Does the efficiency of a firm's intellectual capital and working capital management affect its performance?

Abstract:

This study explores the efficiency of intellectual capital (ICE) and working capital management (WCME) in the GCC industrial sector and its potential impact on firm performance. The data were gathered from Standard & Poor's database from 2015 to 2019. This study uses data envelopment analysis (DEA), regression analysis, and robustness tests to accomplish its aims. The results indicate that most firms do not employ their intellectual and working capital investments well and need improvement actions to achieve the best practices. The regression model results reveal that ICE and WCME significantly and positively influence firms' performance. The results of this study support the resource-based, trade-off, and pecking order theories. The study findings have important implications for many stakeholders; for example, they would be helpful for firm decision-makers in managing their investments in intellectual and working capital to achieve the best practices and improve a firm's performance. In addition, the findings would be helpful for financiers, because high-performance firms are likely to have more reasonable valuations that facilitate debt financing. Moreover, the findings have noteworthy implications for trading procedures as investors aspire to attractive economic returns for their investments in corporations that pasture ICE and WCME issues. Additionally, these findings have important implications for employee job satisfaction and retention by improving IC management.

Keywords: Intellectual capital, working capital management, performance, relative efficiency, data envelopment analysis.

1. Introduction

Firms that desire to outshine in the business environment seek to employ available and limited resources to the best of their ability to achieve their goals. Because scarcity of resources is a significant limitation in the business environment, resource-allocation theory assumes that firms pick the most economical methods for distributing production factors and allocating them to various productive activities to achieve maximum returns (Ferrier, 1994; Li & Cui, 2008). Therefore, firms that desire to excel attempt to use their tangible and intangible assets best. IC is an integral part of a firm’s resources to achieve value from limited resources. Firms with high IC are expected to have better liquidity and risk management systems and are thus less likely to go bankrupt (Shahdadi et al., 2020). The literature argues that IC enables firms to achieve long-term competitive advantage and improve performance (Cenciarelli et al., 2018; Nadeem et al., 2017). In addition, Evans (2011) shows that optimization efficiency may play an integral role in a firm's existence, and failure to achieve this may adversely affect performance and customer loyalty. The extant literature commonly uses the value-added intellectual coefficient (VAIC) as a measure of IC, which includes an aggregate measure of the efficiency of employed capital (CEE), structural capital (SCE), and human capital (HCE). The presence of IC may be verified by the gap in the market-to-book ratio of firms Mouritsen et al. (2001); however, the annual report does not adequately cover its disclosures (Wang et al., 2016). For example, Carvalho et al. (2016); Nadeem et al. (2018); (Shahwan & Habib, 2020), further research is needed to highlight the importance of IC in different regions to establish a methodological framework for IC.

Furthermore, WCM may be considered an opportunity to enhance a firm's value in doing business and deals if buyers and sellers prioritize it through a value-optimizing plan (PwC, 2019). While working capital is the balance of current assets after deducting current liabilities, WCM includes the management of accounts payables, inventory, and receivables. As confirmed in the literature, WCM is one of the main keys to a firm's success. For example, Deloof (2003); Tran et al. (2017) refer to WCM as an important strategy for improving profitability. Moreover, it can support a firm's risk management and enhance its value (Boisjoly et al., 2020; Habib, 2022). In addition, a conservative WCM approach involves higher investment in inventories and accounts receivables, which reduces the supply-related price and costs fluctuations, thus leading to less risk for firms (Fernández-López et al., 2020; Shin & Soenen, 1998). Under this approach, profitability is achieved through sales growth and expansion of market share (Wang et al., 2020). Firms that adopt an aggressive WCM approach assume higher risk by reducing investments in inventories and credit terms to customers (Aktas et al., 2015).

This study examines the differences in efficiencies related to IC and WCM for the GCC-listed industrial sector from 2015 to 2019. It also investigates the impact of IC and WCM efficiency on firm performance in the GCC markets. The industrial sector, which is trying to diversify its revenue from the non-hydrocarbon sector, is a key contributor to the gross domestic product of this region. Environmental changes have pushed the GCC to care for continuous improvement processes to enhance its performance. Several studies have investigated the relationship between IC and WCM efficiency with a firm's performance; for example, Chamberlain and Aucouturier (2021); Gonçalves et al. (2018); Hamdan (2018); Isola et al. (2020); Kabuye et al. (2019); Kweh et al. (2021); Louw et al. (2019); Lyngstadaas (2020); Nadeem et al. (2017, 2018); Tiwari (2021); Vu Thi and Phung (2021), but there are limited or no studies measuring IC and WCM efficiencies using data envelopment analysis (DEA) in the context of GCC markets.

This study contributes to the literature in several ways. Firstly, the critical role of WCM and IC for firms' success is illustrated, as the inefficient employment process may result in liquidity and financial distress issues for firms. Secondly, IC and WCM assessments are important to assist firms in addressing the inefficiency aspects and accomplishing the best practices. Thirdly, most prior studies have explored the efficiency levels of WCM and IC through individual dimensions (Akgün & Memiş Karataş, 2021; Bayraktaroglu et al., 2019; Soewarno & Tjahjadi, 2020; Zimon & Tarighi, 2021). Therefore, the current study has developed models for appraising the efficiency of WCM and IC using the DEA methodology, which picks out the most appropriate practice performance on the efficiency boundary curve instead of traditional methods such as ratio indicators, which pick out the central tendencies' benchmarks. Fourthly, it is important to provide comparative information regarding WCM and IC performance to help stakeholders make appropriate decisions, thus extending the decision-makers' perceptions and understanding of the inherent role of IC and WCM in firm performance and the need to develop appropriate policies and strategies to enhance IC and WCM to improve a firm's performance. Finally, publicly listed firms in GCC countries operate in environments with unique institutional, economic, and political characteristics (Dalwai et al., 2015). GCC countries are characterized by a hereditary monarchy that differentiates them through legal structures (Mazaheri, 2013). The GCC markets have also shifted their focus to achieving a diversified economy versus an oil-based economy to integrate with the international economy (Buallay et al., 2020). Therefore, firms seek to employ and optimize their WCM and IC to achieve best practices through their unique structures and objectives. The gaps in empirical studies highlight the need to appraise WCM and IC and verify their potential influence on firm performance (Dalwai & Salehi, 2021; Habib, 2022; Tarek & Rafik, 2020). Thus, supporting firms to obtain the best performance and excel in the business environment.

The structure of this research article is as follows: Section 2 presents the literature review, Section 3 discusses the study's methodology, Section 4 presents the analysis of the results, and Section 5 concludes with findings and recommendations.

2. Literature Review

2.1 Theoretical background

The literature on working capital discusses two major policies: the working capital investment (WCI) policy and the working capital financing (WCF) policy. WCI policy determines the level of current assets, measured as the ratio of current assets to total assets (Nazir & Afza, 2009). A high ratio indicates high investment in current assets in relation to total assets. Companies can adopt either aggressive or conservative WCI policy (Habib & Mourad, 2022). Under an aggressive WCI policy, firms run the risk of working capital inadequacy, as the investment in current assets is low (Habib & Mourad, 2022). The aggressive strategy provides higher liquidity to firms through low investment in receivables and inventory, but at the cost of low sales (Habib & Mourad, 2022). In comparison, the conservative WCI policy provides firms with higher investments in current assets but at a high cost of liquidity. Prior studies have reported that high investment in receivables and inventory ensures that firms have interruption-free production processes, good relationships with customers, and an overall increase in sales, but consequently results in high interest expenses affecting shareholders' value (Aktas et al., 2015; Baños-Caballero et al., 2014; Habib & Mourad, 2022; Nabi et al., 2016).

WCF policy determines the use of current liabilities to finance current assets and is measured as the ratio of current liabilities to total assets (ANG et al., 2014). Companies also have the option of adopting aggressive or conservative WCF policy. As per the aggressive financing policy, current assets are financed with short-term debt, whereas under the conservative financing policy, current assets are financed with long-term debt (Nabi et al., 2016). The use of current liabilities is found to be less costly but highly risky as companies are forced to settle short-term debt soon. Alternatively, the use of long-term liabilities is less risky, as it allows more time to settle the debt but carries the cost of high interest expense (Alrahamneh et al., 2020).

A firm has three major motivations for holding cash, which are widely documented in academic literature. The transaction, precautionary, and speculative motives are all directed toward the line of thought process, which suggests that cash is advantageous for firms and is a strong buffer to alleviate liquidity shortages (Mun & Jang, 2015). Firms require cash to carry out normal activities, meet unforeseen events, and invest in profitable opportunities that may arise in the future (Martínez-Sola et al., 2018). Chang et al. (2017) indicate that, in theory, the cash held by a firm is offset between benefits and costs. In addition, trade-off and pecking order theories are widely used in finance. Trade-off theory suggests that an optimal level of cash is achieved with the balance of its associated costs and benefits (Miller & Orr, 1966). Bahreini and Adaoglu (2018) claim that trade-off theory also suggests that firms should determine a certain level of the debt ratio, whereby any increase above this level would lead to financial issues. Pecking-order theory alternatively propagates no optimal level of cash holdings (Myers & Majluf, 1984). According to this theory, a firm in need of cash first depends on the internal source of funds. If external financing is required, debt is preferred to equity. Equity is associated with high issuing costs, making it costly in comparison to debt. Firms with high profitability have less external borrowing.

The resource-based theory originated in the 1980s and became more prominent in the 1990s (Barney, 1991; Wernerfelt, 1984). The theory argues that firms can achieve sustainable competitive advantage by using resources with attributes of being "valuable", "rare", "non-substitutable" and "imperfectly imitable" (Hoskisson et al., 1999). These resources strengthen and leverage internal advantages and support neutralizing external environmental weaknesses (Habib & Kayani, 2022; Habib & Mourad, 2022). While a resource can be valuable as long as a few competitors possess it, its standalone may sometimes have little value, and a bundle of physical, human, and organizational capital is important for sustainable competitive advantage. Resource-based theory suggests that IC is one of the most critical intangible resources (Wright et al., 1994). According to resource-based theory, IC is a strategic resource that occupies two-thirds of a company's assets and, when managed well, results in value generation (Grant, 1991).

In addition, the resource-based view explains the relationship between IC and firm performance in several studies (Bataineh et al., 2022; Bhattacharjee & Akter, 2021; Ur Rehman et al., 2022). Unique resources, whether tangible or intangible, support firm performance (Habib & Kayani, 2022; Habib & Mourad, 2022). The resource-based theory explains how firms can utilize resources to attain competitive advantage and superior performance (Barney, 1991, 2001). Resources are critical for a firm, as they might support satisfying customer needs and enable the firm to develop or implement strategies to improve its efficiency and effectiveness. Grant (1991) argues that IC can be considered a strategic asset that affects a firm's performance.

2.2 The efficiencies of IC and WCM

IC is the foremost driver of value achieved in knowledge-based economies. Achieving value does not depend only on utilizing physical and financial capital, but also on how IC is managed (Dalwai & Mohammadi, 2020). This makes it important to investigate measurement, efficiency management, and leveraging of IC practices (Dalwai & Mohammadi, 2020). Unfortunately, there are no accounting measures available (Bandt, 1999). IC exists in the relationships, structures, processes, and people of a firm. Employees' training and development leads to IC acquisition (Bontis, 1998). However, agency costs can undermine ICE (Appuhami & Bhuyan, 2015). This may happen when opportunistic managers limit the obtainable cash flow for development and training by increasing their compensation-deemed agency costs. Agency costs contribute to information asymmetry; thus, shareholders cannot capture shares and more external funds are required for investment in IC.

The prevailing consensus suggests that IC can be classified into three prime aspects: relational, structural, and human capital (Mouritsen et al., 2001; Nimtrakoon, 2015; Sveiby, 1997). The ICE has discussed being hard to identify, disclose, and measure through firm reporting (Buallay, 2018). While International Accounting Standard 38 addresses the measurement of intangible assets, it does not adequately address the various components of IC. Rahman (2012) argues that the weakness of traditional accounting practices leads to variations in the market and book value of firms. Over time, various alternatives have been proposed to appraise ICE, such as intangible asset proctors (Sveiby, 1997), the Skandia IC statement Edvinsson and Malone (1997), and VAIC Pulić (1998).

