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INTELLECTUAL CAPITAL EFFICIENCY AND BANK PERFORMANCE IN BANGLADESH: EVIDENCE FROM DHAKA STOCK EXCHANGE

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Abstract

Intellectual capital (IC) is an important source of competitive advantage in modern firms, including the banking sector. This study explores the impact of IC on the profitability, market value, and productivity of banks listed on the Dhaka Stock Exchange in Bangladesh. The study uses Tobin's q to measure market value and reviews the theoretical and empirical literature on the impact of IC on financial performance measures based on the resource-based view of firms. The study finds that IC positively affects the profitability, market value, and productivity of Bangladeshi banks. The impact of human capital on profits was positive, while that of structural capital was negative. However, human capital negatively impacted productivity, while structural capital had no impact on productivity. Capital employed did not affect the financial performance of the sample banks. The findings suggest that banks in Bangladesh have not fully realized the potential of IC to gain a competitive advantage in the market.

INTRODUCTION

In the twenty-first century, business patterns rapidly change in developed and developing economies (Mollah & Rouf, 2022).

A company's success does not rely solely on tangible assets; intangible assets, such as knowledge, processes, databases, strategies, experience, and skills of employees, are also necessary for long-standing success. These intangible assets are known as intellectual capital (IC). IC is viewed as a new source for gaining a competitive advantage over market competitors. As a result, in many modern firms, IC is acquired as a higher priority than physical capital, particularly in the service industry, such as banks. A large number of studies found that IC significantly contributed to creating firm value (Maji & Goswami, 2016; Al-Musali & Ismail, 2014). According

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to Schiavone et al. (2014) and Chowdhury et al. (2019), innovation and profit growth are driven by IC, which is a driving force and an important resource in creating value and developing long-term businesses.

The financial sector, specifically banking, is one of today's most knowledge-intensive sectors. As a matter of theory, IC is a valuable asset for gaining a competitive edge and ensuring success in the banking sector. Numerous empirical studies carried out in developed and developing economies, including Bangladesh, showed that IC positively affects a bank's profitability, market value, and productivity. For example, Pulic (2000a) and Kehelwalatenna and Premaratne (2012) conducted studies on the banking sectors in the UK and the USA, respectively. Zin et al. (2014), Sufian et al. (2016), Kamal et al. (2012), and Poh et al. (2018) examined the effect of IC on banks' profitability and market value in Malaysia. Mondal and Ghosh (2012) investigated the impact of IC on the financial performance of 65 Indian banks. Nawaz and Haniffa (2017) also examined the determinants of IC and its performance, taking a sample of 64 Islamic financial institutions operating across 18 countries. Similarly, Mohiuddin et al. (2006), Hasan et al. (2017), and Mollah and Rouf (2022) examined the effect of IC on Bangladeshi banks' performance as publicly listed companies. The findings of prior empirical studies on the banking sector may not be applicable to Bangladesh's banking sector. This is because the bank management, culture, structure, and regulations of developed and developing economies differ from those of the Bangladeshi banking sector.

The studies relating to the baking sector in Bangladesh measured financial performance using return on assets (ROA) and return on equity (ROE), market value using the market-to-book value of equity (M/B) ratio, and productivity using asset turnover ratio (ATO). It is critical for present and potential investors to accurately measure a banking firm's market value for their investment decision-making purposes. It is also important for the bank to attract the market and its core depositors. Prior Bangladeshi studies assessed banks' market value using the M/B ratio. It is a ratio commonly defined as the market value of a firm's equity divided by the book value of equity (McNichols et al., 2014). However, the M/B ratio does not accurately reflect a bank's market worth since it ignores the value of a bank's intangible assets, such as copyrights, brand, goodwill, and patents, which are acknowledged to be valuable in today's society. Furthermore, this study primarily focuses on intangible assets like intellectual capital, which are also overlooked by the M/B ratio. As a result, the ratio is rarely appropriate for valuing a firm with a large proportion of its intangible assets, such as IT and banking firms or other knowledge-intensive firms. Another drawback is that it provides various asset values when alternative accounting standards are applied, complicating comparisons. Furthermore, because these research studies used a small sample size, the data set used was insufficient to determine the more precise impact of IC on banks' performance.

Given the limitations of prior Bangladeshi studies, the study assessed banks' market value using Tobin's q (Tq) instead of the M/B ratio. Unlike the M/B ratio, Tq takes account of all tangible and intangible assets in calculating the market value of a firm. Tq is the ratio between a company's market value and the cost of replacing its assets (Smith, 2008). In earlier studies, Tq was calculated by dividing the bank's book value by its total debt because it is complicated to figure out precisely what replacement costs are (Ntim, 2009). In contrast to the M/B ratio, Tq is based on a comparison of the firm's total market value (not just its market value of equity) with the replacement value of its assets (not just its historical cost of equity) instead of the market value of its equity. According to McNichols et al. (2014), the market-to-book ratio is not as effective as Tq at predicting future investments and explaining future investment outcomes. Therefore, the purpose of the study was to examine how IC impacts a bank's market value, as measured by Tobin's q (Tq), as well as the banks' profitability, as measured by ROE, and productivity, as measured by ATO, during the period of the study.

