Impact of Intellectual Capital on Bank Performance during COVID-19: Evidence from a Developing Economy

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Abstract

The purpose of this study is to assess the impact of intellectual capital (IC) on bank performance during the pre-and post-COVID-19 period. A balanced quarterly panel data of 29 banks from the banking sector of Bangladesh from 2018 to 2022 is used to assess this empirical issue. IC of banks is measured by the value-added intellectual capital while bank performance is measured by return on average asset (ROAA), return on average equity (ROAE), bank efficiency (EFF), and Tobin's Q (MTQ). The pooled ordinary least square with panel corrected standard error model has been used for the panel estimation. The results show that IC is positively associated with the ROAA, ROAE, and EFF but negatively associated with the market-based performance measure, MTQ. It is also evident that the performance-enhancing effect of IC is larger in the post-COVID period than in the pre-COVID period, thus indicating the importance of IC for sustainable bank performance during the crisis. In addition, a non-linear or U-shaped relationship between IC and bank performance is observed. Thus, the study contributes to the empirical literature by highlighting the difference in the impact of IC on bank performance in a developing economy like Bangladesh during the pre-COVID and post-COVID periods, which requires the policymakers to promote IC for ensuring sustainable bank performance during the crisis.

Keywords: Bangladesh, Bank Performance, COVID-19, Intellectual Capital, and Bank Efficiency

01. Introduction

The performance of the banks historically depends on their core activities such as intermediation between surplus and deficit sectors, managing deposits and assets, and offering financial advisory services. The output of these core tasks is reflected in the financial statements of the banks. Being one of the pillars and influential sectors of the economy, the performance of the banking sector is under scrutiny. However, decision-makers and interested parties often look for profitability, efficiency, market performance, and riskiness for analysing

the performance. However, some other important but internal and intangible issues are overlooked. These issues and elements are important because of their crucial role in increasing the value of the bank (Poh *et al.*, 2018) as well as in achieving the efficiency of the bank (Wang *et al.*, 2013). It is also evident that using intellectual capital (IC) brings the best performance from the banks in contrast to physical and tangible capital (Mavridis, 2004). The urgency of financial competitiveness, knowledge-centric corporate atmosphere, and widespread globalization throughout the last few decades have created the need to embrace the idea of including IC in corporate decision-making (Xu & Wang, 2018; Oppong & Pattanayak, 2019)

Financial information, which is explicitly reflected in the financial statements, is mainly for reporting purposes. Although according to Zhou and Fink (2003), it is difficult to define and express the IC because of its nature, Edvinsson (1997) defined IC as the information regarding the employee experience, application of those experiences, relationship with customers, adoption of technology, and efficiency in utilizing implicit knowledge. It is also regarded as intellectual property rights and resources (Mubarik *et al.*, 2021). Several authors regarded IC as the blend of structural capital (SC), relational capital (RC), and human capital (HC) that help to create and add value to existing labour-intensive industries (Edvinsson, 1997; Holienka & Pilkova, 2014; Asare *et al.*, 2021). Structural capital includes patents, copyrights, business processes, information systems, etc. Educational qualifications, work experience, efficiency, and competencies are the components of human capital. Relational capital constitutes customer experience and loyalty, brand value, distribution channels, etc. (Holienka & Pilkova, 2014; Asare *et al.*, 2021). These knowledge-oriented assets can be measured in monetary form with the help of the value-added intellectual coefficient (VAIC) developed by Public (1998, 2004). Several studies, not limited to Pulic, 2004; Ozkan *et al.*, 2017; Hasan & Miah, 2018; Soewarno & Tjahijadi, 2020; Nabi *et al.*, 2020; Onumah & Duho, 2020; Mollah & Rouf, 2022; and Xu *et al.*, 2022 used VAIC to reveal the impact of IC on the performance of the bank. This incorporates capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE) to identify the sources of efficiency of the firm.

Conventional accounting systems prevail as a major influencer of a bank's financial analysis, the increasing gap between the book value and market value of the bank attains the focus of the role of IC. IC plays a significant positive impact on the profitability of the bank in terms of return on assets (ROA) and returns on equity (ROE) (Vo and Tran, 2021; Xu *et al.*, 2022). In terms of increasing the efficiency of the banks, IC gives a competitive edge with the help of HCE by reducing risk and increasing productivity (Onumah & Duho, 2020). The adoption of IC in the bank also improves market performance (Nimtrakoon, 2015; Buallay, 2019; Soewarno & Tjahijadi, 2020). Furthermore, improvement in the global banking sector was expected due to its rapid association with technology and knowledge-centered IC until the arrival of COVID-19. However, due to halted economic activities and worldwide restrictions since December 2019, businesses observed reduced demand and revenues. It indicates the vulnerability of businesses to natural and economic crises (Just & Echaust, 2020). Although the banking sector is also vulnerable to the crisis, banks having resources like IC can sustain the backdrop (Dadoukis *et al.*, 2021; Hariyono, 2021). Several studies before and after COVID-19 showed the banks' resilience from this resource (Kehelwalatenna, 2016; Xu *et al.*, 2022).

