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Samih M. A.
Sowaity

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Intellectual Capital, Sustainability, and Financial Performance. Empirical Evidence for Jordanian Firms

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Título da tese: **Intellectual Capital, Sustainability, and Financial Performance. Empirical Evidence for Jordanian Firms**

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USC
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DE SANTIAGO
DE COMPOSTELA

Table of Contents

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

USC
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Introduction

The importance of intellectual capital (IC) in sustaining economic growth is emphasized in Jordanian National Vision and Strategy (Yaseen & Al-Amarneh, 2021), which underlines the pivotal role played by IC in driving competitiveness and generating future added value (Xu et al., 2022). Successful firms tend to be those that continually innovate, relying on intangibles such as technology and the skills and knowledge of employees – the new engine of corporate development – rather than on plant and machinery to generate value.

The growing interest in IC is supported by the fact that its key role in enhancing competitiveness (Mukherjee and Som, 2019) is revealed when firms achieve different results while employing similar resources. IC is considered to be a main driver of long-term corporate success, wealth generation, and business sustainability (Jian and Jingsuo, 2019; Tarigan et al., 2019). To ensure corporate survival, management needs to pay greater attention to IC development by continuously investing in updating staff knowledge and skills. In addition, policy makers also have a role to play in investing in human capital to enhance corporate efficiency and productivity, and ultimately, boost economic growth.

In a study sponsored by United Nations, Jordan was identified as a nation with a high level of human capital potential but with a relatively low level of structural capital (Bontis, 2004). Jordan, whose economic growth has slowed down dramatically since 2009, has struggled to find solutions for its ailing economy – with a low per capita gross domestic product (GDP), high ratio of external debt (around 95% of GDP), a high unemployment rate, falling real estate values (24% in a decade) (Kardoosh, 2019) – and for shrinking foreign investment (Al Amosh and Khatib, 2021). This depressed economic scenario, which has forced many young Jordanians to consider emigration, has compelled the Jordanian government to undertake aggressive reforms aimed at returning to a normalized growth path (Economic Policy Council, 2016).

USC UNIVERSIDADE DE SANTIAGO

This is the reality that inspires investigations to explore the potential role of IC in boosting productivity, improving corporate performance, and enhancing corporate earning quality, in an endeavor to enhance local and international investments. While numerous studies have comprehensively demonstrated the significance and impact of IC for corporate management in the developed world, a limited number of contributions have tackled this topic in relation to emerging economies (Yaseen & Al-Amarneh, 2021). In the light of this scant literature, research regarding IC is of great importance for Jordan, since it can improve corporate profitability and performance even during crisis times, such as during the Covid-19 pandemic, as evidenced recently by Xu et al. (2022).

Earnings quality (EQ) is another important issue for financial analysis and corporate performance, as it throws light on both current and future functional performance, improves capital market efficiency, and ultimately determines the value of a company. The fraud that has accompanied the bankruptcy of large companies in the early 21st century has raised concerns about corporate EQ. When corporate management manipulates earning, the consequences are severe for a business' future, including high business risk, decreased stock market price, increased cost of capital, and a loss of trust in management. Investigating the association between IC and EQ could play a key role in boosting corporate growth, and in turn, improving Jordan's capital market efficiency, as prerequisite for sustainable economic recovery in Jordan.

We approached the important issues discussed above from different angles in an endeavor to encounter solutions and develop economic indices for Jordan that may benefit corporate stakeholders and help tackle the depressed economy, as well as contribute to the financial academic literature on emerging economies. We conducted three empirical studies of non-financial manufacturing, services, and real estate companies listed on the Amman Stock Exchange (ASE). These sectors, which contribute about 60% to Jordan GDP, play a key role in the economic and social development of Jordan.

USC
DE SANTIAGO
DE COMPOSTELA

The study period commenced in 2009 – to avoid the direct impact of the global financial crisis and to be consistent with the enactment of a new Jordanian tax law in 2009

– and extended to the end of 2018; data collection commenced in the first quarter of 2019. The study sample included 104 of 157 listed non-financial companies that met predefined inclusion criteria. Study data were extracted from annual audited and published financial statements (available on the ASE website) for subsequent content analysis. Different hypotheses were proposed to answer the research questions, and were addressed using multivariate panel regression models developed using the Stata 16 package. In addition, to ensure valid inferences, various statistical diagnostic tests were run on the collected data and appropriate statistical tools were used to resolve data problems. Our three empirical studies are described in what follows.

We first addressed whether voluntary disclosure of environmental, social, and governance (ESG) practices could enhance intellectual capital efficiency as represented by the value-added intellectual coefficient (VAIC) model developed by Pulic (1998) and its three components, namely, human, structural, and relational capital (HC, SC, and RC, respectively). Reported information on ESG issues is useful for corporate stakeholders since ESG practices signal information regarding a firm's pledges that could potentially improve corporate performance. Note that sustainability reporting in Jordan has been taken up very slowly, as it is still voluntary. Recent research has alluded to the need to develop new sustainability indicators for the Jordanian setting (Badran, 2017), and some progress is being made in response to shareholder pressures (Al Amosh and Khatib, 2021). To incentivize listed firms to move towards sustainability development, the government has passed a new income tax regulation that offers exemptions for any charitable, humanitarian, scientific, environmental, social or cultural payments within Jordan.

For that first empirical study, data on ESG information disclosure were collected from the published annual financial statements and classified using content analysis. As no clear ESG parameters were followed in the corporate disclosures, the statistical method applied was based on dichotomous scoring. We found that governance information disclosure is associated with IC efficiency, and that social information disclosure is negatively associated with IC efficiency. In the aggregate, we found that disclosing

USC
DE SANTIAGO
DE COMPOSTELA

information on one or two of the three ESG dimensions enhances IC efficiency. This evidence highlights the importance, for improving intangible assets, of disclosing sustainability practices, which, in turn, can enhance corporate reputation, create added value, and sustain a competitive edge. The empirical results suggest that firms that disclose ESG information are more profitable and more transparent and thus, are have greater IC efficiency, with the proviso that indebtedness should be low. These findings suggest that Jordanian regulatory bodies should legislate to enforce ESG disclosure and introduce harsh sanctions for noncompliance. Furthermore, measures should be associated with developing public ratings and rankings that reflect adherence, although note that adherence is unlikely without legal enforcement of third-party audits.

For the second empirical study, we addressed whether IC and its three components could improve corporate EQ, represented by the total accrual model as a reverse measurement of EQ following Richardson (1995). We found a positive and significant association between IC efficiency and EQ; thus, a high level of IC efficiency leads to a low level of corporate accruals which, in turn, leads to high EQ. This finding suggests that, to attract global investors and other stakeholders, corporate management should improve IC efficiency as a means of restoring trust in the local capital market. However, we also found evidence that suggests that human resources in Jordanian companies may be underutilized or used for purposes not aligned with organizational objectives. We also found that greater investment by large corporations in IC achieves higher EQ, and that high indebtedness is an impediment to investment in IC, which in turn leads to low EQ.

Finally, we examined whether IC efficiency could shape corporate performance, as reflected in return on assets (ROA), return on equity (ROE), earnings per share (EPS), and net profit margin (NPM). Overall, the findings reveal a positive and significant impact of IC efficiency on corporate performance that holds across the manufacturing, services, and real estate sectors. Considering the different IC components, i.e., HC, SC, and RC, a positive relationship was found for RC and HC with some few exceptions. Interestingly, our evidence points to the fact that Jordanian corporate management has not yet fully exploited the potential of intangibles, and also suggests that large firms can take

USC
DE SANTIAGO
DE COMPOSTELA

advantage of economies of scale by investing in intangible assets to improve their performance. However, a novel finding regarding the real estate sector was that large firms do not take advantage of economies of scale to invest in IC as a means to improving profitability, indicating that this sector may have a high percentage of slack assets that do not contribute to value-creation processes and/or may be mismanaged and need restructuring. The fact that the real estate sector is struggling to add value merits further research. Finally, we also found strong evidence that indebtedness harms corporate profitability, suggesting that debt covenants deter firms from investing in IC, with negative repercussions for profitability.

Our findings would suggest that, to improve and sustain competitive advantage and economic growth in Jordan, companies need to attach high priority to building strategies aimed at investment in IC, including in training for human resource managers. It is also recommended for firms to create a new high-ranking organizational chief knowledge officer post for the management, measurement, and reporting of IC information, especially in large corporations.

Ultimately, our findings document evidence for the crucial role of IC efficiency in improving corporate performance, both in terms of profitability indicators and EQ level. We suggest that the economic recovery of the Jordanian capital market depends on firms disclosing and reporting on their sustainability profile in terms of ESG activities and so enhancing their IC efficiency. This is further evidence that IC is a firm's hidden value, which should be reflected clearly and transparently in traditional public financial statements. A commitment to ESG practices reflects greater social engagement by corporations with their communities, and will attract socially responsible investors. We therefore recommend that internal and external stakeholders place greater emphasis on corporate ESG and IC profiles as a way to improve financial performance, boost productivity, and attract local and global investment. As for implications for policy makers, these could support non-financial corporate information (i.e., ESG) disclosure and IC development through legislation, as a way to stimulate capital flows towards Jordan.

USC
DE SANTIAGO DE COMPOSTELA

The rest of this dissertation is organized as follows: Chapter 1 describes the impact of ESG voluntary disclosure on IC efficiency and the interactive effects of ESG components on profitability; Chapter 2 explores the impact of IC efficiency on corporate EQ; and finally, Chapter 3 illustrates the relationship between IC efficiency and financial performance. Each chapter includes its own set of references and appendices.

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DE COMPOSTELA

Chapter One

Environmental, Social, and Governance Information Disclosure and Intellectual Capital Efficiency in Jordanian Listed Firms[1]

Abstract

In this study, we explore the association between the intellectual capital (IC) efficiency of firms and their voluntary disclosure of environmental, social, and governance (ESG) information, using data on Jordanian listed firms and the value-added intellectual coefficient (VAIC) model with its three components of human, structural, and relational capital efficiency (HCE, SCE, and RCE, respectively). We find that disclosing environmental information is unrelated to IC efficiency, that disclosing governance information is associated with raised IC efficiency through the HCE and RCE components, and that disclosing social information is negatively associated with IC efficiency through the SCE and RCE components. We also find that releasing information on one or two of the three ESG dimensions has a positive effect on IC efficiency. This evidence has implications for the management of intangible assets.

Keywords: ESG information disclosure, corporate sustainability, Intellectual capital efficiency, Amman Stock Exchange, VAIC

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1.1 Introduction

In this study, we examine how voluntary information disclosure on the environmental, social, and governance (ESG) dimensions of firms is associated with intellectual capital (IC) efficiency. Reported information on ESG issues is useful for corporate stakeholders concerned with social firms' features that go beyond their financial performance. Specifically, ESG signals information regarding the firm's pledges regarding welfare, social, and environmental issues that contribute to creating a close connection between stakeholder and societal interests. Therefore, ESG information disclosure may enhance a firm's reputation and increase the value of intangible assets as reflected in IC efficiency, embracing employee expertise, organizational processes, and the sum of knowledge contained within the organization.

Previous studies have documented that ESG information disclosure has a positive impact on a firm's financial performance (Endrikat et al., 2014; Juarez, 2017; Alsayegh et al., 2020), improves risk-adjusted returns (Limkriangkrai et al., 2017; Sassen et al., 2016), and enhances a firm's value by augmenting cash flows and reducing the cost of equity (Plumlee et al., 2015). ESG information disclosure can also lessen corporate bond credit spread (Yang et al., 2021) and decrease default risk (Atif and Ali, 2021). Whether disclosure on each ESG dimension, individually or aggregately, affects the value of intangible assets remains an open question.

In this paper, we address how ESG information disclosure is associated with the value of intangible assets as accounted for by the IC efficiency of firms, especially in emerging economies, where intangible assets may play a crucial role in boosting productivity, and where ESG information is crucial to characterizing a firm's sustainability focus (Zhao et al., 2018) and to signaling its social pledge. We fill this gap by analyzing ESG information disclosure by Jordanian companies.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

We study a panel of non-financial Jordanian listed firms (2009-2018) that voluntarily report information on ESG practices when that reporting is not compulsory and external information on ESG ratings is missing. This is an interesting setup, as the

association between ESG information and IC efficiency is not mediated by the intervention of third parties that assess the quality of ESG practices, and consequently, the impact of ESG information on IC is only driven by whether ESG practices are/are not implemented, mitigating difficulties regarding asymmetric information between rating agencies, investors, and corporate managers. Hence, we can clearly identify whether voluntary ESG information disclosure has any impact on IC efficiency, independently of assessments regarding the quality of ESG practices. This is particularly relevant to promoting ESG practices in emerging economies where such practices are not as widespread as in developed countries.

By applying the value-added intellectual coefficient (VAIC) model and its three components of human, structural, and relational capital efficiency (HCE, SCE, and RCE, respectively), we find that disclosing information on the environmental dimension is not associated with IC efficiency (even though corporate engagement in environmental activities improves SCE and RCE), that disclosing information on the governance dimension raises IC efficiency through the HCE and RCE components, and that disclosing social information is negatively associated with IC efficiency through the SCE and RCE components. In assessing whether ESG information disclosure intensity is associated with IC efficiency, we find that releasing information on one or two of the three ESG dimensions is positively associated with IC efficiency.

By reporting evidence on the relationship between ESG disclosure and IC efficiency, our study not only extends the above-mentioned literature on the role of ESG disclosure, but also adds to the IC literature. Previous research has considered, among other variables, the impact of profitability, risk efficiency, barriers to entry, and firm size and age on IC efficiency (see, e.g., Forte et al., 2017, Meressa, 2016; El-Bannany, 2012, 2008; Sardo and Serrasqueiro, 2017), disregarding social and sustainability features that could boost the value of a firm's intangible assets through knowledge innovation and the corporate culture. Our evidence provides information on the relevance of each of the three ESG dimensions for the value of intangible assets as given by IC efficiency.

USC
DE SANTIAGO
DE COMPOSTELA

Our findings have management implications in that ESG information disclosure has positive effects on the value of IC, ultimately affecting the performance of firms. Interestingly, voluntary reporting on ESG practices reflects greater transparency and social involvement, which could attract the interest of socially responsible investors from both Jordan and abroad, increasing thus the capital strength of companies. Our evidence also has implications for policymakers, as they could support through legislation the release of non-financial corporate information to stimulate capital flows towards Jordan, a capital-scarce country.

The rest of the paper is organized as follows: the literature is reviewed and hypotheses are developed in Section 2, the data is described in Section 3, descriptive statistics and empirical results are reported and discussed in Section 4, and finally, Section 5 summarizes our findings and our main conclusions.

1.2 Literature Review and Hypotheses

Growing global concerns regarding the scarcity of natural resources, social inequity, and rapid environmental degradation, sustainability issues are attracting growing attention and are becoming key concerns for companies and investors in terms of realizing long term value (Hami et al., 2015; Ching et al., 2016; Kilic and Kuzey, 2017) and accounting legally and ethically for internal and external actions aimed at ensuring long-term survival (Han et al., 2016; Dumitrascu et al., 2014). Therefore, ESG pillars are a potential source of competitiveness (Crifo et al., 2019; Najul and Santi, 2018).

According to the Global Reporting Initiative (GRI, 2018), the motives underpinning ESG practices and reporting are: (a) to gain a comprehensive understanding of risks and opportunities; (b) to build trust with customers and partners, leading to a positive financial impact; (c) to signal company management quality, as ESG practices proxy better financial risk management (Heenetigala et al., 2015: Atif and Ali, 2021); and (d) to develop customized investment portfolios, improve returns on capital, increase profits, enhance corporate image, and retain talent. ESG information disclosure also reduces

information asymmetry between principals and agents (Kilic and Kuzey, 2018). Table 1.1 summarizes the main features of the three pillars of sustainability as described by ESG information.

Most empirical studies on ESG information disclosure have been conducted for developed economies, but their conclusions cannot be easily generalized to developing countries (Kuzey and Uyar, 2017). Najul and Santi (2018) argue that firms engage in corporate sustainability reporting in response to certain external pressures and not necessarily because of a feeling of responsibility towards the environment, the economy, or society.

Table 1.1 Environmental, social, and governance dimensions.

Environmental performance Disclosure	Activities in favour of maintaining the eco-system (Sunday, 2017) and that reflect corporate eco-literacy. Addressed are the impact of business environmental activities on society and the planet. It covers disclosure policies on CO2 emissions, energy consumption, total waste, energy efficiency emissions reduction, number of environmental safety accidents, total investment in environmental protection as a share of revenues, smole emissions, etc (Han et al., 2016; Zhao et al., 2018).
Social performance disclosure	Addressed are policies such as the number of employees, employee turnover, number of unionized employees, percentage of women in management, percentage of women employees, proportion of employees with disabilities, average annual paid holidays, annual health checks, major equipment accidents, charity donations, sponserships, etc (Han et al., 2016; Zhao et al., 2018).
Governance performance Disclosure	A safeguard against mismanagement. Addressed are corporate organizational characteristics such as ownership structure, board size, independent directors, and outsiders (Ozcan, 2020). Other determinents include the frequency of audit committee meetings, CEO duality (role separation), board gender diversity, existence of a sustainability committee, and age of the youngest director (Giannarakis et al., 2019).

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For the European banking industry for the period 2009-2015, Gangi et al. (2018) document a positive effect of corporate social responsibility (CSR) engagement on financial performance; banks that undertake more CSR initiatives outperform those less engaged in CSR, attract better employees and garner a higher market share. CSR can

enhance value creation as evidenced by Husted and Allen (2007) for the Spanish context. In the same vein, a positive association with ESG information disclosure is reported between government ownership, firm size, and financial leverage in a study of 33 partially state-owned rail companies in 9 countries (Ozcan, 2020). In their study of 53 organizations through structured interviews, Balugani et al. (2020) find a significant association for the sustainability maturity index with corporate profitability, but an insignificant association with country of origin, firm size, and market focus. For their survey of 92 multinational firms over the period 2009-2013, Giannarakis et al. (2016) report evidence that environmental performance positively affects the environmental disclosure level, but the impact on a firm's value is insignificant, and the environmental score is negatively related to financial performance.

The growing interest in IC is supported by the fact that IC is a relevant competitive factor, as evidenced by firms achieving different results when employing similar resources (Mukherjee and Som, 2019; Costa and Canavate, 2015). In addition, the importance of IC in today's knowledge economy is leading companies to favour IC disclosure (Sarraj, 2010) as a good tool to manage corporate talents and competencies, increase transparency, and enhance corporate reputation, which in turn, helps recruit and retain high-level candidates.

As for the relationship between CSR and IC, Pedrini (2007) shows that investment in CSR[2] activities generates benefits for IC efficiency. Branco and Lucia (2006) also evidence a positive correlation between CSR practices and IC efficiency in improving a firm's reputation. Bhattacharya and Sanker (2004) and Mont and Leire (2008) find a strong and positive relationship between CSR activities and a company's brand, pointing to the importance of the structural capital element. In their study of Luxembourg listed firms, Bocquet et al. (2012) find that firms with proactive CSR profiles are more likely to innovate in brands and processes, while firms with reactive CSR profiles experience barriers to innovation. For Malaysian firms, Arshad et al. (2016) document a positive

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[2] The term CSR reflects only environmental and social activities, so governance is not reflected in the cited studies.

relationship between SCE and sustainability performance, but find a weaker positive, but still significant, relationship with HCE and RCE. Likewise, Albakri (2016) and Sharaf (2016) report a connection between IC efficiency and sustainability.

Previous literature has also explored the connection between IC and environmental issues. Omar et al. (2017) document how IC efficiency can be used to resolve environmental problems since it incorporates both tangible and intangible assets in attaining sustainability. Rae et al. (2015) report a significant association between HCE and environmental performance, while Abu Bakar et al. (2017) explore how sustainability is measured specifically towards HCE development through the resolution of social problems. For a survey of Nigerian manufacturing firms, Sunday (2017) finds a positive and significant relationship between IC efficiency and corporate sustainability, and a significant impact of HCE on economic, social, and environmental sustainability. In a study of the effects of green IC efficiency on competitive advantage, Chen (2008) – who splits IC into green HCE, green SCE, and green RCE components, and business sustainability into economic, social, and environmental dimensions – documents that green IC is a key element in sustainable operations. Based on Chen's (2008) framework, Omar et al. (2017) document that IC efficiency can be used to solve environmental problems since it incorporates both tangible and intangible assets in managing environmental problems to attain sustainability.

Our study contributes to the literature by accounting for the hitherto unexplored impact of sustainability disclosure, proxied by ESG information disclosure, on IC efficiency. ESG information disclosure may have a signaling effect for intangible asset values and managerial commitment to different sustainability actions that may increase stakeholder involvement, ultimately affecting firm performance. Specifically, on the basis of the above empirical evidence, we test the following hypotheses for Jordanian listed companies:

USC
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Hypothesis 1: Information disclosure on ESG dimensions is associated with IC efficiency.

Hypothesis 1a: Information disclosure on ESG dimensions is associated with the different components of IC efficiency.

Hypothesis 2: ESG information disclosure intensity is associated with IC efficiency.

Hypothesis 2a: ESG information disclosure intensity is associated with the different components of IC efficiency.

The first hypothesis draws on previous empirical evidence suggesting that the three ESG dimensions are not homogeneous across economic sectors, i.e., once ESG is disaggregated into its parts, different significant impacts may be documented for corporate performance (Johnson et al., 2019).

1.3 Research design

1.3.1 Data

The data sample includes observations for all non-financial (manufacturing, services, and real estate) companies listed on the Jordanian Amman Stock Exchange (ASE) over the decade 2009-2018.

Although Jordan has high human capital potential, it has a low level of structural capital (Bontis, 2004), low per capita GDP, high public debt and unemployment levels. It is struggling to find solutions for its ailing economy, where economic growth has slowed down dramatically since 2009, and the 24% drop in the value of real estate and 40% free-fall in the construction sector associated with shrinking foreign investment. A large proportion of Jordanian young people cannot find decent employment and so are forced to consider emigration (Al Amosh and Khatib, 2021). These realities are the main driver for research that can enrich the corporate literature for emerging economies.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Disclosure practices in Jordan are still emerging and are voluntary. While the level of ESG information disclosure is weak, some progress is being made in response to shareholder pressures (Al Amosh and Khatib, 2021). Like many developing countries that have received less attention in the literature, Jordan suffers from ESG practices (Yang et

al., 2020). In 2015, the Jordanian government launched a comprehensive development plan, called Jordan 2025, setting economic, social, and environmental goals aimed at achieving sustainable development (Al Amosh and Khatib, 2021). They added, among its measures to incentivize listed and unlisted firms to contribute to sustainability development issues, The Jordanian government passed new income tax legislation in 2009 that tax-exempt any charitable, humanitarian, scientific, environmental, social or cultural payments within Jordan by firms participating in sustainability activities.

The study period was selected to commence in 2009 to avoid the direct effect of the global financial crisis (William et al., 2017), and to be consistent with the launch of the new Jordanian tax law of 2009—and extends to the end of 2018 (as data collection commenced in the first quarter of 2019). Companies were included if audited and disclosed statements were reported and published in the ASE official website (www.ase.com.jo). Table 1.2 shows details of the companies and sectors and describes the selection process followed.