LITERATURE REVIEW AND DEVELOPMENT OF HYPOTHESES

Intellectual capital (IC) is becoming more widely recognized as a crucial component of corporate and national growth in the modern world of knowledge management (Akhter, 2020). This is because IC is acknowledged as a critical intangible resource and a source of long-term competitive advantage and economic success for businesses (Subramaniam & Youndt, 2005; Peng et al., 2007). Literature provides a variety of definitions of IC, most of which are pretty similar. For example, IC is a measure of how much a firm is worth on the market compared to

the cost of replacing its assets on the market (Kalkan et al., 2014). Annie (1996) provides a meaningful definition of IC, stating that it "is the term given to the combined intangible assets which enable the company to function." Stewart (1998) defined IC in the shortest form as "packaged useful knowledge." According to Roos et al. (2005), IC refers to all non-financial and non-physical resources that an organization controls entirely or in part and that are used to generate value for the organization. Edvinsson and Malone (1997) and Stewart
(1998) were the pioneers of IC theory, who defined IC as "the possession of knowledge, applied experience, technology, customer relationships, and professional skills that provide a competitive advantage in the marketplace and package useful knowledge." From an accounting point of view, IC is the differential of a company's assets in terms of market value and book value, as well as IC has the potential to turn into profit and benefit despite not being on the balance sheet due to its hidden nature (Zarei et al., 2014). In sum, IC includes the employees' experience, knowledge, and skills; organizational processes and systems; information capital; instructional capital; and a broad range of other knowledge (Akhter, 2020). A company must understand how IC contributes to value creation, increased profitability, and improved productivity. Therefore, the theoretical and empirical literature were reviewed to understand the impact of IC on firms' profitability, market value, and productivity, and relevant hypotheses were developed.

Impact of Intellectual Capital on Banks' Profitability, Market Value, and Productivity

According to the resource-based view (RBV), the performance of a firm is driven by its tangible and intangible resources (Soewarno & Tjahjadi, 2020). The RBV contends that rather than focusing on the market and other external sources, businesses should look internally for sources of competitive advantages, such as tangible and intangible resources (Wernerfelt, 1984; Barney, 1991). There is, however, an argument that tangible resources, such as land, buildings, equipment, and capital, may not provide firms with significant long-term advantages since rivals can copy them and get the same asset from the market; however, intangible assets are harder to purchase (Akhter, 2020). It may be possible to increase corporate performance with the right IC value combination (Abdullaha & Sofiana, 2012). For instance, due to their "brain power," termed IC, multinational corporations like Microsoft, Netscape, and 3M produce value and generate enormous revenue (Sullivan, 1999). According to Wernerfelt (1984) and Hasan et al. (2017), IC is a strategic asset enabling a firm to improve its performance and gain a competitive advantage over its competitors in the long run. In fact, companies cannot gain and maintain a competitive advantage over rivals that lack human talent, capability, and innovation (Raja et al., 2009). Therefore, it is predicted that firms' intellectual capital will positively affect their profitability, market value, and productivity. A number of studies supported the theoretical arguments about the relationship between IC, as measured by valueadded intellectual coefficients (VAIC), and financial performance, as well as the market value and productivity of the banking sector. For example, the studies by Zin et al. (2014) and Sufian et al. (2016) showed that intellectual capital and its components (human capital and structural capital) had a positive and significant impact on the financial performance of the Malaysian banking sector, supporting the theoretical prediction. Earlier, Kamal et al. (2012) conducted a study focusing on the banking sector in Malaysia and found a significant relationship between the IC, the market value, and the productivity of banks based on a sample of 18 commercial banks during the period 2004–2008. Poh et al. (2018) recently assessed how intellectual capital affected the Malaysian banking industry. According to empirical findings, the performance of the banking sector has been significantly impacted by the level of human capital and structural capital, suggesting that the banking sector should focus on intellectual capital and physical capital to improve performance.

Using a sample consisting of 4,254 firm-year observations, including the financial institutions listed on the Taiwan Stock Exchange from1992–2002, Chen et al. (2005) also confirmed that the value of a firm, as measured by the market-tobook value of equity ratio (M/B), and financial performance, as measured by ROA and ROE, was positively affected by IC. Kehelwalatenna and Premaratne (2012) examined the empirical relationship between IC and profitability, productivity, and investor reactions to the banking sector in the USA from 2000–2010. The study revealed a positive impact of IC on profitability, productivity, and investor reactions. Similarly, Nawaz and Haniffa (2017) examined 64 Islamic financial institutions operating in 18 different countries between 2007 and

2011 and found that IC, measured by VAIC, and financial performance, measured by ROA, are positively related. A similar relationship was also found between IC and the financial performance of 65 Indian banks from 1999–2008 by Mondal and Ghosh (2012). Earlier, Pulic (2000b) revealed that the average values of VAIC and market values of firms were highly correlated using data from 30 listed FTSE-250 UK firms for 1992–1998.

Most pertinently, Mohiuddin et al. (2006) conducted a study on 22 Bangladeshi banks to examine how IC contributes to the creation of banks' value. They documented that IC contributed positively to value creation, as assessed by the M/B ratio, and financial performance, as assessed by ROA and ROE, in the banking sector as a whole. Later, Hasan et al. (2017) found that VAIC and its elements had a significant positive relationship with the profitability of 27 commercial banks for the year 2013. Most recently, Mollah and Rouf (2022) confirmed that the return on shareholders' equity, measured by ROE, of the listed banks on the Dhaka Stock Exchange in Bangladesh was enhanced by IC. Thus, the following hypotheses are developed:

H_{1a}: There is a positive relationship between IC and the profitability of the listed banks in Bangladesh.

H_{1b}: There is a positive relationship between IC and the market value of the listed banks in Bangladesh. H_{1c}: There is a positive relationship between IC and the productivity of the listed banks in Bangladesh.

