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Impact of Intellectual Capital Components on Bank Performance: An Evidence from Bangladesh

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Abstract: This investigation aims to reveal how the profitability of local private commercial banks in Bangladesh is affected by their intellectual capital determinants. Secondary sources like annual reports of 10 private conventional commercial banks in Bangladesh were used to get data from 2008 to 2020. This paper uses econometric modeling techniques to examine the relationship between the profitability measures of NIM ratio, ROA, and ROE of the selected private commercial banks and a number of relevant components of intellectual capital of banks such as human capital efficiency, structural capital efficiency and Bank's relative efficiency along with some bank-specific control variables including income diversification, bank size, bank age, insolvency risks, leverage ratio and market share.Dynamic panel data models were then built using one-step system GMMtechniques to account for endogeneity, unobserved heterogeneity, and profitability persistence of the data set across the chosen time period. This study hasfound that intellectual capital along with leverage ratio, revenue diversification, bank age, bankruptcy risks, and market share are statistically significant to demonstrate differences in NIM, ROA, and ROE measuring profitability of our sampled banks. The one-step system GMM approach has effectively adapted the dynamic effects of intellectual capital on bank profitability, taking into consideration all estimate conditions. A more accurate evaluation of intellectual capital's effect on the banking industry's profitability may be obtained in a future research encompassing all banks in Bangladesh.

Keywords: Intellectual capital NIM, ROE, Dynamic Panel Investigation, GMM

1.0 Introduction

A country's banking system helps to grow and mobilize funds for national initiatives. Knowledge and technology innovation have grown in recent decades. Intellectual capital is more valuable than physical capital for many firms today. Banking handles almost 80% of Bangladesh's finance activities, making it the country's major financial contributor. Bangladesh does not yet have a knowledge-

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based financial system, but globalization, increasing dependence on information technology, and the emergence of new channels are accelerating the country's transition to one. Due to the novelty of the concept of intellectual capital in Bangladesh, the country's legislature, together with the Company Act of 1994 and the Bank Company Act of 1991, has not yet implemented disclosure requirements for intellectual capital information. Therefore, the disclosure of intellectual capital in Bangladesh is purely voluntary at now.A company discloses intellectual capital voluntarily only when, by doing so, it achieves benefit from making the market less "information-asymmetric"(Abhayawansa & Abeysekera, 2009).Even if there are certain companies in Bangladesh that supply such information, it is not organized. This study is a modest effort to assess whether or not typical performance indicators are enough for measuring intellectual capital performance and the extent to which banks can utilize their intellectual property. This study investigated data from 10 private conventional commercial banks (PCCBs) in Bangladesh covering thirteen years, from 2008 to 2020.The intended contribution of the study's findings to the literature is an explanation of how to evaluate the intellectual capital performance in Bangladesh's banking industry. In addition, it helps determine the potential role that intellectual capital may play in the profitability of Bangladeshi banks.

This paper's primary goal is to demonstrate how the profitability as assessed by ROA, NIM, and ROE of private conventional commercial banks (PCCBs) in Bangladesh is affected by factors unique to each bank's intellectual capital performance, using econometric models.Some particular goals must be completed to attain this underlying goal. One goal is to examine the PCCBs of Bangladesh's bank-specific intellectual capital elements. This article examines the influence of bank-specific ICP variables on the financial performance of private conventional commercial banks in Bangladesh over a 13-year period.

Here's how the remainder of the study's sections are put together. In the second section, there is a brief review of the literature about the study's primary variables. Section three outlines the research technique or methodology employed in the study's implementation. The fourth section shows how the data was analyzed and what the study's results were, along with a discourse of the major findings of the study. The study is brought to an end with some concluding remarks in the fifth section.

2.0 Review of Literatures

Intellectual capital performance has received much attention recently. Intangible resources are a source of better performance and competitive advantage, according to resource and knowledge theories. Several studies have identified key intellectual capital elements that affect profitability. These studies have diverse

empirical outcomes because they use different datasets, time periods, contexts, and nations. Some similar elements were uncovered, allowing intellectual capital in banking to affect profitability.