According to Shahwan and Habib (2020), a precise estimate of efficiency is crucial for obtaining a competitive advantage, so it influences decision-makers to enhance the pure technical efficiencies or efficiency of scale, which leads to the optimization of organizational resources. Prior studies have measured relative efficiency using the DEA approach as an alternative to accounting indices. The DEA approach has been used to evaluate and benchmark ICE in various countries, including Austria (Leitner et al., 2005), Taiwan (Lu et al., 2010; Wu et al., 2006), Italy (Costa, 2012), Poland (Nitkiewicz et al., 2014), and Malaysia (Kweh et al., 2015). Based on prior studies that adopt the DEA approach to assess IC performance, the following hypothesis investigates the research objective of examining significant differences in IC efficiency:

H1. On average, there were statistically significant differences in the efficiency of firms' IC over the study period.

Furthermore, a firm has four critical decisions related to financial management: investment, financing, dividends, and liquidity (Paul & Mitra, 2018). WCM contributes to liquidity and short-term investment decision-making. Working capital is defined as the funds necessary to maintain a firm's operations (Akinlo, 2012). Owing to uncertainties, transaction costs, variations in production costs, or technological constraints, the magnitude of working capital for firms is not the same. However, they must maintain WCM appropriately and reasonably, because excessive amounts result in holding costs and idle funds. In contrast, inadequate funds can cause production and sales disruptions (Habib & Kayani, 2022; Habib & Mourad, 2022).

Previous studies offer dichotomous recommendations for WCI. The first opinion suggests that firms can increase their value when holding a higher WCI, which increases sales and attracts more discounts due to early payments (Deloof, 2003). The competing view argues that firms are likely to go bankrupt with higher WCI, as they require more financing requirements with additional financing expenses (Kieschnick et al., 2013). The findings on WCME in India indicated high volatility of efficiency among companies and lacked expertise in liquidity management (Seth et al., 2021). Various components of WCM play a critical role in contributing to its efficiency. Firms need to make crucial decisions on the stock level to be maintained. de Almeida and Eid (2014) argue that working capital is an essential aspect of appraising a firm's free cash flows. Effective WCM would reduce a firm's dependence on external funding, so cash can be released for further investment and to enhance financial flexibility. The firm administration continuously seeks to maintain optimal levels of working capital. At depressed levels of WCM, higher investment in working capital undertakes the invigorative sales process and discounts for speedy payment to suppliers. Nevertheless, after crossing a certain threshold, higher levels of WCI would incur further interest costs, eroding firm value (Baños-Caballero et al., 2014).

Several studies have argued that traditional WCM ratios have certain limitations. For instance, current and quick ratios have been embraced to measure firms' liquidity levels (Shin & Soenen, 1998). Therefore, it has been slammed for its inherent static nature (Emery & Cogger, 1982; Habib, 2022; Habib & Kayani, 2022; Habib & Mourad, 2022). Alternatively, Richards and Laughlin (1980) proposed the adoption of cash conversion cycle (CCC), but this was slammed for being mathematically inaccurate, not focusing on funds tied up, and lacking differentiation in the weights appointed to each element of working capital. Goel and Sharma (2015) also reported issues with additional measure ratios, such as the weighted CCC, which has mathematical issues owing to the unavailability of pertinent data. The net trade cycle has an equal weight problem. To address these issues with traditional ratios, investigators have adopted alternative techniques for assessing WCME. DEA is one such measure that prior studies have relied on for assessing the WCME (Goel & Sharma, 2015, 2016; Habib, 2022; Habib & Kayani, 2022; Habib & Mourad, 2022; Seth, Chadha, Ruparel, et al., 2020; Seth, Chadha, & Sharma, 2020; Seth et al., 2021). A study of Indian companies from 2004 to 2013 reported a continual improvement in WCME and pointed out that the DEA technique was useful in overcoming the limitations associated with traditional measures of WCME (Goel & Sharma, 2015, 2016). Furthermore, the analysis carried out for the Indian industrial firms from 2008 to 2019 demonstrated stability in WCME (Seth, Chadha, & Sharma, 2020). Based on prior studies that adopt the DEA approach to assess WCM performance, the following hypothesis investigates the research objective of examining significant differences in WCM efficiency:

H2. On average, there were statistically significant differences in the efficiency of firms' WCM over the study period.

2.3 ICE and firm performance

Effective management of IC has been motivated by its influence on a firm's performance and competitiveness (Bayraktaroglu et al., 2019). Gupta et al. (2020); Vishnu and Kumar Gupta (2014) investigated the link between the intellectual capital efficiency (ICE) and Indian pharmaceutical firms' performance. The findings indicate that ICE improves firm profitability. Even the sub elements of human capital and physical capital efficiency increase firms' profitability. Similarly, the dynamic association between ICE and performance has been investigated in Australian-listed firms for over ten years (Clarke et al., 2011; Nadeem et al., 2018). The ICE was positively influenced by the ROE and ROA of Australian firms, endorsing the resource dependency theory. A positive association was confirmed between ICE and accounting-based firm performance measures using a random fixed effects regression for Bahrain and Saudi Arabia (Hamdan, 2018). However, in the same study, the relationship was insignificant for market-based measures with ICE. Oman banks' performance in terms of ROA and ROE was not significantly influenced by ICE (Dalwai et al., 2018). HCE and CEE are associated with asset turnover and price for Indonesian-listed banks (Soewarno & Tjahjadi, 2020). Using an extended VAIC model, Bayraktaroglu et al. (2019) reported that the innovation capital of industrial firms in Turkey moderates the impact of structural capital on ROA and ROE.

Isola et al. (2020) demonstrated a positive contribution of ICE to Nigerian bank performance. South Africa's listed firms also suggest a positive impact of ICE on ROA, ROE, and price-to-book ratio (Nadeem et al., 2017). Additionally, ICE positively influences profitability for high-knowledge-based listed South African firms but negatively impacts productivity (Firer & Mitchell Williams, 2003). Duho (2020) suggests that HCE and VAIC drive the efficiency of Ghanaian non-listed firms and foreign banks and that large banks are more efficient than other banks. Seleim et al. (2007) advocated that certain types of human capital measures show a significantly positive association with the performance of software development firms.

A comprehensive analysis of recent sample research articles investigating ICE's impact of ICEs on firm performance published from 2008 to 2022 is presented in Table 1. This review suggests that IC positively affects firm performance (Akkas & Asutay, 2022; Aljuboori et al., 2022; Chatterjee et al., 2022; Dalwai & Salehi, 2021; Gupta et al., 2022; Hamdan, 2018; Isola et al., 2020; Kweh et al., 2021; Lu et al., 2021; Maji & Hussain, 2021; Nkambule et al., 2021; Tiwari, 2021; Yousaf, 2021). A general trend suggests that many of these studies mostly investigate firms by sector in developing countries. Prior studies on GCC remain popular in the financial sector. Studies have mostly explored this relationship using secondary data, yet few have also used questionnaire methods. All studies with secondary data were analyzed using a regression analysis. Pulic's VAIC model has been popular among studies. None of the studies used the DEA methodology to evaluate IC. Most studies report a positive relationship between IC and its components, and firm performance. The gap in the literature is prominent in terms of methodology, sector, region, and inconsistent findings. Accordingly, this study contributes to the gap between ICE studies and firm performance in the industrial sector. Based on the literature review, the following hypothesis investigates the research objective of examining the relationship between ICE and firm performance:

H3a. ICE positively influences firms' financial performance.

H3b. ICE positively influences firms' market value.

2.4 WCME and firm performance

Prior research has pointed to mixed results regarding the WCME and firm performance in developed countries (Wasiuzzaman, 2015). While these investigations have been expansive for developed economies, they have only lately expanded to developing economies. In developing economies, the link between WCME and performance has been reported employing various proxies. Akinlo (2012) examined the association between WCME and the profitability of Nigerian firms for 10 years. The results were appraised using a fixed-effects approach and pooled model of ordinary least squares. The results indicate that ROA decreases when CCC increase, whereas ROA improves when CCC shortens. Altaf (2020) examined the significance of WCME on hospitals' performance. WCM is measured using WCF. The study concludes that WCM has a non-linear association with hospitals' performance.

Wasiuzzaman (2015) concludes that Malaysian manufacturing firms demonstrate a negative association between working capital and ROA. The relationship for accounts payable was inconsistent with the hypothesized relationship. Wang et al. (2020) analyzed the WCME of Pakistani firms across the corporate life cycle. The findings indicate that growth in WCME leads to a decrease in ROA, regardless of life cycle stages. Soukhakian and Khodakarami (2019) analyzed whether WCME effectively enhances the performance of Iranian firms. The findings suggest that CCC is adversely linked to ROA, but when endogeneity is controlled for, there is no influential association between CCC and ROA. Thus, WCME contributes to firms' short-, but not long-term, performance indicators.

A cross-country analysis was conducted to explore the link between WCM and firm value (Baños-Caballero et al., 2020). WCME is proxied by net working capital, calculated as the balance of inventories and accounts receivable after excluding payable accounts. The results indicate that NWC contributed significantly to improving firm value in nations with higher economic growth. Louw et al. (2019) contribute to the existing literature on WCME for South African retail and construction firms. Using the cointegration technique and the Granger causality test, the findings indicate a positive influence between the WCME and profitability measures. This relationship is better for retail firms than for construction firms. Kabuye et al. (2019) used a questionnaire survey to examine the role of WCME and internal controls on the performance of supermarkets in Uganda. The findings suggest that WCME is a significant predictor of performance and that supermarkets with effective WCM also have better internal control, which enhances firm performance. Table 2 reviews the sample of recent research articles examining the impact of WCM on firm performance (Ameer & Othman, 2021; Anton & Afloarei Nucu, 2021; Chambers & Cifter, 2022; Dhole et al., 2019; EL-Ansary & Al-Gazzar, 2020; Enqvist et al., 2014; Mardones, 2021; Masri & Abdulla, 2018; Mun & Jang, 2015; Rey-Ares et al., 2021; Seth, Chadha, Sharma Satyendra, et al., 2020; Soukhakian & Khodakarami, 2019). The research area remains of interest for both developing and developed countries, specifically for the non-financial sector. The findings reported in these studies are mixed and interesting. The measurement of WCM takes the form of ratios in almost all studies. The secondary data analysis adopted in the extant literature is mostly performed using regression analysis. Prior studies demonstrate an evident gap in WCM measurements, and the findings related to the relationship with firm performance. Prior studies have argued the need for further research to investigate firms' physiognomies, such as the role of WCME in firms' performance (Habib, 2022; Habib & Kayani, 2022; Habib & Mourad, 2022; Kabuye et al., 2019). Based on the literature review, the following hypothesis investigates the research objective of examining the relationship between WCME and firm performance:

H4a. WCME positively influences firms’ financial performance.

H4b. WCME positively influences firms’ market value.

3. Data and Methodology

The methodology part of this study covers data collection, recognizing the study models used based on the DEA approach, determining the inputs and outputs of these models, and recognizing the study’s regression analysis and additional analyses.

3.1 Data description:

The data were gathered from Standard & Poor's database from 2015 to 2019. The initial sample consisted of 150 public firms listed in the industrial sector. These firms are located in GCC countries. Following Habib (2022); Habib and Kayani (2022); Habib and Mourad (2022); Pastor and Ruiz (2007); Portela et al. (2004), negative data values and lack of data restrict the DEA model's ability to conduct the analyses. Therefore, 110 companies were precluded. Accordingly, the final decision-making units (DMUs) consist of 40 industrial firms with 200 firm-year observations. Notably, the current DMUs size in this study is suitable for implementing DEA methodology. According to Cooper et al. (2007); Sarkis (2007), the DMUs size must be more than three times that of the model variables. Two models were developed in this study. The first model appraises the ICE consisting of three inputs and two outputs, whereas the second appraises the WCME consisting of four inputs and two outputs.

3.2 Study models and variables measurement:

3.2.1 DEA efficiency models:

Various methodological techniques, such as stochastic frontier, deterministic frontier, and mathematical programming techniques, have been employed to evaluate the efficiency of DMUs; however, mathematical programming is distinguished by being non-parametric, thus providing better flexibility and ease of use (Cooper et al., 2007; Habib & Shahwan, 2020; Mourad, 2022; Mourad et al., 2022; Olesen & Petersen, 2016; Wu et al., 2013).

