4.1 Descriptive statistics

For descriptive statistics, Table 2 presents the descriptive results of dependent, independent and control variables.

Table 2 Descriptive statistics

Variable	*Ob.*	*Mean*	*Std. dev.*	*Min.*	*Max.*
VAIC	430	5.53	4.05	–6.88	23.1
CEE	430	0.33	0.58	–0.27	6.73
HCE	430	4.35	3.77	–8	19.6
SCE	430	0.89	1.32	–3.69	22.3
Board size	430	8.72	2.2	4	15
CEO duality	430	0.21	0.41	0	1
Gender	430	0.07	0.11	0	0.57
Education	430	0.11	0.14	0	0.6
Profitability	430	0.04	0.1	–0.63	0.73
Firm size	430	17.83	1.83	13.54	22.6

Source: The authors

According to Table 2, the mean of VAIC is 5.53 with a minimum value of –6.88 and maximum value of 23.12. Furthermore, the board size of Palestinian-listed companies is approximately nine persons in the board, with a minimum value of 4 and a maximum of 15. This violates the code of CG in Palestine, which indicates that board size should not exceed 11 persons. In addition; there is a duality between the chairman of the board of directors and the CEO in Palestinian companies in 20.7% of companies. Moreover, there is little representation of women on the boards of Palestinian companies, which is about 6.9%. In addition, the percentage of board members who have a master's or PhD degree is nearly 10.1%.

4.2 Normality, heteroskedasticity, correlation matrix and multicollinearity

When utilising OLS regression, there are several crucial factors to take into account, normality being one of the most crucial. According to normality, for the data to meet statistical assumptions, their distribution should be roughly normal. Furthermore, heteroscedasticity – defined as the existence of unequal variances in the errors – is a critical component of testing since it might impact the correctness of the findings (Daryanto, 2020). When the residuals were tested for normality using the Shapiro-Wilk W test, the results indicated that the p-value of 0.048 was statistically significant at the 0.05 level. Therefore, it makes sense to believe that the residuals do not have a normal distribution. Furthermore, heteroscedasticity was detected and constant variance in the model was verified using the Breusch-Pagan/Cook-Weisberg test. The results indicate that, at the 0.05 level, the p-value of 0.040 was statistically significant. Thus, the issue of heteroskedasticity arose. To eliminate the issues of heteroskedasticity and normality, robust regression was employed to evaluate the results and to test the hypothesis.

Table 3 Person correlation matrix

Variables		*1*	*2*	*3*	*4*	*5*	*6*	*7*
1	VAIC	1						
2	Board size	–0.025	1					
3	CEO duality	–0.052	–0.102	1				
4	Board gender	0.066	–0.163	0.059	1			
5	Education	0.119	0.217	–0.127	0.021	1		
6	Profitability	0.082	–0.012	–0.069	0.071	0.047	1	
7	Firm size	–0.016	0.532	0.002	–0.103	0.059	–0.005	1

Table 4 Variance inflation factor tests

Variables	*VIF*	*1 / VIF*
Board size	1.507	0.664
Firm size	1.407	0.711
Board education	1.072	0.933
Board gender	1.039	0.962
CEO duality	1.034	0.967
Profitability	1.012	0.988
Mean VIF	1.179	.

When utilising OLS regression to assess the link between the independent and dependent variables, correlation is yet another crucial factor to take into account. The degree of relationship between two variables is called correlation. To make sure that multicollinearity is not an issue, it is crucial to test for correlation between the independent, control and dependent variables as well as between the independent variables themselves. To ensure that there is no multicollinearity, we conducted the

person correlation matrix in Table 3 and variance inflation factor tests in Table 4. The results from the correlation matrix indicate that the correlations between variables are predominantly low, with none exceeding 0.80. The highest observed correlation is 0.53, occurring between board size and firm size. This finding is essential for confirming the absence of multicollinearity.

The result of variance inflation factor test was used, and the VIF for all variables less than 10. So that, no multicollinearity occurred (Sulaiman et al., 2021; Wondola et al., 2020).