The banking sector of Bangladesh, having 61 banks in the bucket, is affected by the pandemic. Ghosh & Saima(2021) and Gazi et al. (2022) documented the adverse impact of COVID-19 on banks' profitability, liquidity position, and non-performing loans. Although literature related to the impact of IC on the performance of the bank during a crisis exists in the global context,

the number of studies in the Bangladesh context is very limited. Mollah & Rouf (2022) studied the listed banks and found that the performance of the banks is significantly related to the HCE and CEE in contrast to the findings of Nobi *et al.*, (2020) who indicated the significance of SCE. Hasan & Miah (2018) investigated the effect of IC on the performance of banks using 49 listed financial institutions whereas Rahman & Ahmed (2012) studied several companies to find the association between IC and market value and financial performance. To our knowledge, there are a few studies that tried to reveal the impact of IC on bank performance during COVID-19 in the Bangladesh context. Giving due consideration to the above-mentioned matters, the study focuses on two questions: first, how IC efficiency affects the performance of banks, and second, how each component of VAIC affects the performance. Alongside this, we will assess the existence of a quadratic relationship between banks' performance and IC. The remaining part of this paper begins with the literature review in Section 2. Section 3 focuses on the research methodology followed by the findings and analysis of the study in Section 4. Section 5 covers the concluding remarks.

02. Literature Review

The drivers behind the performance of the bank are no longer related to only customer base, capital employed, and efficiency, neither can we say the factors are accurately reflected in the financial statements. Although the outputs of the statements show both tangible and intangible facts, it is highly acknowledged that some inherent variables work behind the scenes, paving the way to more value creation, energized intellectual resources, and sustainable performance. With the empowerment of the capability of generating, executing, and quantifying intangible assets like knowledge, ideas and information, formal and informal training and education, IC helps tremendously in offering higher efficiency for the organization (Dean & Kretschmer, 2007; Wang *et al.*, 2013; Poh *et al.*, 2018). Having a prevalent impact on a firm, its impact ranges from superior financial performance to effective decision-making (Xu & Wang, 2018; Oppong & Pattanayak, 2019).

Buallay *et al.* (2020) defined SCE as the combination of organizational culture and structure. Previous literature also regarded SCE as organizational systems and procedures for quick and innovative solutions (Chu *et al.*, 2006), a combination of organizational systems and procedures, culture, databases, schedules, and hardware (Meles *et al.*, 2016), information technology (IT) and philosophy of the business (Rudez & Mihalic, 2007). While delivering the service, employees are at the heart of everything having a wide range of knowledge, education, behaviour, client handling procedures, moral values, capabilities, and work experiences. Martinez-Torres (2006) labelled HCE as individual expertise, ability to innovate, and skills, whereas Lim *et al.*, (2010) opposed the idea by referring it to team knowledge, skills, overall working behaviour, and organizational philosophy.

As the economy has been turning into knowledge-centric development from the physical, the impact of IC is more visible now than ever. The effect of embracing IC ranges from improving the corporate environment to financial statements. Previous literature documented the enormous footprint of IC in boosting the performance of the banks in terms of profitability, efficiency, asset quality, productivity, and market value. For achieving a competitive edge in terms of sustainable client base and organizational performance, the inclusion of IC can play a vital role (Choudhury, 2010; Wang et al., 2013). Buallay (2019) analysed 59 banks from gulf cooperative council (GCC) countries and concluded the positive contribution of IC to operating

and financial performance comparable to ASEAN countries (Nimtrakoon, 2015), Indonesia (Soewarno & Tjahijadi, 2020), Turkey (Ozkan et al., 2017), Vietnam (Le & Nguyen, 2020), India (Weqar et al., 2020). Mavridis (2004) scripted the superiority of IC over physical capital on the performance in Japan. IC also helps to improve the profitability scenario of the banks. From a study of 34 banks in China and 39 banks in Pakistan, the positive contribution of IC on profitability was evident (Xu et al., 2022), alike Haris et al., (2019) and Weqar et al. (2020).

IC also contributes toward efficiency (Meles et al., 2016; Ozkan et al., 2017; Onumah & Duho, 2020). A study on 339 banks in 31 African countries revealed the role of IC in achieving cost efficiency, allocating resources, and increasing technical aspects of the banks (Adesina, 2019). Through experience, education, and effective training, it is possible to pick the well-performing assets of the banks. The impact of embracing IC, especially HCE, and SCE, availed the bank to improve the quality of banks' assets (Le & Nguyen, 2020; Asare et al., 2021; Vo & Tran, 2021). Along with improving performance and asset quality, IC also helps in increasing the productivity of the banks (Weqar et al., 2020) which paves the way to increase the market value (Nimtrakoon, 2015). Besides conventional banks, IC also injects its benefits into Islamic banks. Rehman et al. (2022) scripted the positive impact of IC by studying 129 Islamic banks across 29 Islamic countries.