One well-known mathematical programming application is the DEA approach, which depends on mathematical programming to estimate the relative efficiency scores of DMUs. DEA is a non-parametric approach that does not mandate presumptions regarding the data distribution or weights of the underlying production function (Cooper et al., 2007; Dalei & Joshi, 2020; Ganji & Rassafi, 2019; Habib, 2022; Habib & Kayani, 2022; Habib & Mourad, 2022; Mourad et al., 2021; Nitkiewicz et al., 2014; Pourhejazy et al., 2022; Shahwan & Habib, 2020, 2021; Tone, 2001, 2016). In addition, DEA models offer a quantitative evaluation of how efficiency can be achieved by using input and output data. For example, the DEA model is useful for evaluating the cash utilization efficiency of listed biomedical companies in China (Qu et al., 2019), airline efficiency in China and India (Yu et al., 2019), product deletion decisions (Pourhejazy et al., 2022), technical efficiency of refineries (Dalei & Joshi, 2020), Austria’s firm performance (Leitner et al., 2005), Taiwan’s firm performance (Lu et al., 2010; Wu et al., 2006), Italian firms’ performance (Costa, 2012), Polish firms’ performance (Nitkiewicz et al., 2014), and Malaysia’s firm performance (Kweh et al., 2015). This study uses the DEA methodology for efficiency analysis because of its flexibility and accuracy in analyzing the relationship between multiple outputs and inputs, as the current analysis involves multiple dependent variables, that is, outputs, and the DEA approach efficiently analyzes the relationship between outputs and inputs variables through an adopted model (Avkiran, 2011; Desta, 2016; Habib & Mourad, 2022; Mourad et al., 2022; Seth, Chadha, & Sharma, 2020; Shahwan & Habib, 2020; Yu et al., 2019). In addition, the concentration of the methodology for optimization is considered a well-known mathematical programming application that targets the best practice of efficiency, and it can provide essential information for DMUs for continuous improvement that may support inefficient units to reach the best practices (Habib & Kayani, 2022; Habib & Shahwan, 2020; Long Kweh et al., 2013; Mourad et al., 2021; Mourad et al., 2022; Pourhejazy et al., 2022; Qu et al., 2019; Shahwan & Habib, 2021; Tone, 2016)

To estimate efficiency through the DEA methodology, we need a collection of inputs and outputs germane to the research's primary objective, as the DMUs are expected to deliver a set of outputs according to a set of employed inputs germane to the research's primary objective (Cooper et al., 2007; Fixler et al., 2014; Habib & Kayani, 2022; Habib & Mourad, 2022; Ozcan, 2014). By reviewing many previous studies related to IC, as demonstrated in the literature review section, the inputs for estimating ICE should incorporate items that account for a considerable portion of IC investments or substantially impact IC. Further, each DMU invests in IC to preserve consistency and improve efficiency. Thus, DMUs that care about the efficiencies of employed capital, human capital, and structural capital can be regarded as more efficient (Appuhami & Bhuyan, 2015; Chatterjee et al., 2022; Dalwai & Mohammadi, 2020; Isola et al., 2020; Shahwan & Habib, 2020). Following the aforementioned literature review, the current study model related to IC employs the efficiencies of capital employed (CEE), human capital (HCE), and structural capital (SCE) as inputs, and the market-to-book ratio (M/B) and return on assets (ROA) as outputs. Similarly, by reviewing many previous studies related to WCM, as demonstrated in the literature review section, this study adopts items that account for a considerable portion of WCM investments or substantially impact WCM as inputs variables. Following the literature review, the current study model bonded to WCM employs inventory (INV), cost of goods sold (COGS), accounts receivables (ACR), and accounts payable (ACP) as inputs, and net revenue (REV) and net income (INC) as outputs. Table 3 presents the definitions of the DEA models variables.

[Insert Table 3 here]

Following (Cooper et al., 2007; Habib, 2022; Mourad et al., 2021; Mourad et al., 2022; Ozcan, 2014; Shahwan & Habib, 2021), the efficiency scores based on the DEA model are obtained by solving the next linear optimization model:

$$
\begin{aligned}
& \max \Theta \\
& \text{subject to} \\
& \sum_{u=1}^{n} \lambda_u x_{iu} \leq x_{i0} \qquad && i = 1, \dots, s \\
& \sum_{u=1}^{n} \lambda_u y_{ru} \geq \Theta y_{r0} \qquad && r = 1, \dots, m \\
& \sum_{u=1}^{n} \lambda_u = 1 \\
& \lambda_u \geq 0 \qquad && u = 1, \dots, n
\end{aligned}
\tag{1}
$$

where Θ signifies the relative-efficiency score, i.e., the ICE or WCME depending on the model used; x_{iu} denote the inputs values i to unit u, y_{ru} denote the outputs values r to unit u, and x_{i0} and y_{r0} represent the contracted inputs and outputs respectively of the DMU currently rated, and λ_u denote the optimal weights to be attached to unit u. By applying the above-mentioned model to assess ICE, the model includes CEE, HCE, and SCE as inputs, and M/B and ROA as outputs. Correspondingly, to assess the WCME, the model includes the INV, COGS, ACR, and ACP as inputs, and REV and INC as outputs.

3.2.2 Regression model:

Following the firms' relative efficiency evaluated via the DEA approach, we conducted a multilinear regression to identify the potential statistical influence of ICE and WCME on the financial and market measures of DMUs. Specifically, we use ROA and return on equity (ROE) as profitability measures, and Tobin's Q as a measure of DMU market value. According to the literature (Appuhami & Bhuyan, 2015; Buallay, 2018; Costa, 2012; Dalwai & Mohammadi, 2020; Dalwai & Sewpersadh, 2021; Isola et al., 2020; Shahwan & Habib, 2020), we controlled for three variables: firm size (SIZE), which was measured by the natural logarithm of total assets; financial leverage (LEV), which was measured by dividing the DMU's total liabilities by its shareholders' equity; and firm age (AGE) as a proxy for learning, which was measured by the natural logarithm of the DMU's age since inception. Accordingly, the following regression model describes this study's dependent, independent, and control variables.

$$y_{it} = \beta_0 + \beta_1 (ICE)_{it} + \beta_2 (WCME)_{it} + \beta_3 (SIZE)_{it} + \beta_4 (LEV)_{it} + \beta_5 (AGE)_{it} + \varepsilon_{it} \tag{2}$$

Where y_{it} represents DMUs performance as measured by $(ROA)_{it}$, $(ROE)_{it}$, and $(Tobin's\ Q)_{it}$ for each firm i at time t; ROA is defined by dividing a DMU's net income by its total assets; ROE is defined by dividing a DMU's net income by its shareholders' equity; Tobin's Q is defined by dividing a DMU's total market value by its total assets; ICE is a score of IC efficiency via the DEA approach for a firm i at time t; WCME is a score of WCM efficiency via the DEA approach for a DMU's i at time t; SIZE, LEV, and AGE are the control variables as described above; β_0 is a constant; $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ describes the coefficients; and ε_{it} points to an error idiom.

4. Results and discussion

4.1 Descriptive statistics

Table 4 presents the descriptive statistics for the regression model variables. In GCC industrial sector, the average of ICE and WCME are 0.62 and 0.82, with a standard deviation of 0.28 and 0.19, respectively. According to the study results, the percentages of efficient DMUs concerning ICE and WCME are only approximately 20% and 37.5%, respectively. This indicates that most DMUs in the GCC industrial sector do not employ their intellectual and working capital investments well, and need improvement actions to achieve the best practices. According to the study results, these actions are related to fundamental improvements in CEE, HCE, SCE, sales, working capital. In addition, the average SIZE, LEV, and AGE are 5.74, 0.95, and 3.27, with a standard deviation of 1.49, 1.05, and 0.56, respectively. Additionally, the average ROA, ROE, TobinsQ are 0.07, 0.13, and 2.13, with a standard deviation of 0.06, 0.12, and 3.99, respectively.

[Insert Table 4 here]

4.2 DEA models results

Table 5 summarizes the relative efficiency scores for all the DMUs under analysis using the DEA-ICE model. The results indicated that the ICE was approximately 59.2%, 62.9%, 56.2%, 62.7%, and 64.8% (on average) for the study years from 2015 to 2019, respectively. The results indicate that 34, 32, 34, 29, and 32 firms over the study period from 2015 to 2019 appear inefficient and require corrective action to reach the frontier curve and achieve the best practices.

[Insert Table 5 here]

Table 6 summarizes the relative efficiency scores for all DMUs under analysis using the DEA-WCME model. The results indicated that the WCME was approximately 85.8%, 83.6%, 82.4%, 78.5%, and 78% (on average) for the study years from 2015 to 2019, respectively. The results indicate that 23, 25, 24, 27, and 26 firms over the study period from 2015 to 2019 appear inefficient and require corrective action to reach the frontier curve and achieve the best practices.

[Insert Table 6 here]

Table 7 reveals a complemental statistical test verifying influential differences in DMUs' DEA scores through the sign and Wilcoxon tests over the analysis period. Table 7, Panel A, indicates a statistically influential difference in the DEA-ICE scores between 2015-2016 and 2016-2017 at a significance level of 0.01. In addition, the results showed that the difference was significant between 2017-2018 at a 0.1 significance level and was insignificant between 2018 and 2019. Accordingly, H1 is partially supported. Conversely, Panel B indicated no statistical difference in the DEA-WCME scores over the study period at a significance level of 0.05. Accordingly, H2 is not supported.

[Insert Table 7 here]

4.3 Regression models results

Data gathered for several DMUs over a period are known as longitudinal data, i.e., pooled or panel. The type of assessment of a model must be determined first, as the data are longitudinal. The F-timer (Chow) test was employed to determine whether the study model should be determined using panel data or ordinary least squares (Salehi et al., 2019; Salehi et al., 2018). The results indicated no variation between the calculated coefficient for Individual mass and the calculated coefficients for individual cross-section (P-value < 0.05).

[Insert Table 8 here]

Table 8 shows pairwise correlations and multicollinearity verification. Panel A presents pairwise correlation results for the study variables. WCME is significantly and positively correlated with ICE. SIZE negatively correlated with ICE and positively correlated with WCME. LEV is negatively correlated with ICE and WCME. AGE is negatively correlated with ICE, but insignificantly correlated with WCME. The results show no explanatory variables with coefficients greater than 0.8. Panel B confirms that multicollinearity did not emerge between the explanatory variables, as the highest variance inflation factor (VIF) value is 1.68 with a tolerance value of 0.59.

[Insert Table 9 here]

Regression analysis was used to determine the factors affecting the DMUs performance. Table 9 shows the heteroscedasticity-corrected estimates. The results reveal a significant and positive influence of ICE and WCME on ROE and ROA at the 0.01 significance level, which lends support to the resources-based theory that suggests improvement in firm performance due to the efficient use of its resources and also supports the conservative WCI policy that advocates a higher firm performance with more investment in current assets. Therefore, hypotheses H3a and H4a are supported. In addition, the results reveal a significant and positive influence of ICE on Tobin's Q at the 0.01 significance level, which lends support to the resources-based theory that suggests improvement in firm performance due to the efficient use of its resources. Therefore, the H3b hypothesis is supported. Moreover, the results reveal a significant and positive influence of WCME on Tobin's Q, but at a 0.1 significance level. Therefore, H4b was not supported at a significance level of 0.05. This indicates the influential role of ICE and WCME in enhancing firm performance and achieving a competitive advantage. Simultaneously, the effects of SIZE and AGE were negatively significant with performance measures at a significance level of 0.05. Additionally, the effect of LEV was only positively significant for ROE and Tobin's Q at a 0.01 significance level. According to prior studies, ICE findings are consistent with former evidence, for example, Hamdan (2018); Isola et al. (2020); Nadeem et al. (2017, 2018). In addition, the WCME findings are consistent with prior evidence, for example, Habib (2022); Kabuye et al. (2019); Louw et al. (2019); Seth, Chadha, Ruparel, et al. (2020); Seth, Chadha and Sharma (2020); Seth et al. (2021).

4.4 Additional analyses results

4.4.1 DEA models robustness

A robustness test was performed to determine the validity of the study results. Following, e.g., Fixler et al. (2014); Habib (2022); Habib and Kayani (2022); Habib and Mourad (2022); Habib and Shahwan (2020); Mourad et al. (2021), the interior-validity test has been executed to validate study results. Accordingly, the Mann–Whitney U test was used to explore whether variable elimination sequentially followed a significant difference in the essential DEA model scores. Moreover, Spearman rank correlation between the fundamental and adjusted DEA models was also carried out.