4.3 Regression results

Robust regression was used in the study to test the hypothesis and to detect any problems with heteroskedasticity and normality (Lima et al., 2010). However, the relationship between CG and VAIC is seen in Table 5 regression analysis. Main model displays the dependent variable VAIC, while Models (I), (II) and (III) display the dependent variables CEE, HCE and SCE, respectively.

Robust regression result indicates that board size has an insignificant association with VAIC, CEE, HCE, and SCE. Thus, the first hypothesis is rejected. This result is in line with Appuhami and Bhuyan (2015). According to the regression results, CEO duality has an insignificant association with VAIC, CEE, HCE and SCE. Thus, the second hypothesis is rejected. This result is consistent with (Martins et al., 2018).

Board gender diversity has a positive significant association with VAIC at p-value = 0.1, and a positive significant association with HCE at p-value = 0.05, these results are consistent with previous research conducted by Nadeem et al. (2019). However, gender diversity has a significant negative association with SCE at p-value = 0.1. This result is in line with previous research (Aslam and Haron, 2020). In addition to that, there is no association between board gender diversity and CEE. So, the third hypothesis is accepted at p-value = 0.1. The positive association with VAIC explained by Kang et al. (2007) that women on boards might have a better grasp of customer behaviour, needs, and how businesses can meet those needs. In addition, according to Tejedo-Romero et al. (2017), these phenomena indicate that women's involvement in organisational structure is crucial because they have a greater understanding of stakeholders like employees and the surrounding environment.

According to Table 5, the board education has a highly positive significant association with VAIC, CEE, HCE and SCE. This result is consistent with previous research (Al-Juaidi, 2020; Lajili et al., 2020). It implies that the board members' varied educational experiences reflect the differences in their expertise and experience levels. This diversity affects the board's ability to come up with original solutions for challenging issues. Moreover, it adds to a wider range of perspectives, improving the development and assessment of strategies. This result is in line with the human capital theory that highlights how education and training contribute to the growth of knowledge, competence, and continuous development, just like any other capital investment. According to Al-Juaidi (2020), diversity in education is viewed as a chance for businesses to innovate in many ways like IC. Thus, the fourth hypothesis is accepted.

Accordingly, the research results are summarised in Table 6.

Table 5 Robust regression results

Variables	*Main model*		*Model (I)*		*Model (II)*		*Model (III)*	
	VAIC		*CEE*		*HCE*		*SCE*	
	Coefficient	*t-statics*	*Coefficient*	*t-statics*	*Coefficient*	*t-statics*	*Coefficient*	*t-statics*
Board size	0.07	0.31	–0.01	–0.32	0.05	0.21	0.03	1.03
CEO duality	–1.84	–1.45	0.064	0.59	–1.90	–1.55	–0.01	–0.06
Board gender	6.79*	1.72	–0.17	–0.59	7.65**	1.98	–0.69*	–1.74
Board education	11.11***	3.4	0.36**	1.97	9.66***	3.03	1.10**	2.38
Profitability	9.28	1.63	0.96**	2	10.22*	1.81	–1.90	–1.4
Firm size	–0.04	–0.23	0.066***	3.27	–0.04	–0.22	–0.07	–1.13
Constant	7.51**	2.02	–0.80***	–2.59	6.18*	1.76	2.12*	1.92
Observations	430		430		430		430	
R-squared	0.031		0.059		0.031		0.043	

Note: Robust standard errors in parentheses; ***p < 0.01, **p < 0.05 and *p < 0.1.