Table 1.2 Included/excluded listed Jordanian firms.

Industry	Total listed	Excluded firms	Included firms	% of full sample	% Inclusion	# Obs.
Included sectors						
Manufacturing	47	5	42	40%	89%	420
Services	77	26	51	49%	66%	510
Real estate	33	22	11	11%	33%	110
Excluded sectors						
Banking*	15	15	0			0
Insurance*	21	21	0			0
Total	**193**	**89**	**104**	**100%**		**1040**
	Margin of error calculation for sample selection at 95% level of confidence					
	Manufacturing	Margin of error	Services	Margin of error	Real estate	Margin of error
Full sample	42 of 104	11.73%	51 of 104	9.84%	11 of 104	28.08%
Sub-sample	42 of 47	4.99%	51 of 77	8.03%	11 of 33	24.50%

***** Banking and insurance firms are excluded due to a different reporting structure that means they are not comparable with non-financial firms.

Companies were selected according to predefined criteria as follows:

1. Financial data with a clear reporting structure of the company are available over the period of the study.
2. The company has continuous activity during the study period and trades publicly on the ASE over the sample period.
3. To ensure comparability, fiscal years should end on 31 December and fiscal year definition should not be changed during the sample period.

Valid for statistical analysis were 42 of 47 manufacturing sector companies (pharmaceutical, medical, chemical, paper, food, beverage, tobacco, mining, extraction, engineering, construction, electrical, and textiles), 51 of 77 services companies (healthcare, education, hotels, tourism, transportation, technology, communication, media, utilities, energy, commercial, and diversified financial services), and 11 of 33 real estate companies (land management and housing projects). Excluded were companies with missing data and an unclear disclosed data structure. ASE listed public companies in 2019 numbered 193 when data collection started. Meeting the above criteria were 104 companies, reflecting a total of 1040 annual observations.

1.3.2 Variables

From the audited accounting information for Jordanian companies, we extract ESG information disclosure data by means of content analysis of published annual financial statements, and then compute IC efficiency and its three components (HCE, SCE, and RCE), and control variables.

We measured ESG information disclosure in two different ways. First, we use ESG information[3] disclosure in annual financial statements as reflected in an independent variable based on dichotomous scores: 1 for each individual ESG dimension – i.e., environmental, social, and governance – if disclosed, regardless of any criteria the company may follow, and 0 otherwise. Environmental disclosure is based on the firm's

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

[3] Sustainability disclosure for the ASE, which joined the United Nations Sustainable Stock Exchanges (SSE) initiative in March 2016, is close to voluntary except for corporate governance.

performance in relation to climate change, hazardous waste, nuclear energy, and sustainability indicators; social disclosure is based on the firm's performance in relation to consumer protection, diversity, human rights, animal welfare, child labour, and employee health and safety indicators; and governance disclosure is based on the firm's performance in terms of management structure, executive compensation, and conflict of interest indicators (Atif and Ali, 2021). We thus have three dummy variables that reflect the firm's performance in each ESG dimension. Second, we account for the relative aggregate disclosure of ESG information using the approach described by Oliveira et al. (2010) and Hasan et al. (2017). Thus, from information on the dummies for each ESG dimension, we reflect disclosure intensity as maximum disclosure, moderate disclosure, and minimum disclosure, using proxies scored as 1 when information on three, two, and one dimensions is disclosed, respectively, and 0 otherwise.

We computed IC efficiency using Pulic's (1998) widely used VAIC model, as it is easily computed from audited financial statements. Its three IC efficiency components are described as follows:

1. HCE indicates the innovation potential of a firm, reflecting the genetic inheritance, know-how, and experience of employees in terms of professional skills, experience, innovativeness, competencies, and mental agility (Todericiua and Alexandra, 2015). Regarded as a critical strategic resource for organizational growth and survival (Sunday, 2017; Sharabati et al., 2013; Fathi et al., 2013), HCE indicates the contribution to corporate added value of each unit of spending on employee costs: the higher this value the greater the HCE (Stahle et al., 2011). This component includes employee salaries, bonuses, other compensations, and training costs (Sarea and Alansari, 2016).
2. SCE reflects the share of organizational capital in the value creation process by capturing all nonhuman capital in an organization, including databases, corporate charts and culture, patents and trademarks, systems, processes, policies, procedures, and overall infrastructures that empower human resources to perform (Todericiua and Alexandra, 2015). Sarea and Alansari (2016), as cited in Chen and Hwang (2007),

USC DE SANTIAGO DE COMPOSTELA

described the major distinction between HCE and SCE: human capital is attached to the employee and disappears if they leave the firm, whereas SCE is owned by the firm and remains even after the employee leaves.

3. RCE reflects the physical and financial capital in the value creation process that drives HCE and SCE (Nuryaman, 2015; Meressa, 2016). It includes all company's formal and informal relationships with stakeholders (Todericiua and Alexandra, 2015).

In addition, as in the CSR literature, we take into account control variables for firm size and risks so as to avoid confounding effects. Firm size is measured as the natural logarithm of the firm total assets, whereas risk is reflected in leverage, defined as the debt-to-asset ratio and where a higher ratio reflects greater exposure to default and bankruptcy. (See the Appendix for specific details on computations for all variables).

1.3.3 Regression model

We used a panel regression model where the dependent variable is IC efficiency or any of its components, the independent variables are the dummy ESG information disclosure variables, and the control variables are firm size and leverage:

$$VAIC_{i,t} = \alpha_i + \beta_1 E_{i,t} + \beta_2 S_{i,t} + \beta_3 G_{i,t} + \beta_4 Size_{i,t} + \beta_5 Leverage_{i,t} + \varepsilon_{i,t}. \qquad (1)$$

where $E_{i,t}$, $S_{i,t}$, and $G_{i,t}$ denote the dummy variables that indicate whether firm *i* releases environmental, social, and/or governance information at time *t*, respectively, and where β_1, β_2, and β_3 account for the marginal effects of that disclosure on IC efficiency as given by the dependent variable *VAIC*. Exchanging $E_{i,t}$, $S_{i,t}$, and $G_{i,t}$ in Eq. (1) for *ESGMax*, *ESGMod* and *ESGMin*, we obtain maximum, moderate, and minimum ESG information disclosure intensity, respectively. Likewise, exchanging *VAIC* for each of its components (*HCE, SCE,* and *RCE*), we can check for the effects of ESG information disclosure on the individual IC efficiency components. To control for unobserved heterogeneity by cross-section and over time, we include firm fixed-effects dummies, as given by α_i, and year fixed-effect dummies.

USC DE SANTIAGO DE COMPOSTELA

1.4 Empirical results

1.4.1 Descriptive statistics

Tables 1.3 and 1.4 present descriptive statistics for all the variables used in our analysis. Control variables (except size), and the dependent variables were winsorized at the 5% level to control for the effect of outliers, and the normality of all variables was checked by running the Shapiro-Wilk's test (see Appendix A for specific details of computations).

The mean VAIC value is 3.6757, indicating that added value is positively generated from integration of all the IC components during the study period, i.e., the contribution of IC in generating added value exceeds the costs incurred. The VAIC standard deviation is 3.0898, indicating that IC dispersion over the listed firms is relatively low. As for individual VAIC components, HCE and RCE exhibit the highest and lowest mean values, at 2.8594 and 0.1327, respectively. The relatively high mean value for HCE is explained by the key role played by human resources in adding value, and, since HCE is the dominant VAIC component, it may determine and enhance the competitive edge of a firm. The descriptive statistics also indicate that the added value generated by the VAIC components exceeds the costs incurred.

Table 1.3 Descriptive statistics for environmental, social, and governance information disclosure.

	E		S		G		ESGMin		ESGMod		ESGMax	
	N	%	N	%	N	%	N	%	n	%	N	%
Nondisclosure	410	39	315	30	71	7	813	78	872	84	453	44
Disclosure	630	61	725	70	969	93	227	22	168	16	587	56
Total	1040	100	1040	100	1040	100	1040	100	1040	100	1040	100

Notes. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions.

As for the independent variables, these are all dummy variables (excepting the control variables), implying that the mean values represent disclosing firm frequencies in the sample over the studied period. For the environmental, social, and governance dimensions, mean values are 0.61, 0.70, and 0.93, respectively. Disclosure is greatest for the governance dimension (93%), and lowest for the environmental dimension (61%). Mean values for minimum, moderate, and maximum ESG information disclosure

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

intensity are 0.22, 0.16, and 0.56, respectively; around 56% of the companies disclose their full ESG profile, 16% disclose information on two ESG dimensions, 22% disclose information on a single ESG dimension, while the remaining 6% do not disclose any type of ESG information.

Regarding control variables, firm mean size is 7.5046, and the fact that size ranges from a minimum of 5.3013 to a maximum of 9.9848 reflects great variation. The mean leverage value of 0.27 (under one third of total assets is financed by creditors) indicates that indebtedness is within an acceptable range and is not a threat to the firms' existence.

Table 1.4 Descriptive statistics for the full sample.

Variable	Mean	Min	Max	SD	Skewness	Kurtosis	Observations
VAIC	3.6757	-0.3064	12.6096	3.0898	1.5451	5.1041	1040
HCE	2.8594	-0.7995	11.3493	2.7857	1.7168	5.7891	1040
SCE	0.5644	-0.3224	1.5159	0.4025	0.0649	3.7169	1040
RCE	0.1327	-0.0181	0.3926	0.1075	0.8605	3.1457	1040
E	0.6058	0	1	0.4889	-0.4329	1.1874	1040
S	0.6971	0	1	0.4597	-0.8579	1.7361	1040
G	0.9317	0	1	0.2523	-3.4236	12.721	1040
ESGMax	0.5644	0	1	0.4961	-0.2599	1.0675	1040
ESGMod	0.1615	0	1	0.3682	1.8393	4.3831	1040
ESGMin	0.2183	0	1	0.4132	1.3641	2.8607	1040
Size	7.5046	5.3013	9.9848	0.5571	0.7369	4.2019	1040
Leverage	0.2740	0.0072	0.7881	0.2215	0.7459	2.7323	1040

Notes. The full sample includes annual data for firms listed on the ASE for the period 2009-2018. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; VAIC, value-added intellectual coefficient, composed of human, structural, and relational capital efficiency (HCE, SCE, and RCE).

1.4.2 Regression results

Panel fixed-effects and random-effects estimators are presented below, along with the Hausman test to select the appropriate model. The Breusch-Pagan Lagrangian multiplier (LM) test was also run to determine whether ordinary least squares (OLS) or generalized least squares (GLS) was more appropriate for model estimation.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Table 1.5 presents evidence for two regression models where the dependent variable is the VAIC, and the explanatory variables are information disclosure for each ESG dimension and disclosure intensity.

Table 1.5 Regression results for the impact of environmental, social, and governance information disclosure on the value-added intellectual coefficient.

ESG dimensions		ESG disclosure intensity	
Intercept	-0.086(0.983)	Intercept	-0.871(0.986)
E	0.032(0.221)	ESGMax	0.430(0.264)
S	**-0.382*(0.214)**	ESGMod	**0.491*(0.286)**
G	**0.747***(0.233)**	ESGMin	**0.797***(0.266)**
Size	0.554 (0.659)	SIZE	0.546(0.529)
Leverage	-1.142 (1.021)	Leverage	-1.151(0.976)
R-squared	0.1750	R-squared	0.1758
F-stat	29.75***	F-stat	30.21***
Group	104	Group	104
Observations	1040	Observations	1040
Hausman	$x^2(14)$ 19.55	Hausman	$x^2(14)$ 20.07
	Random effect		Random effect
Breusch-Pagan LM	$x^2(1)$ 1194.24***	Breusch-Pagan LM	$x^2(1)$ 1196.03***
	GLS applied		GLS applied
Year effect	Yes		Yes

Notes. Significance: *p<0.10, **p<0.05, and ***p<0.01. F-stat results for regression model significance: ***, **, and * at the 1%, 5%, and 10% levels. Bootstrap standard errors are reported in parenthesis. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; GLS: generalized least squares.

At the 10% significance level, the evidence in Table 1.5 points to social information disclosure having a negative significant effect on IC efficiency, indicating that disclosing information on corporate engagement in social issues negatively affects IC efficiency. In contrast, at the 1% significance level, the results evidence a positive effect of governance disclosure on IC efficiency, but no significant impact for environmental disclosure; this nonsignificant result for the environmental dimension is inconsistent with the evidence reported by Omar et al. (2017) and Chen (2008). Corporate size and leverage have no effect on VAIC, suggesting that all firms disclose information on corporate governance, irrespective of size or indebtedness, to improve IC efficiency. Accordingly, Hypothesis 1 is accepted, except in relation to the environmental dimension.

As for disclosure intensity, the evidence in Table 1.5 indicates that there is a positive significant impact of minimum ESG disclosure and moderate ESG disclosure on IC efficiency at the 1% and 10% significance levels, respectively, but no significant effect for full disclosure. That evidence indicates that one or two ESG information disclosure dimensions may improve IC efficiency. Accordingly, hypothesis 2 is accepted, except in relation to maximum ESG disclosure.

Tables 1.6, 1.7 and 1.8 below summarize results on the relationship between ESG disclosure and the three individual components of IC efficiency.

Table 1.6, showing evidence on the relationship between ESG information disclosure and HCE, points to a positive and significant relationship between corporate governance information disclosure and HCE at the 5% significance level, underlining a relevant role in recruiting and retaining quality human resources. In contrast, we find no evidence of an association between either social or environmental information disclosure and HCE, contradicting the results of Ab Samad et al. (2019), Sunday (2017), and Rae et al. (2015). We accordingly reject our Hypothesis (1a) regarding HCE, except for governance disclosure. As for firm size and leverage, and consistent with Alvarez et al. (2011), size has a positive and significant impact on HCE, and leverage has a negative and significant effect on HCE.

Table 1.6 Regression results for the impact of environmental, social, and governance information disclosure on human capital efficiency.

	ESG dimensions		ESG disclosure intensity
Intercept	-5.095(2.696)	Intercept	-5.066(2.282)
E	-0.046(0.239**)**	ESGMax	0.331(0.243)
S	-0.203(0.194)	ESGMod	**0.593**(0.252)**
G	**0.582**(0.270)**	ESGMin	**0.567**(0.235)**
Size	**1.003***(0.384)**	Size	**0.996***(0.332)**
Leverage	**-1.693***(0.741)**	Leverage	**-1.719***(0.633)**
R-squared	0.1939	R-squared	0.1922
F-stat	37.40***	F-stat	37.92***
Group	104	Group	104
Observations	1040	Observations	1040
Hausman	x^2(14) 7.16	Hausman	x^2(14) 7.13
	Random effect		Random effect
Breusch-Pagan LM	x^2(1) 1403.11***	Breusch-Pagan LM	x^2(1) 1405.12***
	GLS applied		GLS applied
Year effect	Yes		Yes

Notes. Significance: *p<0.10, **p<0.05, and ***p<0.01. F-stat results for regression model significance: ***, **, and * at the 1%, 5%, and 10% levels. Bootstrap standard errors are reported in parenthesis. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; GLS: generalized least squares.

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Considering ESG disclosure intensity, estimates reveal a significant impact of minimum and moderate ESG disclosure on HCE at the 5% significance level. Whereas leverage has a significant and negative impact on HCE, the relationship between firm size

and HCE, consistent with the results reported by Ozcan (2020), is significant and positive; a possible explanation is that large firms have a greater incentive to disclose ESG practices in order to attract talent that will impact positively on their competitive edge. This finding is in line with Astuti et al. (2018), Eleftheriadis and Evgenia (2014), lbakri (2016), and Arshad et al. (2016), but inconsistent with Mukherjee and Som (2019). As for leverage, when high, it negatively affects HCE, since corporate engagement in costly ESG practices is influenced by external control by creditors, impeding improvements in HCE. Accordingly, we accept Hypothesis (2a) regarding HCE, except for maximum ESG disclosure.

Table 1.7 Regression results for the impact of environmental, social, and governance information disclosure on structural capital efficiency.

	ESG dimensions		ESG disclosure intensity
Intercept	-0.052(0.333)	Intercept	-0.051(0.286)
E	**0.070* (0.042)**	ESGMax	-0.025(0.059)
S	**-0.075**(0.041)**	ESGMod	-0.067(0.068)
G	-0.037(0.061)	ESGMin	0.002(0.061)
Size	**0.091**(0.043)**	Size	**0.088**(0.037)**
Leverage	**-0.192*(0.098)**	Leverage	**-0.194*(0.106)**
R-squared	0.0930	R-squared	0.0884
F-stat	46.04***	F-stat	48.11***
Group	104	Group	104
Observations	1040	Observations	1040
Hausman	x^2(14) 9.72	Hausman	x^2(14) 11.05
	Random effect		Random effect
Breusch-Pagan LM	x^2(1) 399.66***	Breusch-Pagan LM	x^2(1) 398.60***
	GLS applied		GLS applied
Year effect	Yes		Yes

Notes. Significance: *p<0.10, **p<0.05, and ***p<0.01. F-stat results for regression model significance: ***, **, and * at the 1%, 5%, and 10% levels. Bootstrap standard errors are reported in parenthesis. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; GLS: generalized least squares.

Table 1.7 presents evidence on the relationship between ESG disclosure and the SCE component, showing a significant and negative relationship between corporate social information disclosure and SCE at the 5% significance level, and a positive and significant association between environmental information disclosure and SCE at the 10% significance level. Thus, disclosures on social activities negatively affect SCE, disclosures on environmental activities increase SCE, while, in contrast, governance

USC UNIVERSIDADE DE SANTIAGO

disclosures haves no effect on SCE. We therefore accept Hypothesis (1a) regarding SCE, except for the governance dimension.

As for the effects of ESG disclosure intensity on SCE, the evidence points to no effects on SCE. Hence, we reject Hypothesis (2a). Our evidence is consistent with the results reported by Arshad et al. (2016), Mont and Leire (2008) and Mukherjee and Som (2019).

Table 1.8 Regression results for the impact of environmental, social, and governance information disclosure on relational capital efficiency.

	ESG dimensions		ESG disclosure intensity
Intercept	0.648***(0.189)	Intercept	0.650***(0.190)
E	**0.012*(0.007)**	ESGMax	**0.017**(0.008)**
S	**-0.014**(0.006)**	ESGMod	0.011(0.008)
G	**0.017**(0.008)**	ESGMin	**0.019**(0.009)**
Size	**-0.069***(0.026)**	Size	**-0.070***(0.026)**
Leverage	-0.047(0.048)	Leverage	-0.048(0.044)
R-squared	0.0829	R-squared	0.0801
F-stat	3.87***	F-stat	3.52***
Group	104	Group	104
Observations	1040	Observations	1040
Hausman	x^2(14) 32.63 ***	Hausman	x^2(14) 40.05***
	Fixed effect		Fixed effect
Breusch-Pagan LM	x^2(1) 2281.72***	Breusch-Pagan LM	x^2(1) 2200.73***
	GLS applied		GLS applied
Year effect	Yes		Yes

Notes. Significance: *p<0.10, **p<0.05, and ***p<0.01. F-stat results for regression model significance: ***, **, and * at the 1%, 5%, and 10% levels. Bootstrap standard errors are reported in parenthesis. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; GLS: generalized least squares.

In Table 1.8, evidence for each of the ESG dimensions reveals that disclosing information on the environmental and governance dimensions has a positive and significant impact on RCE; in contrast, social dimension information disclosure has a significant and negative effect on RCE. Note that the positive relationship we find between environmental performance and RCE is consistent with Hami et al. (2015). Thus, Hypothesis (1a) is accepted for all three IC efficiency components. Our finding that firm size has a negative impact on RCE is not consistent with evidence reported by Ozcan (2020).

USC UNIVERSIDADE DE SANTIAGO

As for the effects of ESG disclosure intensity on RCE, the empirical estimates show that minimum and maximum disclosure is positively associated with RCE at the 5% significance level, suggesting that ESG disclosures improve corporate RCE performance. This finding is consistent with results for sustainability and IC reported by Mukherjee and Som (2019), Branco and Lucia (2006), and Arshad et al. (2016). Finally, we find that firm size has a significantly negative effect on RCE.

1.4.3 Robustness

The main purpose underpinning ESG information disclosure and IC efficiency management are to produce added value and ensure corporate survival (Bukit et al., 2018; Astuti et al., 2018). Accordingly, we argue that profitability is an important mechanism through which ESG information disclosure intensity influences IC efficiency, and, therefore, investigate that relationship via profitability indicators, namely, net profit margin (NPM), earnings per share (EPS), and revenue growth (REVGRW). (See the Appendix for specific details of computations).

Table 1.9 Regression results for the impact on the value-added intellectual coefficient of environmental, social, and governance information disclosure interaction with profitability.

ESG disclosure intensity			
Intercept	4.683(3.569)		
ESGMax*EPS	**2.287***(0.813)**	ESGMax*NPM	**3.697***(0.623)**
ESGMod*EPS	**3.454***(1.064)**	ESGMod*NPM	**4.931***(0.696)**
ESGMin*EPS	**2.884***(1.197)**	ESGMin*NPM	**1.805*(0.969)**
Size	-0.195 (0.498)	ESGMax*REVGRW	**0.003***(0.001)**
Leverage	0.262(0.793)	ESGMod*REVGRW	**0.002***(0.000)**
R-squared	0.0750	ESGMin*REVGRW	**0.243*(0.145)**
F-stat	1463.33***		
Group	104		
Observations	1040		
Hausman	x^2(20) 24.30		
	Random effect		
Breusch-Pagan LM	x^2(1) 1531.48***		
	GLS applied		
Year effect	Yes		Yes

Notes. Significance: *p<0.10, **p<0.05, and ***p<0.01. F-stat results for regression model prediction reliability: ***, **, and * at the 1%, 5%, and 10% levels. Bootstrap standard errors are reported in parenthesis. ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three environmental, social, and governance (ESG) dimensions; NPM: net profit margin; EPS: earnings per share; REVGRW: revenue growth; GLS: generalized least squares.

Table 1.9 summarizes the interaction effect of ESG disclosure and profitability indicators on the VAIC, finding, without exception, that all interaction coefficients are statistically significant and positive. Those results suggest that firms with better ESG disclosure are more profitable and have greater IC efficiency.

The findings confirm the important role of ESG information disclosure in attracting quality human resources that would improve the financial performance of firms, and so attract investors, especially socially responsible investors who are likely to incorporate ESG information in developing and evaluating their portfolios. Consequently, financial markets may need, to ensure greater efficiency, to develop a system to reveal information on firms' socially responsible activities in a timely manner.

Finally, in running our analysis at the sectoral level, we could confirm that ESG information disclosure is relevant to shaping IC efficiency. (For the sake of brevity, these results are not included but are available on request).