Things became tough in December 2019 when COVID-19 smashed the world with its devastating effects with worldwide lockdown, supply chain turbulence, and government restrictions. Indicators including financial and accounting-related measures showed the dark side of the outbreak as the performance worsen and risk increased (Elnahass et al., 2021). The performance of the banks slumped in terms of profitability, productivity, and efficiency during the pandemic. Non-performing loans increased as the borrowers experienced a sharp decline in income (Katusiime, 2021) as well as demand for loans (Li et al., 2021). However, significant differences were evident in pre- and post-COVID situations in banks' financial performance (Siska et al., 2021). Organizations that possessed IC in their system performed better than those not incorporating IC, from a supply chain perspective (Mubarik et al., 2021). Banks, surrounded by technology-based systems, enjoyed a better performance in terms of market value, growth in loans, and resilience during crises (Dadoukis et al., 2021). Hariyono (2021) documented that firms having higher levels of IC benefited positively while adopting the recent technology and system. Following the global trend, the banking sector of Bangladesh saw a decline in profits, value of assets, liquidity, and adequacy of capital (Barua & Barua, 2021; Gazi et al., 2022; Kashem, 2022).

Existing literature has paved the way to identify IC by employing the VAIC model. Pulic (1998, 2004) noted this famous model to calculate the efficiency of an organization by adding HCE, SCE, and CEE. A higher coefficient of this index stands for better IC and value creation. Several studies including Holienka & Pilkova, 2014; Ozkan et al., 2017; Adesina, 2019; Haris et al., 2019; Onumah & Duho, 2020; Le & Nguyen, 2020; Buallay et al., 2020; Asare et al., 2021; Vo & Tran, 2021; and Xu et al., 2022 used VAIC index to analyze the relationship between IC and financial performance through value creation and noted the impact as positive. Ozkan et al. (2017), Buallay et al. (2020), Le & Nguyen (2020), Rehman et al. (2022), and Xu et al. (2022) regarded bank performance in terms of ROAA and ROAE while looking for the impact of IC.

In Bangladesh, there are a few papers that attempted to identify the impact of IC on bank performance. Zheng *et al.* (2022) and Nabi *et al.* (2020) analyzed the impact of IC on the risk-taking behavior of banks and corporate performance, respectively. Hasan & Miah (2018) found

a significant positive relationship between performance and VAIC in recent times. Mollah & Rouf (2022) studied the effect of IC focusing on the performance of banks whereas Gazi *et al.* (2022) concentrated on the profitability and financial performance of banks during COVID-19. However, no study attempted to analyze the impact of IC on the performance of the banks during the pandemic.

03. Data and Methodology

3.1. Data

To address the empirical issues of this study, a balanced panel data comprising 29 listed banks on the Dhaka Stock Exchange (DSE) from the first quarter of 2018 to the first quarter of 2022 is selected for the estimation. The construction of the panel database of this study is based on data availability. In Bangladesh, only listed banks in DSE publish quarter reports. As a result, 34 listed banks in DSE were selected but had to exclude 5 banks due to the unavailability of quarter reports in all of the periods. The annual reports are collected from the websites of the respective banks.

3.2. Variable Description

3.2.1. Bank profitability measures

This study has used two accounting-based performance measures: ROAA and ROAE. ROAA has emerged as one of the most widely used measures of bank profitability in the empirical literature (Dietrich & Wanzenried, 2011). ROAA measures the managerial efficiency of the bank to generate profit from the utilization of the bank's assets. ROAA is also defined as the ratio of net profit after tax to total average asset expressed in percentage. This study has used average total assets rather than the total assets of a particular fiscal quarter to capture the changes in a bank's assets during the fiscal quarter [(1)]. The other accounting-based profitability measure is the ROAE, which estimates the return earned by the bank's management through the utilization of the shareholder's equity. ROAE is also defined as the ratio of net profit after tax to total average equity expressed in percentage. Though this profitability indicator is criticised for disregarding the risk associated with leverage (Dietrich & Wanzenried, 2011), ROAE has been commonly used as a profitability indicator by the existing literature.

3.2.2. Bank efficiency measure

This study has selected non-parametric data envelopment analysis (DEA) for measuring bank efficiency (EFF). DEA was first developed by Charnes *et al.* (1978) as a linear programming technique designed to assess the efficiency of non-profit organizations in the public sector. Here, the term 'efficiency' means the ability of a firm to make optimal conversion of its input into output. In DEA, each firm in a sample is considered a Decision-making Unit (DMU) and helps to measure the relative efficiency score for every DMU. Thus, every bank of the sample of this study is considered a DMU. The application of DEA will help to measure the relative efficiency of the 'n' DMUs against the best-observed efficiency derived from a multiple input-output framework. The efficiency score generated by DEA ranges from 0 to 1. A DMU lying in the efficient frontier with an efficiency score of 1 is considered the most efficient DMU within

the sample. Among the various DEA, models developed over the years, this study has selected the Slack-Based Measure (SBM) developed by Tone (2001) to measure EFF. SBM measure is selected due to its simultaneous focus on dealing with input excesses and output shortfalls of the DMU, and its unit invariance and monotone decreasing feature regarding the input excess and output shortfall (Tone, 2001) which are lacking in the other traditional feature such as Charnes–Cooper–Rhodes (CCR) measure and Banker–Charnes–Cooper (BCC) measure. In this study, A DMU (bank in this study) is SBM efficient with a value of 1 if the DMU is on the frontier of the production possibility set with no input and output slack. The efficiency estimation through the employment of DEA is significantly influenced by the approach required to specify the inputs and outputs (Sathye, 2001). There are two common approaches widely used in the empirical literature for the specification of inputs and outputs to estimate efficiency through DEA, namely the intermediation approach and the production approach. This study has adopted the intermediation approach over the production approach for specifying inputs and outputs. The preference for the intermediation approach is driven by the fact that it is more suitable for measuring the bank-level efficiency of a particular banking industry whereas the production approach is more suitable for measuring the branch-level efficiency of a particular bank. Following the studies of Avkiran (1999), Uddin & Suzuki (2011), and Uddin & Suzuki (2014), this study has used two outputs namely interest income and non-interest income, and two inputs namely interest expense and non-interest expense to measure EFF. Since these variables are revenues and costs reported in income statements, the estimated efficiency score can be viewed as profit efficiency (Avkiran, 2011). The constant return to scale assumption was used to estimate the profit efficiency of banks in this study [(2)].

