

## THE EFFECT OF RELATIONAL CAPITAL ON THE INTELLECTUAL CAPITAL AND FIRM PERFORMANCE NEXUS: EVIDENCE FROM THE JORDANIAN INDUSTRIAL SECTOR

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**Abstract:** This study aims to investigate the relationship between intellectual capital (IC), measured through value-added intellectual coefficient (VAIC<sup>TM</sup>) and firm performance, measured through market-to-book (M/B) value ratio of the industrial sector in Jordan, using the relational capital (RC) as a moderating variable. Hierarchical regression models are applied with data collected from 50 industrial companies listed on the Amman Stock Exchange (ASE) during 2008–2017. The results of the analysis show that VAIC<sup>TM</sup> has a significant positive effect on the M/B. In terms of VAIC<sup>TM</sup> components, it has been shown that capital employed efficiency (CEE) has a significant positive effect on the M/B. In addition, RC is found to have a positive effect on the firm performance. Furthermore, RC, measured through relational capital efficiency (RCE) has a moderating role on the relationship between IC and a firm's performance, which negatively affects the performance of industrial sector in Jordan. Similarly, RC also has a moderating role on the relationship between VAIC<sup>TM</sup> components (HCE and SCE) and M/B.

The results of this study can be used as a starting point by policymakers and managers of industrial sector in Jordan to understand the importance of IC components and their interactions, especially the relational capital, in developing strategies to improve the firm performance.

Keywords: Intellectual capital, relational capital, value-added intellectual coefficient, firm performance, industrial sector.

### Introduction

In recent years, there has been an emergence of knowledge economies due to the rapid development of technology that occurred at the end of the twentieth century which has led to a shift in the factors of production from land, employment, and physical capital (the traditional concept of capital) to the emergence of a new capital concept, which takes into account the technical expertise of workers in the companies, their intellectual creativity and intelligence, which is known as intellectual capital (IC). This form of capital explains that knowledge and ideas are the basis of wealth creation (Slimani *et al.*, 2016).

IC is an intangible asset, which relies on the knowledge, information, and experience accumulated by corporate employees (Bradley,

1997). It comprises of human capital (HC), which shows the level of education, training, and experience of company employees. This part constitutes 36% of the total intellectual capital. While structural capital (SC) constitutes 29%, it examines the corporate infrastructure and includes the material elements in the companies. Finally, relational capital (RC) or commonly known as customer capital (CC) makes up 35% of the total intellectual capital, which examines the company's relationship with its customers (Bontis, 2003; Ramanauskaitė & Rudzionienė, 2013).

Until now, there has been no precise definition of IC, given the diverse factors that affect its nature. One of the most influential definitions of IC was established by Sullivan (2000), who advocated that IC represents

company knowledge that has the potential to be converted into tangible profit. In addition, researchers found a gap between the book and market value of companies, which refers to IC (Edvinsson, 1997). The definition of IC that is used in the present study is as defined by Pulic (2008): “the people or the employees who have the knowledge and the ability to transform this knowledge to the new products or to create value to the company”.

Various scholars have suggested more than 60 classifications and measurement methods of IC (Ramanauskaitė & Rudžionienė, 2013). The present study utilises VAIC™ model, designed by the Ante Pulic in 1998. It measures the firms' total value creation efficiency of three key resources: human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE). VAIC™ model has gained widespread use in many countries because it is easy to measure, and at the same time, allows the comparison be made between firms (Fijałkowska, 2014). However, one of the criticisms faced by VAIC™ is the lack of inclusion of relational capital (RC) in the model (Iazzolino & Laise, 2013; Momani *et al.*, 2020; Mondal, 2016; Nazari & Herremans, 2007; Stähle, Stähle, & Aho, 2011).

The importance of RC to firms, is to gain a unique competitive advantage, through obtaining the right feedback from external channels such as customers and suppliers. Besides, RC is the most important component for any firms because it is the main source of income to the companies in sustaining its business activities (Sharabati *et al.*, 2013).

Thus, this study aims to investigate the relationship between VAIC™ and performance of companies in the industrial sector in Jordan for the period 2008 to 2017. Because of the criticism faced by the VAIC™ model mentioned earlier, this study further investigates whether relational capital (RC), measured by relational capital efficiency (RCE) moderates the relationship between IC and industrial firms' performance measure, namely the market-to-book (M/B) value ratio.

Generally, IC related studies in Jordan uses sub-sectors in Amman Stock Exchange (ASE). For example, pharmaceutical manufacturing (Sharabati *et al.*, 2010, 2013; Sharabati & Nour, 2013), banks (Al-shubiri, 2011; Momani, 2017; Momani & Nour, 2019) human capital (HCE), hotel industry (Zeglat & Zigan, 2013, and telecommunication companies (Yaseen *et al.*, 2016). The present study seeks to fill the gap by looking at the main sectors in Jordan, one being the industrial sector. According to the central bank of Jordan 2017 annual report, the industrial sector is the second most important sector, contributing about 21.1% to Jordan's gross domestic product (GDP).

This study contributes significantly in that it provides information about the firms' performance improvements following the IC application to the managers of the industrial sector, as well as policymakers in Jordan. By utilising the RC element, it is expected that managers can improve the firms' performance, and sustain companies in the competitive economy (Sharabati *et al.*, 2013).

The remaining part of this paper is dedicated to a literature review and hypotheses development, followed by the research methodology of the study, and the results obtained from regression analysis. The paper ends with a discussion of its findings and conclusion.

## Literature Review and Hypotheses Development

### *Intellectual Capital and Its Components*

The term IC, was first used in 1969 by Galbraith (Pouraghajan *et al.*, 2013). Generally, an accepted definition of IC is still lacking. Several efforts have been made to develop an acceptable definition for IC. For instance, Bradley (1997) defines IC as a company's capacity to convert knowledge and intangible assets into wealth-creating resources. Marr *et al.* (2004) define IC as a group of knowledge assets that improve an organisation's competitive position by adding value to it. Stewart and Ruckdeschel (1998)

argued that IC that is not actively used in the firm is capital that is buried and wasted. Ozkan *et al.* (2017) mentioned that IC represents intangible assets that are not listed explicitly on a firm's balance sheets but that positively impact the firm's performance.