[Insert Table 10 here]

Panel A of Table 10 presents the validity tests of the DEA-ICE model. Using Spearman correlation, the results show that efficiency ranks are not significantly altered at a significance level of 0.01. Moreover, the Mann–Whitney U test results confirmed that excluding CEE, SCE, and HCE from the DEA-ICE model had no significant influence on coherence at a significance level of 0.05. Furthermore, a comparison between the inherent model results through the output orientation and the adjusted model results through the input orientation was carried out to enhance the validity results. According to Panel B, the Spearman correlation results indicate that the efficiency ranks are not significantly altered at a significance level of 0.01. In addition, the Mann–Whitney U test showed that the distributions for both models had similar patterns. Based on the preceding section, the adopted DEA-ICE model refers to the internal validity of the model.

On the other side, panel C exhibits the validity tests of the basic DEA-WCME model. Using Spearman correlation, the results show that the efficiency ranks are not significantly altered at a significance level of 0.01. Moreover, the Mann–Whitney U results confirmed that excluding INV, ACR, ACP, and COGS sequentially from the DEA-WCME model had no significant influence on coherence at a significance level of 0.05. Moreover, panel D shows that the efficiency ranks are not significantly altered at a 0.01 significance level between the inherent model via output orientation and the adjusted model results via input orientation. Besides, the Mann–Whitney U test showed that distributions for both models have a similar pattern.

[Insert Table 11 here]

The external validity test was executed to confirm the solidity of the results across time, as demonstrated in Table 11. Accordingly, the Kruskal–Wallis H test was performed to explore consistency. Panels A and B show the results, indicating that the DEA-ICE and DEA-WCME distributions have the same shape over time. Furthermore, the Spearman correlation results indicated that scores were not significantly altered at a 0.01 significance level of 2015–2019. Hence, the distribution of DEA efficiency models does not seem to differ significantly across time.

4.4.2 Regression models robustness

Robustness tests were performed by using additional analyses to examine the validity of the findings. Robustness tests were performed to compare the basic model results with those obtained from additional techniques and models. Table 12 presents the generalized least squares (GLS) estimator. The results demonstrate that the coefficients of all the study variables are in the same direction and significance as those of the basic analysis. Accordingly, the results demonstrated greater confidence and robustness.

[Insert Table 12 here]

Moreover, regression analyses were performed with first-order autoregressive disturbance AR(1) to verify that the results did not change with the use of additional techniques. Table 13 demonstrates that the coefficients of all the study variables are in the same direction and significance as those of the basic analysis. Accordingly, the results demonstrate greater confidence and robustness.

[Insert Table 13 here]

5. Conclusion and Policy Implications

Improving efficiency is essential for firms to achieve their goals. This study explores the efficiency of IC and WCM in the GCC industrial sector and its potential impact on firm performance. The results indicate that most firms in the GCC industrial sector do not employ their intellectual and working capital investments well, and need improvement actions to achieve the best practices. According to the results, these actions are related to fundamental improvements in CEE, HCE, SCE, sales, and working capital. In addition, the results indicate that ICE and WCME play important roles in enhancing firm performance and achieving a competitive advantage. These results are consistent with prior research showing that improvements in ICE and WCME lead DMUs' to achieve better performance (Hamdan, 2018; Isola et al., 2020; Kabuye et al., 2019; Louw et al., 2019; Nadeem et al., 2017, 2018; Seth, Chadha, Ruparel, et al., 2020; Seth, Chadha, & Sharma, 2020; Seth et al., 2021).

The results of this study support theoretical assumptions that are widely popular in finance, such as resource-based, trade-off, and pecking order theories. Resource-based theory suggests that firms would utilize their resources to attain competitive advantage and superior performance (Barney, 1991, 2001). The current results support resource-based theory, showing that ICE and WCME lead firms to achieve better performance. Therefore, firms should efficiently employ their intellectual and working capital resources to achieve superior performance. Trade-off theory suggests that firms should operate efficiently to achieve an optimal level of cash with the balance of its associated costs and benefits through WCM. Firms should operate efficiently, whereby any increase above this level leads to financial issues (Bahreini & Adaoglu, 2018; Ghazouani, 2013; Jahanzeb et al., 2013). In addition, the Pecking-order theory suggests that firms would first depend on internal sources of funds for their investments to improve performance; therefore, firms should first operate efficiently to achieve the optimal level of liquidity through WCM (Jahanzeb et al., 2013; Serrasqueiro & Caetano, 2015).

The findings of this study have important implications for various stakeholders. For example, the findings would be helpful for firm decision-makers in managing their investments in intellectual and working capital, as the findings indicate that firms need to make a set of fundamental improvements in CEE, HCE, SCE, sales, and working capital to achieve the best practices, thus extending the decision-makers' perceptions and understanding of the inherent role of IC and WCM in firm performance and the need to develop appropriate policies and strategies to enhance IC and WCM to improve a firm's performance. In addition, these findings would be helpful for financiers, as many empirical studies discern the positive effect of profitability on a firm's leverage (Addae et al., 2013; Bauer, 2004; Singh & Bagga, 2019). Therefore, high-performance firms are likely to have more reasonable valuations to facilitate debt financing. Moreover, the findings have important implications for trading strategies as investors seek attractive economic gains from their investments in firms that care about WCM and IC issues. Moreover, these findings have important implications for employee job satisfaction and retention. Longo and Mura (2011); Torre et al. (2021) show that IC positively affects job attitudes related to job satisfaction and retention. Therefore, these findings may help managers design and develop appropriate policies and strategies to improve IC management.

This study had some limitations that should be addressed in future research. The impact of the coronavirus crisis on ICE and WCME was not considered in this study and should be investigated in future studies. In addition, future examinations should include other sectors and factors, such as capital structure, environmental, social, and governance (ESG) criteria, managerial ability, and real earnings management, which are noteworthy features of firms' policies and strategies.

References

Addae, A. A., Nyarko-Baasi, M., & Hughes, D. (2013). The Effects of Capital Structure on Profitability of Listed Firms in Ghana. *European Journal of Business and Management*, *5*(31), 215-230.

Akgün, A. İ., & Memiş Karataş, A. (2021). Investigating the relationship between working capital management and business performance: evidence from the 2008 financial crisis of EU-28. *International Journal of Managerial Finance*, *17*(4), 545-567. https://doi.org/10.1108/IJMF-08-2019-0294

Akinlo, O. O. (2012). Effect of Working Capital on Profitability of Selected Quoted Firms in Nigeria. *Global Business Review*, *13*(3), 367-381. https://doi.org/10.1177/097215091201300301

Akkas, E., & Asutay, M. (2022). The impact of intellectual capital formation and knowledge economy on banking performance: a case study of GCC's conventional and Islamic banks. *Journal of Financial Reporting and Accounting*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JFRA-08-2021-0251

Aktas, N., Croci, E., & Petmezas, D. (2015). Is working capital management value-enhancing? Evidence from firm performance and investments. *Journal of Corporate Finance*, *30*, 98-113. https://doi.org/10.1016/j.jcorpfin.2014.12.008

Aljuboori, Z. M., Singh, H., Haddad, H., Al-Ramahi, N. M., & Ali, M. A. (2022). Intellectual Capital and Firm Performance Correlation: The Mediation Role of Innovation Capability in Malaysian Manufacturing SMEs Perspective. *Sustainability*, *14*(1). https://doi.org/10.3390/su14010154

Alrahamneh, L., Chu, E. Y., & Hong, M. (2020). THE IMPLICATIONS OF DEBT FINANCING ON WORKING CAPITAL MANAGEMENT EFFICIENCY: EVIDENCE FROM MENA EMERGING MARKETS. *International Journal of Industrial Management*, *8*(1), 62-67. https://doi.org/10.15282/ijim.8.0.2020.5764

Altaf, N. (2020). Working Capital Financing, Firm Performance and Financial Flexibility: Evidence from Indian Hospitality Firms. *Global Business Review*, 1-12. https://doi.org/10.1177/0972150920961371

Ameer, R., & Othman, R. (2021). The Impact of Working Capital Management on Financial Performance of Cost Leadership and Differentiation Strategy Firms in Different Business Cycles: Evidence from New Zealand. *Journal of Asia-Pacific Business*, *22*(1), 39-57. https://doi.org/10.1080/10599231.2021.1866398

ANG, S. K., Koh, A., Brigham, E., & Ehrhardt, M. (2014). *Financial management: Theory and practice*. Research Collection Lee Kong Chian School Of Business, Cengage Learning.

Anton, S. G., & Afloarei Nucu, A. E. (2021). The Impact of Working Capital Management on Firm Profitability: Empirical Evidence from the Polish Listed Firms. *Journal of Risk and Financial Management*, *14*(1). https://doi.org/10.3390/jrfm14010009

Appuhami, R., & Bhuyan, M. (2015). Examining the influence of corporate governance on intellectual capital efficiency. *Managerial Auditing Journal*, *30*(4/5), 347-372. https://doi.org/10.1108/maj-04-2014-1022

Avkiran, N. K. (2011). Association of DEA super-efficiency estimates with financial ratios: Investigating the case for Chinese banks. *Omega*, *39*(3), 323-334. https://doi.org/10.1016/j.omega.2010.08.001

Bahreini, M., & Adaoglu, C. (2018). Dividend payouts of travel and leisure companies in Western Europe: An analysis of the determinants. *Tourism Economics*, *24*(7), 801-820. https://doi.org/10.1177/1354816618780867

Bandt, J. D. (1999). The Concept of Labour and Competence Requirements in a Service Economy. *The Service Industries Journal*, *19*(1), 1-17. https://doi.org/10.1080/02642069900000001

Baños-Caballero, S., García-Teruel, P. J., & Martínez-Solano, P. (2014). Working capital management, corporate performance, and financial constraints. *Journal of Business Research*, *67*(3), 332-338. https://doi.org/10.1016/j.jbusres.2013.01.016

Baños-Caballero, S., García-Teruel, P. J., & Martínez-Solano, P. (2020). Net operating working capital and firm value: A cross-country analysis. *BRQ Business Research Quarterly*, *23*(3), 234-251. https://doi.org/10.1177/2340944420941464

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of management*, *17*(1), 99-120. https://doi.org/10.1177/014920639101700108

Barney, J. B. (2001). Is the Resource-Based "View" a Useful Perspective for Strategic Management Research? Yes. *The Academy of Management Review*, *26*(1), 41-56. https://doi.org/10.2307/259393

Bataineh, H., Abbadi, S. S., Alabood, E., & Alkurdi, A. (2022). The effect of intellectual capital on firm performance: the mediating role of family management. *Journal of Islamic Accounting and Business Research*, *13*(5), 845-863. https://doi.org/10.1108/JIABR-02-2022-0032

Bauer, P. (2004). Determinants of capital structure: empirical evidence from the Czech Republic. *Czech Journal of Economics and Finance (Finance a uver)*, *54*(1-2), 2-21.