3.2.3. Market performance measure

Following the study of Lee & Kim (2013), this study has used Tobin's Q (MTQ) as the market data-based bank performance measure calculated as:

$$\text{MTQ}= \frac{ASSET+(MB-1)*BE}{ASSET}$$

Here, ASSET represents book value to total assets. MB is the market price per share of a bank divided by the book value per share. BE represents the book value of total equity.

3.2.4. Measuring IC

This study has employed the VAIC methodology of Pulic (2000) to estimate the IC efficiency of banks. Following the studies of Ozkan *et al.* (2017), and Onumah & Duho (2020), this study has calculated VAIC as, VAIC= HCE + SCE + CEE. Here, VAIC represents the IC efficiency of banks defined as the marginal value created by the bank's management by each unit of its resources. Its three additive components are HCE, SCE, and CEE. HCE measures the marginal value created by human capital, SCE measures the marginal value created by structural capital, and CEE measures the marginal value contributed by one unit of shareholders' fund. To estimate these three additive components of VAIC, the total value added is required to be estimated and calculated as follows (Adesina, 2019; Asare *et al.*, 2021; Onumah & Duho, 2020), VA= Output – Input. Here, VA is the total value added of banks. Output refers to total gross revenue (sum of total interest income and total non-interest income), and Input refers to total operating cost (sum of total interest expense and total non-interest expense excluding personnel expense [(3)]. The three additive components of VAIC are calculated as HCE=VA/HC,

SCE=SC/VA, and CEE=VA/CE. Here, HC refers to the Human capital proxied by total personnel expense; SC refers to the structural capital estimated as the difference between VA and HC; CE represents the capital employed estimated as the book value of the net asset.

3.2.5. Control variables

This study has employed several variables to account for the bank-specific characteristics that can influence bank performance apart from IC. Bank size (SIZE) proxied by the natural logarithm of total assets is included in the regression equations to capture the possible scale effect as larger size helps the banks not only to achieve economies of scale but also attain a higher degree of loan diversification than smaller banks, thus increasing operational efficiency and improving profitability for large banks (Smirlock, 1985). Financial leverage (LEVERAGE) proxied by the ratio of total debt to total equity is used to assess the impact of financing decisions on the bank's performance (Xiaopeng & Tzung-Cheng, 2011). Credit risk exposure (LLP) proxied by the ratio of loan loss provision to total loan is used to measure the potential impact of credit risk exposure on the bank performance as bank performance is expected to decline with increased exposure to credit risk (Athanasoglou *et al.*, 2008). This study includes a dummy variable, ISLAMIC, to address whether Islamic banks or conventional banks are more profitable during the period of the recent global pandemic, COVID-19. The rationale for including this variable is influenced by the fact that Islamic banks tend to be more cost-efficient during the financial crisis, which contributes to the improved financial performance of Islamic banks compared to conventional counterparts (Alqahtani *et al.*, 2017). Lerner index (LERNER) is used to control the impact of bank market power on the performance of banks (4). According to the structure conduct performance (SCP) hypothesis, higher market power allows the banks to engage in collusive behaviour to earn greater net interest margins on traditional lending activities and higher fees on non-traditional banking activities, thus boosting the profitability of banks (Dietrich and Wanzenried,2011).

3.3. Empirical Model

To assess the impact of intellectual capital on the bank performance, the following model is required to be estimated:

$$PERF_{it} = \alpha_{it} + \beta_1 VAICit + \beta_1 SIZE_{it} + \beta_2 LEVERAGE_{it} + \beta_3 LLP_{it} + \beta_4 ISLAMIC_{it} + \beta_5 LERNER_{it} + \beta_t Q_t + \varepsilon_{it} \quad (1)$$

Here, the subscripts *i* represents bank, and *t* represents time. In equation 1, PERF is the dependent variable representing the bank performance measures proxied by ROAA, ROAE, EFF, and MTQ. VAIC is the main explanatory variable representing the IC efficiency of banks. The control variables are SIZE representing the size of banks, LEVERAGE representing the degree of financial leverage inherent in the capital structure of banks, LLP representing the credit risk exposure of banks, ISLAMIC is a dummy variable equal to unity if a bank is an Islamic bank otherwise zero, and LERNER representing the market power of banks. Q represents quarter dummies which are included to measure the impact of time effects in the baseline regression.