(Pulic, 2004, 2008) stated that IC is the main resource for creating a competitive advantage and posited that traditional measurement methods of company performance are not appropriate for measuring knowledge performance, as, in his view, traditional measures do not explain the value created from knowledge assets (Iazzolino & Laise, 2013). Some researchers did not agree with the definition of IC and its components, but most studies divided it into three main components. According to Petrash (1996), the component of IC comprises human capital (HC), structural capital (SC), and relational capital (RC), also known as customer capital (CC).

According to the resource-based view theory, human capital is a unique resource that can drive competitive advantage for the long-term of company's life (Welbourne & Pardodel-Val, 2009). HC is the core element of the IC because it is the main source of innovation, sustainability and competitive advantage, which depends on the employees who have a higher degree of skills, experiences, talents with higher education (Ngugi, 2013). Human capital can be depicted as the number of company's employees, the employee's education, and years of experience in the company's field work (Lee & Lin, 2018). Andreeva & Garanina (2016) define HC as a company's ability to get benefits from the employee's knowledge, skills, and experience, as well as innovations.

The second primary element of the IC is SC which consists of processes, information technology systems and databases of companies. It helps and supports the HC (Chahal & Bakshi, 2016). In the recent years, interest in SC research has increased rapidly because of the companies' wish to be competitive in the market. It consists of the internal and external capital (Gogan *et al.*, 2015) for most of the organizations, the changes have become more frequent and appear faster

than their ability for adjustment and speed in responsibility. Organisations wishing to obtain competitive advantage must understand that these intangible assets represent a greater value than traditional tangible assets. Measuring structural capital (SC). SC supports HC to create the wealth for the company and remains in it after employees leaving the company (Pouraghajan *et al.*, 2013).

The third component of IC is RC, which explains the relationships between the companies and its customers and market channels (Masoomzadeh *et al.*, 2020). RC, also known as customer capital (CC) is based on the knowledge of marketing channels and customers, knowledge from customers and suppliers and related industries (government) (Bontis, 1998). Martí (2003) emphasized that RC is the relationship between the company and its customers, suppliers, shareholders, and banks including all the marketing strategies of the company and its related trademarks and others.

#### ***VAIC™ and Firm Performance***

VAIC™ model measured the value creation efficiency by using accounting numbers from annual reports (Pulic, 2000) the higher the company's value creation efficiency will be (whereby human capital, as the decisive value creation factor of modern business. This method combined financial and physical capital efficiency and intellectual capital efficiency (ICE) to measure the performance of a company (Pulic, 2000, 2004b, 2008; Stähle *et al.*, 2011) the higher the company's value creation efficiency will be (whereby human capital, as the decisive value creation factor of modern business. Thus, this method does not measure the value of IC itself but it measures the IC efficiency and financial as well as physical capital impact on the company (Stähle *et al.*, 2011; Ulum *et al.*, 2014).

Pulic (2000, 2004, 2008) the higher the company's value creation efficiency will be (whereby human capital, as the decisive value creation factor of modern business mentioned that the suitable tool to measure the value

creation in the economy knowledge for the companies is the value-added (VA) because it measures the productivity for every type of work at the company's level. VA is defined as an indicator for measuring the employees' knowledge performances. It is computed as the difference between output (i.e. the revenue or the total sales) and input (all cost or expenses except for employee cost) (Pulic, 2004). Because of the decisive role of the employees in the value creation process, the labour expenses cannot be regarded as costs but treated as an investment (Pulic, 2000).

According to Pulic methodology, HCE is basically interpreted as employee expenses and considers it as an HC. This means that this expenditure is not treated as an expense but as an investment of the employees. To determine the HCE value, VA amount is divided into HC (Pulic, 2008). While SC remains in the company after leaving employees, such as programs and software, database and infrastructure, the SCE is measured by dividing SC on the VA (Abdulsalam et al., 2011). Finally, CEE explains the value created per one monetary unit of shareholders capital. It is calculated as VA divided by the book value for the company and refers as CE.

Researchers have studied how IC and its components are related to firms' financial performance. Taking 151 listed companies on the Hong Kong Stock Exchange as the sample, Chu et al. (2011) found a significant and negative relationship between VAIC<sup>TM</sup> and M/B; and a positive relationship between CEE and M/B, return on equity (ROE), and return of assets (ROA). Murale et al. (2010) examined the effect of VAIC<sup>TM</sup> on the M/B ratio of 13 companies in the Bombay Stock Exchange and found a positive significant relationship between VAIC<sup>TM</sup>, CEE, HCE, SCE and M/B Ratio.

Al-shubiri (2011) human capital (HCE) studied IC via VAIC<sup>TM</sup> and the relationship with financial performance of 14 commercial banks in Jordan, for the period of 2002-2007 and documented a significant positive relationship with M/B ratio and financial performance (ROA, ROE). In the Kingdom of Saudi Arabia and the

Kingdom of Bahrain, a positive relationship between IC and accounting-based performance was noted (Hamdan, 2018). Momani et al. (2020) studied the impact of VAIC<sup>TM</sup> on the firm performance for the Jordanian industrial companies through the period 2008-2017 and found a positive relationship between VAIC<sup>TM</sup> and firm performance.