A firm's intellectual capital is composed of three types of inputs: human capital, structural capital, and capital employed, all of which contribute to the success of the firm (Hasan et al., 2017; Mollah & Rouf, 2022). Although IC has three components, their explanatory powers on firm profitability, market value, and productivity may differ from the aggregate value of IC. Therefore, to understand the impact of three inputs of IC, namely human capital, structural capital, and capital employed, on the profitability, market value, and productivity of firms, the relevant theoretical and empirical literature was reviewed, and relevant hypotheses were formulated.

Impact of Human Capital on Banks' Profitability, Market Value, and Productivity

Employees' knowledge, professional skills, level of education, expertise, and creativity are all considered part of their human capital (Abdullaha & Sofian, 2012). A group of highly qualified professionals and customer-centric people with a better understanding of technical knowledge is required for the financial sector, especially banks, to be more comprehensive than before. The efficient and effective use of human capital (HC) is indispensable to the performance and efficiency of a firm. Moreover, high levels of HC assist firms in maintaining a sustainable relationship with key stakeholders to achieve capitalization (Sardo et al., 2018; Bansal & Singh, 2020). Therefore, theoretically, human capital is expected to develop cost-effective, innovative processes, new products, and services, resulting in increased profit in the knowledge-based economy (Soewarno & Tjahjadi, 2020). The financial theory also suggests that increasing HC will enhance firms' profitability. Several studies documented a positive effect of HC on firms' performance, market value, and productivity. For example, Maji and Goswami (2016) examined 100 listed Indian firms using the VAIC model and found that HC positively impacted India's engineering and steel industries. According to Tovstiga and Tulugurova (2007), the financial performance of firms is largely explained by the HC component of IC. While taking a sample of 953 South Korean manufacturing firms from 2013–2018, Xu and Liu (2020) found that human capital acted as the performance-enhancing factor. Also, Smriti and Das (2018) demonstrated that firms with high levels of HC had a beneficial effect on productivity.

Most empirical studies confirmed that HC was the most important performance enhancer in the financial sector. According to the study by Goh (2005), investments in HC generated a larger return in Malaysian commercial banks than investments in structural capital. Joshi et al. (2010) documented a positive association between HC and the performance of Australian listed banks from 2005–2007. Saruchi et al. (2019) examined how HC affected performance and found that human capital was the only performance-enhancing indicator in Islamic banks. Amin (2020) revealed that their investments significantly improved the financial performance of banks in Bangladesh in human capital development. Recently, the study of Mollah and Rouf (2022) also revealed that HC significantly improved Bangladeshi publicly traded banks' performance, as indicated by ROE and ROA. Thus, the following hypotheses are developed:

H_{2a}: There is a positive relationship between HC and the profitability of the listed banks in Bangladesh.

H_{2b}: There is a positive relationship between HC and the market value of the listed banks in Bangladesh. H_{2c}: There is a positive relationship between HC and the productivity of the listed banks in Bangladesh.

Impact of Structural Capital on Banks' Profitability, Market Value, and Productivity

Structural capital (SC) can be described as the non-human storage facilities of information that include firms' databases, procedures, software systems, charts and schedules, corporate culture, strategies, policies, and distribution networks (Kalkan et al., 2014; Abdullaha & Sofian, 2012). SC is regarded as the cornerstone of the company (Mollah & Rouf, 2022), as it drives HC to produce and use knowledge (Nadeem et al., 2018).

Consistent with the Organizational Learning Theory, it is argued by Njuguna (2009) that organizational learning occurs when a firm acquires new knowledge that enables it to innovate and can be protected by patents or copyrights. Prior studies revealed a positive impact of structural capital on the firms' financial performance, market value, and productivity. For example, Hudgins (2014) found that structural capital is significantly related to the profitability and productivity of US insurance companies. Using a sample consisting of 71 Indian software companies from 2013–2018, Bansal and Singh (2020) provided evidence of the positive impact of SC on firms' profitability, as assessed by ROA, but a negative effect on productivity, as indicated by ATO. Earlier, Chen et al. (2005) demonstrated that firms' intellectual capital and its components had a positive impact on market value, as measured by M/B ratios of equity, and financial performance, as measured by ROA and ROE, of the Taiwanese publicly traded companies from 1992–2002. Thus, the following hypotheses are developed:

H_{3a}: There is a positive relationship between SC and the profitability of the listed banks in Bangladesh.

H_{3b}: There is a positive relationship between SC and the market value of the listed banks in Bangladesh. H_{3c}: There is a positive relationship between SC and the productivity of the listed banks in Bangladesh.

Impact of Capital Employed on Banks' Profitability, Market Value, and Productivity

The capital employed (CE) in a firm can be defined as its efforts and capabilities to manage its resources (Soewarno & Tjahjadi, 2020). According to Pulic (2004), a company can generate a greater return with one unit of CE. The financial theory suggests that "the better the use of capital employed, the higher the profit earned by the firm" (Soewarno & Tjahjadi, 2020). Many prior empirical studies (e.g., Singla, 2020; Sidharta & Affandi, 2016; Nawaz & Haniffa, 2017; Wang et al.,

2021; Kweh et al., 2019; Mollah & Rouf, 2022) provided a positive effect of firms' CE on profitability, as measured by ROA and ROE. Soewarno and Tjahjadi (2020) empirically showed that Indonesian banks had good capital management, resulting in higher ROA, a proxy of profitability. Nadeem et al. (2018) also found that CE had a positive effect on firms' asset turnover, which proxied productivity and market value as determined by M/B equity ratios. Using the data of 63 firms in India for the period 2008–2017, Singla (2020) demonstrated that capital-employed efficiency (CEE) increased the firms' profitability, as measured by ROA, and market value, as measured by the the M/B ratio. The results of a study recently published by Mollah and Rouf (2022), which examined a sample of listed commercial banks in Bangladesh, indicated that it was relatively more profitable to invest in CE than structural capital. Thus, the following hypotheses are developed:

H_{4a}: There is a positive relationship between CE and the profitability of the listed banks in Bangladesh.