Table 6 Results summary

	Hypotheses	*Result*
H_1	Board size has a significant association with intellectual capital efficiency.	Rejected
H_2	CEO duality has a significant association with intellectual capital efficiency.	Rejected
H_3	Board gender diversity has a significant association with intellectual capital efficiency.	Partially accepted
H_4	Board education has a significant association with intellectual capital efficiency.	Accepted

5 Conclusions and recommendation

This study contributes to the literature by investigating the association between CG and IC by Palestinian firms during 2013–2022. The study hypotheses aimed to examine the association between CG variables (board size, CEO duality, board gender diversity and board education) and IC efficiency. Robust regression was used in the study to test the hypothesis and to detect any problems with heteroskedasticity and normality. The study's result provides that board gender diversity and board education have a significant association with IC and their components (CEE, HCE and SCE), while board size and CEO duality have an insignificant association with IC and their components (CEE, HCE and SCE). This emphasises the importance of board education and gender diversity in the evaluation of the IC.

The study practical implications include recommendation for policymakers, regulators, and managers of firms appoint more directors with high educational levels (master's and PhD) to their boards to increase the performance of IC in their firms. Moreover, the results show the need to increase women's representation on the board of directors of Palestinian firms. Finally, the research results help the PCMA in supporting the implementation of the five-year financial technology strategy, as this study provides empirical evidence to support this initiative at the appropriate time. The study has some limitations, Firstly, there is no specific measurement to measure the IC around the world, so that, we cannot compare our results with companies that use different measurements. Secondly, there is no specific index to measure the CG or the variables that represent the CG. Thirdly, the sample size is small due to the small size of the Palestinian market. In addition to that, future studies should examine more variables and study the association with IC such as board experts, director age, and director independence characteristics. In addition, conducting the study in a different environment and for a longer period.

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Appendix

Table 7 Study sample

Number	*Companies*	*Symbols*	*Sector*
1	Birzeit Pharmaceuticals	BPC	Industrial
2	The Vegetable Oil Industries	VOIC	Industrial
3	Jerusalem Pharmaceuticals	JPH	Industrial
4	Palestine Poultry	AZIZA	Industrial
5	Jerusalem Cigarette	JCC	Industrial
6	National Aluminum And Profiles	NAPCO	Industrial
7	Golden Wheat Mills	GMC	Industrial
8	Arab Company For Paints Products	APC	Industrial
9	The National Carton Industry	NCI	Industrial
10	Palestine Plastics Industries	LADAEN	Industrial
11	Beit Jala Pharmaceutical	BJP	Industrial
12	Palestine Telecommunications	PALTEL	Service
13	Wataniya Palestine Mobile Telecommunications	OOREDOO	Service
14	Palestine Electric	PEC	Service
15	Al Wataniayh Towers	ABRAJ	Service
16	Ramallah Summer Resorts	RSR	Service
17	The Arab Hotels	AHC	Service
18	Palestinian For Distribution & Logistics Services	WASSEL	Service
19	Nablus Surgical Center	NSC	Service
20	PALAQAR For Real Estate Development	PALAQAR	Service
21	Palestine Development & Investment	PADICO	Investment
22	Palestine Industrial Investment	PIIC	Investment
23	Arab Palestinian Investment	APIC	Investment
24	Palestine Real Estate Investment	PRICO	Investment
25	Union Construction and Investment	UCI	Investment
26	Palestine Investment & Development	PID	Investment
27	Arab Investors	ARAB	Investment
28	Al-Aqariya Trading Investment	AQARIYA	Investment
29	Jerusalem Real Estate Investment	JREI	Investment
30	Bank of Palestine	BOP	Bank
31	Palestine Islamic Bank	ISBK	Bank
32	Arab Islamic Bank	AIB	Bank
33	The National Bank	TNB	Bank
34	Al Quds Bank	QUDS	Bank
35	Palestine Investment Bank	PIBC	Bank
36	Palestine Securities Exchange	PSE	Bank

Appendix

Table 7 Study sample (continued)

Number	*Companies*	*Symbols*	*Sector*
37	National Insurance	NIC	Insurance
38	Trust International Insurance	TRUST	Insurance
39	Global United Insurance	GUI	Insurance
40	Palestine Insurance	PICO	Insurance
41	Al-Takaful Palestinian Insurance	TIC	Insurance
42	Al Mashriq Insurance	MIC	Insurance
43	Ahliea Insurance Group	AIG	Insurance