Companies that have the ability to exploit their resources effectively will be able to increase their net profits. This leads to an increase in the market value of the company and then an increase the confidence of investors. Therefore, it will increase the share price of the company and the M/B ratio (Chatzcoudes, 2013) one of ratios related to market value. For proof this matter (subject. Theoretically, the increase of VAIC<sup>TM</sup> will increase with M/B ratio (Chatzoudes et al., 2011b). Most of prior studies which are discussed earlier supported that there is a positive relationship between VAIC<sup>TM</sup> and M/B. These studies suggested that the increasing gap between M/B relation and explained the value of IC that measured by VAIC<sup>TM</sup> (Chatzoudes et al., 2011a; Pouraghajan et al., 2013; Kamath, 2015; Nuryaman, 2015; Suhendra, 2016; Smriti & Das, 2017). Based on the above discussion the study proposes the following hypotheses:

H1: VAIC<sup>TM</sup> has a significant relationship with M/B ratio in the industrial sector and the Amman Stock Exchange.

It is of particular interest to know how do the different elements of VAIC<sup>TM</sup> based on the conceptual model developed by Pulic, (2000) the higher the company's value creation efficiency will be (whereby human capital, as the decisive value creation factor of modern business relate to the M/B ratio. Therefore, the following sub-hypotheses are formulated as follows:

H1a: HCE has a significant relationship with M/B ratio in the industrial sector on the Amman Stock Exchange.

H1b: SCE has a significant relationship with M/B ratio in the industrial sector on the Amman Stock Exchange.

H1c: CEE has a significant relationship with M/B ratio in the industrial sector on the Amman Stock Exchange.

### **Relational Capital**

The third component of IC is RC which explains the relationships between the companies and its customers. RC is based on the knowledge of marketing channels and the customers, knowledge from customers and suppliers and related industries (government) (Bontis, 1998). Harris, (2000), Martí (2003) and Starovic & Marr (2005) emphasise that RC is the relationship between the company and its customers, suppliers, shareholders and banks including all the marketing strategies of the company and its related trademarks and others.

Statistically, if the relationship between the independent variable and the dependent variable depends on another variable, the latter is called a moderating variable (Frazier *et al.*, 2004). According to Hair *et al.* (2014), the moderator effect in which a third independent variable or the moderator causes the relationship between dependent and independent variable to change, depends on the value of the moderator variable. Therefore, in the present study, the RC becomes the moderating variable, which is measured through RCE (Kehelwalatenna, 2016; Nazari & Herremans, 2007; Ulum *et al.*, 2017; Vishnu & Gupta, 2014), to investigate the relationship between VAIC<sup>TM</sup> and firm performance in the Jordanian industrial sector.

Previous studies have addressed the VAIC<sup>TM</sup> and its relationship with the firm's performance. These studies reveal that some

companies still suffer from inefficient utilization for sources because the results showed a different relationship between VAIC<sup>TM</sup> and firm performance. A few studies modified the relationship among VAIC<sup>TM</sup> by adding RC as a new component to ICE, and firms' performance (Bayraktaroglu *et al.*, 2019; Nazari & Herremans, 2007; Ulum *et al.*, 2014; Vishnu & Gupta, 2014; Zulkifli *et al.*, 2017).

In recognising the moderating role of RC, the second objective of the present study is looking at the relationship between VAIC<sup>TM</sup> and the firms' performance. The following hypotheses come to fill the gap in the literature with regards to the role of RC on the VAIC<sup>TM</sup> and M/B.

H2: The RC as moderator has an influence on the VAIC<sup>TM</sup> and M/B ratio in the industrial sector of the Amman Stock Exchange.

In terms of VAIC<sup>TM</sup> components, the following sub-hypotheses are formulated as follows:

H2a: RC as moderator has an influence on the HCE and M/B ratio in the industrial sector of the Amman Stock Exchange.

H2b: RC as moderator has an influence on the SCE and M/B ratio in the industrial sector of the Amman Stock Exchange.

H2c: RC as moderator has an influence on the CEE and M/B ratio in the industrial sector of the Amman Stock Exchange. Figure 1 illustrates the conceptual framework for this study.



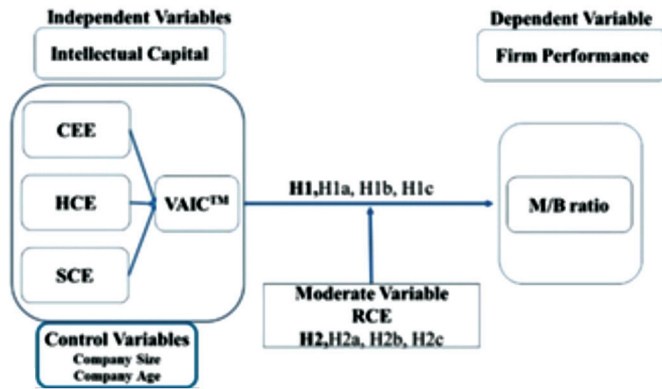


Figure 1: Conceptual Framework

**Research Methodology**

**Sample Selection**

The population of the present study comprises all 77 companies in the industrial sector listed on the ASE, which consist of 11 sub-sectors. Sample data was collected from annual reports for the 2008-2017 period. The selected companies are based on the following criteria:

- 1) The industrial company must be listed on the ASE within the period of this study.
- 2) The shares of the industrial companies must be actively published and traded in ASE during the period of study.
- 3) The financial year of the industrial companies in ASE must end in 31st of December every year.

Of the 77 industrial companies, 50 companies met the sampling criteria. Table 1 presents the sample for this study. After the exclusions of outliers and 36 observations with abnormal data values, 464 firm-year observations are included in the final sample.

Table 1: Sample of study

Sub-Sector	N	%
Pharmaceutical and Medical Industries	5	10
Chemical Industries	8	16
Paper and Cardboard Industries	1	2
Printing and Packaging	1	2
Food and Beverages	8	16
Tobacco and Cigarettes	2	4
Mining and Extraction Industries	11	22
Engineering and Construction	6	12
Electrical Industries	3	6
Textiles, Leathers and Clothing	5	10
Total	50	100%

**Variables**

The variables used in the analysis can be broadly classified into four categories: dependent, independent, moderating, and control variables.