1.4.4 Result Implications

Our evidence highlights the importance of disclosing ESG information in increasing the value of intangible assets as measured by the IC, thereby enhancing the company's reputation and competitive edge, and increasing investor and stakeholder interest. We summarize the practical implications of our study as follows:

1. The study draws attention to the potential offered by corporate involvement in sustainability practices in improving IC efficiency, which, in turn, can improve added value and competitive edge, with the proviso that firms should adhere to low indebtedness in their capital structure.
2. ESG disclosure, especially for small companies, improves corporate RCE and therefore represents a better chance of survival, as it presents issues positively, by forward-forecasting, to current and potential investors and to other corporate stakeholders.
3. Given the negative impact of social information disclosure on SCE and RCE, to generate added value, management should align social practices with the firm's

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vision and strategic objectives, which requires reengineering engagement in social practices with an approach that reflects an added-value perspective.

4. Owing to ASE adoption in 2016 of the United Nations Sustainable Stock Exchanges (SSE) initiative, regulatory bodies in Jordan should legislate professional codes as a way to enforce sustainability (ESG) reporting for listed firms and include harsh sanctions for noncompliance, e.g., delisting. It is also recommended to extend board governance committees' authority and control over sustainability issues, since adherence is unlikely without the oversight of sustainability committees (Kilic and Kuzey, 2017).

5. The Jordan Securities Commission could create corporate ratings to reflect adherence to ESG information reporting rules, with rankings available online for public scrutiny.

6. Empirical results suggest that firms that disclose ESG information are more profitable, and thus, have greater IC efficiency imply that disclosing information on ESG dimensions is advisable for firms to be able to attract investors and other stakeholders.

7. It is recommended that the Jordan Securities Commission authorizes third-party sustainability audits, to ensure credibility, secure the investment environment, and attract international capital, since such audits would improve transparency for capital market stakeholders.

1.5 Conclusions

We have explored how voluntary information disclosure on the ESG dimensions of firms is associated with IC efficiency and with each of its components. For Jordanian listed firms, we have documented that governance information disclosure is associated with increased IC efficiency, and especially with the RCE and HCE components, that social information disclosure is negatively associated with decreased IC efficiency, mainly through the SCE and RCE components, and that information disclosure for the

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environmental dimension is not associated with IC efficiency, although it positively affects the SCE and RCE components. We also find that disclosing information on one or two dimensions of ESG has a positive effect on IC efficiency, mainly transmitted through the RCE and HCE components.

In relation to the limitations of this study, as with other empirical studies, the results may be affected by endogeneity problems. While this research used year and firm fixed-effects to control for unobservable confounding variables possibly differing over time and across industrial sectors, it was not possible to fully control for all other unobservable bias or omitted variables that could potentially influence the explanatory power and results of the regression model. Another limitation arises from the absence of clear standards for Jordanian firms disclosing ESG practices, as the information we use in our study was obtained from reports that mostly reflect each company's own narrative of ESG practices. A further possible limitation is in relation to the validity of the VAIC model to account for IC efficiency (Stahle et al., 2011); hence, future research could consider other models for measuring IC and IC efficiency.

As for future research, our study could be extended by considering other models of IC and ESG measurement, by including financial firms, by including additional control variables, and by drawing comparisons with different economies and settings through the use of a scoring method that tests the quality of ESG information disclosure and its relationship with intellectual capital, among others.

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1.7 Appendix (A)

This section describes diagnostic checks for the full study sample coupled with the related tables. In panel data with time series of more than 10 years, there is always the possibility of non-stationarity shocks that will affect the long-term equilibrium of the series (Oppong and Pattanayak, 2019). Therefore, a Levin-Lin-Chu panel unit root test checks for data stationarity. Evidence from this test, reported in Table C1, indicates that all variables are stationary except for the dummy variables, which by their nature are not subject to diagnostic tests. This study is based on only 10 years, while there are only effects in panel series when the period is more than 10 years.

Table A1. Panel unit root test results for the whole sample.

Variables	Adjusted t-stat	p-value
ESGMax	16.356	1.000
ESGMod	13.250	1.000
ESGMin	17.654	1.000
E	12.051	1.000
S	10.864	1.000
G	11.756	1.000
VAIC	-11.596	0.000***
RCE	-9.739	0.000***
SCE	-11.690	0.000***
HCE	-13.355	0.000***
Leverage	-11.728	0.000***
SIZE	-28.197	0.000***

Notes. The Levin-Lin-Chu panel unit root test includes the adjusted t-statistic and p-value, and a significant p-value indicates that variables are stationary. Significance: ***, **, and * at the 1%, 5%, and 10% levels. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions.

The results for the Wooldridge test for autocorrelation are reported in Table C2. Some models have autocorrelation and heteroskedasticity problem. However, to ensure valid statistical inference regarding problems of heteroskedasticity and autocorrelation in the models, cluster-robust standard errors are estimated, as this has the advantage that it produces heteroskedasticity-consistent standard errors that are robust and so appropriate for balanced panel data.

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Table A2. Autocorrelation and heteroskedasticity test.

		VAIC		SCE		
E S G	Wooldridge test autocorrelation	$F(1,103) = 6.801$	0.011	E S G	*F (1,103) = 6.801*	0.011
	Breusch-Pagan test heteroskedasticity	$x^2(1)$=*24.97*	0.000		$x^2(1)$=*50.78*	0.000
ESGMax ESGMod ESGMin	Wooldridge test autocorrelation	$F(1,103) = 1.031$	0.312	ESGMax ESGMod ESGMin	*F (1.103) = 1.031*	0.312
	Breusch-Pagan test heteroskedasticity.	$x^2(1)$= *45.65*	0.000		$x^2(1)$=*48.99*	0.000
		RCE		HCE		
E S G	Wooldridge test autocorrelation	*F(1,103) =6.801*	0.011	E S G	*F (1,103) = 6.801*	0.011
	Breusch-Pagan test heteroskedasticity	$x^2(1)$=*24.97*	0.000		$x^2(1)$ =*117.28*	0.000
ESGMax ESGMod ESGMin	Wooldridge test autocorrelation	$F(1,103) = 1.031$	0.312	ESGMax ESGMod ESGMin	$F(1,103)$ *=1.031*	0.312
	Breusch-Pagan test heteroskedasticity	$x^2(1)$=*28.89*	0.000		$x^2(1)$=*120.76*	0.000

Notes. Significant x^2 values in both the Wooldridge and Breusch Pagan tests indicate autocorrelation and heteroskedasticity problems treated by robust standard errors. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; VAIC, value-added intellectual coefficient, composed of human, structural, and relational capital efficiency (HCE, SCE, and RCE).

Table A3. Definition and measurement of study variables.

Variable	Label and measurement	Definition
Value added (VA)	VA=output-input VA=IN+HC+D+A+T+I IN=net income after tax HC=employee costs D=depreciation A=amortization T=taxes I= interests	Output refers to net revenues generated. Input refers to expenses incurred excluding employee benefits.

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Continued from Table A 3

Relational capital (RC)	Total net tangible assets	Capital that enables HC and SC in creating added value (Nuryaman, 2015). It is capital employed equal to the book value of net total assets.
Human capital (HC)	All costs invested in employees	Knowledge owned by the staff. Refers to wages, salaries, bonuses, compensations, social security expenses, insurance, end of service benefits, and any other renumeration.
Structural capital (SC)	SC=VA-HC	Knowledge owned by the company. Excludes employees' costs from VA to determine the value added by structural elements
Relational capital efficiency (RCE)	RCE=VA/CE	RCE† coefficient describing the value-added created by each monetary unit spent on capital employed
Human capital efficiency (HCE)	HCE=VA/HC	HCE coefficient describing the value added generated by each monetary unit spent on HC
Structural capital efficiency (SCE)	SCE=SC/VA	SCE coefficient describing the value added generated by structural capital efficiency
Intellectual capital efficiency (ICE)	ICE=SCE+HCE	ICE coefficient describing the value created by intangible asset efficiency
Value-added intellectual coefficient (VAIC)††	VAIC=RCE+HCE+SCE	Overall value-added efficiency generated by intellectual coefficient proxied by IC. Higher VAIC represents greater efficiency in IC employed, and thus greater value generated to the firm (Yang, 2019).
Firm size (SIZE)	SIZE= (Log TA)	Firm size, to control for the effect of large and small firms on the regression model Calculated by taking the logarithm for total net assets (TA).
Financial leverage (LEV)	LEV =(TD/TA)	Company indebtedness, to control for the effect of firm debt on the regression model, considered a risk factor in our study Calculated by dividing total debt (TD) by total net assets.

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Notes. † RCE includes the efficiency that HCE and SCE fail to capture. Pulic (1998) argues that IC cannot create value on its own but must be combined with physical and financial capital (Yang, 2019). †† VAIC includes the three individual efficiency components and their aggregation.

Finally, the Shapiro-Wilk's test provides evidence that some of the data are not normally distributed. As a result, evidence on Spearman's correlation is presented to show dependence among variables. Table C4 presents the Shapiro-Wilk's test and Spearman's correlation results. No evidence was found of high correlation between the explanatory variables except for VAIC with HCE and E with ESGMax. This not a problem, however, as the variables are not included in the same regression model. Results for multicollinearity analysis using the variance inflation factor (VIF) show no multicollinearity among variables except for ESGMax, ESGMod and ESGMin, but this is not problem because they are dummy variables and not subject to diagnostic tests. A VIF value of less than 2.5 reflects the robustness of the study model in explaining the effect on the dependent variable.

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Table A4: Spearman correlation matrix /normality and multicollinearity test for the whole sample

Variables	VAIC	RCE	SCE	HCE	E	S	G	ESGMax	ESGMod	ESGMin	SIZE	Leverage	VIF
VAIC	1.000												
RCE	0.215***	1.000											
	0.000												
SCE	0.693***	0.172***	1.000										
	0.000	0.000											
HCE	**0.920*** **	0.273***	0.5464***	1.000									
	0.000	0.000	0.000										
E	0.022	0.104***	0.023	0.018	1.000								1.88
	0.477	0.000	0.468	0.569									
S	-0.001	0.053*	-0.013	-0.001	0.676***	1.000							1.93
	0.972	0.089	0.666	0.977	0.000								
G	0.059*	-0.056*	0.018	0.050	0.250***	0.311***	1.000						1.11
	0.056	0.073	0.571	0.106	0.000	0.000							
ESGMax	0.025	0.123***	-0.003	0.016	**0.918*** **	0.750***	0.308***	1.000					4.86
100%	0.417	0.000	0.917	0.599	0.000	0.000	0.000						
ESGMod	-0.030	-.122***	0.021	-0.014	-.320***	0.107***	0.015	-499***	1.000				3.85
67%	0.329	0.000	0.509	0.664	0.000	0.001	0.624	0.000					
ESGMin	0.025	-.081***	-0.003	0.016	-.650***	-.792***	0.115***	-602***	-.232***	1.000			3.29
33%	0.431	0.009	0.936	0.608	0.000	0.000	0.000	0.000	0.000				
Size	0.262***	0.033	0.163***	0.273***	-.079***	0.014	0.049	-0.053	0.063**	0.033	1.000		1.09
	0.000	0.286	0.000	0.000	0.011	0.650	0.112	0.081	0.040	0.295			
Leverage	-.135***	0.169***	-0.188***	-.136***	-0.038	-0.031	-0.042	-0.024	-0.28	0.033	0.144***	1.000	108
	0.000	0.000	0.000	0.000	0.223	0.322	0.181	0.437	0.364	0.291	0.000		
Shapiro-Wilk	0.000	0.000	0.000	0.000	0.999	0.535	0.000	1.000	0.000	0.001	0.000	0.000	

Notes. Spearman correlation is used due to the non-normal distribution of data for some variables. Variance inflation factor (VIF) values are within the acceptable statistical range. Significance: ***, **, and * at the 1%, 5%, and 10% levels. E, S, and G: environmental, social, and governance (ESG) information disclosure; ESGMin, ESGMod, and ESGMax: disclosure of one, two, and three ESG dimensions; VAIC, value-added intellectual coefficient, composed of human, structural, and relational capital efficiency (HCE, SCE, and RCE).

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Chapter Two

Does intellectual capital efficiency affect earnings quality? Evidence for Jordanian listed companies[4]

Abstract

This paper examines whether intellectual capital (IC) efficiency is associated with earnings quality (EQ) for Jordanian listed firms. Using the value-added intellectual coefficient and total accruals models to measure both IC and EQ, a positive and significant association was found between IC efficiency and EQ. Also found was a significant positive relationship between relational capital efficiency and EQ, a significant negative relationship between structural capital efficiency and EQ, and no relationship between human capital efficiency and EQ except in the real estate sector. Those results have implications for the competitive advantage of firms over rivals, for corporate management decision-making, and for the performance of the Jordanian capital market.

Keywords: intellectual capital efficiency; earnings quality; Amman Stock Exchange; total accruals; value-added intellectual coefficient VAIC™

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2.1 Introduction

Intangible assets, as given by knowledge, brands, patents and trademarks, customer relationships, and R&D (Deznopolsac et al., 2017), may be more relevant for the company's value than tangible assets. In fact, the share of this kind of assets in the market value of a company may amount to 75-85% (Ciprian et al., 2012).

In modern competitive economies, creativity and innovation play an important role. Organizations are therefore becoming increasingly aware of difficulties with their physical and financial assets in terms of generating competitive advantages; however, perceiving that their intangible assets are priceless, irreplaceable and unending will enable companies to create value for their products and services (Costa and Canavate, 2015; Alipour, 2011). Knowledge, as proxied by education or R&D investments, has been identified as a major determinant of technological change and as a relevant competitive tool (Stahla and Lin, 2015). Accordingly, the potential for creating competitive advantage and long-term value basically relies on efficient management of intangible assets rather than tangible assets and the key to the continuity of a company is successful management of its intellectual capital (IC) (Al-Musali and Ismail, 2014; Palacios and Galvan, 2007). Therefore, briefly, a possible definition of the IC is: an intangible asset that generates value for acquiring wealth (Aljuboori et al., 2022). It is the value-added capability that considers physical, human, and structural capital that can uplift companies' overall performance (Bhattacharjee and Akter, 2022).

Over the last few years, a significant number of models to measure intangibles have been generated and developed (Palacios and Galvan, 2007), among which IC has been widely recognized as a critical tool to successfully operate businesses in a highly competitive environment (Taheri et al., 2013; Makki et al., 2009). Although some studies have highlighted the importance of IC efficiency[5] to the value of firms and the need to develop appropriate measurement tools, traditional financial accounting still does not take into account the full range of intangible resources that drive a company's value and its growth prospects (Edvinsson and Malone, 1997). Therefore, the measurement and disclosure of IC efficiency is a widely discussed topic within the field of knowledge management (Sydler et al., 2014).

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[5] IC accounts for human and structural dimensions, while IC efficiency stands for the collective efficiencies of human, structural and relational capital of IC engagement in value-added creation.

IC efficiency is an important factor in determining earnings quality (EQ).[6] According to Dechow and Schrand (2004), EQ plays a key role in financial analysis processes, as it can help analyse both current and future functional performance and thus determine the value of a company. Therefore, EQ is one of the more important characteristics of the financial reporting system since high EQ improves capital market efficiency. Not surprisingly, investors and other users of financial statements are interested in high-quality financial accounting information. For that reason, standard setters strive to develop accounting standards that improve EQ, while many recent changes in auditing, corporate governance and enforcement releases have a similar objective (Ewert et al., 2010). A vast amount of accounting literature has tested and investigated this issue (see, e.g., Dechow et al., 1995; 1998; 2010; 2011; Dechow and Schrand, 2004), which would suggest that high-quality earnings improve capital market efficiency. Furthermore, standard setters strive to develop accounting standards that improve reporting on EQ, a topic considered vital in the accounting literature and widely addressed by all interested stakeholders, especially in view of the accounting scandals that have stunned the world's largest corporations, including Enron and WorldCom (Ajidi and Aderemi, 2014). In addition, the growing number of frauds that have accompanied the bankruptcy of large companies has created concerns about the health of EQ (Darabi et al., 2012). Dechow et al. (2010) argue that there are serious consequences for any business' future when managers are involved in earnings manipulation leading to low EQ for a firm, specifically: (a) increased beta (risk), which will increase the cost of capital due to low engagement from potential investors in buying corporate shares; (b) decreased stock market price, which will lead to a lowering of the firm's value; (c) loss of trust between the company and various stakeholders; and (d) negative professional implications for senior managers.

In this paper, we conduct an empirical analysis on the impact of IC efficiency on EQ for an emerging economy, Jordan, by examining different industries that include companies listed in the Amman Stock Exchange (ASE). Addressing the impact of IC efficiency on EQ for the case of Jordanian companies is particularly interesting for reasons as follows. First, IC and EQ could play a key role in boosting the company growth that is necessary for sustainable economic recovery in Jordan. By understanding and interpreting the relational impact between IC efficiency – as a firm's

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[6]EQ is a measure of how well earnings reflect the actual performance of a firm and the convertible power of earnings into cash flows (Dechow and Schrand, 2004; Dechow et al., 2011), or of the continuation of the current level of earnings in upcoming periods (Sloan, 1996). When profit is closer to cash flow, accruals are less and so will result in higher EQ (Chan et al., 2006).

growing value-added generator – and EQ – as an internal performance indicator – for the listed Jordanian firms, this research provides additional evidence for an emerging economy in evaluating companies' utilization of their human resources as the most important source of leverage for the building of competitive advantage. Second, in order to achieve excellence in competition in a context of a poorly performing Jordanian economy, both private and public sector organizations should excel in achieving sustainable competitive advantage and effective knowledge capital management, considered the dominant component in IC efficiency that stands behind this excellence (Murwaningsari and Ardy, 2018). Third, the new trend for knowledge-based economies determines that organizations live and die based on this kind of knowledge, with the most successful companies making the best possible use of intangible assets (Darabi et al., 2012); this study thus tries to capture these advancements for the benefit of the developing Jordanian corporate capital market. Fourth, this study includes the real estate sector, which plays a key role in boosting growth in the Jordanian economy. Finally, highlighted is the role of IC efficiency when integrated in decision-making processes by the firm's stakeholders in order to develop strategies to enhance performance (Alipour, 2011). Current and potential investors and other stakeholders may therefore appreciate and be interested in harnessing the study's findings in terms of aligning their financial and investment decisions. In particular, international investments, which account for 50% of total investment in the Jordanian economy (Alrefai, 2019), could be enhanced on the basis of the IC potential of Jordanian firms.

Previous empirical literature has found mixed results on the impact of IC efficiency on EQ. Most studies that have investigated this relationship support the existence of a significant positive relationship (see, e.g., Mojtahedi, 2018; 2013; Sarea and Alansari, 2016; Khajavi et al., 2016; Marzban et al., 2014; Taheri et al., 2013; Parast et al., 2013; Zanjirdar and Chogha, 2012). In contrast, Darabi et al., (2012) documented independence between EQ and certain IC components, namely, structural capital and relational (or employed) capital. Mixed results from the previous literature requires further investigation about the role of IC efficiency and its components in determining EQ in emerging countries, such as Jordan, where there is high human capital potential but a low level of structural capital (Bontis, 2004). The Jordanian economy has been weakening since 2009, with low per capita gross domestic product (GDP), high public debt and high unemployment, accompanied by a 24% drop in the value of real estate (Kardoosh, 2019). Accordingly, the existence of high human capital potential associated with ailing corporate

performance signalling potential corporate output manipulation (i.e., the EQ issue) for Jordanian corporations has produced a unique knowledge gap in the Jordanian corporate setting that inspired this study.

Using the total accruals (TACC) approach and the value-added intellectual coefficient (VAIC) model (Pulic, 1998) to measure both EQ and IC, respectively, we add to the previous literature by conducting a comprehensive empirical study of IC performance and its relationship with EQ for the particular case of Jordanian listed companies, for which, to the best of our knowledge, no previous research has been conducted. The empirical evidence, in this study, reveals a positive relationship between IC efficiency proxied by (VAIC) and EQ proxied by total accruals for the entire sample of firms, and, in particular, for the services sector; however, no support is found for this relationship in the manufacturing and real estate sectors. The empirical results also show a positive relationship between relational capital efficiency (RCE) and EQ for the entire sample and its components. Furthermore, the empirical results support a negative significant relationship between structural capital efficiency (SCE) and EQ for the entire sample period for the services and the real estate sector. However, in contrast with previous empirical results, no evidence is found for the relationship between human capital efficiency (HCE) and EQ, except for the real estate sector.

These findings contribute to enhancing accounting literature results and throw some light on the current debate on the IC-EQ relationship, and, furthermore, could guide different stakeholders in their financial and investment decisions regarding the Jordanian stock market. The findings may also enhance understanding of possible impacts between important corporate dimensions, such as EQ and IC ingredients that contribute to generating value added and sustaining competitive advantage, while improving Jordanian capital market performance.

The rest of this study is structured as follows. Section 2 consists of a literature review and hypotheses development. Section 3 outlines variable computation methods and the regression approach. Section 4 describes the data sample. Section 5 reports empirical results. Section 6 presents the discussion, and finally section 7 summarizes the conclusions and recommendations.

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2.2 Literature review and Hypotheses development

2.2.1 Literature review

Although the EQ concept is widely referred to in theoretical and empirical studies, there is not as yet a consensus among researchers and scholars on its definition. Some authors regard the earnings continuity feature as an indicator of quality through dividend payouts, as this enables investors to predict future returns (Skinner and Soltes, 2009; Dechow and Shrand, 2011). Bodie and Marcus (2002) as cited elsewhere (Ramadan, 2015) have defined EQ as "the continuation of the current level of earnings in the coming periods". As a result, earnings persistence in the future is associated with earnings predictability, sustainability and low volatility (Dechev et al., 2012; Schipper and Vincent, 2003).

According to Dechow and Schrand (2004), EQ plays a significant role in financial analyses by focusing on the three basic corporate dimensions: present functional performance, future functional performance, and company pricing. Dechow and Shrand (2011) argue that standards setters, legislators, and auditors regard earnings as high quality when they are disclosed according to generally accepted accounting principles (GAAP); however, creditors regard earnings as high quality when they can be converted into cash flows. Francis et al. (2006) have reported that executive managers' reputations are not only linked to profits, but also to the EQ level: (a) high EQ is important for rationalizing decision-making processes; (b) EQ is used to evaluate managers' abilities and competence and reflects creditor concerns regarding the real financial capacity of firms to meet debt covenants on time; and (c) EQ — as proved by Dechev et al. (2012) — is an appealing performance indicator for many other stakeholders such as clients, suppliers, employees, standard setters, governments, and competitors.

The accounting literature has identified several factors that determine the EQ level, such as ownership by the board of directors in firms (with higher ownership leading to lower EQ; see Hamdan, 2012), business model, type of industry, macroeconomic circumstances, internal auditing, financial statement reporting options, operating cycle, disclosure policies, stock exchange commission and the probability of litigation (Dechev et al., 2012). However, the potential linkage between firms' IC efficiency and their EQ is another possible influential factor

USC DE SANTIAGO DE COMPOSTELA

(Sarea and Alansari, 2016). Analyzing the impact of IC efficiency on EQ is a critical topic in the management accounting literature.

In addressing the relationship between EQ and IC efficiency, one of the main challenges is their measurement. DeFond (2010) has argued that there is a significant inherent limitation on EQ measurement accuracy in EQ models that cannot be validated. Thus, new measurement models are constantly being developed in the accounting literature. Larson et al. (2018) documented several EQ measurement models from the mid-1980s to date, showing that no single measure has superiority for all decision models (Dechow et al., 2010). However, all the EQ measures reported in the literature basically rely on the TACC model as a proxy for signaling EQ level.