Bayraktaroglu, A. E., Calisir, F., & Baskak, M. (2019). Intellectual capital and firm performance: an extended VAIC model. *Journal of Intellectual Capital*, *20*(3), 406-425. https://doi.org/10.1108/jic-12-2017-0184

Bhattacharjee, S., & Akter, R. (2021). Intellectual capital efficiency and firm performance: evidence from an emerging knowledge-economy. *International Journal of Learning and Intellectual Capital*, *19*(1), 30-52. https://doi.org/10.1504/IJLIC.2021.10038760

Boisjoly, R. P., Conine, T. E., & McDonald, M. B. (2020). Working capital management: Financial and valuation impacts. *Journal of Business Research*, *108*, 1-8. https://doi.org/10.1016/j.jbusres.2019.09.025

Bontis, N. (1998). Intellectual capital: an exploratory study that develops measures and models. *Management Decision*, *36*(2), 63-76. https://doi.org/10.1108/00251749810204142

Buallay, A. (2018). Audit committee characteristics: an empirical investigation of the contribution to intellectual capital efficiency. *Measuring Business Excellence*, *22*(2), 183-200. https://doi.org/10.1108/mbe-09-2017-0064

Buallay, A., Abuhommous, A. A. A., & Kukreja, G. (2020). The relationship between intellectual capital and employees' productivity: evidence from the Gulf Cooperation Council. *Journal of Management Development*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/jmd-05-2019-0210

Carvalho, C., Rodrigues, A. M., & Ferreira, C. (2016). The Recognition of Goodwill and Other Intangible Assets in Business Combinations - The Portuguese Case. *Australian Accounting Review*, *26*(1), 4-20. https://doi.org/10.1111/auar.12073

Cenciarelli, V. G., Greco, G., & Allegrini, M. (2018). Does intellectual capital help predict bankruptcy? *Journal of Intellectual Capital*, *19*(2), 321-337. https://doi.org/10.1108/jic-03-2017-0047

Chamberlain, T. W., & Aucouturier, J. (2021). Working Capital Management and Firm Performance: Some Evidence from Europe. *International Advances in Economic Research*, *27*(4), 321-323. https://doi.org/10.1007/s11294-022-09839-6

Chambers, N., & Cifter, A. (2022). Working capital management and firm performance in the hospitality and tourism industry. *International Journal of Hospitality Management*, *102*(3), 103144. https://doi.org/10.1016/j.ijhm.2022.103144

Chang, Y., Benson, K., & Faff, R. (2017). Are excess cash holdings more valuable to firms in times of crisis? Financial constraints and governance matters. *Pacific-Basin Finance Journal*, *45*, 157-173. https://doi.org/10.1016/j.pacfin.2016.05.007

Chatterjee, S., Chaudhuri, R., Thrassou, A., & Sakka, G. (2022). Impact of firm's intellectual capital on firm performance: a study of Indian firms and the moderating effects of age and gender. *Journal of Intellectual Capital*, *23*(1), 103-126. https://doi.org/10.1108/JIC-12-2020-0378

Clarke, M., Seng, D., & Whiting, R. H. (2011). Intellectual capital and firm performance in Australia. *Journal of Intellectual Capital*, *12*(4), 505-530. https://doi.org/10.1108/14691931111181706

Cooper, W. W., Seiford, L. M., & Tone, K. (2007). *Data Envelopment Analysis* (2 ed.). Springer US. https://doi.org/10.1007/978-0-387-45283-8

Costa, R. (2012). Assessing Intellectual Capital efficiency and productivity: An application to the Italian yacht manufacturing sector. *Expert Systems with Applications: An International Journal*, *39*(8), 7255–7261. https://doi.org/10.1016/j.eswa.2012.01.099

Dalei, N. N., & Joshi, J. M. (2020). Estimating technical efficiency of petroleum refineries using DEA and tobit model: An India perspective. *Computers & Chemical Engineering*, *142*, 107047. https://doi.org/10.1016/j.compchemeng.2020.107047

Dalwai, T., & Mohammadi, S. S. (2020). Intellectual capital and corporate governance: an evaluation of Oman's financial sector companies. *Journal of Intellectual Capital*, *21*(6), 1125-1152. https://doi.org/10.1108/JIC-09-2018-0151

Dalwai, T., Mohammadi, S. S., & Al Siyabi, K. (2018). *An empirical analysis of intellectual capital and firm performance of Oman's financial sector companies* 3rd International Conference on Banking and Finance Perspectives (ICBFP), Famagusta, Cyprus.

Dalwai, T., & Salehi, M. (2021). Business strategy, intellectual capital, firm performance, and bankruptcy risk: evidence from Oman's non-financial sector companies. *Asian Review of Accounting*, *29*(3), 474-504. https://doi.org/10.1108/ara-01-2021-0008

Dalwai, T., & Sewpersadh, N. S. (2021). Intellectual capital and institutional governance as capital structure determinants in the tourism sector. *Journal of Intellectual Capital*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JIC-03-2021-0085

Dalwai, T. A. R., Basiruddin, R., & Abdul Rasid, S. Z. (2015). A critical review of relationship between corporate governance and firm performance: GCC banking sector perspective. *Corporate Governance*, *15*(1), 18-30. https://doi.org/10.1108/CG-04-2013-0048

de Almeida, J. R., & Eid, W. (2014). Access to finance, working capital management and company value: Evidences from Brazilian companies listed on BM&FBOVESPA. *Journal of Business Research*, *67*(5), 924-934. https://doi.org/10.1016/j.jbusres.2013.07.012

Deloof, M. (2003). Does Working Capital Management Affect Profitability of Belgian Firms? *Journal of Business Finance Accounting, 30*(3-4), 573-588. https://doi.org/10.1111/1468-5957.00008

Desta, T. S. (2016). Are the best African banks really the best? A Malmquist data envelopment analysis. *Meditari Accountancy Research*, *24*(4), 588-610. https://doi.org/10.1108/medar-02-2016-0016

Dhole, S., Mishra, S., & Pal, A. M. (2019). Efficient working capital management, financial constraints and firm value: A text-based analysis. *Pacific-Basin Finance Journal*, *58*. https://doi.org/10.1016/j.pacfin.2019.101212

Duho, K. C. T. (2020). Intellectual capital and technical efficiency of banks in an emerging market: a slack-based measure. *Journal of Economic Studies*, *47*(7), 1711-1732. https://doi.org/10.1108/jes-06-2019-0295

Edvinsson, L., & Malone, M. (1997). Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower.

EL-Ansary, O., & Al-Gazzar, H. (2020). Working capital and financial performance in MENA region. *Journal of Humanities and Applied Social Sciences*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JHASS-02-2020-0036

Emery, G. W., & Cogger, K. O. (1982). The Measurement of Liquidity. *Journal of Accounting Research*, *20*(2), 290-303. https://doi.org/10.2307/2490741

Enqvist, J., Graham, M., & Nikkinen, J. (2014). The impact of working capital management on firm profitability in different business cycles: Evidence from Finland. *Research in International Business and Finance*, *32*, 36-49. https://doi.org/10.1016/j.ribaf.2014.03.005

Evans, J. R. (2011). *Quality Management, Organization, and Strategy* (6 ed.). Cengage Learning, Inc.

Fernández-López, S., Rodeiro-Pazos, D., & Rey-Ares, L. (2020). Effects of working capital management on firms' profitability: evidence from cheese-producing companies. *Agribusiness*, *36*(4), 770-791. https://doi.org/10.1002/agr.21666

Ferrier, G. D. (1994). Ownership Type, Property Rights, and Relative Efficiency. In A. Charnes, W. W. Cooper, A. Y. Lewin, & L. M. Seiford (Eds.), *Data Envelopment Analysis: Theory, Methodology, and Applications* (1 ed., pp. 273-283). Springer. https://doi.org/10.1007/978-94-011-0637-5_14

Firer, S., & Mitchell Williams, S. (2003). Intellectual capital and traditional measures of corporate performance. *Journal of Intellectual Capital*, *4*(3), 348-360. https://doi.org/10.1108/14691930310487806

Fixler, T., Paradi, J. C., & Yang, X. (2014). A data envelopment analysis approach for measuring the efficiency of Canadian acute care hospitals. *Health Services Management Research*, *27*(3-4), 57-69. https://doi.org/10.1177/0951484815601876

Ganji, S. S., & Rassafi, A. A. (2019). DEA Malmquist productivity index based on a double-frontier slacks-based model: Iranian road safety assessment. *European Transport Research Review*, *11*(1), 4. https://doi.org/10.1186/s12544-018-0339-z

Ghazouani, T. (2013). The capital structure through the trade-off theory: Evidence from Tunisian firm. *International Journal of Economics and Financial Issues*, *3*(3), 625.

Goel, U., & Sharma, A. K. (2015). Analysing Efficiency Change in Working Capital Management using Malmquist Productivity Index. *Journal of Information and Optimization Sciences*, *36*(6), 595-616. https://doi.org/10.1080/02522667.2015.1047586

Goel, U., & Sharma, A. K. (2016). Measuring efficiency of working capital management: a two-stage data envelopment analysis approach. *International Journal of Business Excellence*, *10*(4), 523-544.

Gonçalves, T., Gaio, C., & Robles, F. (2018). The impact of Working Capital Management on firm profitability in different economic cycles: Evidence from the United Kingdom. *Economics and Business Letters*, *7*(2), 70. https://doi.org/10.17811/ebl.7.2.2018.70-75

Grant, R. M. (1991). The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation. *California Management Review*, *33*(3), 114-135. https://doi.org/10.2307/41166664

Gupta, J., Rathore, P., & Kashiramka, S. (2022). Impact of Intellectual Capital on the Financial Performance of Innovation-Driven Pharmaceutical Firms: Empirical Evidence from India. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-022-00927-w

Gupta, K., Goel, S., & Bhatia, P. (2020). Intellectual Capital and Profitability: Evidence from Indian Pharmaceutical Sector. *Vision*, *24*(2), 204-216. https://doi.org/10.1177/0972262920914108

Habib, A. M. (2022). Does the efficiency of working capital management and environmental, social, and governance performance affect a firm’s value? Evidence from the United States. *Financial Markets, Institutions and Risks*, *6*(3), 18-25. https://doi.org/10.21272/fmir.6(3).18-25.2022

Habib, A. M., & Kayani, U. N. (2022). Does the efficiency of working capital management affect a firm's financial distress? Evidence from UAE. *Corporate Governance: The international journal of business in society*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/cg-12-2021-0440

Habib, A. M., & Mourad, N. (2022). Analyzing the Efficiency of Working Capital Management: a New Approach Based on DEA-Malmquist Technology. *Operations Research Forum*, *3*(3), 20. https://doi.org/10.1007/s43069-022-00155-7

Habib, A. M., & Shahwan, T. M. (2020). Measuring the operational and financial efficiency using a Malmquist data envelopment analysis: a case of Egyptian hospitals. *Benchmarking: An International Journal*, *27*(9), 2521-2536. https://doi.org/10.1108/bij-01-2020-0041

Hamdan, A. (2018). Intellectual capital and firm performance: Differentiating between accounting-based and market-based performance. *International Journal of Islamic and Middle Eastern Finance and Management*, *11*(1), 139-151. https://doi.org/10.1108/IMEFM-02-2017-0053

Hoskisson, R. E., Hitt, M. A., Wan, W. P., & Yiu, D. (1999). Theory and research in strategic management: Swings of a pendulum. *Journal of Management*, *25*(3), 417-456. https://doi.org/10.1177/014920639902500307

Isola, W. A., Adeleye, B. N., & Olohunlana, A. O. (2020). Boardroom female participation, intellectual capital efficiency and firm performance in developing countries: Evidence from Nigeria. *Journal of Economics, Finance and Administrative Science*, *25*(50), 413-424. https://doi.org/10.1108/JEFAS-03-2019-0034

Jahanzeb, A., Ur Rehman, S., Bajuri, N. H., Karami, M., & Ahmadimousaabad, A. (2013). Trade-Off Theory, Pecking Order Theory and Market Timing Theory: A Comprehensive Review of Capital Structure Theories. *International Journal of Management and Commerce Innovations (IJMCI)*, *1*(1), 11-18.

Kabuye, F., Kato, J., Akugizibwe, I., & Bugambiro, N. (2019). Internal control systems, working capital management and financial performance of supermarkets. *Cogent Business & Management*, *6*(1), 1573524. https://doi.org/10.1080/23311975.2019.1573524

Kieschnick, R., Laplante, M., & Moussawi, R. (2013). Working Capital Management and Shareholders' Wealth*. *Review of Finance*, *17*(5), 1827-1852. https://doi.org/10.1093/rof/rfs043

Kweh, Q. L., Chan, Y., & Ting, I. W. K. (2015). Intellectual Capital Efficiency and its Determinants. *Kajian Malaysia*, *33*(1), 105-124.