**Dependent Variable**

The M/B ratio (or named the Price to Book ratio) is used to estimate a company’s current market value compared to its book value (Madinios *et al.*, 2011). A firms performance depends on the efficient use of intellectual resources to a large extent, thereby creating gaps between market and book value (Ghosh & Maji, 2015).

$$M/B = MV_{it}/BV_{it}$$

**Independent Variables**

Pulic’s VAIC™ (Pulic, 2008) model is employed to measure the IC in this study. VAIC™ is the sum of HCE, SCE and CEE. The procedures for calculating VAIC™ are as follows:

The value-added (VA) is measured as the difference between output and input. The output (OUT) considers all revenue and income from sold products and services. The input (IN) considers all expenses, except employee expenses. VAIC™ model considered employee

expenses as output because of the active role played by the labours in the value creation process (Belkaoui, 2003b; Pulic, 1998, 2004, 2008), Table 2 summarizes the calculation steps of VAIC™<sub>it</sub>.

**Moderating Variable**

A mediator variable is defined as a variable that clarifies the relevance between dependent and independent variables (Frazier *et al.*, 2004)line 8, right column, under the heading Checklist for Evaluating Mediation Analyses Using Multiple Regression, the question incorrectly asks, “Was the relation between the predictor and the outcome (Path b. According to Hair *et al.*, (2014) a moderator effect in which a third independent variable or the moderator causes the relationship between a dependent and independent variable to change, depends on the value of the moderator variable. It is also known as an interactive effect and is like the interaction effect seen in the analysis of variance methods. RC is used as a moderating variable in this study. It is measured through relational capital efficiency (RCE) (Nazari & Herremans, 2007; Ulum *et al.*, 2014, 2017). RCE is calculated as follows:

$$RCE = \frac{\text{market, sale and adverstising expenses}}{\text{value added}} \dots \text{ (Nazari \& Herremans, 2007; Ulum et al., 2014)}$$

Table 2: Calculation Steps of VAIC™

STEP	VARIABLES	EQUATION
STEP 1	VA	$VA_{it} = OP_{it} + EC_{it} + D_{it} + I_{it} + Div_{it} + T_{it}$
STEP 2	HCE	$HCE_{it} = VA_{it} / HC_{it}$
STEP 3	SC	$SC_{it} = VA_{it} - HC_{it}$
STEP 4	SCE	$SCE_{it} = SC_{it} / VA_{it}$
STEP 5	CEE	$CEE_{it} = VA_{it} / CE_{it}$
STEP 6	VAIC™	$VAIC_{it}^{TM} = CEE_{it} + HCE_{it} + SCE_{it}$

### Control Variables

This study involves two control variables which are company size and company age (Ahmad & Ahmed, 2016; Alhassan & Asare, 2016; Dzenopoljac *et al.*, 2017; Hamdan, 2018; Ozkan *et al.*, 2017; Sherif & Elsayed, 2016). The company size is measured through the natural logarithm for book value of the total assets in the company (Dang *et al.*, 2018; Harford *et al.*, 2008). Meanwhile, the company age is measured by the current year minus the formation year, and to make the study data more consistent, natural logarithm of age is used because logarithms capture large numbers with small numbers (Yasuda, 2005).

### Regression Models

Focusing on the aim of the study to examine the moderating effect of RC on the relationship between VAIC<sup>TM</sup>, its components and the M/B, hierarchical regression is used. According to Raudenbush and Bryk (2002) and Whitener (2001), hierarchical regression consists of four steps:

- Step 1 - To test the control variables (company size and company age).
- Step 2 - To test the independent variables with control variables (VAIC<sup>TM</sup>, HCE, SCE, CEE, and control variables).
- Step 3 - To test the independent variables and moderating variable with control variables (VAIC<sup>TM</sup>, HCE, SCE, CEE, RCE, and control variables).
- Step 4 - To test the independent variables and moderating variable with interaction with the independent variables and control variables (VAIC<sup>TM</sup>, HCE, SCE, CEE, RCE, VAIC<sup>TM</sup>\*RCE, HCE\*RCE, SCE\*RCE, CEE\*RCE and control variables).

All the models in this study are based on Hausman test panel data that employed the fixed effect model. The models testing for this study are as follows:

$$\text{Model 1: } M/B_{it} = \alpha_0 + \beta_1 \text{VAIC}_{it}^{\text{TM}} + \beta_2 \log\text{Size}_{it} + \beta_3 \log\text{Age}_{it} + \varepsilon_{it}$$

$$\text{Model 2: } M/B_{it} = \alpha_0 + \beta_1 \text{HCE}_{it} + \beta_2 \text{SCE}_{it} + \beta_3 \text{CEE}_{it} + \beta_4 \log\text{Size}_{it} + \beta_5 \log\text{Age}_{it} + \varepsilon_{it}$$

$$\text{Model 3: } M/B_{it} = \alpha_0 + \beta_1 \text{VAIC}_{it}^{\text{TM}} + \beta_2 \text{RCE}_{it} + \beta_3 \log\text{Size}_{it} + \beta_4 \log\text{Age}_{it} + \varepsilon_{it}$$

$$\text{Model 4: } M/B_{it} = \alpha_0 + \beta_1 \text{HCE}_{it} + \beta_2 \text{SCE}_{it} + \beta_3 \text{CEE}_{it} + \beta_4 \text{RCE}_{it} + \beta_5 \log\text{Size}_{it} + \beta_6 \log\text{Age}_{it} + \varepsilon_{it}$$

$$\text{Model 5: } M/B_{it} = \alpha_0 + \beta_1 \text{VAIC}_{it}^{\text{TM}} + \beta_2 \text{RCE}_{it} + \beta_3 \text{RCE}_{it} * \text{VAIC}_{it}^{\text{TM}} + \beta_4 \log\text{Size}_{it} + \beta_5 \log\text{Age}_{it} + \varepsilon_{it}$$

$$\text{Model 6: } M/B_{it} = \alpha_0 + \beta_1 \text{HCE}_{it} + \beta_2 \text{SCE}_{it} + \beta_3 \text{CEE}_{it} + \beta_4 \text{RCE}_{it} + \beta_5 \text{RCE}_{it} * \text{HCE}_{it} + \beta_6 \text{RCE}_{it} * \text{SCE}_{it} + \beta_7 \text{RCE}_{it} * \text{CEE}_{it} + \beta_8 \log\text{Size}_{it} + \beta_9 \log\text{Age}_{it} + \varepsilon_{it}$$

### Empirical Analyses

#### Descriptive Statistics

Table 3 presents descriptive statistics of the variables in this study. The result shows that the mean value of VAIC<sup>TM</sup> is 1.09085 with a minimum of 0.47748 and a maximum of 1.7917. The mean value of the HCE is the highest compared with CEE and SCE, which suggest HC is the driving element of value creation. It is notable that RCE is at low level, with mean value of -0.00002.