Intellectual capital is discussed in various domains and from numerous perspectives, hence no universal definition exists. Not only are IC words often inadequately defined, but there is also scholarly disagreement(Marr & Moustaghfir, 2005). Commonly, Intellectual capital refers to a company's intangible assets or business resources that affect its performance and efficiency, despite not being included on the balance sheet. Sullivan (2000) defines intellectual capital as earnings-generating knowledge. Intellectual capital adds to an organization's competitive advantage, according to CIMA (2011). It comprises of in-house knowledge, expertise, contacts, experience, professional skills and abilities, working relationships, and technological competence. Wang and Chang (2005) divided intellectual capital into four categories: customer, human, process and innovation. Intellectual capital, as defined by Huang(2007), is the sum total of a company's knowledge and ability that serves as a source of profit for the company.

The research on factors that determine intellectual capital is, relatively speaking, still in its formative stages. In a study conducted by El-Bannany (2008), six variables thought to affect IC were involved. Investment in IT systems, personnel cost effectiveness, hurdles to entrance, financial performance, risk, and effectiveness were all factors considered. The initial three criteria have a negative connection with the final three. According to the findings, increasing expenditures on information technology can have a negative effect on productivity. Risk, profitability, and effectiveness, as stated byEl-Bannany (2008), all have an impact on intellectual capital. In 2012, El-Bannany studied the nine IC parameters. The author continued his earlier studies. In this study, the global financial crisis, age, number of years listed on a stock market, and concentration ratio were dummy variables. Only the length of a company's stock market listing affects IC positively, according to this research. Growth, number of years in business, competitiveness, insolvency risk, employment costs, IT investments, and concentration were all factors Meressa (2016) considered. The studies found that insolvency risk, growth, and age all hurt ICP. The data also demonstrated that all other criteria, except concentration and size, have a statistically significant impact on ICP. In 2017, Hidayah & Adityawarmanemployed six ICP variables. These included entry barriers, concentration, growth, ROA, risk, and age. Growth and age negatively affected ICP, as (Meressa, 2016)found. The remaining parameters have a positive impact on ICP, but only risk, financial performance, and concentration are statistically significant at 1%, 5%, and 10%. (Depoers, 2000) says banking literature considers many entry barrier measurement techniques. Fixed-asset-to-total-assets ratio seems to best depict barriers to entry.

Muhammad and Ismail found that in Malaysia's financial markets, capital utilization produces higher market value than intellectual capital (2009). Indicators or determinants of Malaysian banks with high financial performance (as assessed by standard economic measurements) were low in a 2001-2003 study (Goh, 2005). Recent research suggests that Malaysian banks benefit more from IC than insurance and securities industries. Intellectual capital efficacy is not a major contribution to bank profitability, experts say. The size of the banks, the number of employees, and the total quantity of stock owned by shareholders have little to relationship with their overall IC performance. (Joshi, et al., 2010).

Mondal & Ghosh (2012) obtained data from 65 Indian banks for their research. Experiments show that intellectual capital is crucial to a bank's financial performance and growth. Multiple regression analysis was used to compare intellectual capital performance to company profitability. When IC is broken down into its core components, human capital effectiveness increases bank profits. This suggests that investing more on human capital leads to greater bank success. According to the findings of a study that was carried out by Saengchan, (2007), the effectiveness of intellectual capital is proven to have a significant relationship with the financial performance of commercial banks. This finding lends credence to the hypothesis that intellectual capital is a significant contributor to the competitive advantage enjoyed by Thai banks.

Even while, earlier study implies that intellectual capital performance should affect financial success, however other studies contradict this, calling into question the validity of the previous research. Ozkan, et al., (2017)employed the VAIC technique to analyze this connection and found no statistically significant correlation in the Turkish banking industry. Morariu (2014)sampled 72 Romanian businesses registered on BSE in 2010 and found no significant relationship between IC and other financial indicators such as ROE and asset turnover. Firer & Williams, (2003) looked for a link between IC and corporate performance indicators (ROA, ROE) but found none.