On the other hand, Blair and Wallman (2001) have argued that different definitions of IC have led to different measurements models. In general terms, IC reflects the knowledge and skills residing with employees and the collective know-how that contributes to value creation in an organization (Magrassi, 2002). IC may thus be considered as a significant hidden value that is not captured by financial statements, but that can be found in the difference between the firm's market value and book value (Edvinsson and Malone, 1997).

Not surprisingly, measuring the IC of companies has resulted in a plethora of proposed methods and theories in recent years. Each model has its advantages and disadvantages, depending on the purpose of the valuation (Andriessen, 2004). Sveiby (2001, 2010) proposed measures for intangibles fall into at least four categories: (a) direct intellectual capital (DIC) methods, which estimate the dollar value of intangible assets by identifying its various components, which, once identified, can be directly evaluated either individually or aggregately; (b) market capitalization methods (MCMs), which calculate the difference between a company's market capitalization and its stockholders' equity as the value of its IC or intangible assets; (c) return on assets (ROA) methods, which are calculated as the average pre-tax earnings for a period of time divided by the average total tangible assets; (d) scorecard methods (SCMs), whereby various components of intangible assets are identified for which indicators and indices are generated and reported in scorecards or graphs. As an indication of the importance of intangible assets nowadays, the European Commission has recommended that the key to future competitiveness and wellbeing lies in the increasing knowledge base shared by European citizens (Palacios and Galvan, 2007).

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This research focuses on three-dimensional categorization of VAIC components, i.e., HCE, SCE and RCE (Bontis, 1998; Nuryaman, 2015; Edvinsson and Malone, 1997), explained in turn in what follows. HCE is considered a primary element of VAIC and the most important source of sustainable competitive advantage (Hejase et al., 2016) and is considered the key driver in creating value and achieving competitive advantage (Chen et al., 2005). It can be defined as the knowledge, skills, competences, experiences, know-how, creativity, motivation, education, and loyalty that employees could take with them if they left the organization and which cannot be owned by the organization (Taheri et al., 2013; Hosnavi and Ramezan, 2011; Magrassi, 2002; Edvinsson and Malone, 1997). In essence, it indicates the value added for each monetary unit spent on employees. SCE may be defined as the knowledge that stays within the firm, such as organizational routines, procedures, information systems, formulas, policies, organizational competitive intelligence, company cultures, computers, databases and operational processes that boost productivity (Hosnavi and Ramezan, 2011; Bontis, 1998). Basically, it indicates the value added for each monetary unit spent on organizational infrastructure. Finally, RCE includes all resources developed as a result of the company's external relationships with customers, suppliers, investors, creditors and partners in R&D and underpinning HCE and SCE in creating value added (Bontis, 1998). It reflects the value added of each monetary unit spent on physical resources. Sarea and Alansari (2016) draw a major distinction between human and structural components: the human component may disappear at any time if an employee leaves the company, whereas the structural component is owned by the firm and remains in it even after an employee leaves. However, human and structural components cannot function without the relational component. In other words, IC is the subordinate concept of VAIC, built on the assumption that value creation is derived from two primary resources: physical capital resources and intellectual resources. Thus, VAIC reflects IC engagement in value creation process from all sources (Vakilifard and Rasouli, 2013).

This study, in assessing the impact of IC efficiency on EQ, considers the three value-added creators (HCE, SCE and RCE) from the VAIC model developed by Pulic (1998). Pulic's VAIC model provides information about value creation efficiency for tangible and intangible assets. That approach is relatively easy to use because it builds on data extracted from the accounts contained in audited financial statements. Pulic (1998) has stated that two key resources create added value that achieves greater efficiency in resource use: RCE (financial and physical assets), and IC

efficiency, reflecting the total engagement of HCE and SCE and RCE in value-added creation process.

The potential relationship between IC efficiency and EQ has recently been examined by various scholars. A study by Cenciarelli et al. (2018) on US companies over the period 1985-2015 evidenced that IC efficiency is better than standard models in predicting corporate bankruptcy, pointing to the crucial role of IC efficiency in predicting earnings manupulation that may lead to corporate failure. In the same vein, Sarea and Alansari (2016) as cited elsewhere advocated that firm and mangerial characteristics are the main influencial factors on EQ, suggesting that IC efficiency considered as a main intangible asset significantly affects the market value of companies by contributing to enhancing their EQ (Palacios and Galvan, 2007). Finally, Andriessen (2004) evidenced that IC efficiency improves internal management and external reporting and is reflected directly in the real and future value of the enterprise.

Accordingly, following the above studies, this research focuses on the impact of IC efficiency on EQ in the Jordanian setting. Notably, a significant shift between intangible assets and tangible assets in the corporate resources structure was documented by Pulic (2000), from 20/80 in 1978 to 80/20 in 1998, a reality that may be not identified by emerging economy leaders. For the particular case of Jordanian listed companies, this change was more moderate. The competitiveness of the Jordanian economy fell, according to Global Competitiveness Index, which ranked Jordan 60 out of 180 countries in terms of corruption in 2019. Therefore, having information on the potential impact of IC efficiency on EQ may be useful in highlighting the potential of IC for raising Jordanian firm productivity and, thus, for boosting economic growth which in turn may attract foreign investments.

2.2.2 Hypotheses development

This study aimed to answering the following research question: is IC efficiency related to EQ level in ASE-listed non-financial companies? Based on this question, study hypotheses are developed and introduced. However, to verfy these hypotheses, two multivariate regression equations are set and analysed through Stata program, version 16 software package as reported at section 2.5.

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Previous empirical results have documented the importance of IC in enhancing firms'productivity and profitability. Taheri et al. (2013) documented a significant relationship between IC efficiency and earnings stability as an indicator for EQ, with firm size affecting this

relationship. Darabi et al. (2012) evidenced a positive significant relationship between IC efficiency and EQ, as did Murwaningsari and Ardi (2018). Marzban et al. (2014) supported a significant relationship between IC efficiency and earnings stability as an indicator for EQ. Additionally, Zanjirdar and Chogha (2012) evidenced a meaningful relationship between VAIC and EQ indicators such as earning stability and earning predictability. In a similar vein, Azizi (2013) documented a positive and significant relationship between IC efficiency and EQ and propose this model as potentially useful for potential investors in decision-making. Finally, Yang (2019) confirmed that high IC efficiency leads to cost behavior manipulation, suggesting that when managers want to avoid unfavourable earnings, they apply cost management, which, in turn, decreases the EQ level.

In light of the above evidence on the association between IC efficiency and EQ in different economic contexts, in this study we examine whether total IC efficiency could be a determinant of the EQ level in Jordanian listed-companies by testing the following hypothesis:

Hypothesis 1*: A non-significant statistical relationship exists between IC efficiency and EQ.*

In addition, we also investigate the VAIC components separately to show the differential impact of each component. Parast et al. (2013) documented a non-significant relationship for RCE and SCE with EQ, but a positive significant impact for HCE on EQ. However, Mojtahedi (2018, 2013) evidenced a significant impact of RCE, SCE and HCE on EQ, and a significant relationship between size and EQ in the Malaysian stock exchange. In the same vein, using panel data, Darabi et al. (2012) showed a significant association between HCE and EQ, but not for SCE and RCE with EQ. Contrarily, Sarea and Alansari (2016) supported a significant relationship for RCE, SCE and HCE with EQ, with corporate indebtedness affecting this relationship regardless of firm size and age. In addition, Yang (2019) documented that, of the IC efficiencies, HCE had the greatest impact on cost manipulation. Finally, Taheri et al., (2013) found a significant association between HCE and earnings persistence as an indicator for EQ, regardless of firm size, and a non-significant relationship for RCE and SCE. As the above studies report inconclusive results, a second hypothesis is formulated with mixed expected signs, as follows:

Hypothesis 2: *RCE, SCE and HCE do not have a statistically significant impact on EQ.*

USC DE COMPOSTELA

2.3 Methodology

Following Richardson et al. (2005), EQ was computed as the absolute TACC value, an inverse indicator for EQ: a higher absolute value for TACC will reflect poor EQ. TACC can be used as an indicator of profitability power in the current and future performance of corporations (Mojtahedi, 2013). While alternative measures have been used to assess the EQ level, including earnings stability (Zanjirdar and Chogha, 2012), earning persistence, earning predictability (Marzban et al., 2014), and discretionary accruals (Darabi et al., 2012; Mojtahedi, 2013), TACC — based on a cash flow approach — has the following advantages: (a) TACC is easier to use in this empirical study due to the availability of data for cash flow statements disclosed to the public as part of audited annual financial statements enforced by ASE; (b) as it is based directly on the cash flow statement rather than balance sheet statement, use of the TACC measure is recommended by Collins and Hribar (2002), who validated the relevancy of estimating TACC commpared to other approaches, although they advise re-evaluating empirical findings that used the balance sheet approach in the light of potential wrongly measured accruals.

TACC is defined, using a balance sheet approach or a cash flow approach, as:

$$TACC_{i,t} = \left(\Delta CA_{i,t} - \Delta CL_{i,t} - \Delta CASH_{i,t}\right) + \left(\Delta STDEB_{i,t} - DEPN_{i,t}\right) \quad (1)$$

$$TACC_{i,t} = NPAT_{i,t} - CFO_{i,t} \quad (2)$$

where, for firm i and for year t:

- $\Delta CA_{i,t}$ is the change in current assets
- $\Delta CL_{i,t}$ is the change in current liabilities
- $\Delta CASH_{i,t}$ is the change in cash
- $\Delta STDEB_{i,t}$ is current maturities of long-term and short-term debt included in current liabilities
- $DEPN_{i,t}$ is the depreciation and amortization expense
- $NPAT_{i,t}$ is the net profit after tax
- $CFO_{i,t}$ is the cash flow from operations
- $TACC_{i,t}$ is total accruals.

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Annual TACC for each firm is scaled by dividing the value by the average total net assets of the firm for two fiscal years (current and previous total assets divided by two); this is why data for 2008 must be available.

As mentioned above, IC efficiency is measured using the VAIC developed by Pulic (1998). Although VAIC is not a monetary measure,[7] it is an aggregate indicator of a firm's efficiency in employing its resources and creating value (Sarea and Alansari, 2016). VAIC represents how value added has been created per invested monetary unit in each resource; thus, the higher the coefficient, the better the company performance (Machairoudis, 2010). The three components of the VAIC are described as follows:

1. HCE, interpreted as an indicator of human capital, captures the knowledge, professional skills, experience, and innovativeness of employees within an organization, and reflecting the value added for every monetary unit spent on employee costs, including salaries, compensations, bonuses and training (Ahanger, 2010; Sarea and Alansari, 2016). The greater the HCE ratio, the greater the efficiency of human capital in creating value added (Stahle et al., 2011).
2. SCE, which reflects the value added created from the organizational structure, consists of all non-human capital in an organization, including databases, organizational charts, procedures and guidelines, company's systems, processes, policies, procedures and overall infrastructures (Ahanger, 2010). It indicates how much value is added for every monetary unit spent on organizational resources.
3. RCE, which indicates the physical and financial capital employed in the value creation process (Nuryaman, 2015), reflects knowledge of market channels, customer and supplier relationships, and governmental and industry networks (Boujelbene and Affes, 2013). It indicates how much value is added for every monetary unit spent on physical resources.

The following panel regression model was used to test the above indicated hypotheses:

$$EQ_{i,t} = \alpha_{i,t} + \beta_1 VAIC_{i,t} + \beta_2 LEV_{i,t} + \beta_3 SIZE_{i,t} + e_{i,t} \quad (3)$$

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where $e_{i,t}$ denotes the stochastic component for firm *i* and time *t*, and where the parameters α and β_1 account for the fixed effects and the impact on EQ of VAIC, respectively. Hypothesis 1 is

[7] For limitations of the VAIC measure, see Sardo and Serrasqueiro (2017) and Stahle et al. (2011).

rejected as β_1 is significantly different from zero. Note that hypothesis 2 is tested when VAIC is substituted by RCE, SCE and HCE in Eq. (3). To conduct the inference, standard error was computed by double clustering at the firm and time level (see Petersen, 2009).

Finally, the regression analysis also considers, following previous empirical analyses, control variables for financial leverage (LEV) and size (SIZE), which may impact on the relationship between EQ and IC. The parameters β_2 and β_3 account for the impact of LEV and SIZE on EQ. LEV acts as a proxy for indebtedness, and SIZE as a proxy for different firm sizes (Darabi et al., 2012; Mojtahedi, 2013, 2018). These variables are (accounting-based) company internal factors that affect the book value of assets (Taheri et al., 2013) and the impact on EQ. LEV is measured as the ratio between total debt and total assets. Prior studies reveal that high financial leverage implies low EQ (Nuhu et al., 2014; Sarea and Alansari, 2016). Likewise, Dechow et al. (2010) documented that manipulated firms have higher leverage ratios and are more likely to violate debt covenants during and after the manipulation period, thereby reducing EQ. SIZE is the natural logarithm for total net assets for firm *i* in year *t* (see Ajidi and Aderemi, 2014; Gul et al., 2012; Darabi et al., 2012, Mojtahedi, 2018; Parast et al., 2013). Definitions, variable labels and measurements are reported in the Appendix (Table A1).

2.4 Data

The data sample includes all manufacturing, services and real estate companies listed on the ASE in Jordan, the paper has excluded the banking and insurance industries because they have different reporting structure that cannot be compared with nonfinancial sectors. Annual information for the sample starts in 2009, to avoid the direct extreme effect of the global financial crisis on financial data, and extends to 2018. The included companies had to have available, from the ASE official website (www.ase.com.jo), all audited and disclosed annual financial statements based on standard financial report accounting standards and meeting study predefined parameters. From the accounting information for those companies, the VAIC, VAIC components and TACC were computed and additional information was obtained on some control variables. Table 2.1 shows the companies and sectors, along with a description of the selection process followed.

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Inclusion criteria were as follows:

1. Financial data with a clear reporting structure of the company are available throughout the period of study to be able to calculate all variables under analysis.
2. The company has had continuous activity during the study period.
3. The company should not be delisted from the ASE during the study period.
4. Financial data for the 2008 fiscal year are available.

Of the 193 listed public companies in ASE, 104 companies met the above criteria, yielding 1040 annual observations. Included from the manufacturing sector as valid for statistical analysis were 42 (of 47) companies investing in pharmaceutical and medical, chemical, paper, food and beverage, tobacco and cigarettes, mining and extraction, engineering and construction, electrical, and textiles sectors. Included from the services sector were 51 (of 77) companies investing in health care, education, hotels and tourism, transportation, technology and communication, media, utilities and energy, commercial, and diversified financial services. Included were 11 (of 33) real estate companies investing in land and housing activities. Finally, the bottom rows of Table 1 show a margin of error analysis for the included sectors, indicating that the accuracy of the sample selection falls within a margin of error with a 95% level of confidence.

Table 2.1 Included/excluded listed Jordanian firms.

Industry	Total listed	Excluded firms	Included firms	% Of full sample	% Inclusion	# Obs.
Included sectors						
Manufacturing	47	5	42	40%	89%	420
Services	77	26	51	49%	66%	510
Real estate	33	22	11	11%	33%	110
Excluded sectors						
Banking	15	15	0			0
Insurance	21	21	0			0
Total	193	89	104	100%		1040

	Margin of error calculation for sample selection at 95% level of confidence					
	Manufacturing	Margin of error	Service	Margin of error	Real estate	Margin of error
Full sample	42 of 104	11.73%	51 of 104	9.84%	11 of 104	28.08%
Sub-sample	42 of 47	4.99%	51 of 77	8.03%	11 of 33	24.50%

***** Banking and insurance firms are excluded due to a different reporting structure that means they are not comparable with non-financial firms.

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2.5 Empirical results

2.5.1 Descriptive statistics

To mitigate the effect of outliers, explanatory and dependent variables were winsorized at the 5% level, while size was not controlled for that effect. Likewise, the normality of all variables was checked by running the Shapiro-Wilk's test (results are reported in Appendix).

Table 2.2 presents descriptive statistics for the full sample. The average EQ is -0.0273, for maximum and minimum values of 0.6122 and -0.5016, respectively; this means that cash flows are generated more than accruals in net income and that EQ ranges on average between positive and negative values. The standard deviation (SD) equals 0.0988, indicating that that accruals display low dispersion. The mean value of VAIC is 3.6757, for maximum and minimum values of 12.6096 and -0.3064, respectively, indicating that added value is positively generated from the integration of all the VAIC components during the period under study. This descriptive result indicates that the contribution of IC efficiency to generating added value exceeds the generation cost. The standard deviation of VAIC equals 3.0898, which indicates that VAIC dispersion among all the listed firms is close. As for the VAIC components, HCE exhibits the highest mean (2.8594), while RCE displays the lowest mean value (0.1327). The relatively high mean for HCE can be explained by the key role of human resources in adding value, and, since HCE is the dominant component of VAIC, it may play a crucial role in determining the future success of a firm. The descriptive statistics also indicate that the value-added contributions from investing in IC efficiency exceed, on average, the cost incurred by all the VAIC components. Interestingly, the combined mean value of HCE and SCE (3.42) is higher than the mean value of RCE (0.13), indicating that the firms create value from IC efficiency rather than from physical capital. Finally, the matrix correlation in Table B1 (Appendix) evidences a significant negative correlation between EQ and VAIC (-0.12), indicating that increasing corporate value-added efficiency in tangible and intangible resources improves EQ level. Additionally, the correlations between EQ and RCE, SCE, HCE, SIZE and LEV are 0.003, 0.012, -0.125, -0.13 and -0.161, respectively.

Regarding control variables, the mean LEV value is 0.2740, ranging between a minimum of 0.2215 and a maximum of 0.7881; this implies that about one third of asset financing comes from creditors. This percentage of indebtedness may be favorable for tax purposes from the perspective of management, owing to its one-third contribution in added-value activities for the capital

USC DE SANTIAGO DE COMPOSTELA

employed (note that the RCE mean equals 0.1327) and also the fact that it improves return on equity (ROE) and earnings per share (EPS). Furthermore, a high indebtedness ratio implies an additional external control over management performance; this reduces agency costs and the likelihood of creative accounting (high accruals), which, in turn, will be positively reflected in the EQ. The mean firm size is 7.5046, ranging from a minimum value of 5.3013 to a maximum value of 9.9848, and explained by the fact that the firms differ greatly in size. Finally, SIZE and LEV are positively correlated with EQ (see Table B1 in Appendix B).

Table 2.2 Descriptive statistics for the full sample.

	Mean	Minimum	Maximum	SD	Skewness	Kurtosis	# Obs.
EQ	-0.0273	-0.5016	0.6122	0.0988	0.3404	8.1942	1040
VAIC	3.6757	-0.3064	12.6096	3.0898	1.5450	5.1041	1040
RCE	0.1327	-0.0181	0.3926	0.1075	0.8605	3.1457	1040
SCE	0.5644	-0.3224	1.5160	0.4025	0.0649	3.7169	1040
HCE	2.8594	-0.7995	11.3493	2.7857	1.7168	5.7891	1040
LEV	0.2740	0.2215	0.7881	0.0072	0.7459	2.7323	1040
SIZE	7.5046	5.3013	9.9848	0.5571	0.7370	4.2019	1040

Note. The sample includes annual data for firms listed on the ASE for the period 2009-2018. SD denotes standard deviation.

Tables 2.3, 2.4 and 2.5 shows descriptive statistics for firms included in the manufacturing, services and real estate sectors, respectively. EQ mean values proxied by TACC are -0.0345, -0.0254 and -0.0088 for the manufacturing, services and real estate sectors, respectively, indicating that cash flows exceeded net income on average for the three sectors, with real estate displaying the lowest value. Therefore, sectors with different ratios have relatively high EQ. Respective SDs for EQ equal 0.1073, 0.090 and 0.1024, indicating that TACC value dispersion among the listed firms is narrow, mirroring moderate EQ levels in all sectors. Sectorial means for VAIC, with respective values of 3.3394, 3.8899, and 3.9663, show relatively close values for the three sectors that are also quite close to the value for the full sample. Moreover, the mean values for VAIC indicate that the value added by IC efficiency in all the sectors exceeded the cost incurred. HCE has the highest mean value in all three sectors (2.5371; 3.0763; 3.0846), with the real estate sector exhibiting the highest value. As for the full sample, the highest mean HCE value in all sectors is explained by the fact that human resources make the greatest contribution to added value of all the IC components. In addition, in the three sectors, mean RCE values are 0.1385, -0.1454 and 0.0516, while mean SCE values are 0.5167, 0.5807 and 0.6706. Therefore, in the manufacturing and real estate sectors, the value added exceeds the costs incurred in terms of physical and financial capital, whereas the services sector struggled to add value from physical and financial capital. All three

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

sectors succeeded in adding value from investing in structural capital. Correlations reported in Tables B2-B4 (Appendix B) indicate positive and significant correlation between EQ and VAIC except in the real estate sector, and between EQ and HCE in the manufacturing and service sectors, whereas correlation with SCE is negative in the real state sector.

Table 2.3 Descriptive statistics for the manufacturing sector.

	Mean	Minimum	Maximum	SD	Skewness	Kurtosis	# Obs.
EQ	-0.0345	-0.5016	0.4017	0.1073	-0.0580	5.9218	420
VAIC	3.3394	-0.3064	12.6096	2.8281	1.653	5.917	420
RCE	0.1385	-0.0181	0.3926	0.0977	0.672	3.252	420
SCE	0.5167	-0.3224	1.5160	0.4244	0.182	3.541	420
HCE	2.5371	-0.7995	11.3493	2.4645	1.864	7.052	420
LEV	0.3347	0.0072	0.7881	0.2007	0.442	2.421	420
SIZE	7.4349	6.3508	9.9848	1.232	5.073	4.2019	420

Note. The sample includes annual data for manufacturing firms listed on the ASE for the period 2009-2018. SD denotes standard deviation.

Finally, mean values for LEV in the manufacturing, services and real estate sectors are 0.3347, 0.2714 and 0.0548, respectively, meaning that about one third of asset financing in manufacturing and services comes from creditors, compared to close to 5% for the real estate sector. As for the SIZE variable, average values for the manufacturing, services and real estate sectors are 7.4349, 7.5989 and 7.3338, respectively, implying no significant size differences across sectors.

According to the descriptive statistics for the full sample and its components, there is no straightforward evidence on positive, negative or no relationship between IC and EQ. The evidence therefore needs to be obtained on the basis of a regression analysis, developed below.

Table 2.4 Descriptive statistics for the services sector.

	Mean	Minimum	Maximum	SD	Skewness	Kurtosis	# Obs.
EQ	-0.0254	-0.4552	0.6122	0.0900	0.6406	10.9913	510
VAIC	3.8899	-0.3064	12.6096	3.1143	1.6251	5.2177	510
RCE	-0.1454	-0.0180	0.3925	0.1147	0.8219	2.7735	510
SCE	0.5807	-0.3224	1.5160	0.3606	0.0235	4.3331	510
HCE	3.0763	-0.7995	11.3493	2.8514	1.7765	5.7424	510
LEV	0.2714	0.0072	0.7887	0.2290	2.9631	2.421	510
SIZE	7.5989	5.3013	9.2549	0.5543	0.5905	4.1573	510

Note. The sample includes annual data for services firms listed on the ASE for the period 2009-2018. SD denotes standard deviation.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Table 2.5 Descriptive statistics for the real estate sector.