The mean value of M/B is -0.01047, indicating that the Jordanian industrial companies are earning poor return on its assets. In addition, the mean values of company size and age are 16.50316 and 3.00786, respectively.

This descriptive results coincide with results in (Al-shubiri, 2011; Alqadi & A'alamat, 2018; Hamdan, 2018; Momani *et al.*, 2020; Ulum *et al.*, 2014) structural capital efficiency, and capital adequacy efficiency, but differ from studies such as (Dadashinasab & Sofian, 2014; Maditinos *et al.*, 2011; Momani & Nour, 2019; Sherif & Elsayed, 2016; Zulkifli *et al.*, 2017) using various econometric techniques, the



Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>Independent variables</b>					
VAI <sup>CTM</sup>	464	1.09085	0.44716	0.47748	1.7917
HCE	464	1.02616	0.63374	0.11093	2.50787
SCE	464	-0.00001	0.09461	-0.22475	0.92219
CEE	464	0.30629	0.22524	0.02150	0.87348
<b>Moderating variable</b>					
RCE	464	-0.00002	0.20263	-0.19109	0.51637
<b>Dependent variable</b>					
M/B	464	-0.01047	0.67574	-2.0402	2.6582
<b>Control variables</b>					
Size	464	16.50316	1.35857	11.94746	20.63084
Age	464	3.00786	0.73844	0	4.18966

**VAI<sup>CTM</sup>** = Value added intellectual coefficient. **HCE** = Human capital efficiency. **SCE** = Structural capital efficiency. **CEE** = Capital employed efficiency. **M/B** = Market to book ratio. **RCE** = Relational capital efficiency. **Size** = Company size. **Age** = Company age.

impact of intellectual capital (IC). The reasons being: firstly, the study period, and secondly the study sector.

### Correlation Analysis

Table 4 presents the outcome of correlation analysis for the dependent and independent variables. The correlation analysis shows that M/B is positively and significantly correlated with VAIC, HCE, CEE and AGE. Among all components of IC, CEE exhibits significantly positive and highest correlation with the moderating variable, RCE. It also indicates that there is no multicollinearity amongst the variables as none correlates above 0.80 (Gujarati, 2001).

However, the correlation exceeded 0.8 in the case of VAIC<sup>TM</sup> and HCE (p-value = 0.955), and VAIC<sup>TM</sup> and SCE (p-value = 0.810). Nevertheless, this is not a problem because each variable is formulated in a separate regression model. Furthermore, it is confirmed by the variance inflation factors (VIF), which show the values range between 1.04 and 2.60, within the

cut-off points of 10 as reported by Hair *et al.* (2010). Hence, multicollinearity appears not to be a serious concern in this study. The results of correlation analysis are consistent with the results in Dženopoljac *et al.* (2016); Dženopoljac *et al.* (2017); Ozkan *et al.* (2017); Yilmaz & Acar (2018) and Zulkifli *et al.* (2017), but differ from Smriti & Das (2017).

### Regression Results

Table 5 shows the results from the panel data regression that employed the fixed effects model after Breusch and Pagan Lagrangian multiplier and Hausman test analysis were carried out. These models have been applied by many previous studies such as Amin & Aslam (2017); Frazier *et al.* (2004); Haan *et al.* (2016); Han & Li (2015); Hsu & Wang (2012); Sardo *et al.* (2018); Tayles *et al.* (2007) and Zeglal & Zigan (2013).

Table 6 presents the regression results of testing the effect of RCE on the relationship between VAIC<sup>TM</sup> and M/B. Model 1 includes VAIC<sup>TM</sup> as the main independent variable, the

Table 4: Pearson Correlation Analysis

Variables	VAIC	HCE	SCE	CEE	M/B	RCE	SIZE	AGE
VAIC	1							
HCE	.955*	1						
SCE	.810*	.762*	1					
CEE	.431*	.389*	.427*	1				
M/B	.125*	.130*	.035	.342*	1			
RCE	.039	-.009	-.030	.209*	-.040	1		
SIZE	.439*	.454*	.393*	.209*	.026	-.052	1	
AGE	-.119**	-.091***	-.069	-.104*	.171*	-.0214	.0502	1

\* Correlation is significant at the 0.01, \*\* at the 0.05, and \*\*\* at the 0.1 level.

Table 5: Lagrange and Hausman Test

Model	Lagrange Multiplier		Hausman		Appropriate Model
	Chi <sup>2</sup>	Sig.	Chi <sup>2</sup>	Sig.	
1	825.84	0.0000	12.3600	0.0062	Fixed effect
2	820.71	0.0000	13.0300	0.0111	Fixed effect
3	805.17	0.0000	25.2600	0.0001	Fixed effect
4	625.16	0.0000	28.2800	0.0000	Fixed effect
5	566.33	0.0000	37.7100	0.0000	Fixed effect
6	569.69	0.0000	37.6200	0.0000	Fixed effect

results indicate that VAIC<sup>TM</sup> is positively and significantly influencing M/B (coefficient = 0.13, p-value = 0.01), thereby supporting H1. Model 3 includes the moderating variable RCE, the results indicate that RCE is also positively and significantly influencing M/B (coefficient = 0.01, p-value = 0.01).