H_{4b}: There is a positive relationship between CE and the market value of the listed banks in Bangladesh. H_{4c}: There is a positive relationship between CE and the productivity of the listed banks in Bangladesh.

MATERIALS AND METHODS Sample Selection and Data Sources

This study included all 30 publicly traded banks listed on the Dhaka Stock Exchange (DSE) as of December 2020. It spans the years 2016–2020. The study used an unbalanced panel dataset with 146 observations due to missing some observations on intellectual capital, financial performance, and productivity for three fiscal years of two listed banks. Most of the data that was collected for the study was taken from the annual reports of the corresponding banks. A number of missing data was, however, collected from the websites of the banks as well as the DSE.

Variables' Definition and Measurements

Banks' financial performance, market value, and productivity were the dependent variables of the study. This study measured banks' financial performance from the accounting return perspective. The accounting return perspective performance was assessed by banks' return on equity (ROE). The market value of the sample banks was measured from the market return perspective, which was assessed by Tobin's q (Tq). The asset turnover ratio (ATO) was used to assess the productivity of the listed banks. ATO is an efficiency ratio that compares net revenue to average total assets to measure and analyze a bank's ability to generate revenue from its assets (Mollah & Rouf, 2022).

The independent variable was the listed banks' intellectual capital (IC). A bank's employees' knowledge, expertise, business training, and proprietary information may give the bank a competitive edge in terms of productivity and performance (Starovic & Marr, 2004). This study measured "intellectual capital" using the model, namely "Value Added Intellectual Coefficient (VAIC)," developed by Pulic (1998). This model is a monetary-based intellectual capital measurement tool that can assess intellectual capital efficiency across the broad spectrum of industries (Soewarno & Tjahjadi, 2020). It provides a more objective measurement of intellectual capital efficiency than traditional measures, like EBITDA, within a knowledge-based economy (Marzo, 2022). According to Pulic (1998), the VAIC model assists stakeholders in understanding to what extent a company's total intellectual capital can contribute to the creation of value for its stakeholders.

The VAIC model begins by calculating the firm's capacity to create value-added (VA). The VA is a measurement of the difference between an output and input (i.e., output minus input) (Clarke et al., 2011). All goods and services offered for sale on the market to make revenue are referred to as "output." All costs associated with creating goods and services are included as "inputs," except those related to human resources. Human resource costs are not viewed as costs in this model; instead, they are seen as an investment that adds value to the company (Bansal & Singh, 2020). VA can also be calculated as gross value added or as net value added (Bansal & Singh, 2020).VA as gross value added:

$VA = dp + w + d + i + m + t + r$

VA as net value added:

$VA = i + w + t + ni$

Where *dp* refers to depreciation expenses; *w* denotes wages and salaries; *d* refers to dividend expenses; *i* refers to interest expenses; *m* refers to minority expenses; *t* refers to taxes; *r* refers to retained earnings; *ni* refers to net income. This study adopted VA in terms of net value added.

IC combines human capital, structural capital, and capital employed by a firm. Human capital is measured by human capital efficiency (HCE), which indicates how much value is created by each unit of money spent on human resources (i.e., total salaries and wages taken by employees). Structural capital is measured by structural capital efficiency (SCE), which indicates how much value is created by the firm's supporting systems, procedures, processes, methods, capabilities, and databases that make use of its human capital (Khavandkar et al., 2016). The capital employed is measured by capital employed efficiency (CEE), which indicates how much value is created by the volume of economic capital employed by the firm (Marzo, 2022). Therefore, the VAIC represents a combination of three capital efficiency ratios obtained by taking the value added (VA) and adding the three types of capital together:

HCE + SCE + CEE

Apart from the independent variables, several non-related intellectual capital factors may have an influence on banks' profitability and productivity. For example, the firm's physical capacity (PC), which is calculated as the proportion of fixed resources to total resources (Pal & Soriya, 2012), may have an impact on its profitability and productivity. The debt-equity ratio (DER) and the firm's size (FmSize) may also influence the firm's profitability and productivity. Therefore, the study examined the effects of PC, DER, and FmSize, as control variables, on the profitability and productivity of the publicly traded banks in Bangladesh. Table 1 presents variables included in the study and their measurements.