	Mean	Minimum	Maximum	SD	Skewness	Kurtosis	# Obs.
EQ	-0.0088	-0.2588	0.5034	0.1024	1.2854	8.3896	110
VAIC	3.9663	-0.3064	12.6096	3.7723	0.9595	2.9280	110
RCE	0.0516	-0.0181	0.3926	0.0668	0.9595	2.9280	110
SCE	0.6706	-0.3224	1.5160	0.4726	-0.1995	2.8352	110
HCE	3.0846	-0.7995	11.3493	3.4623	1.0702	3.2022	110
LEV	0.0548	0.0072	0.3310	0.0731	2.1051	6.8844	110
SIZE	7.3338	6.2759	8.2714	0.5453	-0.1765	2.0258	110

Note. The sample includes annual data for real estate firms listed on the ASE for the period 2009-2018. SD denotes standard deviation.

2.5.2 Regression results for hypothesis 1

Panel fixed and random effects estimators are presented below, along with the Hausman test to select the appropriate model. The Breusch-Pagan LM test was also run to determine whether least squares or generalized least squares was more appropriate.

Table 2.6 presents evidence for the full sample and for each sector. For the full sample and the services sector, the estimated VAIC parameter is negative and significant at the 10% level, while no significant effect was found for the manufacturing and real estate sectors. This evidence indicates that high intellectual efficiency in using corporate tangible and intangible resources leads

Table2.6 Regression results for the impact of VAIC on EQ.

	Full sample	Manufacturing	Services	Real estate
Intercept	0.189***(0.000)	0.255***(0.000)	0.139**(0.014)	-1.388***(0.000)
VAIC	-0.001*(0.096)	-0.001 (0.191)	-0.002 *(0.085)	-0.001(0.372)
SIZE	-0.017***(0.001)	-0.003***(0.000)	-0.011 (0.140)	0.194***(0.000)
LEV	0.048***(0.000)	0.039*(0.054)	0.048***(0.000)	0.706***((0.000)
R-squared	0.1848	0.2093	0.2249	0.2231
F-stats	31.58***	16.76**	15.75***	9.19***
Groups	104	42	51	11
Observations	1040	420	510	110
Hausman	$x^2(3)$ 1.58	$x^2(3)$ 4.70	$x^2(3)$ 2.72	$x^2(3)$ 14.39***
	Random effect	Random effect	Random effect	Fixed effect
Breusch-Pagan LM	$x^2(1)$ 56.17***	$x^2(1)$ 8.88***	$x^2(1)$ 31.39***	$x^2(1)$ 14.82***
	GLS applied	GLS applied	GLS applied	GLS applied
Year effect	Yes	Yes	Yes	Yes

Notes. P values in parentheses: *p<0.10, **p<0.05 and ***p<0.01. F-stats reflects the regression model relevance as ***, ** and * at the 1%, 5% and 10% significance levels.

to low TACC and high EQ. Thus, hypothesis 1 is rejected for both the full sample and the services sector, as it supports, using a random effects estimator, a positive relationship between IC efficiency and EQ. Hypothesis1 is not rejected for the remaining sectors, however. The evidence for the full sample and services sector is consistent with previous studies (see, e.g., Mojtahedi,

2018; Sarea and Alansari, 2016; Khajavi et al., 2016; Mojtahedi, 2013; Azizi, 2013; Marzban et al., 2014; Taheri et al., 2013; Asadollahi et al., 2013; Parast et al., 2013; Darabi et al., 2012; Zanjirdar and Chogha, 2012), but contradicts Shehada (2018).

Finally, the regression results reveal a relationship between SIZE and TACC that is significantly negative for the full sample and the manufacturing sector, but positive for the real estate sector. Therefore, the results for the full sample and the manufacturing sector showing a positive relationship between SIZE and EQ, indicating that large firms are more successful in efficiently using their IC to improve EQ. This result is consistent with some previous studies (see, e.g., Mojtahedi, 2013;2018; Taheri et al., 2013; Asadollahi et al., 2013; Parast et al., 2013), but not with the evidence reported by Darabi et al. (2012) and Sarea and Alansari (2016). Furthermore, empirical estimates indicate a significant negative relationship between LEV and EQ for the full sample and for the different sectors. This implies that high indebtedness represents an impediment for investing in IC efficiency that leads to improved EQ. The evidence for the negative impact of LEV on EQ reported here is consistent with Nuhu et al. (2014) and Darabi et al. (2012), but contradicts Sarea and Alansari (2016), who show that LEV has a positive impact on EQ, and Mojtahedi (2013; 2018), who document no significant relationship between LEV and EQ.

2.5.3 Regression results for hypothesis 2

The evidence for the different components of VAIC (RCE, SCE, and HCE) is presented in Table 2.7 The estimated coefficients for RCE for the full sample and for the manufacturing, services and real estate sectors are significant at the 1%, 5%, 1% and 5% levels, respectively. Hypothesis 2 is rejected for RCE, as a relationship exists that is positive and significant for RCE with EQ, but negative for the real estate sector using the fixed effects estimator. This evidence indicates that high RCE leads to low TACC and thus high EQ, with investment in financial and physical capital capable of enhancing EQ (except in the case of the real estate sector). These results are supported by previous studies (see Mojtahedi, 2013; 2018; Khajavi et al., 2016; Marzban et al., 2014; Asadollahi et al., 2013; Parast et al., 2013; Taheri et al., 2013; Zanjirdar and Chogha, 2012; Sarea and Alansari, 2016), but are at odds with other studies that find no support for that relationship (Shehada, 2018; Darabi et al., 2012). The potential reason for this finding is that Jordanian financial managers and investors are seeking to maximize their firms' profits, so they can directly influence EQ using their maximum knowledge and mental agility.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Table 2.7 also presents results for hypothesis 2, referring to the relationship between SCE and EQ. Empirical estimates show that SCE is positive and significant for the full sample, services and the real estate sectors at the 5%, 5% and 10% levels, respectively, and that there is no significant effect in the manufacturing sector. Thus, a high/low SCE leads to high/low TACC, which, in turn, leads to low/high EQ, implying that internal organizational systems designed to capture, store and disseminate organizational information and knowledge appear to impact negatively on EQ. Hypothesis 2 is therefore rejected for SCE, except for the manufacturing sector using the fixed effects estimator. This evidence is not consistent with some previous empirical studies (see Mojtahedi, 2013, 2018; Shehada, 2018; Khajavi et al., 2016; Marzban et al., 2014; Asadollahi et al., 2013; Parast et al., 2013; Taheri et al., 2013; Zanjirdar and Chogha, 2012; Sarea and Alansari, 2016; Majidahet al., 2016), although the results for the manufacturing sector are consistent with Darabi et al. (2012).

Likewise, Table 2.7 reports also results for the relationship between HCE and EQ. A significant and positive impact at the 5% level of significance exists only for the real estate sector, while there is no significant impact for the remaining sectors or for the full sample. Thus, for the real estate sector, high/low HCE leads to low/high TACC, and, hence, to high/low EQ. Therefore, hypothesis 2 cannot be rejected for HCE, except for the real estate sector using the fixed effects estimator. The insignificant relationship for the full sample, manufacturing and services sector is inconsistent with some previous studies (see Mojtahedi, 2013, 2018; Khajavi et al., 2016; Marzban et al., 2014; Asadollahi et al., 2013; Parast et al., 2013; Taheri et al., 2013; Zanjirdar and Chogha, 2012; Sarea and Alansari, 2016; Darabi et al., 2012), but is consistent with Shehada (2018). Hence, although HCE makes the highest contribution to corporate added value for the listed companies, as observed from the descriptive statistics, outside of the real estate sector, there is no evidence of an impact of this contribution on EQ.

Finally, evidence for the control variables supports a significant positive relationship between SIZE and EQ for the full sample and for the VAIC components, indicating that large firms have an advantage in investing in IC efficiency that leads to higher EQ than in small firms. However, mixed evidence is documented for LEV and EQ, when VAIC is segregated into its components. Based on the results for the full sample, high indebtedness acts as an impediment to investing in IC efficiency aimed at improving EQ.

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Table 2.7 Regression results for the impact of RCE, SCE and HCE on EQ.

	Full sample	Manufacturing	Services	Real estate
Intercept	0.329***(0.000)	0.514***(0.000)	0.314***(0.001)	-1.449***(0.000)
RCE	-0.064***(0.008)	-0.174**(0.043)	-0.186***(0.001)	0.307**(0.031)
SCE	0.017**(0.023)	0.006(0.660)	0.021**(0.029)	0.021*(0.068)
HCE	0.001(0.642)	0.002 (0.505)	0.001(0.632)	-0.006**(0.027)
SIZE	-0.035***(0.001)	-0.059***(0.000)	-0.033***(0.005)	0.201***(0.000)
LEV	0.044**(0.037)	0.058*(0.082)	0.028 (0.001)	-0.556***(0.000)
R-squared[8]	0.0417	0.0639	0.0443	0.2809
F-stats	5.83***	4.63***	3.68***	103.07***
Groups	104	42	51	11
Observations	1040	420	510	110
Hausman	$x^2(5)$ 12.66**	$x^2(5)$ 12.52**	$x^2(5)$ 9.77***	$x^2(5)$ 16.86***
	Fixed effect	Fixed effect	Fixed effect	Fixed effect
Breusch-Pagan LM	$x^2(1)$ 60.46***	$x^2(1)$ 9.85***	$x^2(1)$ 35.05***	$x^2(1)$ 3.47**
	GLS applied	GLS applied	GLS applied	GLS applied
Year effect	Yes	Yes	Yes	Yes

Notes. P values in parentheses: *p<0.10, **p<0.05 and ***p<0.01. F-stats reflects the regression model relevance as ***, ** and * at the 1%, 5% and 10% significance levels.

2.6 Discussion

This research has examined the relationship between IC efficiency and EQ in Jordan using Richardson et al.'s (2005) TACC model to measure EQ, and Pulic's (1998) VAIC model to measure IC efficiency. Our main findings for the emerging-economy Jordanian ASE stock market indicates that a high level of IC efficiency, as reflected in the VAIC model, would be expected to lead to high EQ among ASE-listed firms. This evidence may play a significant role in attracting the interest of global investors and other stakeholders to the local market in a developing country like Jordan.

Considering different components of VAIC, the findings document the following:

1. RCE is positively related to EQ for the full sample and for the different sectors with the exception of the real estate sector. This finding signals a high percentage of possible slack in inefficient or underutilized assets in the real estate sector.

2. There is a significant negative relationship between SCE and EQ, except for the manufacturing sector, implying that Jordanian corporate management is relation-based and not a system-based, giving the managers room to manipulate earnings.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

[8]The relatively low explanatory power for R^2 in the VAIC components model might be attributed to the peculiarity of the Jordanian corporate context. However, the low R^2 might signal extra information for corporate stakeholders about the existing impact between the studied variables. Further, F-stats shows significant model relevancy in explaining the included variables.

3. There is no significant relationship between HCE and EQ, except for the real estate sector. This empirical evidence is explained in five ways, as follows: (a) human resources in Jordanian companies are underutilized in improving EQ performance (an issue that should raise a red flag especially for existing investors in relation to senior management); (b) human capital may be used for other agendas not aligned to organizational goals; (c) the VAIC method might be flawed in measuring the added value of human resources in all industry sectors; (d) HCE may be attributed by other resources not included in its measurement; and finally, (e) the findings are representative of the Jordanian economic environment, with unique managerial practices that cannot be generalized to emerging economies. However, although not all the VAIC components have an impact on EQ, the finding that IC efficiency can influence the performance of the company is consistent with Bontis (2004).

Also documented is the fact that, in general, there is a significant positive relationship between firm size and EQ, except in some sample components, meaning that larger/smaller corporations are considered to invest more/less in IC efficiency, leading to higher/lower EQ. Likewise, there is a significant negative relationship between financial leverage and EQ (except in the real estate sector), implying that high indebtedness leads to low investment in IC efficiency, which in turn leads to low EQ. The significant negative relationship between financial leverage and EQ can be explained by management motivation in Jordan to manipulate earnings to show artificial results, with the aim of obtaining funding from creditors in the capital markets, and ultimately leading to neglected investment in IC efficiency. Dechow et al. (1995) documented that firms with a high percentage of earnings manipulation have a higher leverage ratio and are more likely to violate debt covenants during and after the manipulation period, thereby decreasing the level of EQ.

2.7 Conclusions

Some of the empirical findings reported here are not consistent with those for other emerging economy contexts. Undoubtedly, EQ indicators are one of the most important corporate signals to stakeholders. The practical implications of the reported empirical evidence are as follows:

1. Jordanian listed companies are recommended to include reporting and disclosures on IC and EQ in their traditional financial statements, as this information could help decision-making by current and potential investors and other stakeholders.

2. Jordanian corporate management does not take IC efficiency seriously in terms of improving EQ. The fact that corporate management in Jordan is relation-based and not system-based in filling job vacancies leaves considerable room for economic deterioration.

3. Empirical results may provide important feedback for the Jordanian Securities Commission and the ASE. Jordanian regulatory body needs to enforce strict guidelines and procedures governing recruiting, screening and hiring by listed corporations, as the results indicate that high-potential talented professionals are overlooked.

4. The Jordanian Securities Commission and the Exchange Committee could create a public corporate index, with a ranking available for public scrutiny, reflecting company EQ and IC efficiency and could grant awards to the most committed companies. This could help investors in allocating their resources optimally.

5. Investors are recommended to take into consideration firm size and indebtedness as indicators of EQ, since most research supports their strong significant impact on the EQ level, while corporate accountants are recommended to adopt IC measurement methods for reporting.

6. Interesting lessons that can be learned from this empirical study are as follows: (a) although the existence of high human capital potential in Jordan as evidenced by Bontis (2004), this resource does not contribute to improving the EQ level, which would suggest that human resources are undervalued or underutilized in the Jordanian setting; (b) different IC and EQ measures should be applied in different economic contexts and, since the Jordanian corporate environment has its own peculiarities, corporate performance indicators should be used cautiously.

7. For researchers, it is highly advisable to use IC efficiency measurement models that combine financial and non-financial approaches to employee and customer satisfaction and other non-financial corporate features.

8. This study has important implications for different users of financial statements, who could reconsider the IC efficiency of companies in developing prediction models to evaluate current and future firm performance.

Finally, this study has some limitations. First, like other empirical studies, the results may be affected by endogeneity problems. While this research used year and firm fixed effects to control for unobservable confounding variables that may differ across time and industrial sectors, it was not possible to fully control for all other unobservable or omitted variables that could potentially influence the explanatory power of the regression model and its results. Second, the

USC UNIVERSIDADE

study excludes the banking and insurance sectors due to their different financial reporting systems and their lack of clear boundaries between operating and financing activities. Third, the scope of the study is limited to 10 years (2009-2018) and to just three economic sectors. Fourth, the choice of the TACC measure has an impact on findings and inferences since different categories of accrual measures have different properties. Fifth, the findings of this study should be interpreted with cautious since the VAIC model has limitations, with some scholars questioning the validity and appropriateness of the model (Stahle et al., 2011). The argument is that the model is designed to measure the efficiency of the firm's human capital and capital investment rather than IC and that it relates all operating expenses to IC. Future research should therefore consider other models to achieve a better measurement of IC and its efficiency; despite those limitations, the VAIC model continues to be used in developed countries, as exemplified by the study conducted by Yang (2019) for the Australian corporate context.

To sum up, the findings of this study may offer avenues for future research that take into account other micro- and macroeconomic factors in different economic settings, e.g., adopting broader mixed methods and investigating the impact of IC efficiency on non-financial corporate performance indicators such as customer satisfaction and market share.

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2.9 Appendix (B)

This section describes the diagnostic checks for the full study sample and its three components (manufacturing, services and real estate sectors).

Table B1. Spearman correlation's matrix and normality test for the full sample.

Variables	EQ	IC-VAIC	RCE	SCE	HCE	LEV	SIZE	VIF
EQ	1.000							
IC-VAIC	-0.120***	1.000						1.11
	(0.0001)							
RCE	0.003	0.215***	1.000					1.01
	(0.992)	(0.000)						
SCE	0.012	0.693***	-0.172***	1.000				1.04
	(0.7001)	(0.000)	(0.000)					
HCE	-0.125***	0.920***	0.273***	0.547***	1.000			1.13
	(0.001)	(0.000)	(0.000)	(0.000)				
LEV	0.161***	-0.135***	0.169***	-0.188***	-0.136***	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
SIZE	-.130***	0.263***	0.033	0.163***	0.273***	0.144***	1.000	
	(0.000)	(0.000)	(0.286)	(0.000)	(0.000)	(0.000)		
Shapiro Wilk test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Spearman's correlation is used due to the non-normal distribution of data for the variables.

Table B2. Spearman's correlation matrix and normality test for the manufacturing sector.

Variables	EQ	IC-VAIC	RCE	SCE	HCE	LEV	SIZE	VIF
EQ	1.000							
IC-VAIC	-0.182***	1.000						1.14
	(0.0002)							
RCE	-0.080	0.299***	1.000					1.05
	(0.1002)	(0.000)						
SCE	-0.064	0.688***	-0.063	1.000				1.04
	(0.1888)	(0.000)	(0.196)					
HCE	-0.196***	0.900***	0.384***	0.510***	1.000			1.18
	(0.001)	(0.000)	(0.000)	(0.000)				
LEV	0.098**	-.3549***	-0.174***	-0.276***	-.3961***	1.000		
	(0.044)	(0.000)	(0.000)	(0.000)	(0.000)			
SIZE	-0.198***	0.243***	- 0.008	0.163***	0.254***	0.109**	1.000	
	(0.000)	(0.000)	(0.869)	(0.001)	(0.000)	(0.026)		
Shapiro-Wilk's	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Spearman's correlation is used due to the non-normal distribution of data for the variables.

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Table B3. Spearman's correlation matrix and normality test for the service sector.

Variables	EQ	IC-VAIC	RCE	SCE	HCE	LEV	SIZE	VIF
EQ	1.000							
IC-VAIC	-0.092**	1.000						1.12
	(0.037)							
RCE	0.024	0.087***	1.000					1.01
	(0.594)	(0.050)						
SCE	0.009	0.785***	-.224***	1.000				1.03
	(0.843)	(0.000)	(0.000)					
HCE	-.091***	0.944***	0.100**	0.688***	1.000			1.17
	(0.041)	(0.000)	(0.023)	(0.000)				
LEV	0.182***	-0.028	0.204***	-0.057	0.037	1.000		
	(0.000)	(0.530)	(0.000)	(0.201)	(0.410)			
SIZE	-0.065	0.271***	0.033	0.161***	0.210***	0.352***	1.000	
	(0.145)	(0.000)	(0.455)	(0.000)	(0.000)	(0.00)		
Shapiro-Wilk's	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Spearman's correlation is used due to the non-normal distribution of data for the variables.

Table B4. Spearman's correlation matrix and normality test for the real estate sector.

Variables	EQ	IC-VAIC	RCE	SCE	HCE	LEV	SIZE	VIF
EQ	1.000							
IC-VAIC	0.035	1.000						1.11
	(0.715)							
RCE	0.061	0.676***	1.000					1.01
	(0.524)	(0.00)						
SCE	0.347***	0.351***	-0.102	1.000				1.04
	(0.000)	(0.000)	(0.290)					
HCE	0.016	0.892***	.793***	0.104***	1.000			1.09
	(0.872)	(0.000)	(0.000)	(0.281)				
LEV	0.093	-0.199**	0.124	-0.181*	-0.174*	1.000		
	(0.333)	(0.037)	(0.196)	(0.058)	(0.070)			
SIZE	-0.024	0.231**	-0.088	0.234**	0.197**	-.959***	1.000	
	(0.802)	(0.015)	(0.360)	(0.014)	(0.039)	(0.000)		
Shapiro-Wilk's	0.000	0.000	0.000	0.040	0.000	0.000	0.002	

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Spearman's correlation is used due to the non-normal distribution of data for the variables.

The Shapiro-Wilk's test evidenced that the data was not normally distributed. As a result, evidence on Spearman's correlation is presented to show dependence among variables Tables B1-B4 present the Shapiro-Wilk's test and Spearman's correlation results. No evidence was found of high correlation between the explanatory variables except in the case of VAIC and HCE, which have Spearman's correlation values of 0.920, 0.900, 0.944, and 0.892 for the full sample and manufacturing, services and real estate sectors, respectively. Results for multicollinearity analysis using the variance inflation factor (VIF) show no multicollinearity among variables. A VIF value

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of less than 2.5 reflects the robustness of the study model in explaining the effect on the dependent variable.

In panel data with time series of more than 10 years, there is always the possibility of non-stationarity shocks that will affect the long-term equilibrium of the series (Oppong and Pattanayak, 2019). Therefore, a Levin-Lin-Chu (LLC) panel unit root test was applied to check for data stationarity. Evidence from this test, reported in Table A.5, indicates that all variables are stationary in all sectors except the SCE variable in the real estate sector. However, this was not a problem for this study based on only 10 years because, in panel series, there are only effects when the period is more than 10 years.

Table B5. Panel unit root test results for all variables.

	Full sample		Manufacturing		Services		Real estate	
Variable	Adjusted t-stats	P-value	Adjusted t-stats	P-value	Adjusted t-stats	P-value	Adjusted t-stats	P-value
EQ	-14.897	0.000***	-11.306	0.000***	-8.210	0.000***	-6.552	0.000***
IC(VAIC)	-11.596	0.000***	-9.410	0.000***	-7.570	0.000***	-1.451	0.073*
RCE	-9.739	0.000***	-6.364	0.000***	-5.486	0.000***	-5.805	0.000***
SCE	-11.690	0.000***	-8.700	0.000***	-10.360	0.000***	0.815	0.792
HCE	-13.355	0.000***	-10.258	0.000***	-8.565	0.000***	-2.613	0.004***
LEV	-11.728	0.000***	-4.177	0.000***	-11.023	0.000***	-5.681	0.000***
SIZE	-28.193	0.000***	-9.831	0.000***	-4.560	0.000***	-36.652	0.000***

Notes: Levin-Lin-Chu panel unit root test including the adjusted t-statistic and p value. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. When the p value is significant in the panel root test, this indicates that the independent variables are stationary.

Finally, the Wooldridge test for autocorrelation was run. All the models have autocorrelation in the full sample and its components, except for the SCE model. Moreover, the Breusch-Pagan LM test was applied to examine the heteroscedasticity problem, indicating that all the models have this problem except for the real estate sector. However, the real estate regression models have neither autocorrelation nor heteroscedasticity problems. Table A6 report results for those tests. To ensure valid statistical inference among problems of heteroskedasticity and autocorrelation in the models, cluster-robust standard errors were estimated, as this estimator has the advantage that it produces heteroscedasticity-consistent standard errors that are robust and so appropriate for balanced panel data.