Kweh, Q. L., Ting, I. W. K., Lu, W.-M., & Le, H. T. M. (2021). Nonlinearity in the relationship between intellectual capital and corporate performance: evidence from Vietnamese listed companies. *Journal of Intellectual Capital*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JIC-03-2020-0105

Leitner, K. H., Schaffhauser-Linzatti, M., Stowasser, R., & Wagner, K. (2005). Data envelopment analysis as method for evaluating intellectual capital. *Journal of Intellectual Capital*, *6*(4), 528-543. https://doi.org/10.1108/14691930510628807

Li, X., & Cui, J. (2008). A Comprehensive Dea Approach for the Resource Allocation Problem based on Scale Economies Classification. *Journal of Systems Science and Complexity*, *21*(4), 540-557. https://doi.org/10.1007/s11424-008-9134-6

Long Kweh, Q., Chuann Chan, Y., & Wei Kiong Ting, I. (2013). Measuring intellectual capital efficiency in the Malaysian software sector. *Journal of Intellectual Capital*, *14*(2), 310-324. https://doi.org/10.1108/14691931311323904

Longo, M., & Mura, M. (2011). The effect of intellectual capital on employees' satisfaction and retention. *Information & Management*, *48*(7), 278-287. https://doi.org/10.1016/j.im.2011.06.005

Louw, E., Hall, J. H., & Pradhan, R. P. (2019). The Relationship Between Working Capital Management and Profitability: Evidence from South African Retail and Construction Firms. *Global Business Review*, 1-21. https://doi.org/10.1177/0972150919865104

Lu, W.-M., Wang, W.-K., Tung, W.-T., & Lin, F. (2010). Capability and efficiency of intellectual capital: The case of fabless companies in Taiwan. *Expert Systems with Applications*, *37*(1), 546-555. https://doi.org/10.1016/j.eswa.2009.05.031

Lu, Y., Tian, Z., Buitrago, G. A., Gao, S., Zhao, Y., & Zhang, S. (2021). Intellectual Capital and Firm Performance in the Context of Venture-Capital Syndication Background in China. *Complexity*, *2021*, 3425725. https://doi.org/10.1155/2021/3425725

Lyngstadaas, H. (2020). Packages or systems? Working capital management and financial performance among listed U.S. manufacturing firms. *Journal of Management Control*, *31*(4), 403-450. https://doi.org/10.1007/s00187-020-00306-z

Maji, S. G., & Hussain, F. (2021). Technical efficiency, intellectual capital efficiency and bank performance in emerging markets: the case of India. *Journal of Advances in Management Research*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/jamr-09-2020-0218

Mardones, J. G. (2021). Working capital management and business performance: evidence from Latin American companies. *Economic Research-Ekonomska Istraživanja*, 1-17. https://doi.org/10.1080/1331677X.2021.1986675

Martínez-Sola, C., García-Teruel, P. J., & Martínez-Solano, P. (2018). Cash holdings in SMEs: speed of adjustment, growth and financing. *Small Business Economics*, *51*(4), 823-842. https://doi.org/10.1007/s11187-018-9990-y

Masri, H., & Abdulla, Y. (2018). A multiple objective stochastic programming model for working capital management. *Technological Forecasting and Social Change*, *131*, 141-146. https://doi.org/10.1016/j.techfore.2017.05.006

Mazaheri, N. (2013). The Saudi monarchy and economic familism in an era of business environment reforms. *Business and Politics*, *15*(3), 295-321. https://doi.org/10.1515/bap-2012-0039

Miller, M. H., & Orr, D. (1966). A Model of the Demand for Money by Firms*. *The Quarterly Journal of Economics*, *80*(3), 413-435. https://doi.org/10.2307/1880728

Mourad, N. (2022). Second-order conic programming for data envelopment analysis models. *Periodicals of Engineering and Natural Sciences*, *10*(2), 487-499. https://doi.org/10.21533/pen.v10i2.2992
Mourad, N., Habib, A. M., & Tharwat, A. (2021). Appraising healthcare systems' efficiency in facing COVID-19 through data envelopment analysis. *Decision Science Letters*, *10*(3), 301-310. https://doi.org/10.5267/j.dsl.2021.2.007
Mourad, N., Tharwat, A., Habib, A. M., Wafik, D., & Hamed, M. A. (2022). Appraising the economic efficiency of european football teams: Evidence from Covid-19 crisis using data envelop analysis. *Journal of Positive School Psychology*, *6*(8). https://journalppw.com/index.php/jpsp/article/view/10611
Mouritsen, J., Larsen, H. T., & Bukh, P. N. (2001). Valuing the future: intellectual capital supplements at Skandia. *Accounting, Auditing & Accountability Journal*, *14*(4), 399-422. https://doi.org/10.1108/09513570110403434
Mun, S. G., & Jang, S. (2015). Working capital, cash holding, and profitability of restaurant firms. *International Journal of Hospitality Management*, *48*, 1-11. https://doi.org/10.1016/j.ijhm.2015.04.003
Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*(2), 187-221.
Nabi, G., Yousaf, M. S., & Ali, I. (2016). Impact of Working Capital Management Approaches (Aggressive/Conservative) on the Profitability and Shareholder's Worth: Comparative Analysis of Cement and Sugar Industry. *Research Journal of Finance Accounting*, *7*(5), 60-65.
Nadeem, M., Gan, C., & Nguyen, C. (2017). Does intellectual capital efficiency improve firm performance in BRICS economies? A dynamic panel estimation. *Measuring Business Excellence*, *21*(1), 65-85. https://doi.org/10.1108/mbe-12-2015-0055
Nadeem, M., Gan, C., & Nguyen, C. (2018). The Importance of Intellectual Capital for Firm Performance: Evidence from Australia. *Australian Accounting Review*, *28*(3), 334-344. https://doi.org/10.1111/auar.12184
Nazir, M. S., & Afza, T. (2009). Impact of Aggressive Working Capital Management Policy on Firms' Profitability. *IUP Journal of Applied Finance*, *15*(8), 1-13.
Nimtrakoon, S. (2015). The relationship between intellectual capital, firms' market value and financial performance. *Journal of Intellectual Capital*, *16*(3), 587-618. https://doi.org/10.1108/jic-09-2014-0104
Nitkiewicz, T., Pachura, P., & Reid, N. (2014). An appraisal of regional intellectual capital performance using Data Envelopment Analysis. *Applied Geography*, *53*, 246-257. https://doi.org/10.1016/j.apgeog.2014.06.011
Nkambule, N. A., Wang, W.-K., Ting, I. W. K., & Lu, W.-M. (2021). Intellectual capital and firm efficiency of US multinational software firms. *Journal of Intellectual Capital*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JIC-02-2021-0041
Olesen, O. B., & Petersen, N. C. (2016). Stochastic Data Envelopment Analysis—A review. *European Journal of Operational Research*, *251*(1), 2-21. https://doi.org/10.1016/j.ejor.2015.07.058
Ozcan, Y. A. (2014). *Health Care Benchmarking and Performance Evaluation* (2 ed., Vol. 210). Springer US. https://doi.org/10.1007/978-1-4899-7472-3
Pastor, J. T., & Ruiz, J. L. (2007). Variables With Negative Values In Dea. In J. Zhu & W. D. Cook (Eds.), *Modeling Data Irregularities and Structural Complexities in Data Envelopment Analysis* (pp. 63-84). Springer, Boston, MA. https://doi.org/10.1007/978-0-387-71607-7_4
Paul, P., & Mitra, P. (2018). Analysis of the Effect of Working Capital Management on Profitability of the Firm: Evidence from Indian Steel Industry. *Asia-Pacific Journal of Management Research and Innovation*, *14*(1-2), 32-38. https://doi.org/10.1177/2319510X18812142
Portela, M. C. A. S., Thanassoulis, E., & Simpson, G. (2004). Negative data in DEA: a directional distance approach applied to bank branches. *Journal of the Operational Research Society*, *55*(10), 1111-1121. https://doi.org/10.1057/palgrave.jors.2601768
Pourhejazy, P., Thamchutha, P., & Namthip, T.-i. (2022). A DEA-based decision analytics framework for product deletion in the luxury goods and fashion industry. *Decision Analytics Journal*, *2*, 100019. https://doi.org/10.1016/j.dajour.2021.100019
Pulić, A. (1998). Measuring the performance of intellectual potential in the knowledge economy. The 2nd McMaster Word Congress on Measuring and Managing Intellectual Capital McMaster University, Hamilton, Ontario, canada.
PwC. (2019). *Working Capital Report 2019/20: Creating value through working capital (Unlocking cash in digital age)*. P. w. h. Coopers. http://www.pwc.com/gx/en/working-capital-management-services/assets/working-capital-report-final.pdf
Qu, Y., Ma, J., & Yan, X. (2019, 24-27 March 2019). Evaluation of Cash Utilization Efficiency of Listed Companies in Biomedical Industry Based on DEA Model. 2019 5th International Conference on Information Management (ICIM),
Rahman, S. (2012). The role of intellectual capital in determining differences between stock market and financial performance. *International Research Journal of Finance and Economics*, *89*, 46-77.
Rey-Ares, L., Fernández-López, S., & Rodeiro-Pazos, D. (2021). Impact of working capital management on profitability for Spanish fish canning companies. *Marine Policy, 130*. https://doi.org/10.1016/j.marpol.2021.104583
Richards, V. D., & Laughlin, E. J. (1980). A Cash Conversion Cycle Approach to Liquidity Analysis. *Financial Management*, *9*, 32.
Salehi, M., Mahdavi, N., Zarif Agahi Dari, S., & Tarighi, H. (2019). Association between the availability of financial resources and working capital management with stock surplus returns in Iran. *International Journal of Emerging Markets*, *14*(2), 343-361. https://doi.org/10.1108/IJoEM-11-2017-0439

Salehi, M., Tarighi, H., & Safdari, S. (2018). The relation between corporate governance mechanisms, executive compensation and audit fees. *Management Research Review*, *41*(8), 939-967. https://doi.org/10.1108/mrr-12-2016-0277
Sarkis, J. (2007). Preparing Your Data for DEA. In J. Zhu & W. D. Cook (Eds.), *Modeling Data Irregularities and Structural Complexities in Data Envelopment Analysis* (pp. 305-320). Springer US. https://doi.org/10.1007/978-0-387-71607-7_17
Seleim, A., Ashour, A., & Bontis, N. (2007). Human capital and organizational performance: a study of Egyptian software companies. *Management Decision*, *45*(4), 789-801. https://doi.org/10.1108/00251740710746033
Serrasqueiro, Z., & Caetano, A. (2015). Trade-Off Theory versus Pecking Order Theory: capital structure decisions in a peripheral region of Portugal. *Journal of Business Economics and Management*, *16*(2), 445-466.
Seth, H., Chadha, S., Ruparel, N., Arora, P. K., & Sharma, S. K. (2020). Assessing working capital management efficiency of Indian manufacturing exporters. *Managerial Finance*, *46*(8), 1061-1079. https://doi.org/10.1108/MF-02-2019-0076
Seth, H., Chadha, S., & Sharma, S. (2020). Benchmarking the efficiency model for working capital management: data envelopment analysis approach. *International Journal of Productivity and Performance Management*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/IJPPM-10-2019-0484
Seth, H., Chadha, S., Sharma Satyendra, K., & Ruparel, N. (2020). Exploring predictors of working capital management efficiency and their influence on firm performance: an integrated DEA-SEM approach. *Benchmarking: An International Journal*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/BIJ-05-2020-0251
Seth, H., Chadha, S., Sharma, S. K., & Ruparel, N. (2021). Exploring predictors of working capital management efficiency and their influence on firm performance: an integrated DEA-SEM approach. *Benchmarking: An International Journal*, *28*(4), 1120-1145. https://doi.org/10.1108/BIJ-05-2020-0251
Shahdadi, K. M., Rostamy, A. A. A., Sadeghi Sharif, S. J., & Ranjbar, M. H. (2020). Intellectual capital, liquidity, and bankruptcy likelihood. *Journal of Corporate Accounting & Finance*, *31*(4), 21-32. https://doi.org/10.1002/jcaf.22460
Shahwan, T. M., & Habib, A. M. (2020). Does the efficiency of corporate governance and intellectual capital affect a firm's financial distress? Evidence from Egypt. *Journal of Intellectual Capital*, *21*(3), 403-430. https://doi.org/10.1108/jic-06-2019-0143
Shahwan, T. M., & Habib, A. M. (2021). Do corporate social responsibility practices affect the relative efficiency of Egyptian conventional and Islamic banks? *International Journal of Emerging Markets*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/ijoem-05-2020-0518
Shin, H. H., & Soenen, L. (1998). Efficiency of Working Capital Management and Corporate Profitability. *FINANCIAL PRACTICE AND EDUCATION*, *8*(2), 37-45.
Singh, N. P., & Bagga, M. (2019). The Effect of Capital Structure on Profitability: An Empirical Panel Data Study. *Jindal Journal of Business Research*, *8*(1), 65-77. https://doi.org/10.1177/2278682118823312
Soewarno, N., & Tjahjadi, B. (2020). Measures that matter: an empirical investigation of intellectual capital and financial performance of banking firms in Indonesia. *Journal of Intellectual Capital*, *21*(6), 1085-1106. https://doi.org/10.1108/jic-09-2019-0225
Soukhakian, I., & Khodakarami, M. (2019). Working capital management, firm performance and macroeconomic factors: Evidence from Iran. *Cogent Business & Management*, *6*(1), 1-24. https://doi.org/10.1080/23311975.2019.1684227
Sveiby, K. E. (1997). *The new organizational wealth: Managing & measuring knowledge-based* (1 ed.). Berrett-Koehler Publishers.
Tarek, Y., & Rafik, M. (2020). The Impact of Working Capital Management on Corporate's Performance: Evidence from Egypt. *International Journal of Business and Management*, *15*(6), 151-162. https://doi.org/10.5539/ijbm.v15n6p151
Tiwari, R. (2021). Nexus between intellectual capital and profitability with interaction effects: panel data evidence from the Indian healthcare industry. *Journal of Intellectual Capital*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JIC-05-2020-0137
Tone, K. (2001). A slacks-based measure of efficiency in data envelopment analysis. *European Journal of Operational Research*, *130*(3), 498-509. https://doi.org/10.1016/S0377-2217(99)00407-5
Tone, K. (2016). Data Envelopment Analysis as a Kaizen Tool: SBM Variations Revisited. *Bulletin of Mathematical Sciences and Applications*, *16*, 49-61. https://doi.org/10.18052/www.scipress.com/BMSA.16.49
Torre, C., Tommasetti, A., & Maione, G. (2021). Technology usage, intellectual capital, firm performance and employee satisfaction: the accountants' idea. *The TQM Journal*, *33*(3), 545-567. https://doi.org/10.1108/TQM-04-2020-0070
Tran, H., Abbott, M., & Jin Yap, C. (2017). How does working capital management affect the profitability of Vietnamese small- and medium-sized enterprises? *Journal of Small Business and Enterprise Development*, *24*(1), 2-11. https://doi.org/10.1108/JSBED-05-2016-0070
Ur Rehman, A., Aslam, E., & Iqbal, A. (2022). Intellectual capital efficiency and bank performance: Evidence from islamic banks. *Borsa Istanbul Review*, *22*(1), 113-121. https://doi.org/10.1016/j.bir.2021.02.004
Vishnu, S., & Kumar Gupta, V. (2014). Intellectual capital and performance of pharmaceutical firms in India. *Journal of Intellectual Capital*, *15*(1), 83-99. https://doi.org/10.1108/jic-04-2013-0049
Vu Thi, A.-H., & Phung, T.-D. (2021). Capital Structure, Working Capital, and Governance Quality Affect the Financial Performance of Small and Medium Enterprises in Taiwan. *Journal of Risk and Financial Management*, *14*(8), 381. https://doi.org/10.3390/jrfm14080381
Wang, Q., Sharma, U., & Davey, H. (2016). Intellectual capital disclosure by Chinese and Indian information technology companies. *Journal of Intellectual Capital*, *17*(3), 507-529. https://doi.org/10.1108/jic-02-2016-0026