To assess the impact of each component of IC on the bank performance, the following regression equation is specified:

$$PERF_{it} = \alpha_{it} + \beta_1 HCEit + \beta_2 SCEit + \beta_3 CEEit + \beta_4 SIZE_{it} + \beta_5 LEVERAGE_{it} + \beta_6 LLP_{it} + \beta_7 ISLAMIC_{it} + \beta_8 LERNER_{it} + \beta_t Q_t + \varepsilon_{it} \quad (2)$$

Here, HCE is the human capital efficiency, SCE is the structural capital efficiency, and CEE is the capital employed efficiency of banks respectively in regression equation 2.

To assess the existence of a non-linear relationship between intellectual capital and bank performance, the following regression equation is specified:

$$PERF_{it} = \alpha_{it} + \beta_1 VAICit + \beta_2 VAIC^2 it + \beta_3 SIZE_{it} + \beta_4 LEVERAGE_{it} + \beta_5 LLP_{it} + \beta_6 ISLAMIC_{it} + \beta_7 LERNER_{it} + \beta_t Q_t + \varepsilon_{it} \quad (3)$$

Here, the quadratic term, $VAIC^2$ is included in regression equation 3 to capture the non-linear relationship between IC and bank performance based on the notion that effectively utilizing intangible resources could be challenging as increased investments in structural and human capital might lower profits if management cannot provide greater efficiency (Vo and Tran, 2021). Before the selection of an appropriate panel estimator, a series of diagnostic tests have been performed. The Breusch and Pagan Lagrangian multiplier test for individual effects in the panel models suggests the presence of individual panel effects in all the models. Thus, the ordinary least square regression (OLS) estimator is not an appropriate panel estimator for this study. The presence of heteroskedasticity has been confirmed by both the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and the White test for heteroskedasticity. To investigate the presence of autocorrelation in the panel data, the Wooldridge test for autocorrelation is applied, which suggests the presence of first-order autocorrelation across panels. All these tests indicate that the panel dataset is restricted due to these non-spherical errors. To overcome these limitations, this study selects the pooled ordinary least square with panel corrected standard error model (PCSE) model developed by Beck & Katz (1995), which has the ability to handle both heteroskedasticity and auto-correlation for efficient panel estimation. Thus, equations 1-3 are estimated by using the PCSE model.

04. Empirical Results

4.1. Descriptive Statistics (5)

Based on the descriptive statistics of all the variables of this study, it can be observed that the mean value of ROAA, ROAE, and MTQ is lower in the post-COVID period compared to the post-COVID period, which suggests that the profitability and market performance of banks have declined during the surveillance period. This is consistent with Elnahass *et al.* (2021) who found that the profitability of banks is negatively affected by the emergence of COVID-19 around the world. However, the mean value of EFF in the post-COVID period (0.8157) is higher than that of in the pre-COVID period (0.803), implying that the efficiency of banks in Bangladesh has improved during the post-COVID period, which is consistent with Sang (2022) who opined that the efficiency of Vietnamese banks has improved in the post-COVID period.

4.2. Correlation Analysis (5)

Based on the correlation analysis, the highest correlation coefficient is observed between ROAA and ROAE (0.94) followed by HCE and VAIC (0.89), and SCE and VAIC (0.84). However, this is not going to be an issue for the panel estimation as these variables will be used separately in

all regression equations. Despite this, values of the correlation coefficient between variables are lower than the maximum threshold of 0.7 recommended by Kennedy (2008). Besides, the Variance inflation factor (VIF) test is also conducted. The results of the VIF test show that the maximum variance inflation between variables is lower than the maximum threshold of 5 suggested by Hair *et al.* (2012). Thus, multi-collinearity is not going to be an issue for the panel estimation.