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Table B6. Autocorrelation and heteroscedasticity test

		EQ							
	Tests	Whole sample		Manufacturing		Services		Real Estate	
VAIC	Wooldridge test	$F(1,103)7.709$	0.006	$F(1,41)0.39$	0.001	$F(1,50)19.38$	0.000	$F(1,10)0.009$	0.926
	Autocorrelation								
	Breusch-Pagan test	$x^2(1)$	0.000	$x^2(1)$	0.000	$x^2(1)$	0.000	$x^2(1)$	0.325
	heteroskedasticity.	=30.06		=10.57		= 5.38		=0.97	
RCE	Wooldridge test	$F(1,103)48.33$	0.000	$F(1,41)24.0$	0.000	$F(1,50)18.26$	0.000	$F(1,10)2.56$	0.141
SCE	Autocorrelation								
HCE	Breusch-Pagan test	$x^2(1)$	0.000	$x^2(1)$	0.000	$x^2(1)$	0.000	$x^2(1)$	0.038
	heteroskedasticity.	=46.31		=12.51		=49.20		=4.30	

Note: When chi2 values are significant in both Wooldridge and Breusch Pagan tests, this indicates that autocorrelation and heteroscedasticity problems exist, treated by "clustered robust" standard errors command.

Table A1. Definition and Measurement of Variables

Variable	Label and measurement	Definition
Value added (VA)	VA=output-input VA=IN+HC+D+A+T+I IN=net income after tax HC=employee costs D=depreciation A=amortization T=taxes I= interests	Output refers to net revenues generated. Input refers to expenses incurred excluding employee benefits.
Relational capital (RC)	Total net tangible assets	Capital that enables HC and SC in creating added value (Nuryaman, 2015). Refers to capital employed equal to the book value of net total assets.
Human capital (HC)	All costs invested in employees	Knowledge owned by the staff. Refers to wages, salaries, bonuses, compensations, social security expenses, insurance, end of service benefits or any other renumeration.
Structural capital (SC)	SC=VA-HC	Knowledge owned by the company. Excludes employees' costs from VA to determine the value added by structural elements
Relational capital efficiency (RCE)	RCE=VA/CE	RCE[9] coefficient describing the value-value-created by a $ spent on capital employed
Human capital efficiency (HCE)	HCE=VA/HC	HCE coefficient describing the value added generated by a $ spent on HC

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[9]RCE includes the efficiency that HCE and SCE fail to capture. Pulic (1998) argues that IC cannot create value on its own, and so must be combined with physical and financial capital (Yang, 2019).

Continued from Table A1		
Structural capital efficiency (SCE)	SCE=SC/VA	SCE coefficient describing the value added generated by structural capital efficiency.
Intellectual capital efficiency (ICE)	ICE=SCE+HCE	ICE coefficient describing the value created by intangible assets efficiency.
Value-added intellectual coefficient VAIC[10]	VAIC=RCE+HCE+SCE	Overall value-added efficiency generated by intellectual coefficient proxied by IC. A greater VAIC represents greater efficiency in IC capitals employed, and thus greater value generated to the firm (Yang, 2019).
Firm size (SIZE)	SIZE= (Log TA)	Firm size, to control for the effect of large and small firms on the regression model. Calculated by taking the logarithm for total net assets (TA).
Financial leverage (LEV)	LEV =(TD/TA)	Company indebtedness, to control the effect of firm debt on the regression model. Calculated by dividing total debts (TD) by total net assets.

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[10]VAIC includes the three individual efficiencies and is the aggregation of the three efficiencies.

Chapter Three

Intellectual Capital Efficiency and Financial Performance in Jordanian Listed Companies

Abstract

We examine whether intellectual capital efficiency (IC) shapes the corporate performance of Jordanian listed firms over the period 2009-2018. We document a positive impact of IC on corporate performance that holds across different sectors. Considering the different IC components, we find a positive relationship with corporate performance for both relational capital efficiency (except for the real estate sector) and human capital efficiency (except for the services sector), but find that the impact of structural capital efficiency is mixed. Our evidence points to the fact that Jordanian corporate management has not yet fully exploited the potential of intangible assets.

Keywords: Intellectual Capital Efficiency, Corporate Performance, Profitability, Amman Stock Exchange ASE, VAIC

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3.1 Introduction

In this millennium, fewer people will do physical work and more will do brain work, implying an accumulation of intellectual capital (IC) (Haris et al., 2019) as a resource that allows sustainable acquisition of wealth. Human capital in particular, considered to be the most important IC component (Aljuboori et al., 2022), is highly influential in improving corporate profitability, as documented by Xu and Feng (2020), who argue that expenditure on staff should be treated as an investment rather than an expense due to its long-term impact. Pulic (2008) has emphasized a strong link between IC efficiency and organizational success in creating competitive advantage. Therefore, it is essential for firms to understand, identify, develop and efficiently utilize IC to strengthen competitiveness.

In this article, we examine whether IC efficiency shapes corporate performance by Jordanian non-financial companies listed on the Amman Stock Exchange (ASE), with a view to offering novel insights into corporate performance drivers in Jordan, a developing economy. Non-financial manufacturing firms contribute 60% to Jordanian gross domestic product (GDP), signaling the importance of this study. Because Jordan has a high ratio of external debt to GDP (around 95%), in an attempt to return to a normalized growth path, the Jordanian government has committed to aggressive reforms in the hope of attracting international investment (Economic Policy Council, 2016). Since Jordan has been identified as a nation with a high level of human capital but a relatively low level of organizational capital (Bontis, 2004), exploring the IC potential for improving Jordanian economic performance is of particular interest.

The empirical literature has documented heterogeneous findings with respect to the impact of IC – and its components, namely, human capital (HC), structural capital (SC) and relational capital (RC) – on corporate performance in different settings. In their study on the influence of IC efficiency on financial performance (proxied by return on assets (ROA), return on equity (ROE) and asset turnover) in the Bangladeshi textile industry over the period 2013-2017, Chowdhury et al. (2018) show that RC efficiency and SC efficiency are influential, while HC efficiency has an insignificant impact. Other studies point to significant linkage between IC (and its components) with corporate performance (see, e.g., Oppong and Pattanayak, 2019; Tarigan et al., 2019; Mohammad et al., 2018; Camfield et al., 2018). In contrast, Oyedokun and Saidu (2018) and Al Momani and Nour (2019) document a non-significant relationship for IC and its components with

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ROA, and for IC efficiency with ROE, respectively. Mixed and inconclusive evidence has also been reported for many countries, prompting researchers to conduct further studies across time, industries and countries in different economic contexts. We contribute to the growing empirical literature on this topic with additional and holistic evidence for different sectors in a developing economy.

We measure IC efficiency using Pulic's (1998) value-added intellectual coefficient (VAIC) model, widely used in many empirical studies to measure firm IC in different countries and sectors (Xu et al., 2022; Xu and Wang, 2018; Ozkan et al., 2017). To demonstrate the robustness of the analysis, we use different profitability metrics, namely, ROA, ROE, earnings per share (EPS) and net profit margin (NPM), as have been used in previous empirical studies to account for corporate performance (see, Xu et al., 2022; Xu and Feng, 2020; Mohammad et al., 2018; Nuraini et al., 2018; Nadeem et al., 2018; Chowdhury et al., 2018; Suseno et al., 2017; Yilmaz and Acar, 2018; Fazlzadeh, 2017). Using panel regression analyses, we demonstrate a significant positive relationship between IC efficiency and corporate performance for all sectors, independently of the profitability metric used – a result that also holds for the real estate sector, which is a mainly a physical capital-based sector. Furthermore, we document evidence for the crucial role played by HC efficiency in corporate wealth creation. Unexpectedly, despite the evidence for the studied period based on year-wise analyses, Jordanian corporate management is failing to develop an awareness of the critical role played by intangible assets.

This research contributes to the extant literature as follows. First, we show that the IC efficiency contribution to corporate performance varies widely by sector (Makki et al., 2009), which would indicate that results for any particular sector cannot be generalized. Note that Jian and Jingsuo (2019) reported that most IC theories are oriented to descriptive purposes, whereas this study focuses on a comparison. Second, we find that dynamic temporal effects have a decisive impact on the relationship between IC efficiency and corporate performance. Third, we consider the real estate sector, a physical capital-based sector, which has been largely overlooked by the research community, despite turbulent performance in recent years (Kardoosh, 2019). Finally, we consider not only the usual ROA and ROE indicators, but also EPS and NPM, thereby reporting more robust evidence on the relationship between IC efficiency and corporate performance. Our empirical results should be of interest for policy makers, and also for managers in terms of reassessing the management of IC resources to sustain business operations over time. Our findings

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are particularly important for more turbulent economies, including Jordan, where the potential of IC is not fully understood and so is underexploited by management (Sharabati et al., 2010).

The remainder of this study is organized as follows: Section 2 describes a review of the literature and our hypotheses; Section 3 describes the data and methodological design of the study; Section 4 outlines the descriptive statistics and empirical results; and finally, Section 5 contains our discussion, conclusions and recommendations.

3.2 Literature review

3.2.1 Defining and measuring IC

IC has been the focus of intense debate by researchers (e.g., Aljuboori et al., 2022), and is generally understood as an important driver of firm competitiveness and future value generation (Xu et al., 2022; Xu and Feng, 2020). In a knowledge-based economy, the importance of IC in value creation is attributed to its distinctive characteristics as a main driver of long-term corporate success, wealth, financial performance and sustainability (Jian and Jingsuo, 2019; Xu and Wang, 2018; Tarigan et al., 2019; Filipe and Zeila, 2017; Reboredo and Sowaity, 2022). Therefore, corporate management needs to pay attention to IC and to continuously invest in updating knowledge and staff skills (Haris, 2019). Not surprisingly, interest in the impact of IC on corporate performance, including during stress periods like the Covid-19 pandemic, has grown at both the academic and practitioner levels (Albertini and Fabienne, 2019; Xu et al., 2022).

However, no standard definition for IC is widely accepted by scholars (Ozkan et al., 2017; Hapsah et al., 2018). Most scholars concentrate on the human dimension, describing IC as encompassing the aggregated experience and professional skills of employees that provide a company with a competitive edge (Edvinsson and Malone, 1997).

Interest in how to measure IC has spurred the development of several metrics (Jian and Jingsuo, 2019). On the basis of the financial, physical and human capital in an organization, scholars have achieved a consensus on IC components, i.e., HC, SC and RC (Aljuboori et al., 2022; Xu and Wang, 2018). Thus, whereas financial capital, associated with the productive capacity of an organization, refers to the net value of assets and physical capital, IC refers to the science and knowledge included in SC and HC, respectively (Lee and Lin, 2018); however, SC and HC without employed capital, i.e., RC, fail to capture the value creation process (Bontis, 2004). Those three

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IC components are at the core of Pulic's VAIC model (1998), developed to measure IC efficiency in firms, and widely used in studies related to IC (Firer and Williams, 2003). The VAIC is easy to compute, offers comparability across sectors, companies and countries (Tarigan et al., 2019), and yields objective and verifiable data, as it is directly derived from audited and reliable financial statements.

3.2.2 Defining and measuring corporate performance

Corporate performance can be defined as the capacity of an organization to efficiently and effectively exploit its available resources to achieve profitability, growth and productivity (Taouab and Issor, 2019). Reasons for corporate performance measurement, as identified by Kamath (2015), are as follows: (1) to help organizations formulate and assess strategy execution and management compensation; (2) to communicate accessible and trusted indicators to stakeholders; and (3) to motivate staff to adopt the most appropriate organizational behaviors that strengthen their loyalty and responsibility. Corporate performance is usually measured using profitability indicators, mainly, ROA, ROE, EPS and NPM (see, e.g., Oppong and Pattanayak, 2019; Tarigan et al., 2019; Camfield et al., 2018).

3.2.3 IC and corporate performance: hypothesis development

Previous research has explored the association between IC efficiency and corporate performance. Xu et al. (2022) have documented a significant impact of IC on profitability, even during the Covid-19 pandemic period. Sharif and Elsayed (2015) argue that IC efficiency is a critical prerequisite for sustained corporate performance. Makki et al. (2009) show, in a study of Pakistani listed firms, that IC efficiency contributes significantly to EPS, and this evidence was further corroborated by Suhendra (2015). Sumedrea (2013) evidenced a significant link between IC efficiency and profitability as reflected in ROA, ROE and revenue growth, while Ahangar (2011) supported an informative link between IC efficiency and corporate performance proxied by ROA and revenue growth. Al Momani and Nour (2019), however, document an insignificant relationship with ROE for VAIC and its components except for RC, while Saleh (2015) document a positive relationship between IC efficiency and all its components with financial performance, except for ROE.

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In light of the above, since a significant association exists between IC efficiency and corporate performance in different contexts, IC efficiency could be a major determinant of corporate performance for Jordanian non-financial listed firms. The more a firm makes efficient use of all its resources in creating value, the more profitable it will be. We accordingly propose hypothesis H1 regarding the potential aggregate impact of IC efficiency on corporate performance as follows:

Hypothesis H1. *IC efficiency has a significant impact on ROA, ROE, EPS and NPM.*

It is also important to investigate the individual impact of each VAIC component on corporate performance, given that investors place different values on HC, SC and RC (Xu and Wang, 2018).

Recently, Xu et al. (2022), in a study set in the China and Pakistan, evidenced a significant positive relationship of HC, SC and RC efficiency with ROA and ROE, even in times of crisis such as the Covid-19 pandemic. Fillipe and Zelia (2017), in a study of non-financial listed firms in 14 western European countries, reported that IC efficiency is an important resource for value creation, and that HC is a key factor in firm wealth. RC efficiency and SC efficiency positively impact short-run and long-run corporate performance, respectively; Ozkan et al. (2017), in a study of Turkish listed firms, find a significant positive relationship between RC efficiency and ROA, but negligible effects regarding HC and SC efficiency, while Suseno et al. (2017), in their study of the Bank of Perkreditan Rakyat in Malaysia, found that SC and HC efficiency have no influence on ROA, while RC efficiency has a significant effect on overall corporate performance. Nuraini et al. (2018), in their study of Sharia banking companies in Indonesia over three years, found a positive significant impact of VAIC on ROA, ROE and revenue growth. Xu and Wang (2018), in a study of listed Korean manufacturing firms during 2012-2016, document a positive impact of HC and RC efficiency and a negative effect of SC on corporate performance. Similarly, Yilmaz and Acar (2018) reported a significant effect for HC and RC on financial performance for Turkish listed companies over the period of 2011-2014. In contrast, few studies have reported no relationship between corporate performance and SC (e.g., Suseno et al., 2017), HC (e.g., Mohammad and Ismail, 2009) and RC (e.g., Hashim, 2015). The above evidence would suggest that most studies report mixed findings for the differential impact of the three VAIC components

USC DE SANTIAGO DE COMPOSTELA

on corporate performance. Accordingly, to further explore this relationship, we propose the following hypothesis:

Hypothesis H2. *HC, SC and RC each have a significant impact on ROA, ROE, EPS and NPM.*

3.3 Research design

3.3.1 Data and sampling

The data sample includes yearly information on all non-financial manufacturing, services and real estate companies listed on the Amman Stock Exchange (ASE) over the decade 2009-2018. Table 3.1 summarizes the sampling process and the included sectors. Included were companies with audited annual financial statements uploaded to the ASE official website (www.ase.com.jo) and meeting predefined parameters as follows: (1) continuous activity during the study period and stocks traded publicly; (2) not delisted from the ASE by the Jordan Securities Commission (JSC) during the study period; and (3) fiscal year for annual reporting ending on 31 December.

Table 3.1 Included/excluded Jordanian listed firms.

Sector	Total	Excluded	Included	Full sample %	Sub-sample %	# Obs.
Included						
Manufacturing	47	5	42	40%	89%	420
Services	77	26	51	49%	66%	510
Real estate	33	22	11	11%	33%	110
Excluded						
Banking*	15	15	0			0
Insurance*	21	21	0			0
Total	**193**	**89**	**104**	**100%**		**1040**

	Margin of error (ME) for sample selection at the 95% confidence level					
	Manufacturing	ME	Services	ME	Real estate	ME
Full sample	42 of 104	11.73%	51 of 104	9.84%	11 of 104	28.08%
Sub-sample	42 of 47	4.99%	51 of 77	8.03%	11 of 33	24.50%

***** Banking and insurance firms are excluded due to a different reporting structure that means they are not comparable with non-financial firms.

Of the 193 public ASE-listed companies at the beginning of 2019, 104 were included in the sub-sample as meeting the inclusion criteria, yielding 1040 annual observations. Included as valid for statistical analysis were companies as follows: 42 (of 47) manufacturing companies investing in the pharmaceutical and medical, chemical, paper, food and beverages, tobacco and cigarettes, mining and extraction, engineering and construction, electrical and textiles sectors; 51 (of 77) services companies investing in healthcare, education, hotels and tourism, transportation,

USC DE SANTIAGO DE COMPOSTELA

technology and communication, media, utilities and energy, commercial and diversified financial services sectors; and 11 (of 33) real estate companies investing in land and construction activities.

3.3.2 Methodology

Although corporate performance may be measured using market-based information, we use accounting-based measures, given that the main goals in any organization are growth and profitability (Sumedrea, 2013). Accordingly, we use four profitability metrics: ROA, ROE (following Nadeem et al., 2018; Xu and Wang, 2018; Oyedokun and Saidu, 2018; Chowdhury et al., 2018; Radic, 2018; Gogan et al., 2016; Ozkan et al, 2017, among others), EPS (following Saleh, 2015; Fazlzadeh, 2017; Suhendra, 2015), and NPM (following Yilmaz, 2018; Nuryaman, 2015).

The independent variables used are the VAIC components as a proxy for IC efficiency (see, e.g., Tarigan et al., 2019; Mohammad et al., 2018; Yilmaz and Acar, 2018; Radic, 2018; Oyedokun et al., 2018; Ozkan et al., 2017). VAIC reflects value-added per monetary unit invested in a resource: the higher the coefficient the greater the company capacity to efficiently apply IC to improving performance (Pulic, 2008; Sumedrea, 2013). This aggregate indicator, signaling IC involvement in value creation, thus reflects overall efficiency in deploying a firm's resources. The three VAIC components are as follows: HC, measured in terms of dollar expenditure on staff costs (including salaries, bonuses, training, etc), captures the knowledge, professional skills, experience, innovativeness, commitment and competence of a firm's employees (Xu and Feng, 2020; Xu and Wang, 2018; Sarea and Alansari, 2016); (b) SC reflects the non-human capital in an organization, including IT systems, databases, routines, organizational charts, procedures, guidelines, systems, processes, policies, strategies and overall infrastructures (Filipe and Zeila, 2017); and (c) RC reflects the physical and financial capital employed in the value creation process (Nuryaman, 2015). Dependent variables are the four-profitability metrics, namely, ROA, ROE, EPS and NPM.

Finally, the control variables, related to internal factors that affect the book value of a firm's assets (e.g., Tarigan et al., 2019; Forte et al., 2017): financial leverage (LEV), to control for indebtedness, and firm size (SIZE), to control for the firm's size effect. Several studies have documented that a higher debt ratio means a higher risk of bankruptcy, indicating that debt is an important factor affecting firm value and performance (Agustinus & Rachmadi, 2008). Firm size is scaled by the natural logarithm for total net assets for firm *i* in fiscal year *t* (see Ajidi and

USC UNIVERSIDADE SANTIAGO

Aderemi, 2014; Sharif and Elsayed, 2015, among others). While some studies have documented that large firms are more fragile than small ones (Agustinus and Rachmadi, 2008), Radic (2018) reported that firm size has no impact on firm profitability. Dependent, independent and control variables and their calculations are described in Table C14 (Appendix C).

Given the nature of the dataset, we use panel analysis consisting of time-unit observations. Accordingly, the following multivariate panel models, exemplified by ROA, are established to test our hypotheses H1 and H2:

$$ROA_{i,t} = \alpha_i + \beta_1 IC_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 \sum YEARS + \varepsilon_{i,t} \quad (1)$$

$$ROA_{i,t} = \alpha_i + \beta_1 RCE_{i,t} + \beta_2 SCE_{i,t} + \beta_3 HCE_{i,t} + \beta_4 Size_{i,t} + \beta_5 Lev_{i,t} + \beta_6 \sum YEARS + \varepsilon_{i,t} \quad (2)$$

where α_i is a constant that accounts for fixed effects, and $\varepsilon_{i,t}$ denotes the stochastic component for firm *i* and time *t*. Parameters β_1 in Eq. (1) and β_1, β_2, and β_3 in Eq. (2) account for the impact on corporate performance of the efficiency of VAIC's three components, labelled RCE, SCE and HCE) ; parameters β_2 and β_3 in Eq. (1) and β_4 and β_5 in Eq. (2) account for the effects of the control variables (LEV and SIZE); and parameters β_4 in Eq. (1) and β_6 in Eq. (2) are time dummy variables, to account for temporal effects. If β_1 in Eq. (1) and β_1, β_2 and β_3 in Eq. (2) are significantly different from zero, then hypotheses H1 and H2 hold, respectively.

3.4 Empirical results

3.4.1 Descriptive statistics

To mitigate the impact of outliers, all variables are winsorized at the 5% level (Hongjing et al., 2016); note that the SIZE variable is not controlled for outliers because it is measured by the natural logarithm. Likewise, the normality, stationarity, autocorrelation and heteroskedasticity of all variables are checked by running the relevant statistical tests (see results in Appendix C).

Table 3.2 reports descriptive statistics of the analyzed variables. The mean VAIC value is 3.6757, suggesting that added value is positively generated from integration of all the IC components, while standard deviation (SD) of 3.0898 points to great variability between firms. The highest (2.8594) and lowest (0.1327) means occur for HC and RC. The high mean for HC

USC DE SANTIAGO DE COMPOSTELA

signals the crucial and predominant role of human resources in adding value. As for the control variables, the mean LEV value is 0.2740, implying that about one third of assets are financed by creditors, while the mean SIZE value is 7.5046, with low dispersion between firms. Regarding the profitability metrics, mean values for ROA, ROE, EPS and NPM are 0.02, 0.03, 0.08 and 0.02, respectively, indicating that all the sampled firms are profitable and performing reasonably well, while SD values of 0.06, 0.10, 0.17 and 0.31 for ROA, ROE, EPS and NPM, respectively, point to great performance variability between firms.

Table 3.2 Descriptive statistics for the sample.

	Mean	Min	Max	SD	Skewness	Kurtosis	# Obs.
Independent variables							
VAIC	3.6757	-0.3064	12.6096	3.0898	1.5450	5.1041	1040
RC	0.1327	-0.0181	0.3926	0.1075	0.8605	3.1457	1040
SC	0.5644	-0.3224	1.5160	0.4025	0.0649	3.7169	1040
HC	2.8594	-0.7995	11.3493	2.7857	1.7168	5.7891	1040
Dependent variables							
ROA	0.0217	-0.1150	0.1446	0.0622	-0.1587	3.0722	1040
ROE	0.0318	-0.2138	0.2208	0.1024	-0.4476	3.3625	1040
EPS	0.0820	-0.1880	0.5730	0.1746	1.1791	4.4808	1040
NPM	0.0179	-0.8980	0.5271	0.3077	-1.3689	5.4383	1040
Control variables							
LEV	0.2740	0.2215	0.7881	0.0072	0.7459	2.7323	1040
SIZE	7.5046	5.3013	9.9848	0.5571	0.7370	4.2019	1040

Note. The sample includes annual data for ASE-listed firms for the period 2009-2018.