Wang, Z., Akbar, M., & Akbar, A. (2020). The Interplay between Working Capital Management and a Firm's Financial Performance across the Corporate Life Cycle. *Sustainability*, *12*(4), 1661. https://doi.org/10.3390/su12041661

Wasiuzzaman, S. (2015). Working Capital and Profitability in Manufacturing Firms in Malaysia: An Empirical Study. *Global Business Review*, *16*(4), 545-556. https://doi.org/10.1177/0972150915581098

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180. https://doi.org/10.1002/smj.4250050207

Wright, P. M., McMahan, G. C., & McWilliams, A. (1994). Human resources and sustained competitive advantage: a resource-based perspective. *The International Journal of Human Resource Management*, *5*(2), 301-326. https://doi.org/10.1080/09585199400000020

Wu, C., Li, Y., Liu, Q., & Wang, K. (2013). A stochastic DEA model considering undesirable outputs with weak disposability. *Mathematical and Computer Modelling*, *58*(5), 980-989. https://doi.org/10.1016/j.mcm.2012.09.022

Wu, W.-Y., Tsai, H.-J., Cheng, K.-Y., & Lai, M. (2006). Assessment of intellectual capital management in Taiwanese IC design companies: using DEA and the Malmquist productivity index. *R&D Management*, *36*(5), 531-545. https://doi.org/10.1111/j.1467-9310.2006.00452.x

Yousaf, M. (2021). Intellectual capital and firm performance: evidence from certified firms from the EFQM excellence model. *Total Quality Management & Business Excellence*, 1-17. https://doi.org/10.1080/14783363.2021.1972800

Yu, H., Zhang, Y., Zhang, A., Wang, K., & Cui, Q. (2019). A comparative study of airline efficiency in China and India: A dynamic network DEA approach. *Research in Transportation Economics*, *76*, 100746. https://doi.org/10.1016/j.retrec.2019.100746

Zimon, G., & Tarighi, H. (2021). Effects of the COVID-19 Global Crisis on the Working Capital Management Policy: Evidence from Poland. *Journal of Risk and Financial Management*, *14*(4). https://doi.org/10.3390/jrfm14040169

Table 1

Summary of studies investigating the relationship between IC and firm performance

Authors	Period of study	Region of study	Sample size	Industry	Dependent variables	Independent variables	Methodology	Conclusion
Gupta et al. (2022)	2009-2018	India	82 firms	Pharmaceutical	ROA, ROE, ROS, Tobin's Q	VAIC, HCE, SCE, CEE	Pooled regression	IC positively impact firm performance. CEE drives firm performance.
Akkas and Asutay (2022)	2012-2020	GCC	24 Islamic and 32 Conventional banks	Banks	ROE, ROA	VAIC, HCE, SCE, CEE	Pooled regression	HCE and CEE have a positive relationship with firm performance.
Chatterjee et al. (2022)	2018	India	328 respondents from 12 firms	Top 1000 companies in 2019	Firm performance	IC, Human Capital (HC), Structural Capital (SC), Customer Capital (CC)	Questionnaire; Partial least square (PLS) – Structural equation modelling (SEM)	SC, HC and CC positively impact firm performance
Aljuboori et al. (2022)	2021	Malaysia	280 responses	SME	Firm performance	IC, Human Capital (HC), Structural Capital (SC), Customer Capital (CC)	SEM	IC improves innovation capabilities and subsequently increases firm performance.
Kweh et al. (2021)	2010-2018	Vietnam	1,395 firm year observations	Listed companies	Corporate performance – ROA, StoNED framework	IC, HC, SC, RC	Regression analysis with firm-year cluster-robust standard errors	HC, SC and RC contribute to high corporate efficiency, while HC and RC contribute to high corporate profitability
Nkambule et al. (2021)	2012-2016	US	246 firms	Multinational software companies	Firm efficiency using DEA	HC, innovation capital (IC), process capital (PC), CC	Hierarchical regression analysis	IC has a positive impact on firm performance
Dalwai and Salehi (2021)	2015-2019	Oman	380 firm year observations	Industrial	ROA, ROE	A-VAIC	OLS regression	IC does not influence firm performance. SCE positively influences ROA.
Yousaf (2021)	2015-2019	Czech	226 firms	Construction, manufacturing, automobile	ROA, ROE, ATO	VAIC, HCE, SCE, CEE	Pooled regression	IC positively impact firm performance
Maji and Hussain (2021)	2005-2018	India	37 firms	Commercial banks	ROA, ROE, NIM	VAIC, Technical efficiency (Input oriented DEA model)	System GMM, Quantile regression	Positive relationship between technical efficiency and firm performance, IC and firm performance
Lu et al. (2021)	2014-2018	China	575 observations	Firms accepting VCS funding	ROA, ROE	VAIC	OLS, GMM	IC has a positive impact on firm performance
Tiwari (2021)	2009-2018	India	459 firms	Healthcare	ROA	VAIC, MVAIC	Panel regression	IC is positively related to firm performance
Isola et al. (2020)	2008-2017	Nigeria	14 firms	Banks	ROA, ROE	HCE, SCE and CEE	Random effect regression	IC positive impact firm performance
Hamdan (2018)	2014-2016	Saudi Arabia & Bahrain	198 firms	Various sectors	ROA, Tobin's Q	HCE, SCE and CEE	OLS	Positive relationship for HCE, SCE and CEE with ROA. No relationship of the IC components with TobinQ.

Table 2

Summary of studies investigating the relationship between WCM and firm performance

Authors	Period of study	Region of study	Sample size	Industry	Dependent variables	Independent variables	Methodology	Conclusion
(Chambers & Cifter, 2022)	2004-2019	109 countries	2696 firms	Hospitality and tourism	ROA	CCC	Two step system GMM	WCM and ROA have positive linear relationship for sports firms. U-relationship is observed for accommodation, food and travel firms.
Anton and Afloarei Nucu (2021)	2007-2016	Poland	719 listed firms	Non-financial firms	ROA	WCM ratio and its square	OLS	WCM and firm profitability has an invested U-relationship
Mardones (2021)	2000-2018	Latin America	461 companies	Non-financial firms	ROE, Tobin's Q	Working capital investment to total assets (WKM)	OLS	The relationship between WKM and firm performance is positive and non-linear relationship
Rey-Ares et al. (2021)	2010-2018	Spain	377 companies	Fish canning	ROA ROE	Days sales outstanding (DSO), Days Inventory Outstanding (DIO), Days Payables Outstanding (DPO), CCC	Dynamic Panel	Inverted U-relationship for DSO and DIO with economic profitability
Dhole et al. (2019)	2000-2016	Australia	4422 firm year observations	Non-financial	Share Price	Cash ratio, CCC	Regression	Higher valuation with efficient WCM even if its firms have financial constraints
Masri and Abdulla (2018)	10 years	Bahrain	10 firms	Start-up retailer and its competitors	Profitability	Accounts receivable, Accounts payable, Inventory levels	Multiple objective stochastic program, regression	Accounts payable and accounts receivable has positive impact on profitability, Inventory has negative impact on profitability
EL-Ansary and Al-Gazzar (2020)	2013-2019	MENA	134 listed firms	Consumer goods	ROA, ROE	Net working capital	GMM regression analysis	NWC levels has non-linear effect on ROA, no effect on ROE
Seth, Chadha, Sharma Satyendra, et al. (2020)	2008-2019	India	212 listed firms	Manufacturing	Net sales, profit after tax	Firm-specific determinants, WCM efficiency	Data Envelopment analysis, Structural Equations Modelling	Leverage has an indirect negative effect on firm performance through WCM
Enqvist et al. (2014)	1990-2008	Finland	1136 firm-year observations	All listed companies	ROA, Gross Operating Income (GOI)	CCC	Regression	Negative relationship between CCC and corporate profitability
Mun and Jang (2015)	1963-2012	USA	298 firms	Restaurant	ROA	Working capital rate (WCR)	OLS	Inverted U-shape relationship between working capital and profitability
Ameer and Othman (2021)	2005-2017	New Zealand	76 firms	All listed firms except financial, real estate and information technology firms	ROA Q Ratio	Net trade cycle (NTC), Number of accounts receivable days (ARD), Number of accounts payable days (APD), number of inventory days (IND)	Pooled OLS	Non-linear relationship between NTC and ROA
(Soukhakian & Khodakarami, 2019)	2010-2016	Iran	111 firms	Manufacturing firms	ROA, refined economic value added (REVA)	CCC	OLS, 2SLS	Negative relationship between ROA and REVA

Table 3

Variables definition

Model	Variable	Definition
Intellectual capital	Capital employed efficiency (CEE)	Percentage of value added (VA) to capital employed (CE) at the end of year t, as VA is the sum of operating profits, total employee costs, depreciation, and amortization, and CE is the physical and financial capital employed and is equal to the balance of the assets after excluding goodwill and intangibles.
	Human capital efficiency (HCE)	Percentage of VA to human capital (HC) at the end of year t, as HC is the total cost of employees.
	Structural capital efficiency (SCE)	Percentage of structural capital (SC) to VA at the end of year t, as SC is a difference between VA generated by the DMU and its HC.
	Market-to-book (M/B)	Percentage of DMU market capitalization to its book value at the end of year t.
	Return on assets (ROA)	Percentage of DMU net income to its total assets at the end of year t.
Working capital management	Inventory (INV)	Book value of inventory at the end of year t.
	Cost of goods sold (COGS)	Book value of the cost of goods sold of year t.
	Accounts receivables (ACR)	Book value of accounts receivables at the end of year t.
	Accounts payable (ACP)	Book value of accounts payable at the end of year t.
	Net revenue (REV)	Book value of net revenue of year t.
	Net income (INC)	Book value of net income of year t.