Table 1. Measurement of Variables

Variables	Measurement units	Measurements
Dependent variables	Profitability, measured by return on equity (ROE)	The net income of a bank (after preferred stock dividends, but before ordinary stock dividends) is divided by its total equity at year's end (Vintilă & Gherghina, 2012).
	Market value, measured by Tobin's q (Tq)	Divide the market value of the bank's common stock plus the bank's total debts by the bank's book value (Ntim, 2009).
	Productivity, measured by asset turnover (ATO)	Total revenue at the end of the fiscal year is divided by total assets (Bansal & Singh, 2020).
Independent variables	Intellectual capital, measured by the value-added intellectual coefficient (VAIC)	A bank's total human capital efficiency, structural capital efficiency, and financial capital efficiency at the end of its fiscal year (Marzo, 2022). Therefore, mathematically, VAIC = HCE+SCE+CEE
	Human capital, measured by human capital efficiency (HCE)	Net value added is divided by wages and salaries paid to employees of a bank at the end of the fiscal (Marzo, 2022). Therefore, mathematically, HCE= Net value added (VA) / Human capital (i.e. , wages and salaries paid to employees)
	Structural capital, measured by a cube of structural capital efficiency (SCE_cube)	Structural capital employed is divided by the net value added of a bank at the end of the fiscal year, where structural capital is the difference between the net value added and human capital employed of a bank (Marzo, 2022). Therefore, mathematically, SCE= Net value added − human capital employed / Net value added. SCE was transformed into SCE_cube to normalize the dataset.
	Capital employed, measured by the square root of capital employed efficiency (CEE_sqrt)	Net value added is divided by the financial capital employed by a bank at the end of the fiscal (Marzo, 2022). Therefore, mathematically, CEE= Net value added / Total assets − Intangible assets. CEE was transformed into CEE_sqrt to normalize the dataset.
Control variables	Debt-equity ratio (DER_log)	The ratio of a bank's total debt to its total shareholders' equity at the end of the financial year (Bansal & Singh, 2020). DER was transformed into DER_log to normalize the dataset.
	Physical capacity (PC)	Proportion of a firm's fixed assets to the total assets (Bansal & Singh, 2020).
	Firm size (FmSize_log)	Total amount of assets held by a bank at the end of its fiscal year (Ntim, 2009). FmSize was transformed into FmSize_log to normalize the dataset.

Model Specification

Using a panel data regression model, this study measured the impact of intellectual capital on the profitability, market value, and productivity of the publicly traded banks in Bangladesh. This study was undertaken using the Breusch and Pagan (1980) Lagrange Multiplier test (B-P LM) as a means of selecting between the pooled regression model and the alternatives to the panel data regression model (e.g., fixed-effects and random-effects models). To determine whether fixed effects models or random effects models should be used, Hausman (1978) specification test was performed. The regression models listed below were estimated.

$$ROE = a_0 + \beta_1 VAIC_{it} + \beta_2 DER_{it} + \beta_3 PC_{it} + \beta_4 FmSize\_log_{it} + \varepsilon_{it} \dots (1)$$

$$ROE = a_0 + \beta_1 HCE_{it} + \beta_2 SCE\_cube_{it} + \beta_3 CEE\_sqrt_{it} + \beta_4 DER\_log_{it} + \beta_5 PC_{it} + \beta_6 FmSize\_log_{it} + \varepsilon_{it} \dots (2)$$

$Tq = a_0 + \beta_1 VAIC_{it} + \beta_2 DER_{it} + \beta_3 PC_{it} + \beta_4 FmSize\_log_{it} + \varepsilon_{it} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots$ (3)

$Tq = a_0 + \beta_1 HCE_{it} + \beta_2 SCE\_cube_{it} + \beta_3 CEE\_sqrt_{it} + \beta_4 DER\_log_{it} + \beta_5 PC_{it} + \beta_6 FmSize\_log_{it} + \varepsilon_{it} \ldots$ (4)

$ATO = a_0 + \beta_1 VAIC_{it} + \beta_2 DER_{it} + \beta_3 PC_{it} + \beta_4 FmSize\_log_{it} + \varepsilon_{it} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots$ (5)

$ATO = a_0 + \beta_1 HCE_{it} + \beta_2 SCE\_cube_{it} + \beta_3 CEE\_sqrt_{it} + \beta_4 DER\_log_{it} + \beta_5 PC_{it} + \beta_6 FmSize\_log_{it} + \varepsilon_i$(6)

Here, *i* denotes the dimension of cross-section, and *t* denotes the dimension of time-series. *α* denotes a constant value over time and specific to a particular cross-sectional bank *i*. $\beta_1 \ldots\ldots \beta_6$ denote the coefficients of explanatory variables, and *ε* denotes the disturbance.

RESULTS AND DISCUSSIONS Descriptive Statistics

Table 2 presents a descriptive statistical analysis of all variables being examined. The mean value of ROE, Tq, and ATO was 19.5 percent, 1.03, and 0.043, with standard deviations of 6.20 percent, 0.06, and 0.009, respectively. VAIC had a mean value of 7.988 with a standard deviation of 2.629, ranging from a minimum of 1.106 to a maximum of 14.652. During the study period, the HCE ranged from a minimum of 0.811 to a maximum of 13.007, with a mean value of 7.007 and a standard deviation of 2.44. SCE values ranged from 0.715 to 0.945, with 0.844 serving as the mean and 0.053 as the standard deviation. The average CEE value was 0.195, with a standard deviation of 0.078, falling between a low of 0.022 and a high of 0.362.

Table 2. Descriptive Statistics of Variables

Variables	Observations	Mean	Std. Dev.	Min.	Max.
Profitability (ROE), %	146	19.50	6.20	5.70	3.23
Market value (Tq)	103	1.03	0.06	0.91	1.13
Productivity (ATO)	146	0.043	0.009	0.0249	0.061
Value-added intellectual coefficient (VAIC)	146	7.988	2.629	1.106	14.652
Human capital efficiency (HCE)	146	7.007	2.440	0.811	13.007
Structural capital efficiency (SCE)	146	0.844	0.053	0.715	0.945
Capital employed efficiency (CEE)	146	0.195	0.078	0.022	0.362
Debt-equity ratio (DER)	146	12.756	3.109	7.454	18.938
Physical capacity (PC)	146	0.017	0.007	0.003	0.032
Firm age (FmSize_log)	146	2.416	0.146	2.119	2.677

As per control variables, the average value of DER was 12.756 with a standard deviation of 3.109, which ranged from a minimum of 7.454 to a maximum of 18.938. In respect of PC, the minimum to maximum ranged value was 0.003 to 0.032, where the mean value was 0.017 with a standard deviation of 0.007. Finally, the average value of FmSize_log was
2.416 with a standard deviation of 0.146, fluctuating from a lowest of 2.119 to a highest of 2.677.