Tables 3.3, 3.4 and 3.5 report summary descriptive statistics for firms included in the manufacturing, services and real estate sectors, respectively; these have fairly similar mean VAIC values (3.3394, 3.8899, and 3.9663, respectively) that are also close to the value for the full sample. Moreover, the mean VAIC values indicate that the value added from IC efficiency in all the sectors exceeds the costs incurred in terms of physical and financial capital. The highest mean value in all sectors is for HC (2.5371, 3.0763, 3.0846), consistent with the fact that human resources make the highest contribution to added value. Mean values for RC are 0.1385, -0.1454 and 0.0516, and for SC are 0.5167, 0.5807 and 0.6706, for the manufacturing, services and real estate sectors, respectively; thus, in the manufacturing and real estate sectors, the value added exceeds the costs incurred, while the services sector struggles to add value from physical capital. Overall, the three sectors succeeded in adding value from investing in SC. Mean LEV values for the manufacturing, services and real estate sectors are 0.3347, 0.2714 and 0.0548, respectively; thus, around one third of assets in manufacturing and services are funded by creditors, compared to only 5% for the real

estate sector. Average SIZE values in the manufacturing, services and real estate sectors are 7.4349, 7.5989 and 7.3338, respectively, with a dispersion that varies by sector.

Table 3.3 Descriptive statistics for the manufacturing sector.

	Mean	Min	Max	SD	Skewness	Kurtosis	# Obs.
VAIC	3.3394	-0.3064	12.6096	2.8281	1.653	5.917	420
RC	0.1385	-0.0181	0.3926	0.0977	0.672	3.252	420
SC	0.5167	-0.3224	1.5160	0.4244	0.182	3.541	420
HC	2.5371	-0.7995	11.3493	2.4645	1.864	7.052	420
ROA	0.0179	-0.1150	0.1447	0.0669	-0.1468	2.6229	420
ROE	0.0183	-0.2138	0.2208	0.1080	-0.4700	2.9971	420
EPS	0.0814	-0.1880	0.5730	0.1884	1.1135	4.1139	420
NPM	0.0009	-0.8980	0.5271	0.269	-1.2347	6.3594	420
LEV	0.3347	0.0072	0.7881	0.2690	0.442	2.421	420
SIZE	7.4349	6.3508	9.9848	1.232	5.073	4.2019	420

Note. The sample includes annual data for ASE-listed manufacturing firms for the period 2009-2018.

Table 3.4. Descriptive statistics for the services sector.

	Mean	Min	Max	SD	Skewness	Kurtosis	# Obs.
VAIC	3.8899	-0.3064	12.6096	3.1143	1.6251	5.2177	510
RC	-0.1454	-0.0180	0.3925	0.1147	0.8219	2.7735	510
SC	0.5807	-0.3224	1.5160	0.3606	0.0235	4.3331	510
HC	3.0763	-0.7995	11.3493	2.8514	1.7765	5.7424	510
ROA	0.0286	-0.1150	0.1446	0.0586	-0.1963	3.4814	510
ROE	0.0503	-0.2138	0.2208	0.0973	-0.4236	3.5434	510
EPS	0.0997	-0.1880	0.5730	0.1710	1.0906	4.1829	510
NPM	0.0685	-0.8980	0.5271	0.2865	-1.5694	6.4379	510
LEV	0.2714	0.0072	0.7887	0.2290	2.9631	2.421	510
SIZE	7.5989	5.3013	9.2549	0.5543	0.5905	4.1573	510

Note. The sample includes annual data for ASE-listed services firms for the period 2009-2018.

Table 3.5 Descriptive statistics for the real estate sector.

	Mean	Min	Max	SD	Skewness	Kurtosis	# Obs.
VAIC	3.9663	-0.3064	12.6096	3.7723	0.9595	2.9280	110
RC	0.0516	-0.0181	0.3926	0.0668	0.9595	2.9280	110
SC	0.6706	-0.3224	1.5160	0.4726	-0.1995	2.8352	110
HC	3.0846	-0.7995	11.3493	3.4623	1.0702	3.2022	110
ROA	0.0037	-0.1150	0.1446	0.0548	0.0892	4.0287	110
ROE	-0.0024	-0.2138	0.2208	0.0863	-0.5314	4.5514	110
EPS	-.0042	-0.1800	0.1200	0.0743	-0.7781	3.4947	110
NPM	-0.1519	-0.8980	0.5271	0.4457	-0.6111	2.1635	110
LEV	0.0548	0.0072	0.3310	0.0731	2.1051	6.8844	110
SIZE	7.3338	6.2759	8.2714	0.5453	-0.1765	2.0258	110

Note. The sample includes annual data for ASE-listed real estate firms for the period 2009-2018.

USC DE COMPOSTELA

Regarding sectors, mean values for ROA, ROE, EPS and NPM are, respectively, 0.02, 0.02, 0.08, and 0.0009 for the manufacturing sector; 0.03, 0.05, 0.10 and 0.07 for the services sector, and 0.004, -0.002, 0.003 and -0.15 for the real estate sector – values that point to differences

in corporate performance between sectors. ROA values, positive and moderate across all sectors, reflect moderate profitability; ROE values are low, and even negative for the real estate sector; EPS values are satisfactory for the manufacturing and services sectors, but poor for the real estate sector; and finally, NPM values are poor except for the services sector.

Finally, a Spearman correlation matrix analysis shows that the ROA, ROE, EPS and NPM profitability indicators are significantly and positively correlated with VAIC and its components at the 1% level for the entire sample of industries, thereby initially confirming a strong impact of IC efficiency on corporate value creation (see Appendix C).

3.4.2 Regression results

Tables 3.6-3.9 report evidence on the impact of IC and its components considering the ROA, ROE, EPS and NPM profitability indicators, respectively, for the sample overall and for each sector.

Table 3.6 Regression results for the impact of IC efficiency on ROA.

	ROA			
	Full sample	Manufacturing	Services	Real estate
Intercept	-0.088(0.432)	-0.204***(0.002)	-0.008(0.917)	0.118 (0.433)
VAIC	**0.013***(0.000)**	**0.011***(0.000)**	**0.017***(0.000)**	**0.011***(0.000)**
SIZE	0.010(0.490)	**0.030***(0.002)**	-0.003(0.714)	-0.022(0.271)
LEV	**-0.075***(0.004)**	**-0.125***(0.000)**	-0.027(0.237)	0.016(0.896)
Poolability	***F (9, 103) **2.21***	***χ^2 (9) **17.20***	***F (9, 50) *1.87***	*χ^2 (9)2.84*
Breusch and Pagan LM test	$x^2(1)$=1157.66*** GLS applied	$x^2(1)$=309.78*** GLS applied	$x^2(1)$ =650.53*** GLS applied	$x^2(1)$=35.52*** GLS applied
Hausman Test	$x^2(12)$ =32.23*** FE	$x^2(12)$ =9.32 RE	$x^2(12)$ = 1.46*** FE	$x^2(12)$ = 1.04 RE
R-squared	0.3714	0.3963	0.3656	0.4029
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	14.09***	303.15***	10.11***	104.18***
Year effect	Yes	yes	Yes	No

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Table 3.6 shows that IC efficiency has a significant positive impact on ROA. This result is consistent with hypothesis H1, corroborates evidence for other countries (e.g., Xu et al., 2022; Tarigan et al., 2019; Mohammad et al., 2018; Nadeem et al., 2018; Xu and Wang, 2018; Nuraini et al., 2018; Radic, 2018; Tasawar and Roszaini, 2017; Kurfi et al., 2017; Murwaningsari and Ardy, 2018; Isanzu, Janeth, 2016; Gogan et al., 2016; Ozkan et al., 2017; Filipe and Zeila, 2017),

but contradicts other reported evidence (e.g., Oyedokun and Saidu, 2018; Vladimir et al., 2016; Nuryaman, 2015). An insignificant relationship is observed between SIZE and ROA (except for the manufacturing sector), indicating that smaller firms have an edge over larger firms in deploying their IC to generate profits. As for LEV, this has a significant negative effect on the ROA for the whole sample and for the manufacturing sector, but an insignificant effect for the remaining sectors.

Table 3.7 Regression results for the impact of RC, SC and HC on ROA.

	ROA			
	Full sample	Manufacturing	Services	Real estate
Intercept	-0.352***(0.000)	-0.229***(0.000)	-0.313***(0.000)	-0.219 (0.445)
RC	**0.551***(0.000)**	**0.412***(0.000)**	**0.641***(0.000)**	**0.595***(0.000)**
SC	0.007(0.101)	**0.023***(0.005)**	0.007(307)	**-0.018**(0.030)**
HC	**0.007***(0.000)**	**0.008***(0.000)**	**0.006***(0.008)**	**0.005***(0.006)**
SIZE	**0.039***(0.001)**	**0.025***(0.003)**	**0.032***(0.002)**	0.025 (0.515)
LEV	**-0.046***(0.016)**	**-0.062***(0.010)**	**-0.046***(0.006)**	0.139 (0.190)
Poolability	F (9, 103) 1.17	χ^2 **(9) *15.38**	F (9, 50)1.49	**F (9, 10) ***22.67**
Breusch and	$x^2(1)$806.87***	$x^2(1)$=166.48***	$x^2(1)$ =459.49***	$x^2(1)$=82.32***
Pagan LM test	GLS applied	GLS applied	GLS applied	GLS applied
Hausman	$x^2(14)$ 60.03***	$x^2(14)$ =20.05	$x^2(14)$ =148.55***	$x^2(5)$ = 11.54**
Test	FE	RE	FE	FE
R-squared	0.6998	0.7245	0.7003	0.8699
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	47.65***	671.56***	63.92***	841.83***
Year effect	No	Yes	No	Yes

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Table 3.7 presents evidence on the VAIC components. RC and HC are significant at the 1% level in all the sectors, whereas results are mixed for SC, which is insignificant for the whole sample and the services sector, but, at the 1% level, is significantly positive for the manufacturing sector and negatively significant for the real estate sector. Hypothesis H2 is therefore supported, given the significant relationship for RC, SC and HC efficiency with ROA for the whole sample and its components, with the exception of SC for the whole sample and the services sector. This evidence is corroborated by other studies (e.g., Xu et al., 2022; Nadeem et al., 2018; Xu and Wang, 2018; Nuraini et al., 2018; Radic, 2018; Murwaningsari and Ardi, 2018; Isanzu, 2016; Gogan et al., 2016; Ozkan et al., 2017; Kozera, 2015; Sharif and Elsayed, 2015; Sumedrea, 2013; Ahangar, 2011; Chen et al.,2005; Saleh, 2015; Fathi et al., 2013), but is also contradicted (e.g., Oyedokun and Saidu, 2018; Vladimir et al., 2016; Hashim et al., 2015; Nuryaman, 2015). There is also a

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significant positive relationship between SIZE and ROA and a significant negative effect of LEV on ROA (in both cases, except for the real estate sector).

Table 3.8 shows that the impact of IC on ROE is significantly positive at the 1% level, thereby supporting hypothesis H1 on the importance of IC for corporate performance as reflected in the ROE. Previous research both confirms this evidence (e.g., Xu et al., 2022; Tarigan et al., 2019; Nadeem et al., 2018; Nuraini et al., 2018; Tasawar and Roszaini, 2017; Murwaningsari and Ardy, 2018; Isanzu, 2016; Gogan et al., 2016; Ozkan et al., 2017; William et al., 2017) and contradicts it (e.g., Al Momani and Nour, 2019; Vladimir et al., 2016; Radic, 2018). We find a significant positive relationship between SIZE and ROE (except for the real estate sector), indicating that larger firms have an edge in deploying their IC to add value for shareholders. LEV has a significant negative effect on the ROE only for the whole sample and the manufacturing sector.

Table 3.8 Regression results for the impact of IC efficiency on ROE.

	ROE			
	Full sample	Manufacturing	Services	Real estate
Intercept	-0.364***(0.003)	-0.687***(0.001)	-0.427***(0.000)	0.128(0.612)
VAIC	**0.020***(0.000)**	**0.016***(0.000)**	**0.025***(0.000)**	**0.016***(0.000)**
SIZE	**0.046***(0.006)**	**0.098***(0.002)**	**0.049***(0.000)**	-0.026(0.424)
LEV	**-0.134***(0.002)**	**-0.287***(0.000)**	-0.006(0.859)	0.071(0.726)
Poolability	**F (9,103) *1.88**	**F (9, 41) *1.97**	**F (9, 50) **2.35**	χ^2 (9) 2.5
Breusch and Pagan	$x^2(1)$ 922.42***	$x^2(1)$ 213.61***	$x^2(1)$ 530.98***	$x^2(1)$ =27.35***
LM test	GLS applied	GLS applied	GLS applied	GLS applied
Hausman	$x^2(12)$ 47.03***	$x^2(12)$ 20.71**	$x^2(12)$=47.28***	$x^2(12)$ =0.46
Test	FE	FE	FE	RE
R-squared	0.3228	0.4112	0.2959	0.3473
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	10.97***	20.27***	6.36***	74.52***
Year effect	Yes	Yes	Yes	No

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Table 3.9 indicates that all IC components have a significantly positive impact on ROE, with the exception of SC for the real estate sector. This result confirms that the IC components contribute greatly to ROE, and therefore to profitability for shareholders, and also underlines the important role of HC and organizational capital in enhancing ROE. Those results support hypothesis H2, except for SC in the real estate sector, where high investment in organizational infrastructure leads to reduced ROE, and shareholder discontent regarding the level of expenditure

USC UNIVERSIDADE DE SANTIAGO

on internal infrastructure. The regression results also point to a significant positive relationship between SIZE and ROE (except for the real estate sector), a significant negative effect of LEV on ROE in the whole sample and in the manufacturing sector, and an insignificant effect for the other two sectors; this would suggest that total indebtedness reduces investment in IC, ultimately negatively affecting shareholder payouts.

Table 3.9 Regression results for the impact of RC, SC and HC on ROE.

	ROE			
	Full sample	Manufacturing	Services	Real estate
Intercept	-0.794***(0.000)	-0.913***(0.000)	-.885 ***(0.000)	-0.442 (0.377)
RC	**0.883***(0.000)**	**0.772***(0.000)**	**0.955 ***(0.000)**	**0.992***(0.000)**
SC	**0.013*(0.087)**	**0.026**(0.049)**	**0.018 *(0.096)**	**-.030***(0.021)**
HC	**0.009***(0.000)**	**0.011***(0.002)**	**0.009 *(0.064)**	**0.005**(0.042)**
SIZE	**0.093***(0.000)**	**0.113***(0.001)**	**0.101** (0.000)**	0.053 (0.435)
LEV	**-0.087***(0.001)**	**-0.162***(0.010)**	-0.033(0.174)	0.231 (0.107)
Poolability	F (9, 103)1.02	F (9, 41) 0.44	**F (9, 50) **2.80**	**F(9,10) ***13.40**
Breusch and Pagan	$x^2(1)$= 831.03***	$x^2(1)$=102.67***	$x^2(1)$454.86***	$x^2(1)$=59.13***
LM test	GLS applied	GLS applied	GLS applied	GLS applied
Hausman	$x^2(14)$ =87.11***	$x^2(14)$ 38.86***	$x^2(14)$ 80.83***	$x^2(5)$ =18.01
Test	FE	FE	FE	FE
R-squared	0.6203	0.6810	0.5580	0.7851
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	43.12***	42.56***	37.09***	189.03***
Year effect	No	No	Yes	Yes

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Tables 3.10-3.13 report regression results for the impact of IC efficiency and of IC components on EPS and NPM. Table 3.10 reports empirical estimates that show that VAIC is significantly and positively associated with EPS, supporting hypothesis H1 for both the whole sample and the three sectors. This evidence is consistent previous empirical research (see Suhendra, 2015; Felizardo et al., 2017; Saleh, 2015). We also find a significant positive relationship between SIZE and EPS in the whole sample and its components (except for the real estate sector), while LEV has a significantly negative effect on profitability for the whole sample and the manufacturing and real estate sectors, and a non-significant negative effect for the services sector.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Table 3.10 Regression results for the impact of IC efficiency on EPS.

	EPS			
	Full sample	Manufacturing	Services	Real estate
Intercept	-0.590***(0.009)	-0.802***(0.001)	-0.843***(0.002)	0.385*(0.066)
VAIC	**0.021***(0.000)**	**0.018***(0.000)**	**0.029***(0.000)**	**0.011***(0.000)**
SIZE	**0.087***(0.005)**	**0.124***(0.000)**	**0.114***(0.001)**	**-0.075**(0.041)**
LEV	**-0.193***(0.001)**	**-0.290***(0.000)**	-0.067(0.468)	**-0.500***(0.012)**
Poolability	F (9,103)1.00	χ^2 (9)14.00	F (9, 50) 0.79	χ^2 (9)5.99
Breusch and	$x^2(1)$1323.58***	$x^2(1)$ =342.77***	$x^2(1)$ 777.28***	$x^2(1)$ =25.77***
Pagan LM test	GLS applied	GLS applied	GLS applied	GLS applied
Hausman	$x^2(12)$ = 19.02*	$x^2(12)$ = 1.82	$x^2(12)$ = 20.04*	$x^2(12)$ = 0.85
Test	FE	RE	FE	RE
R-squared	0.1763	0.4013	0.1794	0.4789
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	9.08***	154.21***	3.91***	65.00***
Year effect	No	No	No	No

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Table 3.**11 Regression results for the impact of RC, SC and HC on EPS.**

	EPS			
	Full sample	Manufacturing	Services	Real estate
Intercept	-1.052***(0.000)	-1.007**(0.024)	-1.465***(0.000)	0.237(0.178)
RC	**0.932***(0.000)**	**0.718***(0.004)**	**1.180***(0.000)**	0.247(0.102)
SC	**0.029**(0.026)**	0.036(0.115)	**0.059***(0.006)**	**-.034***(0.009)**
HC	**0.009***(0.006)**	**0.013***(0.004)**	0.004(0.619)	**.011*** (0.000)**
SIZE	**0.136***(0.000)**	**0.136**(0.030)**	**0.183 ***(0.000)**	-0.034(0.134)
LEV	**-0.145***(0.009)**	**-0.206**(0.036)**	-0.094(0.292)	**-0.325**(0.033)**
Poolability	F (9, 103)0.77	F (9, 41)1.06	F (9, 50)1.19	**χ^2 (9) ***30.54**
Breusch and	$x^2(1)$=760.85***	$x^2(1)$=55.35***	$x^2(1)$ =586.30***	$x^2(1)$=24.41***
Pagan LM test	GLS applied	GLS applied	GLS applied	GLS applied
Hausman	$x^2(14)$ = 22.29*	$x^2(14)$ 25.25**	$x^2(14)$ =26.96***	$x^2(5)$ =7.23
Test	FE	FE	FE	RE
R-squared	0.3300	0.3528	0.3355	0.6286
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	17.35***	26.59***	8.07***	786.99***
Year effect	No	No	No	Yes

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Table 3.11 shows that the IC components are significantly positive for the whole sample, and have a mixed effect for the individual sectors. Thus, at the 1% level, RC is significant for all sectors except real estate, SC is significant for the services and real estate sectors and HC is significant for the manufacturing and real estate sectors, but insignificant for the services sector.

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Hence, hypothesis H2 in relation to EPS is generally supported by our data, with some few exceptions depending on the component and the sector.

Table 3.12 reports a significantly positive effect at the 1% level for the whole sample and also for the manufacturing, services and real estate sectors. This evidence in support of hypothesis H1 implies that IC efficiency improves corporate profitability, i.e., across all sectors, greater IC investment leads to greater profitability. This result is consistent with empirical evidence reported by Yilmaz and Acar (2018), but contradicts evidence reported by Nuryaman (2015).

Table 3.12 Regression results for the impact of IC efficiency on NPM.

	NPM			
	Full sample	Manufacturing	Services	Real estate
Intercept	-1.071***(0.000)	-0.811***(0.001)	-1.324***(0.002)	0.397(0.766)
VAIC	**0.065***(0.000)**	**0.042***(0.000)**	**0.091***(0.000)**	**0.069***(0.000)**
SIZE	**0.119***(0.002)**	**0.102***(0.005)**	**0.140***(0.005)**	-0.114(0.513)
LEV	**-0.330***(0.000)**	**-0.338***(0.005)**	**-0.325***(0.004)**	-0.221(0.835)
Poolability	**F (9,103) *1.77**	**χ^2 (9) **20.51**	F (9, 50) 1.31	**χ^2 (8) *** 8080**
Breusch and	$x^2(1)$ 730.14***	$x^2(1)$ =246.82***	$x^2(1)$ 218.06***	$x^2(1)$ =34.87***
Pagan LM test	GLS applied	GLS applied	GLS applied	GLS applied
Hausman	$x^2(12)$ 39.41***	$x^2(12)$ 3.91	$x^2(12)$ 73.24***	$x^2(12)$ 2.6
Test	FE	RE	FE	RE
R-squared	0.3083	0.3416	0.3408	0.4300
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	10.21***	85.76***	4.44***	59.81***
Year effect	Yes	Yes	No	Yes

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

Table 3.13 shows that the IC components have different impacts on NPM. RC is significantly positive at the 1% level for all sectors and at the 10% level for the real estate sector; in contrast, SC is significantly negative at the 5% level for the whole sample and for the services and real estate sectors, while HC is significant at the 1% level for the whole sample. This evidence implies that RC and HC increase profitability, with HC playing a predominant role. Therefore, except for SC in the manufacturing sector, hypothesis H2 supports a significant relationship for RC, SC and HC efficiency with NPM for the whole sample and for each sector. This evidence is consistent with Haris et al. (2019) and Yilmaz and Acar (2018), but contradicts evidence reported by Nuryaman (2015).

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Table 3.13 Regression results for the impact of RC, SC and HC on NPM.

	NPM			
	Full sample	Manufacturing	Services	Real estate
Intercept	-1.299*** (0.000)	-.837*** (0.001)	-1.880***(0.001)	-1.173(0.230)
RC	**1.139*** (0.000)**	**0.757*** (0.004)**	**1.878***(0.000)**	**1.263*(0.068)**
SC	**-0.085*** (0.011)**	-0.042 (0.211)	**-0.101 **(0.062)**	**-.255***(0.000)**
HC	**0.075*** (0.000)**	**0.057 *** (0.000)**	**0.092 ***(0.000)**	**.077 ***(0.000)**
SIZE	**0.137***(0.001)**	**0.087***(0.009)**	**0.166 ***(0.004)**	0.111 (0.401)
LEV	**-0.204***(0.012)**	-0.173(0.152)	**-0.381***(0.000)**	0.835 (0.270)
Poolability	F (9,103)0.55	χ^2 (9) 15.22	F (9, 50)0.51	χ^2 **(9)***70.67**
Breusch and Pagan LM test	$x^2(1)$792.64*** GLS applied	$x^2(1)$270.28*** GLS applied	$x^2(1)$302.72*** GLS applied	$x^2(1)$=50.55*** GLS applied
Hausman Test	$x^2(14)$ 51.96*** FE	$x^2(14)$ =3.16 RE	$x^2(14)$208.11*** FE	$x^2(14)$ =7.76 RE
R-squared	0.5462	0.5231	0.6119	0.4569
Groups	104	42	51	11
Observations	1040	420	510	110
F-test	14.35***	191.75***	11.90***	111.52***
Year effect	No	No	No	Yes

P-values in parentheses: *p<0.10, **p<0.05, ***p<0.01. The poolability test shows the time-unit effect on the dependent variable (Vijayamohanan, 2017). F-stat results reflect regression model reliability in prediction as ***, ** and * at the 1%, 5% and 10% significance level. FE, fixed effect; RE, random effect.