Table 4

Descriptive statistics

Variables	Obs	Mean	Std. dev.	Min	Max
ICE	200	0.6225	0.2845	0.0995	1.0000
WCME	200	0.8164	0.1899	0.3923	1.0000
SIZE	200	5.7370	1.4855	2.4336	8.9858
LEV	200	0.9550	1.0454	0.0445	6.0923
AGE	200	3.2700	0.5587	1.9459	4.2195
ROA	200	0.0735	0.0622	0.0007	0.3878
ROE	200	0.1273	0.1179	0.0014	0.8103
Tobin's Q	200	2.1270	3.9892	0.2137	36.681

Table 5

ICE relative efficiency scores summary

DMU	2015	2016	2017	2018	2019	DMU	2015	2016	2017	2018	2019
DSM:AHCS	0.464	0.466	0.482	0.373	0.440	KWSE:MUBARRAD	1.000	0.688	0.685	0.649	0.460
ADX:ADAVIATION	0.433	0.563	0.422	0.421	0.483	SASE:9510	0.947	1.000	1.000	1.000	1.000
KWSE:AGLTY	0.999	1.000	0.795	0.856	0.867	DFM:TABREED	0.315	0.432	0.386	0.403	0.545
MSM:AACT	0.680	0.398	0.376	1.000	0.604	KWSE:CLEANING	0.111	0.196	0.152	0.201	0.232
MSM:AMCI	0.730	0.832	0.607	0.560	0.657	ADX:NMDC	0.274	1.000	0.232	0.257	0.447
ADX:ALQUDRA	0.503	0.702	0.383	1.000	1.000	MSM:OCAI	0.549	0.634	0.362	0.455	0.527
SASE:2320	0.492	0.711	0.531	0.585	0.421	MSM:OIFC	0.589	0.448	0.999	1.000	0.965
SASE:4141	0.401	0.741	0.446	1.000	1.000	MSM:ONES	0.212	0.179	0.214	0.125	0.233
BAX:APMTB	1.000	0.981	1.000	1.000	1.000	DSM:QIMD	1.000	0.903	1.000	1.000	1.000
SASE:4110	0.625	1.000	0.664	0.694	0.468	DSM:QNNS	0.355	0.360	0.224	0.204	0.421
KWSE:CGC	0.213	0.397	0.144	0.174	0.298	AIM:RAI	1.000	1.000	1.000	0.743	1.000
DFM:DIC	0.744	1.000	0.582	0.328	0.380	SASE:4031	0.822	0.863	0.679	0.886	0.795
DSM:GWCS	0.475	0.508	0.409	0.413	0.571	SASE:2190	0.245	0.322	0.315	0.438	0.459
KWSE:HAYATCOMM	0.121	0.195	0.149	0.099	0.099	SASE:4040	0.708	0.617	1.000	1.000	0.999
DSM:IQCD	1.000	1.000	1.000	1.000	1.000	BAX:BASREC	0.502	0.703	0.723	0.659	0.892
KWSE:INTEGRATED	0.568	0.874	0.705	0.914	0.778	KWSE:KCPC	0.341	0.566	0.298	0.423	0.637
DSM:IGRD	0.739	0.986	0.196	0.351	0.389	SASE:4260	0.985	0.649	0.575	0.706	0.894
KWSE:JAZEERA	1.000	1.000	0.854	1.000	0.806	KWSE:UPAC	0.639	0.950	0.876	0.728	0.771
KWSE:LOGISTICS	0.322	0.402	0.307	0.281	0.199	MSM:VOES	0.483	0.629	0.499	1.000	0.999
KWSE:PCEM	0.562	0.806	0.778	0.827	1.000	Mean	0.592	0.629	0.562	0.627	0.648
DSM:MCCS	0.520	0.676	0.409	0.314	0.194						

Table 6

WCME relative efficiency scores summary

DMU	2015	2016	2017	2018	2019	DMU	2015	2016	2017	2018	2019
DSM:AHCS	0.799	0.811	0.974	0.957	0.915	KWSE:MUBARRAD	1.000	1.000	1.000	1.000	1.000
ADX:ADAVIATION	0.968	0.883	0.878	0.846	0.877	SASE:9510	0.678	0.498	0.440	0.444	0.434
KWSE:AGLTY	1.000	1.000	1.000	1.000	1.000	DFM:TABREED	1.000	1.000	1.000	1.000	1.000
MSM:AACT	0.782	0.764	0.541	0.495	0.511	KWSE:CLEANING	0.604	0.579	0.585	0.578	0.570
MSM:AMCI	0.605	0.776	1.000	0.564	0.497	ADX:NMDC	0.732	0.631	0.695	0.702	0.690
ADX:ALQUDRA	0.963	0.898	1.000	0.684	1.000	MSM:OCAI	1.000	0.928	0.893	0.942	0.884
SASE:2320	0.799	0.770	0.781	0.678	0.701	MSM:OIFC	1.000	0.799	0.538	0.473	0.503
SASE:4141	1.000	0.737	0.398	0.395	0.425	MSM:ONES	0.662	0.621	0.607	0.623	0.573
BAX:APMTB	1.000	1.000	1.000	1.000	1.000	DSM:QIMD	0.615	0.751	1.000	0.839	0.652
SASE:4110	0.853	0.980	0.862	0.829	0.652	DSM:QNNS	1.000	1.000	1.000	1.000	1.000
KWSE:CGC	0.660	0.668	0.695	0.701	0.667	AIM:RAI	0.708	0.702	0.560	0.565	0.569
DFM:DIC	0.952	1.000	1.000	0.985	0.998	SASE:4031	1.000	1.000	1.000	1.000	1.000
DSM:GWCS	1.000	0.907	0.919	1.000	1.000	SASE:2190	1.000	1.000	0.898	1.000	1.000
KWSE:HAYATCOMM	0.510	0.502	0.519	0.518	0.493	SASE:4040	1.000	1.000	1.000	0.795	0.929
DSM:IQCD	1.000	1.000	1.000	1.000	1.000	BAX:BASREC	0.999	1.000	1.000	0.392	1.000
KWSE:INTEGRATED	1.000	0.886	0.912	1.000	0.675	KWSE:KCPC	0.530	0.532	0.594	0.686	0.642
DSM:IGRD	0.710	0.702	0.683	0.646	0.598	SASE:4260	0.952	1.000	1.000	1.000	1.000
KWSE:JAZEERA	1.000	1.000	1.000	1.000	1.000	KWSE:UPAC	1.000	1.000	1.000	1.000	1.000
KWSE:LOGISTICS	0.796	0.791	0.834	0.797	0.689	MSM:VOES	0.610	0.637	0.605	0.554	0.545
KWSE:PCEM	0.810	0.668	0.667	0.803	0.681	Mean	0.858	0.836	0.824	0.785	0.780
DSM:MCCS	1.000	1.000	0.877	0.893	0.849						

Table 7

Wilcoxon and Sign test results

Panel A: The DEA-ICE model				
Relative efficiency change	Wilcoxon test		Sign test	
	Z-statistic	P-value	Z-statistic	P-value
2015 to 2016	-2.964	0.003**	-3.288	0.001**
2016 to 2017	-3.749	0.000**	-3.617	0.000**
2017 to 2018	-1.687	0.092*	-1.352	0.176
2018 to 2019	-1.342	0.180	-1.543	0.123
Panel B: The DEA-WCME model				
2015 to 2016	-1.753	0.080*	-1.323	0.186
2016 to 2017	-0.456	0.648	0.000	1.000
2017 to 2018	-1.388	0.165	-0.913	0.361
2018 to 2019	-1.617	0.106	-1.323	0.186
Note: *p < 0.1, and **p < 0.01.				

Table 8

Pairwise correlations and multicollinearity verification

Panel A: Pairwise correlations					
Variables	ICE	WCME	SIZE	LEV	AGE
ICE	1.0000				
WCME	0.1331*	1.0000			
SIZE	-0.1449**	0.4866***	1.0000		
LEV	-0.2813***	-0.2124***	0.0707	1.0000	
AGE	-0.2354***	-0.1161	0.3278***	0.2831***	1.0000
Panel B: Variance inflation factor and tolerance					
VIF	1.15	1.57	1.68	1.19	1.33
Tolerance	0.8711	0.6352	0.5943	0.8425	0.7545
Note: *p < 0.1, **p < 0.05, and ***p < 0.01.					

Table 9

Regression results

Variable	(1) ROA	(2) ROE	(3) Tobin's Q
ICE	0.089*** (0.008)	0.142*** (0.014)	2.323*** (0.385)
WCME	0.060*** (0.014)	0.128*** (0.023)	1.025* (0.593)
SIZE	-0.010*** (0.002)	-0.017*** (0.003)	-0.244*** (0.079)
LEV	-0.001 (0.002)	0.033*** (0.005)	0.305*** (0.112)
AGE	-0.009** (0.004)	-0.023*** (0.006)	-0.474*** (0.139)
_cons	0.051*** (0.015)	0.066** (0.028)	1.996*** (0.757)
Obs.	200	200	200
R-squared	0.557332	0.566098	0.330323
Adjusted R-squared	0.545923	0.554915	0.313063
F(5, 194)	48.85026***	50.62113***	19.13834***

Note: *p < 0.1, **p < 0.05, and ***p < 0.01; Standard errors in the model are reported in parentheses.

Table 10

Results of the robustness tests

Variable Removed	Average Efficiency Score	Efficient DMUs (%)	Spearman Rank Correlation Sig.	Mann Whitney U Sig.
Panel A: DEA-ICE model				
None	0.623	20	---	---
CEE	0.450	12.5	0.890**	0.080
HCE	0.583	17.5	0.949**	0.201
SCE	0.595	17.5	0.919**	0.507
Panel B: Output-oriented vs. input-oriented model				
Spearman Rank Correlation Sig.			0.748**	
Asymp. Sig. (Mann-Whitney U)			0.164	
Panel C: DEA-WCME model				
Variable Removed	Average Efficiency Score	Efficient DMUs (%)	Spearman Rank Correlation Sig.	Mann Whitney U Sig.
None	0.816	37.5	---	---
INV	0.797	32.5	0.931**	0.572
ACR	0.778	27.5	0.926**	0.290
ACP	0.779	30	0.880**	0.385
COGS	0.663	30	0.798**	0.170
Panel D: Output-oriented vs. input-oriented model				
Spearman Rank Correlation Sig.			0.958**	
Asymp. Sig. (Mann-Whitney U)			0.813	
Note: **p < 0.01				

Table 11

Distribution variance of efficiency scores over the study period

Period	Panel A: The DEA-ICE model		Panel B: The DEA-WCME model	
	Spearman Rank Correlation Sig.	Kruskal Wallis H Sig.	Spearman Rank Correlation Sig.	Kruskal Wallis H Sig.
2015 to 2016	0.724**	0.377	0.819**	0.414
2016 to 2017	0.797**		0.513**	
2017 to 2018	0.661**		0.630**	
2018 to 2019	0.582**		0.674**	
Note: **p < 0.01				

Table 12

GLS Regression analysis

Variable	(1) ROA	(2) ROE	(3) Tobin's Q
ICE	0.054*** (0.014)	0.103*** (0.027)	1.721** (0.769)
WCME	0.093*** (0.024)	0.228*** (0.045)	2.930** (1.272)
SIZE	-0.015*** (0.004)	-0.032*** (0.008)	-1.698*** (0.340)
LEV	-0.004 (0.004)	0.058*** (0.008)	1.936*** (0.253)
AGE	-0.029*** (0.010)	-0.062*** (0.021)	-1.727* (0.927)
_cons	0.150*** (0.040)	0.209*** (0.081)	12.206*** (3.237)
Obs.	200	200	200
R-sq			
within	0.1128	0.3097	0.4125
between	0.6001	0.4876	0.1808
overall	0.4461	0.4184	0.2004
Note: *p < 0.1, **p < 0.05, and ***p < 0.01; Standard errors in the model are reported in parentheses.			

Table 13

Regression analysis with AR(1) disturbances

Variable	(1) ROA	(2) ROE	(3) Tobin's Q
ICE	0.059*** (0.014)	0.110*** (0.027)	1.548** (0.749)
WCME	0.089*** (0.024)	0.214*** (0.046)	2.501** (1.277)
SIZE	-0.015*** (0.004)	-0.031*** (0.008)	-1.576*** (0.327)
LEV	-0.003 (0.004)	0.057*** (0.008)	1.772*** (0.270)
AGE	-0.027*** (0.010)	-0.057*** (0.020)	-1.526* (0.889)
_cons	0.140*** (0.037)	0.192** (0.075)	11.511*** (3.113)
Obs.	200	200	200
R-sq			
within	0.1038	0.3033	0.4158
between	0.6162	0.4998	0.1802
overall	0.4537	0.4246	0.1994

Note: *p < 0.1, **p < 0.05, and ***p < 0.01; Standard errors in the model are reported in parentheses.