Previous studies reported a positive relationship between RCE and M/B (Ulum *et al.*, 2014, 2017; Yilmaz & Acar, 2018), but on the other hand, there are studies that found insignificant relationship between RCE and M/B (Nimtrakoon, 2015). Model 5 presents the influence of interaction term RCE\*VAIC<sup>TM</sup> on M/B. The results show significant impacts of the interaction of RCE and VAIC on M/B.

Notably the R<sup>2</sup> value in model 5 (R<sup>2</sup>=8.67%) are greater than those in model 1 and 3. The results corroborate that RCE has moderating effect on the relationship between VAIC<sup>TM</sup> and M/B, thereby supporting H2. The coefficient

of RCE\*VAIC<sup>TM</sup> is significantly negative ( $\beta = -0.62$ ,  $t = -2.43$ ), implying that RC expenses lower the firm M/B.

The interaction of variables can be understood by drawing the interaction. A common method that is used to plot the interaction is to choose groups at the mean, at the low and at the high value. We need to examine the regression of dependent variables on independent variables whether at moderate low, or moderate high. If the lines are parallel, there is no interaction; if the lines are not parallel, then there is an interaction (Cohen *et al.*, 2003; Frazier *et al.*, 2004).

Figure 2 clarifies that the company which has a high RCE and high VAIC<sup>TM</sup> faces low M/B. However, if the company has low RCE even though it has high VAIC<sup>TM</sup>, it has a high M/B. Taking from M/B point of view, RCE negatively influences the relationship between VAIC<sup>TM</sup> and M/B ratio.

Table 6: Regression results of model 1, 3, and 5

$$M/B_{it} = \alpha_0 + \beta_1 VAIC_{it}^{TM} + \beta_2 RCE_{it} + \beta_3 RCE * VAIC_{it}^{TM} + \beta_4 \text{logsize} + \beta_5 \text{logage} + \epsilon_{it}$$

Variables	Model 1 Independent Variables		Model 3 Dependent Variables		Model 5 Interaction Variable	
	Coef	T-test	Coef	T-test	Coef	T-test
Constant.	-2.01	-2.66**	-2.01	-2.27**	-1.96	-2.38**
<b>Control Effect</b>						
Size	0.15	3.36***	0.15	2.82**	0.16	3.17**
Age	-0.20	-3.70***	-0.20	-3.7***	-0.24	-4.73***
<b>Main Effect</b>						
VAIC <sup>TM</sup>	0.13	3.45***	0.13	3.36***	0.12	2.83**
<b>Moderate Effect</b>						
RCE			0.01	0.08*	0.51	1.52
<b>Interaction Effect</b>						
RCE*VAIC <sup>TM</sup>					-0.62	-2.43**
R <sup>2</sup>	7.64%		7.65%		8.67%	
R <sup>2</sup> change	0.96%		0.01%		1.02%	
F	26014.09		26014.09		3665.49	
Significant F	0.0000		0.0000		0.0000	

Notes: \*, \*\*, and \*\*\* significant levels at 1%, 5%, and 10%.

VAIC<sup>TM</sup>: Value added intellectual coefficient. Size: company size. Age: company age. RCE: relational capital efficiency. RCE\*VAIC<sup>TM</sup>: interaction between VAIC<sup>TM</sup> and RCE

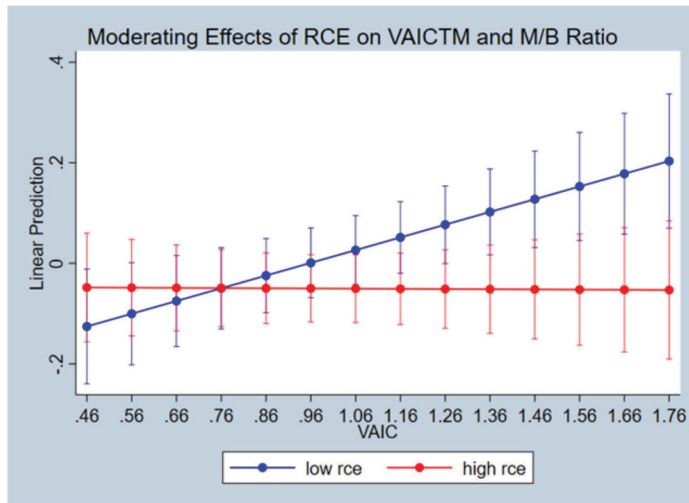


Figure 2: Moderating Effects of RCE on VAIC<sup>TM</sup> and M/B

Table 7 presents the regression results of testing the effect of RCE on the relationship between VAIC<sup>TM</sup> components and M/B. Model 2 illustrates the effect of VAIC<sup>TM</sup> components on M/B ratio. The results found insignificant relationship between HCE, and SCE with M/B. However, a positive significant relationship is found between CEE and M/B. In terms of control variables, company size and company age have a significant positive and negative effect on the M/B respectively. The results rejected H1a and H1b but supported H1c.

Adding RCE to model 4 marginally improves the model's explanatory power (R<sup>2</sup> from 0.0901 to 0.0912). The coefficient on RCE

is not significant ( $\beta = 0.13, t = 0.62$ ). However, the result indicates a significant positive relationship between SCE, CEE, and M/B. Like model 2, company size and company age has a significant positive and negative effect on the M/B respectively.

Finally, the last regression result, model 6, shows the effect of interaction between RCE and VAIC<sup>TM</sup> components on the M/B. The results show that all three components of VAIC<sup>TM</sup> are insignificant. Contrary to model 4, the coefficient on RCE is significant ( $\beta = 0.79, t = 2.65$ ) at 5 percent level. As the interaction between RCE and VAIC<sup>TM</sup> components are entered into the analysis, R<sup>2</sup> increased to 0.1222.