Correlation Matrix

Tables 3 and 4 presented the Pearson correlation between the variables, their respective tolerance (TOL) values, and variance inflation factors (VIP) of (i) the relationship between VAIC and ROE, Tq, and ATO, along with control variables, and (ii) the relationship between the elements of intellectual capital (HCE, SCE, and CEE) and ROE, Tq, and ATO, along with control variables. As shown in Table 3, the correlation coefficients for these variables ranged from 0.053-0.467 and 0.017-
0.784 in Table 4, indicating that the variables were linearly correlated with one another (regardless of positive or negative sign). Because the highest correlation coefficients were 0.784 in Table 3 and 0.467 in Table 4, which were less than 0.80, these results also demonstrated that there was no issue of multicollinearity among the independent variables (Gujararti, Porter, & Gunasekar, 2012). In both tables, TOL estimations were greater than 0.2, and VIF estimations were greater than 10, suggesting no multicollinearity problem.

Table 3. Pearson Correlation between VAIC and ROE, Tq, and ATO

Variables	ROE	Tq	ATO	VAIC	DER-log	PC	FmSize-log
ROE	1						
Tq	-0.154	1					
ATO	0.467***	-0.466***	1				
VAIC	0.208***	0.312***	-0.199***	1			
DER_log	0.232***	0.327***	0.296***	-0.329***	1		
PC	0.057	-0.147*	-0.253***	0.283***	-0.184***	1	
FmSize_log	0.170**	0.091	0.103	-0.053	0.335***	0.070	1
VIF				1.39	1.52	1.45	2.19
TOL (1/VIF)				0.719	0.657	0.689	0.457

Notes: *, **, and * denote the significance level at 1 %, 5%, and 10%, respectively, in the two-tailed test. Return on equity (ROE), Tobin's q (Tq), and asset turnover ratio (ATO) are the dependent variables, whereas the value-added intellectual coefficient (VAIC) is the independent variable. Debt-equity ratio (DER_log), physical capacity (PC), and firm size (FmSize_log) are the control variables. VIF and TOL refer to variance inflation factors and tolerance statistics.**

Table 4. Pearson Correlation between Elements of IC (HCE, SCE, and CEE) and ROE, Tq, and ATO

Variables	ROE	Tq	ATO	HCE	SCE-cube	CEE-sqrt	DER-log	PC	FmSize-log
ROE	1								
ATO									
HCE	0.218***	0.317***	-0.255***	1					
SCE_cube	0.241***	0.345***	-0.269*** -0.047	0.375*** 0.784***	1				
CEE_sqrt	0.333***	0.191**			0.784***	1			
DER_log	0.280***	0.286***	0.299***	0.327***	-0.253*** 0.103	0.296*** -0.329***	1		
PC	0.028	-0.017	-0.184**	-0.147*			0.283***	-0.184**	1
FmSize_log	0.192**	0.172**	-0.057	0.091			-0.053	0.335***	0.069 1
VIF				4.18	4.58		1.46	1.30	1.37 1.43
TOL (1/VIF)				0.239	0.218		0.684	0.772	0.730 0.700
Tq	-0.154 0.467***	1 -0.466***	1						

Notes: *, **, and * denote the significance level at 1 %, 5%, and 10%, respectively, in the two-tailed test. Return on equity (ROE), Tobin's q (Tq), and asset turnover ratio (ATO) are the dependent variables, whereas human capital efficiency (HCE), structural capital efficiency (SCE_cube), and capital employed efficiency (CEE_sqrt) are the independent variables. Debt-equity ratio (DER_log), physical capacity (PC),**

and firm size (FmSize_log) are the control variables. VIF and TOL refer to variance inflation factors and tolerance statistics.

Multiple Regression Results

Impact of Value-Added Intellectual Coefficient (VAIC) on Profitability, Market Value, and Productivity

This study employed random-effects GLS regression in models 1, 2, and 3. This is because the *F*-test and B-P LM test (χ^2) estimations were statistically significant (<.*01*), and the estimations of the Hausman test (χ^2) were statistically insignificant (Table 5). Model 3 was likely to suffer from a heteroscedasticity problem, as evidenced by the statistically significant estimations (<.*05*) of the Breusch-Pagan/Cook-Weisberg test (χ^2). The statistically significant estimations (<.*01*) of the Wooldridge test suggest that all models were affected by autocorrelation. To address the heteroscedasticity issue with model 3, the random-effects GLS regression model with cluster robust standard error was employed. This study employed the random-effects GLS regression model with AR(1) disturbance to address the autocorrelation issue with all models. The estimations of the Wald (χ^2) test were statistically significant (<.*01*), suggesting that all models fit the data well.