3.5 Discussion and conclusions

This study investigates whether IC and its three components (HC, SC and RC) are related to corporate performance by Jordanian ASE-listed non-financial companies over the period 2009-2018. Our main findings are as follows:

1. The significantly positive association between IC and corporate performance supports the fact that IC efficiency has strong potential to become a new source of wealth and sustainable competitive advantage for Jordanian listed companies.
2. Evidence is mixed regarding the impact of individual IC components on corporate performance in different sectors. Results for the whole sample evidence a significant association with all the profitability indicators used (ROA, ROE, EPS and NPM). Unlike Sharabati et al. (2013), we find a significant correlation between HC efficiency and corporate performance.
3. Firm size is significantly and positively associated with corporate performance, except in the real estate sector, indicating that larger firms can take advantage of economies of scale in investing in IC efficiency to improve corporate performance.

USC DE SANTIAGO DE COMPOSTELA

4. Corporate indebtedness has a significant negative impact on corporate performance, indicating that debt acts as an impediment for firms to invest in IC, which in turn negatively affects profitability.

Regarding Point 3, possible explanations for the absence of a relationship between corporate performance and size for the real estate sector are as follows: (1) although larger firms can raise barriers to newcomers, they have no advantage in using their economies of scale to invest in IC to improve profitability; (2) poor asset management efficiency in large firms may act as an impediment to investing in IC. The Jordanian real estate sector may also have particular features, e.g., it may suffer from mismanagement or there may be a high percentage of slack assets that do not add value. Furthermore, the sample maybe does not represent the whole sector. In summary, the fact that the Jordanian real estate sector is struggling to add value merits further investigation.

The empirical evidence reported here has some important implications: (1) the ROA and ROE indicators are more strongly correlated with IC efficiency than the EPS and NPM measures; (2) IC efficiency is demonstrated to be an important strategic asset for better corporate performance, which in turn improves sustainability and competitiveness; (3) the positive association between HC and all the profitability indicators (except for EPS in the services sector) demonstrates that the listed companies successfully motivate and exploit staff potential in leveraging firm revenues and profits; and (4) the positive correlation between RC and corporate performance indicates that the listed companies successfully deploy their physical capital in improving IC efficiency. Finally, mixed results are obtained for the impact of SC in the studied sectors; in the real estate sector, SC has a negative or insignificant impact, implying that organizations lack the required resources or/and that somehow mismanage investment in organizational capital.

Policy implications can be summarized as follows:

1. Jordanian companies, to sustain competitive advantage, need to develop strategies aimed at investing more in and leveraging IC and at aligning IC with strategic goals. There is still room for IC efficiency to improve profitability, and in view of the decreasing trend in IC efficiency, Jordanian companies need to award IC high priority.

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DE SANTIAGO
DE COMPOSTELA

2. IC is again confirmed as a firm's hidden value that exerts significant impact on the creation of added value, yet this is not reflected in traditional financial statements. It is recommended that IC be legally disclosed for public scrutiny.
3. Organizational systems, reflected in the SC of the listed companies, show deficiencies concerning policies, programs, procedures, corporate culture, databases and other organizational capital that would significantly enhance corporate performance. Greater attention needs to be paid to developing strategies to correct and support internal business procedures.
4. A ranking of firms – especially large corporations – in the management, measurement and reporting of IC would be useful for both regulators and investors.
5. More emphasis could be placed on human resource policies due to the impact in creating added value in corporations, including investment in continuous training for human resource managers.
6. Government intervention is required through tax incentives related to intangibles which would boost the drive towards a knowledge-based economy.
7. The Jordanian real estate sector requires corrective actions to tackle mismanagement and poor value-adding capacity.

Finally, some limitations on the evidence reported in this study are as follows: (1) although this study used year-firm fixed and random effects, we did not fully control for other unobservable or omitted corporate or market variables that might influence the results (the endogeneity issue); (2) the scope of the study is limited to ten years (2009-2018) and to just three economic sectors; and (3) the choice of the VAIC model (see Stahle et al. (2011) for VAIC limitations) to measure IC efficiency might impact results and inferences, as different measurement methods have different properties. However, further research is required to investigate and explain potential reverse causality i.e., that good financial performance leads to an increase in IC efficiency.

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3.7 Appendix (C)

This section describes the diagnostic checks for the full study sample and its three sub-samples.

The Shapiro Wilk test provides evidence that the data is not normally distributed and, as a result, evidence of the Spearman's correlation is presented to show dependence among variables (Table C1-C8). However, no evidence is found of high correlation between explanatory variables except in the case of VAIC and HC, with Spearman's correlation values of 0.920, 0.900, 0.944 and 0.892 for the whole sample and manufacturing, services and real estate sectors, respectively. However, this is not a problem as they are not included in the same equation. Results for multicollinearity analysis using the variance inflation factor (VIF) show no multicollinearity among variables. A VIF value of less than 2.5 reflects the robustness of the study model in explaining the effect on the dependent variable.

Table C1. Spearman's correlation matrix for the whole sample

	ROA	ROE	EPS	REVGR	NPM
VAIC	0.630***	0.601***	0.535***	0.203***	0.639***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
RC	0.689***	0.661***	0.608***	0.213***	0.483***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SC	0.285***	0.266***	0.229***	0.067***	0.303***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
HC	0.675***	0.649***	0.583***	0.224***	0.708***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	-.118***	0.003	-0.025	0.041	-0.259***
	(0.000)	(0.930)	(0.428)	(0.192)	(0.000)
SIZE	0.124***	0.213***	0.234***	0.094**	0.113***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)

Note: ***, ** and * represents statistical significance at 1%, 5% and 10% levels, respectively.

Table C2. Spearman Correlation matrix for Normality, Multicollinearity test/ whole sample.

	VAIC	RC	SC	HC	LEV	SIZE	VIF
VAIC	1.000						1.11
RC	0.215***	1.000					1.01
	(0.000)						
SC	0.693***	-.172***	1.000				1.04
	(0.000)	(0.000)					
HC	**0.920*** **	0.273***	0.547***	1.000			1.13
	(0.000)	(0.000)	(0.000)				
LEV	-.135***	0.169***	-.188***	-.136***	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)			
SIZE	0.263***	0.033	0.163***	0.273***	0.144***	1.000	
	(0.000)	(0.286)	(0.000)	(0.000)	(0.000)		

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Continued from Table C2						
Shapiro-Wilk	0.000	0.000	0.000	0.000	0.000	0.000

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively. Spearman correlation is used due to non-normality of data distribution.

Table C3. Spearman's correlation matrix for the manufacturing sector.

	ROA	ROE	EPS	REVGR	NPM
VAIC	0.736***	0.704***	0.608***	0.244***	0.741***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
RC	0.677***	0.689***	0.620***	0.215***	0.574***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SC	0.431***	0.403***	0.335***	0.151**	0.429***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
HC	-0.801***	0.772***	0.678***	0.280***	0.827***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	-0.393***	-0.311***	-.346***	-0.045	-.421***
	(0.000)	(0.000)	(0.000)	(0.361)	(0.000)
SIZE	0.147***	0.147***	0.212***	0.132**	0.193***
	(0.003)	(0.003)	(0.000)	(0.007)	(0.000)

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

Table C4. Spearman's correlation matrix for Normality and Multicollinearity test/ manufacturing sector.

	VAIC	RC	SC	HC	LEV	SIZE	VIF
VAIC	1.000						1.14
RC	0.299***	1.000					1.05
	(0.000)						
SC	0.688***	-0.063	1.000				1.04
	(0.000)	(0.196)					
HC	**0.900*** **	0.384***	0.510***	1.000			1.18
	(0.000)	(0.000)	(0.000)				
LEV	-.355***	-0.174***	-0.276***	-.396***	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)			
SIZE	0.243***	- 0.008	0.163***	0.254***	0.109**	1.000	
	(0.000)	(0.869)	(0.001)	(0.000)	(0.026)		
Shapiro-Wilk	0.000	0.000	0.000	0.000	0.000	0.000	

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively. Spearman correlation is used due to non-normality of data distribution.

Table C5. Spearman's correlation matrix for the services sector.

	ROA	ROE	EPS	REVGR	NPM
VAIC	0.499***	0.478***	0.445***	0.153**	0.514***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
RC	0.695***	0.614***	.569***	0.189***	0.404***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SC	0.209***	0.201***	0.202***	0.030	0.251***
	(0.000)	(0.000)	(0.000)	(0.504)	(0.000)
HC	0.510***	0.497***	0.463**	0.172***	0.559***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	0.023	0.151	0.110***	0.086	-0.295***

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Continued from Table C5

	(0.603)	(0.001)	(0.013)	(0.054)	(0.000)
SIZE	-0.086*	0.275***	0.282***	0.093*	-0.029
	(0.053)	(0.000)	(0.000)	(0.039)	(0.518)

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

Table C6. Spearman's correlation matrix for Normality and Multicollinearity test/ services sector.

	VAIC	RC	SC	HC	LEV	SIZE	VIF
VAIC	1.000						1.12
RC	0.087***	1.000					1.01
	(0.050)						
SC	0.785***	-.224***	1.000				1.03
	(0.000)	(0.000)					
HC	0.944***	0.100**	0.688***	1.000			1.17
	(0.000)	(0.023)	(0.000)				
LEV	-0.028	0.204***	-0.057	0.037	1.000		
	(0.530)	(0.000)	(0.201)	(0.410)			
SIZE	0.271***	0.033	0.161***	0.210***	0.352***	1.000	
	(0.000)	(0.455)	(0.000)	(0.000)	(0.00)		
Shapiro-Wilk	0.000	0.000	0.000	0.000	0.000	0.000	

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively. Spearman correlation is used due to non-normality of data distribution.

Table C7. Spearman's correlation matrix for the real estate sector.

	ROA	ROE	EPS	REVGR	NPM
VAIC	0.750***	0.755***	0.708***	0.218**	0.725***
	(0.000)	(0.000)	(0.000)	(0.022)	(0.000)
RC	0.854***	0.856***	0.764***	0.256**	0.742***
	(0.000)	(0.000)	(0.000)	(0.007)	(0.000)
SC	0.001	0.017***	-0.013	-0.016	0.015
	(0.992)	(0.000)	(0.890)	(0.868)	(0.879)
HC	0.851***	0.854***	0.808***	0.220**	0.841***
	(0.000)	(0.000)	(0.000)	(0.021)	(0.000)
LEV	0.017	0.011**	-0.050	0.082	0.050
	(0.861)	(0.911)	(0.601)	(0.395)	(0.605)
SIZE	0.025	0.033	0.053	-0.058	-0.027**
	(0.798)	(0.732)	(0.584)	(0.546)	(0.000)

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively.

Table C8. Spearman's correlation matrix for Normality and Multicollinearity test/ real estate sector.

	VAIC	RC	SC	HC	LEV	SIZE	VIF
VAIC	1.000						1.11
RC	0.676***	1.000					1.01
	(0.00)						
SC	0.351***	-0.102	1.000				1.04
	(0.000)	(0.290)					
HC	0.892***	.793***	0.104***	1.000			1.09

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Continued from Table C8.						
	(0.000)	(0.000)	(0.281)			
LEV	-0.199**	0.124	-0.181*	-0.174*	1.000	
	(0.037)	(0.196)	(0.058)	(0.070)		
SIZE	0.231**	-0.088	0.234**	0.197**	-.959***	1.000
	(0.015)	(0.360)	(0.014)	(0.039)	(0.000)	
Shapiro-Wilk	0.000	0.000	0.040	0.000	0.000	0.002

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% level, respectively. Spearman correlation is used due to non-normality of data distribution.

In panel data with time series based on more than ten years, there is always the possibility of non-stationarity shocks that affect the long-term equilibrium of the series (Oppong and Pattanayak, 2019). Evidence from a Levin-Lin-Chu panel unit root test to check for data stationarity, reported in Table C9, indicates that all variables are stationary in all sectors except the SC variable in the real estate sector. However, this is not a problem for this study based on only ten years because, in panel series, there are only effects when the period is more than ten years.

Table C9. Panel unit root test results for variables.

	Whole sample		Manufacturing		Services		Real estate	
	Adjusted t-stat	P-value	Adjusted t-stat	P-value	Adjusted t-stat	P-value	Adjusted t-stat	P-value
ROA	-15.416	0.000***	-11.306	0.000***	-9.825	.000***	-10.699	0.000***
ROE	-16.249	0.000***	-7.285	0.000***	-16.172	0.000***	-4.158	0.000***
EPS	-15.413	0.000***	-5.863	0.000***	-13.566	0.000***	-52.149	0.000***
REVGR	-16.483	0.000***	-7.516	0.000***	-10.504	0.000***	-7.057	0.000***
NPM	-52.847	0.000***	-11.066	0.000***	-13.444	0.000***	-5.552	0.000***
VAIC	-11.596	0.000***	-9.410	0.000***	-7.570	0.000***	-1.451	0.073*
RC	-9.739	0.000***	-6.364	0.000***	-5.486	0.000***	-5.805	0.000***
SC	-11.690	0.000***	-8.700	0.000***	-10.360	0.000***	0.815	**0.792**
HC	-13.355	0.000***	-10.258	0.000***	-8.565	0.000***	-2.613	0.004***
LEV	-11.728	0.000***	-4.177	0.000***	-11.023	0.000***	-5.681	0.000***
SIZE	-28.193	0.000***	-9.831	0.000***	-4.560	0.000***	-36.652	0.000***

Notes: Levin-Lin-Chu panel unit root test including the adjusted t-statistic and P-value. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. When the P-value is significant in panel unit root testing, this indicates that the variables are stationary.

Finally, the Wooldridge test for autocorrelation is run, as some models suffer from autocorrelation in the whole sample and its sub-samples. Moreover, the Breusch-Pagan LM test is applied to examine the heteroskedasticity problem, with some of the models having this problem. To ensure valid statistical inference given problems of heteroskedasticity and autocorrelation in the models, cluster-robust standard errors are estimated, as this estimator produces heteroskedasticity-consistent standard errors that are robust and so appropriate for balanced panel data. Tables C10-C13 report results for those tests before treatment.

Table C10. Autocorrelation and heteroskedasticity test for ROA.

		ROA							
		Whole sample		Manufacturing		Services		Real estate	
VAIC	Wooldridge Autocorrelation	$F(1,103) = 7.228$	0.084	$F(1,41) = 9.743$	0.003	$F(1,50) = 19.545$	0.000	$F(1,10) = 0.015$	0.904
	Breusch-Pagan	$x^2(1)$ =2.94	0.086	$x^2(1)$ =2.29	0.1304	$x^2(1)$ =2.66	0.103	$x^2(1)$ =1.02	0.312
RC	Wooldridge	$F(1,103)$	0.000	$F(1,41)$	0.000	$F(1,50)$	0.000	$F(1,10)$	0.001
SC	Autocorrelation	$= 50.00$		$= 22.129$		$= 19.987$		$= 21.331$	
HC	Breusch-Pagan	$x^2(1)$ =1.32	0.251	$x^2(1)$ =3.64	0.0565	$x^2(1)$ =0.52	0.471	$x^2(1)$ =0.12	0.732

Table C11. Autocorrelation and heteroskedasticity test for ROE.

		ROE							
		Whole sample		Manufacturing		Services		Real estate	
VAIC	Wooldridge Autocorrelation	$F(1,103) = 7.228$	0.084	$F(1,41) = 9.743$	0.003	$F(1,50) = 19.545$	0.000	$F(1,10) = 0.015$	0.904
	Breusch-Pagan	$x^2(1)$ =0.09	0.758	$x^2(1)$ =2.37	0.124	$x^2(1)$ =0.06	0.813	$x^2(1)$ =0.80	0.371
RC	Wooldridge test	$F(1,103)$	0.000	$F(1,41)$	0.000	$F(1,50)$	0.000	$F(1,10)$	0.001
SC	Autocorrelation	$= 50.00$		$= 22.129$		$= 19.987$		$= 21.331$	
HC	Breusch-Pagan	$x^2(1)$ =6.44	0.011	$x^2(1)$ =1.52	0.2176	$x^2(1)$ =0.09	0.769	$x^2(1)$ =10.23	0.001

Table C12. Autocorrelation and heteroskedasticity test for EPS.

		EPS							
		Whole sample		Manufacture		Service		Real state	
VAIC	Wooldridge Autocorrelation	$F(1,103) = 7.228$	0.084	$F(1,41) = 9.743$	0.003	$F(1,50) = 19.545$	0.000	$F(1,10) = 0.015$	0.904
	Breusch-Pagan	$x^2(1)$ =82.90	0.000	$x^2(1)$ =22.61	0.000	$x^2(1)$ =15.49	0.000	$x^2(1)$ =2.66	0.103
RC	Wooldridge	$F(1,103)$	0.000	$F(1,41)$	0.000	$F(1,50)$	0.000	$F(1,10)$	0.001
SC	Autocorrelation	$= 50.00$		$= 22.129$		$= 19.987$		$= 21.331$	
HC	Breusch-Pagan	$x^2(1)$= 69.95	0.000	$x^2(1)$ =5.62	0.018	$x^2(1)$ =39.52	0.000	$x^2(1)$ =2.56	0.0.111

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Table C13. Autocorrelation and heteroskedasticity test for NPM.

		NPM							
		Whole sample		Manufacturing		Services		Real estate	
VAIC	Wooldridge Autocorrelation	$F(1,103) = 7.228$	0.084	$F(1,41) = 9.743$	0.003	$F(1,50) = 19.545$	0.000	$F(1,10) = 0.015$	0.904
	Breusch-Pagan	$x^2(1)$ =0.09	0.769	$x^2(1)$= =1.21	0.271	$x^2(1)$ =14.5	0.000	$x^2(1)$ =1.06	0.303
RC	Wooldridge	$F(1,103)$	0.000	$F(1,41)$	0.000	$F(1,50)$	0.000	$F(1,10)$	0.001
SC	Autocorrelation	$= 50.00$		$= 22.129$		$= 19.987$		$= 21.331$	
HC	Breusch-Pagan	$x^2(1)$ 61.67	0.000	$x^2(1)$ =8.62	0.003	$x^2(1)$ =62.25	0.000	$x^2(1)$ =0.24	0.627

Table C14. Description and measurement of variables.

Variable	Label	Definition and measurement
Value Added VA	VA=Output-Input VA=IN+HC+D+A+T+I IN=net income after tax HC=staff costs D=depreciation A=amortization T=taxes I= interests	Output refers to net revenues generated Input refers to expenses incurred excluding staff benefits.
Relational Capital RC	Total net tangible assets	Capital that enables HC and SC to create added value (Nuryaman, 2015). Refers to capital employed equal to the book value of net total assets.
Human Capital (HC)	All costs invested in staff	Knowledge possessed by staff. Refers to wages, salaries, bonuses, social security expenses, insurance, end-of-service benefits and any other renumeration.
Structural Capital (SC)	SC=VA-HC	Knowledge possessed by the firm. Excludes staff costs from VA to determine the value added by structural elements
RC Efficiency (RCE)	RCE=VA/CE	RCE coefficient describing the value-value-created by each dollar spent on capital employed
HC Efficiency (HCE)	HCEVA/HC	HCE coefficient describing the value added generated by each dollar spent on HC

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Continued from Table C14.		
SC Efficiency (SC)	SCE=SC/VA	SCE coefficient describing the value added generated by SC.
Intellectual Capital Efficiency (IC)	ICE=RCE+HCE+SCE	ICE coefficient describing the value created by intangible asset efficiency.
Value-added Intellectual Coefficient VAIC[11]	VAIC=RCE+HCE+SCE	Overall value-added efficiency generated by intellectual coefficient proxied by IC. A greater VAIC represents greater efficiency in IC employed, and thus greater value generated to the firm (Yang, 2019).
Firm Size	SIZE= (Log TA)	Firm size, to control for the effect of large and small firms on the regression model. Calculated by taking the logarithm for total net assets (TA).
Firm Leverage	LEV =(TD/TA)	Company indebtedness, to control for the effect of debt on the regression model. Calculated by dividing total debts (TD) by total net assets.
Return on Assets	ROA=Net Income/Total assets	
Return on Equity	ROE = Net Income/Total Net Equity	
Earnings Per Share	$\text{EPS} = \frac{Net\ Income}{Total\ outstanding\ common\ shares}$	
Net Profit Margin	$\text{NPM} = \frac{Net\ Income}{Total\ Revenues}$	

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Final Conclusions

This thesis has examined the impact of intellectual capital (IC) on sustainability information disclosure, earnings quality, and financial performance of Jordanian firms over the period 2009-2018.

Using the value-added intellectual coefficient (VAIC) model with its three components of human, structural, and relational capital (HC, SC, and RC, respectively), the first part of thesis documents that voluntary disclosure of environmental, social, and governance (ESG) practices enhances IC efficiency, that disclosing governance information improves IC efficiency through the HC and RC components, that disclosing social information is negatively associated with IC efficiency through the SC and RC components, and that environmental information is unrelated to IC efficiency. Likewise, releasing information on more than one of the ESG dimensions has a positive effect on IC efficiency.

The second part of the thesis has explored whether IC efficiency is associated with corporate earnings quality (EQ) as measured by total accruals. Findings are of a significant positive association between IC efficiency and EQ, a significant negative relationship between SC and EQ, and no relationship between HC and EQ for all sectors except for real estate.

Finally, the third part of the thesis has analysed whether IC efficiency could shape corporate financial performance through different profitability indicators. Reported is a positive impact of IC efficiency on corporate performance that holds across all the studied sectors. Likewise, a positive association is found between corporate performance and the HC and RC components, with some few exceptions. However, our evidence indicates a mixed impact regarding the SC component.

The empirical evidence of the thesis has implications for the management of intangible assets to achieve sustainable competitive advantage, improve capital market efficiency, and enhance capital inflows for the emerging Jordanian economy.

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Esta tesis estudia el impacto del capital intelectual (IC) en la difusión de información sobre sostenibilidad, en la calidad de las ganancias y en el desempeño financiero de las empresas jordanas durante el período 2009-2018. La primera parte de la tesis documenta que la divulgación voluntaria de los factores ambientales, sociales y de gobernanza (ESG) mejoran la eficiencia del IC, mientras que la divulgación de información social se asocia negativamente con la eficiencia del IC. La segunda parte de la tesis muestra que existe una asociación positiva y significativa entre la eficiencia del IC y la calidad de los beneficios empresariales. La tercera parte de la tesis documenta la existencia de un impacto positivo de la eficiencia del IC en el desempeño corporativo.