Table 7: Regression results of model 2, 4, and 6

$$M/B_{it} = \alpha_0 + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \beta_3 CEE_{it} + \beta_4 RCE_{it} + \beta_5 RCE_{it} * HCE_{it} + \beta_6 RCE_{it} * SCE_{it} + \beta_7 RCE_{it} * CEE_{it} + \beta_8 logsize_{it} + \beta_9 logage_{it} + \epsilon_{it}$$

Variables	Model 2		Model 4		Model 6	
	Independent Variables		Dependent Variables		Interaction Variable	
	Coef	t-test	Coef	t-test	Coef	t-test
<b>Constant.</b>	-1.73	-2.69**	-1.60	-2.06*	-2.24	-3.37***
<b>Control Effect</b>						
<b>Size</b>	0.14	3.88***	0.13	3.01**	0.18	4.82***
<b>Age</b>	-0.22	-4.20***	-0.23	-4.23***	-0.27	-5.52***
<b>Main Effect</b>						
<b>HCE</b>	-0.03	-0.41	-0.03	-0.43	-0.013	-0.19
<b>SCE</b>	0.37	1.62	0.42	2.00*	0.46	1.53
<b>CEE</b>	0.42	2.73**	0.45	2.84**	0.30	1.63
<b>Moderate Effect</b>						
<b>RCE</b>			0.13	0.62	0.79	2.65**
<b>Interaction Effect</b>						
<b>RCE*HCE</b>					-0.92	-3.18**
<b>RCE*SCE</b>					4.35	2.93**
<b>RCE*CEE</b>					0.46	0.69
<b>R<sup>2</sup></b>	0.0901		0.0912		0.1222	
<b>R<sup>2</sup> change</b>	0.0233		0.0011		0.031	
<b>F</b>	277.07		234.67		333.51	
<b>Significant F</b>	0.0000		0.0000		0.0000	

Notes: \*\*\*, \*\*, and \* significant at the levels 1%, 5%, and 10%.

**HCE:** Human capital efficiency. **SCE:** Structural capital efficiency. **CEE:** Capital employed efficiency. **RCE:** Relational Capital Efficient. **Size:** company size. **Age:** company age. **RCE\*HCE:** interaction between HCE and RCE. **RCE\*SCE:** interaction between SCE and RCE. **RCE\*CEE:** interaction between CEE and RCE

This reveals that RCE has a moderating effect on the relationship between VAIC™ components and M/B. Furthermore, the interaction between RCE and HCE has a negative impact on M/B, therefore supporting H2a. Meanwhile, the interaction between RCE and SCE has a positive impact on M/B, thereby H2b is supported. However, the effect of RCE and CEE interaction on the M/B has become insignificant, thereby rejecting H2c. In addition, company size has a significant positive impact on M/B, while company age has a significant negative impact on M/B.

Figure 3 clarifies that the company which has a high RCE and high HCE faces low in M/B. However, if the company has low RCE, even though it has a high HCE, it has a high M/B ratio. From the M/B point of view, RCE may negatively influence the relationship between HCE and M/B ratio. Therefore, the hypothesis H2a is supported.

Figure 4 clarifies that the company which has a high RCE and high SCE faces high in M/B. However, if the company has low RCE, even though it has a high SCE, it has a low M/B

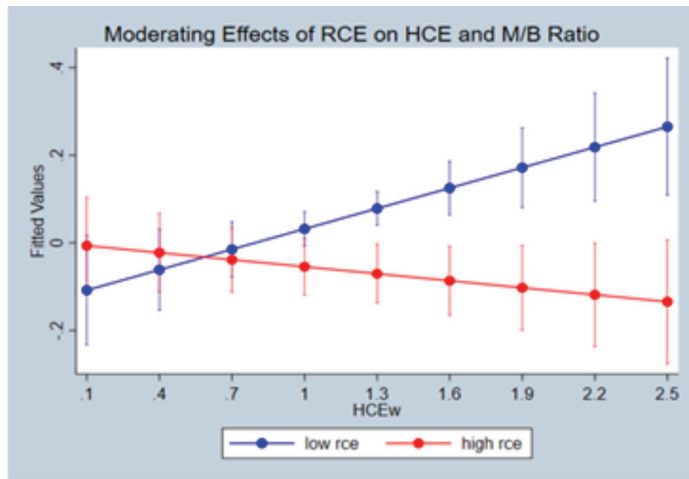


Figure 3: Interaction Effect of RCE on HCE and M/B

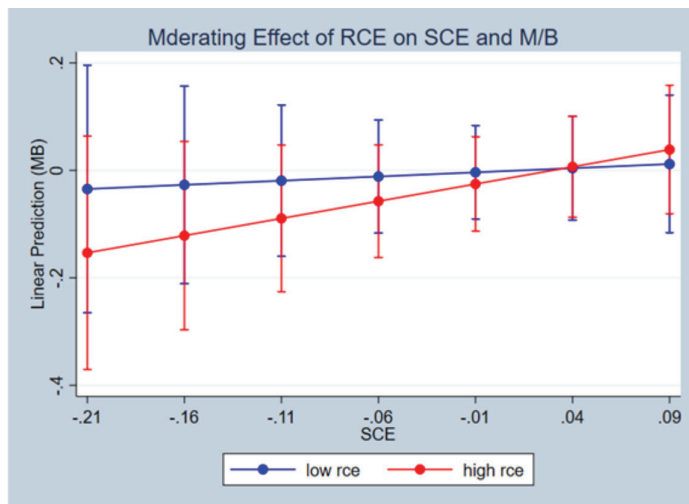


Figure 4: Interaction Effect of RCE on SCE and M/B



ratio. From the M/B point of view, RCE may positively influence the relationship between SCE and M/B ratio. Therefore, the hypothesis H2b is supported.

Figure 5 clarifies that there is no interaction effect of RCE on CEE and M/B ratio. Therefore, hypothesis H2c is not supported.

**Discussion**

The main purpose of the present study is to examine the moderating role of RC, measured by RCE on the relationship between VAIC<sup>TM</sup> and its components with M/B ratio of industrial companies listed on the Amman Stock Exchange during 2008-2017.

