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Does Intellectual Capital Efficiency Affect Earnings Quality? Evidence for Jordanian Listed Companies

Samih M. A. Sowaity

Universidade de Santiago de Compostela, A Coruna, Spain
Email: s0599721030@gmail.com

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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 were 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, corporate management decision-making, and the performance of the Jordanian capital market.

Keywords

Intellectual Capital Efficiency, Earnings Quality, Amman Stock Exchange, Total Accruals, Value-Added Intellectual Coefficient (VAIC)^{TM}

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 asset 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 & Canavate, 2015; Alipour, 2011). Knowledge, as a proxy for education or R & D investments, has been identified as a major determinant of technological change and as a relevant competitive tool (Ståhle et al., 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 the successful management of its Intellectual Capital (IC) (Al-Musali & Ismail, 2014; Palacios & 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 & Akter, 2022).

Over the last few years, a significant number of models to measure intangibles have been generated and developed (Palacios & 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[1] 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 & 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).

IC efficiency is an important factor in determining Earnings Quality (EQ)[2]. According to Dechow & Schrand (2004), EQ plays a key role in financial analysis processes, as it can help analyze 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 & 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

[1]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.

[2]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 & 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).

stunned the world's largest corporations, including Enron and WorldCom (Ajidi & 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: 1) increased beta (risk), which will increase the cost of capital due to low engagement from potential investors in buying corporate shares; 2) decreased stock market price, which will lead to a lowering of the firm's value; 3) loss of trust between the company and various stakeholders; and 4) 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 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 & 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 into 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.

The 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, 2013, 2018; Sarea & Alansari, 2016; Khajavi et al., 2016; Marzban et al., 2014; Taheri et al., 2013; Parast et al., 2013; Zanjirdar & 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 require 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 the 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.

2. Literature Review and Hypotheses Development

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 & Soltes, 2009; Dechow & Shrand, 2011). Bodie & 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 & Vincent, 2003).

According to Dechow & 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, Weili, & 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: 1) high EQ is important for rationalizing decision-making processes; 2) 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 3) 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 (Sarea & 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 & 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 & 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 (2010) proposed measures for intangibles fall into at least four categories: 1) 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; 2) 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; 3) Return on Assets (ROA) methods, which are calculated as the average pretax earnings for a period of time divided by the average total tangible assets; 4) 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 & Galvan, 2007).

This research focuses on three-dimensional categorization of VAIC components, *i.e.*, HCE, SCE and RCE (Bontis, 1998; Nuryaman, 2015; Edvinsson & 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 & Ramezan, 2011; Magrassi, 2002; Edvinsson & 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 & 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 & 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 & 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, De-jun (2009) as cited by Sarea & Alansari (2016) 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 & 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. 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 5.

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 & Ardi (2018). Marzban et al. (2014) supported a significant relationship between IC efficiency and earnings stability as an indicator for EQ. Additionally, Zanjirdar & Chogha (2012) evidenced a meaningful relationship between VAIC and EQ indicators such as earning stability and earning predictability. In a similar vein, Azizi et al. (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 (2013, 2018) 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 & 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.

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 & 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: 1) 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; 2) as it is based directly on the cash flow statement rather than balance sheet statement, use of the TACC measure is recommended by Collins & Hribar (2002), who validated the relevancy of estimating TACC compared 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.

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[3], it is an aggregate indicator of a firm's efficiency in employing its resources and creating value (Sarea & Alansari, 2016). VAIC represents how value added has been created per invested monetary unit in each resource; thus, the higher the coefficient, the better

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

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 (Ahangar, 2011; Sarea & 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 (Ahangar, 2011). 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 & 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:

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

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 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 Equation (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 & 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 & 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**).

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 (2019) official website (https://www.ase.com.jo/ar), 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 1** shows the companies and sectors, along with a description of the selection process followed.

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.

Table 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%

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.

5. Empirical Results

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 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

Table 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.

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 favourable for tax purposes from the perspective of management, owing to its one-third contribution in added-value activities for the capital 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).

Tables 3-5 show 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

Table 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.

Table 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.

Table 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.