4.3. Impact of IC on Bank Performance

Table I shows the main regression results based on regression equation 1. The results for the full sample period are reported in columns 1, 4, 7, and 10; the regression results for the pre-COVID period are reported in columns 2, 5, 8, and 11 and the regression results for the post-COVID period are reported in columns 3, 6, 9, and 12. The regression result is showing a positive relationship between VAIC and bank profitability measures proxied by ROAA and ROAE in columns 1-6, and bank efficiency proxied by EFF in columns 7-9, which is suggesting that an improvement in the IC has resulted in subsequent improvement in profitability and efficiency of banks in different periods. This finding is consistent with Xu et al. (2022), Vo and Tran (2021), Vidyarthi (2019), and Onumah & Duho (2020) who have reported a positive relationship between IC and bank profitability and efficiency. The effect of a hypothetical one standard deviation shift in the VAIC is taken into account in order to comprehend the economic relevance of the size of these coefficients. With regard to full sample period, a one standard deviation increase in IC will see an improvement in ROAA by 0.05% ($(e^{0.0004\times1.3015}-1)\times100$), ROAE by 0.82% ($(e^{0.0063\times1.3015}-1)\times100$), and EFF by 8.62% ($(e^{0.0635\times1.3015}-1)\times100$) [5]. Among the bank performance viables, the performance enhancing effect of IC tends to be largest in EFF, which is indicating that IC is more capable of improving bank efficiency than bank profitability. Similarly, a one standard deviation increase in IC will see an improvement in ROAA by 0.05% ($(e^{0.0004\times1.3542}-1)\times100$), ROAE by 0.77% ($(e^{0.0057\times1.3542}-1)\times100$), and EFF by 8.62% ($(e^{0.0513\times1.3542}-1)\times100$) [5] in the pre-COVID period compared to an improvement in ROAA by 0.05% ($(e^{0.0004\times1.2393}-1)\times100$), ROAE by 0.83% ($(e^{0.0067\times1.2393}-1)\times100$)and EFF by 9.84% ($(e^{0.0757\times1.2393}-1)\times100$) [5] in the post-COVID period. The performance-enhancing effect of IC tends to be larger in the post-COVID period, which is indicating that banks have viewed IC as a channel to improve their profitability and efficiency during the post- COVID period. However, a negative relationship is observed between IC and MTQ in all periods but the negative relationship is not statistically significant in the post-COVID period. However, a negative relationship is observed between IC and MTQ in all periods but the negative relationship is not statistically significant in the post-COVID period. This is suggesting that an improvement in IC has resulted in a decline in the market performance of banks in Bangladesh, which is primarily driven by the pre-COVID period. This finding is not consistent with Hejazi *et al.* (2016) who found a positive relationship between market performance and IC in Iranian banks. Regarding the control variables, SIZE is showing a positive and statistically significant relationship with EFF and MTQ, thus suggesting that both the efficiency and market performance of banks improve as banks become larger. LLP is showing negative and statistically significant relationships with ROAA, ROAE, and EFF. It means that the profitability and efficiency of banks in Bangladesh decline with increased credit risk exposure of banks. This finding is consistent with Matin (2017). Leverage tends to have a significant and negative relationship with ROAA, EFF, and MTQ in different periods, thus suggesting that increased financial leverage results in a decline in the profit, efficiency, and market performance of banks in Bangladesh. This finding is suggesting that banks with higher financial leverage or lower bank capital tend to face a higher

risk of going bankrupt, thus increasing their funding cost. This in turn results in a decline in profitability, efficiency, and market performance (Sufian & Chong, 2008).

The variable, ISLAMIC, is showing a negative and statistically significant relationship with all performance variables in different periods, thus suggesting that Islamic banks have lower profitability, efficiency, and market performance than the conventional banks in Bangladesh in both pre-COVID and post-COVID periods. This finding is inconsistent with Ramlan & Adnan (2016) who have found that Islamic banks are more profitable than conventional banks in Malaysia. LERNER is showing a positive relationship with all the performance measures but the relationship is heterogeneous in different periods considering the statistical significance. The coefficients of LERNER are statistically significant with ROAA, ROAE, and EFF implying that an increase in market power resulted in an improvement in profitability and efficiency of banks in both the pre-COVID and the post-COVID period in Bangladesh. Regarding market performance measures, coefficients of LERNER are statistically significant with MTQ in columns 10 and 12. This is suggesting that an increase in market power helped the banks in Bangladesh to improve their market performance, but such an effect is important during the post-COVID period. Thus, market power is an essential determinant of bank performance in the Bangladesh banking industry, especially during the post-COVID period. The overall findings are suggesting that an increase (decrease) in market power (market competition) results in an improvement in profitability, efficiency, and market performance of banks in Bangladesh, thus providing support to the structure conduct paradigm and is consistent with the finding of Uddin & Suzuki (2014).

4.4. Impact of IC Components on Bank Performance

Table II represents the individual impact of each component of IC on the bank performance using regression equation 2. From Table II, it is observed that HCE has positive coefficients with ROAA and ROAE in different periods but they are statistically insignificant (except in column 2). This is suggesting that HCE has failed to make a significant contribution to improving the profitability of banks in Bangladesh during the sample period. The larger coefficient of HCE reported in column 9 suggests HCE has made more contributions toward the improvement of bank efficiency in post-COVID period. But HCE is showing statistically significant and negative relationships with MTQ in all periods, thus suggesting that banks in Bangladesh have failed to capitalize on the improved employee expertise to increase the market performance of banks. From the regression result, it is also observed that SCE tends to have positive and statistically significant relationships with ROAA, ROAE, and EFF in all periods as reported in columns 1-9. This is indicating that banks with good internal processes, organizational structure, and information technology tend to have higher profitability and efficiency compared to their industry counterparts in the sector in both the pre-COVID and the post- COVID periods. The size of such positive and statistically significant coefficients tends to be larger in the pre-COVID period, meaning that both profit and efficiency-enhancing effects of SCE tend to be larger in the pre-COVID period in Bangladesh. Regarding MTQ, SCE is showing a positive relationship with MTQ in different periods but such a relationship is not significant. CEE tends to have a positive and statistically significant impact on all performance measures (except MTQ in column 12). It reports banks in Bangladesh can improve their profitability, efficiency, and market performance by becoming more efficient in the shareholder's value creation process. Regarding market performance, CEE is showing a positive and statistically significant relationship with MTQ in columns 10 and 11. It designates that the market performance-enhancing effect of CEE is primarily driven by the pre-COVID

period. Based on the overall results regarding the impact of each component of VAIC on bank performance, it is observed that CEE has larger coefficients with all bank performance measures in all periods than other components of VAIC. It can be concluded that CEE is the main component of VAIC that drives bank performance in Bangladesh followed by SCE and HCE. This finding is consistent with Ozkan *et al.* (2017) but does not consistent with Xu *et al.* (2022) who opined that HCE is the main driver of bank profitability in Pakistan and China during the post- COVID period.