Table 5. Estimations of VAIC on ROE, Tq, and ATO

	Model 1 (Profitability–ROE)	**Model 2 (Market value–Tq)**	**Model 3 (Asset turnover–ATO)**
VAIC	0.005(2.07)**	-0.011(-0.21)	-0.0003(-2.53)***
DER_log	0.049(1.57)	1.014(1.65)*	-0.009(-4.34)***
PC	-1.194(-1.19)	7.225(0.39)	0.156(2.22)**
FmSize-log	-0.001(-0.02)	-2.232(-1.70)*	-0.010(-3.08)***
_cons	0.043	9.341***	0.092***
Wald (χ^2)	116.86***	111.82***	127.23***
R^2 (within/between/overall)	0.0632/0.183/0.164	0.571/0.029/0.294	0.612/0.057/0.112
Number of observations	146	103	146
***F*-test (29, 108), (20, 74), (29, 108)**	9.23***	6.35***	34.91***
B-P LM test (χ^2) (01), (01), (01)	92.00*** / 5.61	33.27***	201.23***
Hausman test (χ^2) (4), (7), (8)		5.34	2.75
Breusch-Pagan/Cook-Weisberg test (χ^2) (1), (1), (1)	0.07	1.51	4.11**
Wooldridge test, F(1, 29), F(1, 20), F(1, 29)	38.39***	53.44***	20.05***

Notes: ****p<0.01, **p<0.05,* and **p<0.1. Z* statistics and coefficients are within and outside the parentheses, respectively. The Wald (χ^2) test was conducted to ensure the goodness-of-fit models. *F*-test refers to the F-test in a fixed-effects model. The B-P LM test (χ^2) refers to Breusch and Pagan's (1980) Lagrange Multiplier test.

The regression coefficient of VAIC on ROE was positive and statistically significant (<.*05*) (Table 5), failing to reject hypothesis H_{1a}. The results suggest that the intellectual capital of the sample banks increases their profitability, giving support to the theoretical proposition. This result is also consistent with those of Mohiuddin et al. (2006), Zin et al. (2014), Sufian et al. (2016), Poh et al. (2018), Hasan et al. (2017), and Mollah and Rouf (2022). A possible theoretical explanation for the positive relationship between IC and profitability might be that the sample banks that used intellectual capital as the key source of sustainable competitive advantage ensured high productive activities that led to economic profits for the banks under the study. The regression coefficient of VAIC on Tq was statistically insignificant (>.*10*), rejecting hypothesis H_{1b}. This result suggests that the sample banks failed to increase market value with their intellectual capital. The findings could be attributed to the fact

that DSE, where the banks under study are listed, is externally inefficient because its stock prices are not affected by all available relevant information, such as the banks' intellectual capital.

Regarding productivity, the regression coefficient of VAIC on ATO was statistically significant and negative, rejecting hypothesis H_{1c}. Surprisingly, this result suggests that the productivity of the sample banks decreased due to the high level of intellectual capital during the study period. This result defies the theoretical prediction because it was anticipated that the firms' intellectual capital would increase productivity. The result contradicts Kehelwalatenna and Premaratne (2012) and Kamal et al. (2012).

As for control variables, the statistically significant positive coefficients of DER_log on Tq and PC on ATO suggest that the sample banks' market value and productivity were increased due to their high debt-equity ratio and high physical capacity, respectively. On the other hand, the statistically significant negative coefficients of DER_log and FmSize_log on ATO and FmSize_log on Tq suggest that the sample banks with a high debt-equity ratio and large-sized banks had low productivity, while the market value of the large-sized sample banks was low during the study period. However, no control variables significantly affected the sample banks' profitability during the study period.

Impact of Elements of Intellectual Capital on Profitability, Market Value, and Productivity

Random-effects GLS regression was also used in models 4 and 6 of this study to examine the effects of intellectual capital elements on the sample banks' profitability, market value, and productivity. This is due to the fact that the estimations of the Hausman test (χ^2) were statistically insignificant, and the *F*-test and B-P LM test (χ^2) estimations were both statistically significant (<.*01*) (Table 6). While fixed-effects GLS regression was used in model 5, as the estimation of the Hausman test (χ^2) was statistically significant (<.*05*), and the estimations of the *F*-test and B-P LM test (χ^2) were both statistically significant (<.*01*). According to the statistically insignificant estimations of the Breusch-Pagan/Cook-Weisberg test (χ^2), none of the models was likely to have a heteroscedasticity issue. The statistically significant estimations (<.*01*) of the Wooldridge test suggest that autocorrelation had an impact on all models. Therefore, the random-effects GLS regression model with AR (1) disturbance was used in this study to address the autocorrelation issue with all models. The estimations of the Wald (χ^2) test of models 4 and 6 were statistically significant (<.*05* and <.*01,* respectively), and the estimation of *F* was also statistically significant (<.*01*) for model 5 (Table 6), suggesting a goodness-of-fit of all models.

Table 6. Estimations of HCE, SCE, and CEE on ROE, Tq, and ATO

Model 4	**Model 5 (Profitability–ROE)**	**Model 6 (Market value–Tq)**	**(Asset turnover–ATO)**
HCE	0.006(1.96)**	0.092(1.11)	-0.001(-2.39)***
SCE_cube	-0.053(-1.87)*	0.060(0.13)	-0.002(-0.73)
CEE_sqrt	0.091(1.32)	0.141(0.10)	0.005(0.70)
DER_log	0.048(1.53)	1.502(1.37)	-0.009(-2.50)***
PC	-1.179(-1.19)	30.319(1.41)	0.083(0.78)
FmSize_log	-0.008(-0.12)	-3.033(-0.86)	-0.005(-0.65)
_cons	0.050	9.907***	0.079***
Wald (χ^2)	21.34**		54.46***
***F* (9, 52)**		15.88***	
***R*² (within/between/overall)**	0.143/0.174/0.176	0.733/0.130/0.000	0.407/0.106/0.137
Number of observations	146	82	146
***F*-test (29, 106), (20, 72), (29, 106)**	11.66***	5.88***	33.67***
B-P LM test (χ^2) (01), (01), (01)	89.97***	33.49***	186.06***
Hausman test (χ^2) (10), (9), (10)	16.74	18.44**	4.95
Breusch-Pagan/Cook-Weisberg test (χ^2) (1) (1) (1)		0.46	2.95

Wooldridge test, F(1, 29), F(1, 20), F(1, 29)	53.55*** (0.02)	50.02***	16.04***

Notes: ****p<0.01, **p<0.05,* and **p<0.1. Z* statistics and coefficients are within and outside the parentheses, respectively. The Wald *(χ^2)* test was conducted to ensure the goodness-of-fit models. *F*-test refers to the F-test in a fixed-effects model. The B-P LM test *(χ^2)* refers to Breusch and Pagan's (1980) Lagrange Multiplier test.