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 sectors succeeded in adding value from investing in structural capital. Correlations reported in **Tables B2-B4** (Appendix) 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.

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.

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 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 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 & Alansari, 2016; Khajavi et al., 2016; Mojtahedi, 2013; Azizi et al., 2013; Marzban et al., 2014; Taheri et al., 2013; Asadollahi et al., 2013; Parast et al., 2013; Darabi et al., 2012; Zanjirdar & 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,

Table 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	χ^2 (3) 1.58 Random effect	χ^2 (3) 4.70 Random effect	χ^2 (3) 2.72 Random effect	χ^2 (3) 14.39*** Fixed effect
Breusch-Pagan LM	χ^2 (1) 56.17*** GLS applied	χ^2 (1) 8.88*** GLS applied	χ^2 (1) 31.39*** GLS applied	χ^2 (1) 14.82*** 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.

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 & 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 & 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.

5.3. Regression Results for Hypothesis 2

The evidence for the different components of VAIC (RCE, SCE, and HCE) is presented in Table 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

Table 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[4]	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	χ^2 (5) 12.66** Fixed effect	χ^2 (5) 12.52** Fixed effect	χ^2 (5) 9.77*** Fixed effect	χ^2 (5) 16.86*** Fixed effect
Breusch-Pagan LM	χ^2 (1) 60.46*** GLS applied	χ^2 (1) 9.85*** GLS applied	χ^2 (1) 35.05*** GLS applied	χ^2 (1) 3.47** 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.

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 & Chogha, 2012; Sarea & 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.

Table 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

[4]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.

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 & Chogha, 2012; Sarea & Alansari, 2016; Majidah et al., 2016), although the results for the manufacturing sector are consistent with Darabi et al. (2012).

Likewise, **Table 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 & Chogha, 2012; Sarea & 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.

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;

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: 1) 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); 2) Human capital may be used for other agendas not aligned to organizational goals; 3) The VAIC method might be flawed in measuring the added value of human resources in all industry sectors; 4) HCE may be attributed by other resources not included in its measurement; and finally; 5) 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.

7. Conclusion

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: 1) 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; 2) 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 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.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix

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

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 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 & 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 B5**, 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.

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 B6** 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.

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.

Continued

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[5] 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
Structural capital efficiency (SCE) Intellectual capital efficiency (ICE) Value-added intellectual coefficient	SCE=SC/VA ICE=SCE + HCE	SCE coefficient describing the value added generated by structural capital efficiency. ICE coefficient describing the value created by intangible assets efficiency.
VAIC[6]	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.

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)				

[5]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).
[6]VAIC includes the three individual efficiencies and is the aggregation of the three efficiencies.

Continued

LEV	0.161***	−0.135***	0.169***	−0.188***	−0.136***	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
SIZE	−0.130***	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**	−0.3549***	−0.174***	−0.276***	−0.3961***	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.

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***	−0.224***	1.000				1.03
	(0.843)	(0.000)	(0.000)					

Continued

HCE	−0.091***	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***	0.793***	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**	−0.959***	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.

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

Variable	Full sample		Manufacturing		Services		Real estate	
	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

Continued

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.

Table B6. Autocorrelation and heteroscedasticity test.

Tests		EQ							
		Whole sample		Manufacturing		Services		Real estate	
VAIC	Wooldridge test Autocorrelation	F(1,103) 7.709	0.006	F(1,41) 0.396	0.001	F(1,50) 19.385	0.000	F(1,10) 0.009	0.926
	Breusch-Pagan test heteroskedasticity	χ^2 (1)=30.06	0.000	χ^2 (1)=10.57	0.000	χ^2 (1)=5.38	0.000	χ^2 (1)=0.97	0.325
RCE SCE HCE	Wooldridge test Autocorrelation	F(1,103) 8.33	0.000	F(1,41) 24.07	0.000	F(1,50) 18.26	0.000	F(1,10) 2.56	0.141
	Breusch-Pagan test heteroskedasticity	χ^2 (1)=46.31	0.000	χ^2 (1)=12.51	0.000	χ^2 (1)=49.20	0.000	χ^2 (1)=4.30	0.038

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.