4.5. Non-linear Relationship between IC and Bank Performance

Table III shows the regression result regarding the non-linear relationship between IC and bank performance based on regression equation 3. The variable, VAIC2, is used to capture the non-linear impact of IC on bank performance. It is observed that VAIC has positive and statistically significant relationships with ROAA, ROAE, and EFF but VAIC2 has a negative relationship with these performance measures in all periods, thus suggesting a non-linear relationship between IC and profitability, and efficiency of banks in both periods under study. It means the performance of banks is improved by an increase in the IC efficiency up to a certain level, after which an increase in IC efficiency results in a decline in bank performance. This finding is consistent with the studies of Haris et al. (2019), Yao et al. (2019), Le & Nguyen (2020), Nguyen et al. (2021), and Vo & Tran (2021) who found a non-linear or u-shaped relationship between IC and bank performance in Pakistan and Vietnam.

05. Conclusion

This study aimed at assessing the impact of IC on bank performance in the context of the current global pandemic, COVID-19. A balanced panel of quarterly data from 29 banks from the banking sector of Bangladesh from 2018 to 2022 is used to assess this empirical issue. IC of banks is measured by the value-added intellectual capital while bank performance is measured by ROAA, ROAE, EFF, and MTQ. The results of the PCSE model show that IC is positively associated with the ROAA, ROAE, and EFF but negatively associated with the market-based performance measure, MTQ. It is also evident that the performance-enhancing effect of IC is larger in the post-COVID period than in the pre-COVID period, thus indicating the importance of IC for sustainable bank performance during the crisis. In addition, a non-linear or U-shaped relationship between IC and bank performance is observed. Thus, bank managers should invest more resources in the improvement of IC so that banks can enhance profitability and efficiency, especially in crisis periods like COVID-19. Similarly, regulatory authorities in developing economies should take necessary measures for improving their IC. Further study should include more banks from different parts of the world which will help to gain much more valuable insights regarding the impact of IC on bank performance.

Notes:

1. Though the data of this study starts from the first quarter of 2018, data for both the total asset and the total equity of the fourth quarter of 2017 is collected for every sample bank to calculate the average asset and the average equity of the first quarter of 2018.
2. The preference for constant return to scale (CRS) over variable return to scale (VRS) is driven by the fact that VRS makes efficiency estimation of each DMU by only comparing it with other DMUs of similar size, instead of against all DMUs (Avkiran, 1999). The adoption of CRS allows efficiency estimation through the comparison of small and large

banks. Studies like Avkiran (1999), Uddin & Suzuki (2011), and Uddin & Suzuki (2014) have used CRS assumption in their studies.

3. Pulic (2000) considered the personnel expense as an investment for human resources rather than as an expense due to the active role of employees in the value creation process of the business.
4. For a detailed analysis of LERNER, see Shair et al. (2019) for further details.
5. The reported standard deviation of VAIC is 1.3015 in full sample period, 1.3542 in Pre-COVID period and 1.2393 in Post-COVID period. The results of descriptive statistics, Pearson's correlation coefficient analysis and VIF test are not reported to conserve space but can be provided upon request.

Table 1: Impact of IC on Bank Performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ROAA	ROAA	ROAA	ROAE	ROAE	ROAE	EFF	EFF	EFF	MTQ	MTQ	MTQ
	Full Sample	Pre-Covid	Post-Covid	Full Sample	Pre-Covid	Post-Covid	Full Sample	Pre-Covid	Post-Covid	Full Sample	Pre-Covid	Post-Covid
VAIC	.0004***	.0004***	.0004***	.0063***	.0057***	.0067***	.0635***	.0513***	.0757***	-.009**	-.0099*	-.0051*
SIZE	.0001	.0002	-.0001	.0003	.0034	-.0013	.0704***	.0883***	.0595***	.1232***	.1089***	.1243***
LEVERAGE	-.0212***	-.0213***	-.0195***	.0189	.0944	-.0112	-.8908**	.3543	-1.6359***	-4.0277***	-3.9975***	-4.1673***
LLP	-.3716***	-.4221***	-.3247***	-5.2019***	-5.5295***	-5.1167***	-3.4459	-6.938***	.631	-4.1529	-6.5826	-1.3167
ISLAMIC	-.0008***	-.001**	-.0008***	-.0105***	-.0131**	-.0094**	-.1235**	-.1498***	-.1026***	-.067**	-.075**	-.0448***
LERNER	.0025***	.0045***	.0019**	.0347***	.0583***	.0269***	.1157**	.2611***	.0784*	.1222*	.14	.1125**
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	.4774	.6899	.3302	.4199	.5782	.3203	.4817	.5456	.455	.2728	.2433	.4491
Wald $\chi2$	310.27	622.91	106.43	263.73	358.61	273.93	526.17	428.92	153.43	1606.62	417.51	506.24
Prob > $\chi2$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Observations	493	232	261	493	232	261	493	232	261	459	216	243

This table represents the PCSE model results regarding the impact of IC on bank performance measures based on regression equation 1. ***, **, and * indicate level of significance at 1%, 5% and 10% respectively. Standard errors are not reported to conserve space but can be provided upon request. For the definition of control variables, see section 3.2.