The HCE regression coefficient on ROE was positive and statistically significant (<*.05*) (Table 6), failing to reject hypothesis H_{2a}. In line with financial theory, this finding provides empirical evidence that the sample banks' high level of human capital efficiency boosts their profitability. There are two likely explanations for the positive impact of human capital efficiency on the profitability of banks: first, the sample banks that earned high profitability used efficiently and effectively their employees' knowledge, professional skills, level of education, expertise, and creativity in strategic, tactical, and operational activities. Consequently, the sample banks may have introduced low-cost innovative processes, new products, and services, resulting in high profitability. Second, banks with a high level of human capital were able to maintain a sustainable relationship with key stakeholders. Therefore, there may have been increased profitability for the sample banks as a result of offering existing and new products and services with innovative processes at a low cost. This finding is consistent with the findings of Goh (2005), Joshi et al. (2010), Saruchi et al. (2019), Amin (2020), and Mollah and Rouf (2022).

The study also found a statistically insignificant (>*.10*) regression coefficient of HCE on Tq (Table 6), rejecting hypothesis H_{2b}. This result implies that the market value of the sample banks was unaffected by their human capital efficiency. The observed insignificant impact could be attributed to the reasons stated for the relationship between VAIC and Tq. Another explanation for this would be that the human capital of the sample banks did not provide the investors of the DSE with adequate assurance that they would receive a reasonable return on their investment. In contrast, the HCE to ATO regression coefficient was negative and statistically significant (<*.01*), rejecting hypothesis H_{2c}. This result is unexpected as the finding implies that the high human capital was a detrimental factor for their productivity during the study period, contradicting the theoretical prediction. Theoretically, it was predicted that firms' human capital efficiency would improve productivity. Also, the result is inconsistent with that of Smriti and Das (2018) and Maji and Goswami (2016).

On ROE, the SCE_cube regression coefficient was negative and statistically significant (<*.10*) (Table 6); therefore, the results reject hypothesis H_{3a}. This finding is unexpected and suggests that the sample banks' databases, procedures, software systems, charts and schedules, corporate culture, strategies, policies, and distribution networks were detrimental to their profitability. It is difficult to explain this result, but it might be related to the high costs involved with the structural capital that led to reduced bank profitability. This finding is contrary to those of Chen et al. (2005), Hudgins (2014), and Bansal and Singh (2020), which found that a high level of structural capital increased firm profitability. On Tq and ATO, the SCE_cube regression coefficients were statistically insignificant (>*.10*); therefore, the result rejects hypotheses H_{3b} and *H3c,* respectively. The results suggest that the sample banks' structural capital failed to attract the DSE investors and that the banks did not use structural capital's advantages to increase their productivity during the study period.

Table 6 shows that the regression coefficients of CEE_sqrt on ROE, Tq, and ATO were statistically insignificant (>*.10*), rejecting the hypotheses H_{4a}, H_{4b}, and H_{4c}, respectively. The results suggest that the capital employed efficiency of the sample banks had no contribution to their profitability, market value, and productivity during the study period. The sample banks' inefficient and ineffective capital management may contribute to this result. This is because, as predicted by financial theory, a bank was supposed to increase productivity, profitability, and market value if its capital assets were managed in a better way. Among control variables, only DER_log was negatively and statistically significantly related to ATO, implying that the sample banks' productivity decreased due to their high debt-equity ratio during the study period. According to the regression coefficients, all other control variables had no effect on the sample banks' profitability, market value, or productivity.

CONCLUSIONS

This study examined the impact of intellectual capital and its components (e.g., human capital, structural capital, and capital employed) on the profitability, market value, and productivity of publicly traded banks in Bangladesh from 2016–2020. This study provided mixed empirical evidence. For instance, banks with higher intellectual capital efficiency generated higher profits, but poorer productivity and higher or lower intellectual capital efficiency were not mattered to the market value of the listed banks in Bangladesh. The study provided empirical evidence about the effects of intellectual capital components, showing that increased human capital efficiency in banks resulted in better profits but lower productivity and that the amount of human capital efficiency had no impact on market value. Surprisingly, banks with higher structural capital efficiency had lower profitability but no influence on their market value or productivity during the study period. Capital employed efficiency, on the other hand, had no effect on the profitability, market value, or productivity of the sample banks in Bangladesh.

The study is expected to help the bank management of Bangladeshi banks understand the current role of intellectual capital in improving profitability, market value, and productivity. It is due to the fact that intellectual capital has been found not to play a large enough role in enhancing the performance of banks in the era of the knowledge-based economy and, more importantly, gaining a competitive advantage for banks in the process.

However, this study is not free from limitations. The major limitation of this study is that it covered the study period 2016–2020. It demonstrated how intellectual capital affected banks' performance only from an accounting and market perspective. Therefore, further research could usefully explore the impact of intellectual capital on shareholder value

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