Based on regression analysis, the results in Model 1 indicate that VAIC<sup>TM</sup> has a positive effect on firm performance indicator (M/B), thereby supporting H1. When RCE is entered into the model 3, the results reveal that RCE also have a positive impact on M/B, which supports previous studies (Ulum *et al.*, 2014, 2017; Yilmaz & Acar, 2018) which is between -21.41 until 5.20. Based on M-VAIC scores, performance of IC is classified into four, namely Top Performers, Good Performers, Performers Common, and Bad Performers. The results show that the ranking of three of the four state banks

are on the Top Performers category. M-VAIC can be used to measure the ICP all of industries, not only banks. This is also reinforced by the results of the regression that indicate that the value added (VA, but contrary to the finding by Nimtrakoon (2015). As the interaction term RCE\*VAIC<sup>TM</sup> is entered into the model 5, the results show significant impacts of RCE and VAIC interaction on M/B. Notably the R<sup>2</sup> value in model 5 (R<sup>2</sup>=8.67%) are greater than those in model 1 and 3. The results corroborate that RCE has moderating effect on the relationship between VAIC<sup>TM</sup> and M/B, thereby supporting H2. The coefficient of RCE\*VAIC<sup>TM</sup> is significantly negative ( $\beta = -0.62, t = -2.43$ ), implying that RC expenses lower the firm M/B. In addition, a possible explanation for this result may be that non-financial factor affecting the industrial Jordanian companies such as customer satisfaction. Although companies had spent on advertising and promotion to reach the customers, it may not satisfy the customers (Wang & Chang, 2005).

As illustrated in Table 6, the results in Model 2 found insignificant relationship between HCE, and SCE with M/B. Therefore, H1a and H1b are not supported. However, a positive significant relationship is found between CEE and M/B, which supports H1c. This

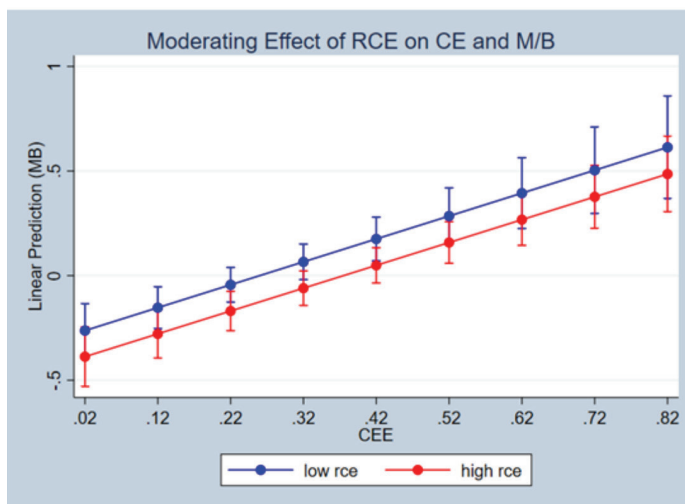


Figure 5: Interaction Effect of RCE on CEE and M/B

implied that in terms of VAIC<sup>TM</sup> components, only the CEE has a positive impact on M/B. The addition of RCE into model 4 slightly improves the model's explanatory power, but the impact is not significant.

The final model 6 results show that all three components of VAIC<sup>TM</sup> are insignificant. RCE is found to have a moderating effect on the relationship between VAIC<sup>TM</sup> components and M/B. Furthermore, the interaction between RCE and HCE has a negative impact on M/B, therefore supporting H2a. This means that, the higher the value of HCE, the lower its M/B. Meanwhile, the interaction between RCE and SCE has a positive impact on M/B, thereby H2b is supported. This means that, the higher the SCE of the companies, the higher their M/B value. However, the effect of RCE and CEE interaction on the M/B has become insignificant, thereby rejecting H2c.

## Conclusion

In the era of knowledge economy, IC has been increasingly regarded as a major driver of business performance. The objective of this study is to examine the relationship between IC, measured through VAIC<sup>TM</sup> and the firm performance, measured through market to book (M/B) value ratio of the industrial sector in Jordan, using the RC as a moderating variable. The regression analysis results on the data from industrial sector in ASE during 2008-2017 period validate earlier studies and extend the IC literature, especially on the role of RC as a moderating factor towards firm performance. This study has several important implications.

First, the effect of RC as a moderator on the relationship between VAIC<sup>TM</sup> and firm performance is consistent with the stakeholder theory because the results show a negative relationship between VAIC<sup>TM</sup> and M/B. In addition, the effect of RC on the relationship between VAIC<sup>TM</sup> components and the firms' performance show a negative relationship of RC with HCE and M/B, and a positive relationship of RC with SCE and M/B. These results may be

due to the political situation in the Middle East, which directly affects Jordan.

The results of this study provides policymakers with alternative knowledge resources and the means to improve the knowledge resource relationship, especially with regards to human and structural capital. These results are important for managers and business leaders in industrial companies to highlight the importance of IC and supporting RC to enhance the most significant IC components to get better performance in the companies.

Following the results of this study, future research should focus on the RC and the relationship between VAIC<sup>TM</sup> and firm performance by paying attention to all sectors in the ASE. In addition, studying a different period from the period of this study, two financial and economic crises that affected Jordan's economy also took place during the period under review.

Nevertheless, this study has some limitations that could be improved in the near future research opportunity. First, the results of this study cannot be generalized to the Middle East, because the sample of the present study was restricted to industrial companies listed in ASE only, and the findings are confined to the industrial companies listed in ASE. Next, the study only uses the quantitative data of VAIC<sup>TM</sup>, RC, and the M/B ratio that are available in the ASE database, published annual reports but ignores the qualitative portions of VAIC<sup>TM</sup> and RC.

Finally, the period for the study comes through two crises; the first one mortgage crisis that affected the Jordanian economy since 2008-2011, and the second one the Arab Spring since the late 2011.

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