Table 2: Impact of Each Component of IC on Bank Performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ROAA	ROAA	ROAA	ROAE	ROAE	ROAE	EFF	EFF	EFF	MTQ	MTQ	MTQ
	Full Sample	Pre-Covid	Post-Covi	Full Sample	Pre-Covid	Post-Covid	Full Sample	Pre-Covid	Post-Covid	Full Sample	Pre-Covid	Post-Covid

			d									
HCE	.0001	.0002*	.0001	.0016	.0014	.0011	.0346***	.017***	.048***	-.0162***	-.0381**	-.0101**
SCE	.0022***	.0026***	.0023***	.0307***	.0392***	.0306***	.3055***	.3077**	.2986**	.0291	.1206	.0308
CEE	.0238***	.0197***	.0253***	.343***	.3231***	.3597***	.8856***	2.7803***	.409**	.6738***	3.5212***	.1639
SIZE	-.0002	-.0001	-.0002	-.0016	-.0008	-.0024	.0638***	.0522***	.0548***	.1156***	.0571**	.1215***
LEVERAGE	-.0352***	-.0412***	-.0293***	-.1826***	-.2326*	-.1494***	-1.4183***	-2.4432***	-1.7636***	-4.4782***	-7.6594***	-4.2442***
LLP	-.4173***	-.4173***	-.4276***	-5.8595***	-5.4492***	-6.5814***	-4.8827**	-6.2343***	-.2882	-6.1461	-6.0559	-2.1477
ISLAMIC	-.0004***	-.0005***	-.0005*	-.0046***	-.0048**	-.0042	-.0997***	-.0795***	-.0841***	-.0529***	.0032	-.0395***
LERNER	-.0003	.0003	-.0006	-.0061	-.0091	-.0082	-.0104	-.311***	.0206	.0298	-.5498**	.088**
Constant	.0351***	.038***	.0308***	.1849***	.207*	.1773***	.1194	1.2155**	.7007*	2.2248***	6.3908***	1.7865***
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	.7077	.7454	.6935	.6714	.6604	.6889	.5219	.6336	.4775	.2974	.3369	.4542
Wald $\chi 2$	784.57	637.14	631.99	981.36	581.88	934.79	605.1	602.76	413.63	177.47	211.40	583.89
Prob > $\chi 2$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Observations	493	232	261	493	232	261	493	232	261	459	216	243

This table represents the PCSE model results regarding the impact of each component of IC on bank performance measures based on regression equation 2. ***, **, and * indicate level of significance at 1%, 5% and 10% respectively. Standard errors are not reported to conserve space but can be provided upon request. For the definition of control variables, see section 3.2.

Table 3: Non-Linear Relationship Between IC and Bank Performance

	(1) ROAA Full Sample	(2) ROAA Pre-Covid	(3) ROAA Post-Covid	(4) ROAE Full Sample	(5) ROAE Pre-Covid	(6) ROAE Post-Covid	(7) EFF Full Sample	(8) EFF Pre-Covid	(9) EFF Post-Covid	(10) MTQ Full Sample	(11) MTQ Pre-Covid	(12) MTQ Post-Covid
VAIC	.0012***	.0012***	.0018***	.0174***	.0132***	.026***	.1447***	.1095***	.1794***	.0027	.0014	.0112
$VAIC^2$	-.0001***	-.0001***	-.0002***	-.0011***	-.0007***	-.0022***	-.0083***	-.0054***	-.0118***	-.0012	-.0009	-.0018
SIZE	-.0001	-.0001	-.0002	.0002	.0033	-.0019	.0693***	.0871***	.0563***	.1222***	.1187***	.1224***
LEVERAGE	-.0228***	-.0228***	-.02***	-.0047	.0643	-.017	-1.0635**	.1207	-1.6674***	-4.0634***	-4.03***	-4.1841***
LLP	-.362***	-.362***	-.3136***	-5.056***	-5.4289***	-4.9642***	-2.3794	-6.1567**	1.4512	-3.9581	-5.6296	-1.1026
ISLAMIC	-.0007***	-.0007***	-.0005	-.0079***	-.0114***	-.0052	-.1041***	-.1365***	-.0798***	-.0637***	-.0814***	-.0404***
LERNER	.002***	.002***	.0013*	.0273***	.0493***	.018**	.0619	.191**	.0305	.1133*	.1207	.1029**
Constant	.0213***	.0213***	.0212***	-.0131	-.1472*	.0415	-.3764	-1.838***	.4581	1.7193***	1.799***	1.7002***
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

R-squared	.5013	.5013	.3828	.4486	.5933	.3708	.508	.5591	.4833	.2736	.1956	.4508
Wald $\chi 2$	454.82	454.82	239.78	359.63	894.80	164.06	1062.91	1015.56	1176.15	952.20	469.50	510.75
Prob > $\chi 2$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Observations	493	493	261	493	232	261	493	232	261	459	216	243

This table represents the PCSE model results showing the non-linear relationship between IC and bank performance measures based on the regression equation 3. ***, **, and * indicate level of significance at 1%, 5% and 10% respectively. Standard errors are not reported to conserve space but can be provided upon request. For the definition of control variables, see section 3.2.

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