Financial firms, especially banks, have faced challenges in recent years. Cross-border competition forces local banks to improve their competitiveness to maintain financial performance. Financial services rely heavily on expertise. The current study is a modest attempt to determine if typical bank performance measures can appropriately measure intellectual capital. Researchers in Bangladesh are eager for a new empirical study to analyze the relationship between Bangladeshi banks' intellectual capital and financial success. The influence of bank-specific drivers of intellectual capital on financial performance as assessed by ROA, ROE, and NIM is a significant issue to investigate as universal or internationally accepted standards of measuring intellectual capital are yet to arise. There have been several researches on the factors of intellectual

capital performance and its impact on profitability in established and emerging nations including Australia, Turkey, Malaysia, India, Thailand, Pakistan, Oman, Ghana, and Taiwan. Existing literature on the influence of bank-specific drivers of ICP on bank financial performance in Bangladesh is sparse and did not explore a variety of bank-specific factors or time series data. This study will try to show the impact of different bank-specific intellectual capital performance variables on the profitability of listed private conventional commercial banks (PCCBs) in Bangladesh and will help bank owners use their intellectual capital variables to increase overall profitability.

Considering the literatures mentioned above, following hypothesis has been constructed to investigate the impact of intellectual capital components on Bank performance in Bangladesh:

H_0: There is no significant relationship between various bank-specific intellectual capital performance indicators and the profitability measured with NIM, ROA and ROE of the commercial banks in Bangladesh

H_1: There is a significant relationship between various bank-specific intellectual capital performance indicators and the profitability as assessed by NIM, ROA and ROE of the commercial banks in Bangladesh

3.0 Data and Methods

This is explanatory research that investigates the relationship between the bank-specific determinants of intellectual capital performance and bank profitability by analyzing whether several bank specific factors of intellectual capital, significantly affected the profitability as assessed by ROA, NIM, and ROE of banks in Bangladesh.

Only secondary sources, such as annual reports over the previous 13 years of 10 PCCBs, were employed to obtain data for this thesis paper, resulting in a panel sample of 130.

This research sampled the following banks: Eastern Bank Ltd., BRAC Bank Ltd., IFIC Bank Ltd.,Bank Asia Ltd., Dutch Bangla Bank Ltd., United Commercial Bank Ltd., Trust Bank Ltd.,Mercantile Bank Ltd.,Prime Bank Ltd., andDhaka Bank Ltd.The sample of ten banks was selected by considering only conventional banks and excluding state-owned and Islamic commercial banks, as this study focuses solely on the intellectual capital factors of the local Private Conventional Commercial Banks in order to determine with precision the effects of bank-specific determinants of intellectual capital of banks. Data are included from 2008 all the way until 2020. Selecting a period of thirteen years was considered reasonable to ensure sufficient data availability.

3.1 Identification of Variables

In order to simplify the study, the panel data set includes nine independent variables and three dependent variables. The profitability of banks as measured by ROA, NIM, and ROE was selected as the dependent variable for this analysis and the explanatory or independent variables included in the study were selected following extensive research into the relevant literature.

To perform the study successfully, the components of the intellectual capital such as Human capital efficiency,Structural capital efficiency, relational capital efficiency and bank's relative efficiency along with some bank specific-control variables such as income diversification, bank size, bank age, insolvency risks, leverage ratio and market share.

The following section offers information on chosen factors and the empirical literature's expected influence on dependent variables. The + (Positive) sign shows that the explanatory variable positively affects the dependent variable; if the coefficient rises, profitability rises, and vice versa. The - (Negative) sign implies that the independent variable has an inverse connection with profitability; as the coefficient climbs, profitability will plummet and vice-versa.

Table 1. Identification of Variables

Variables/Factors	Notation	Estimators	Expected sign of coefficients
Dependent Variables			
Return on Assets	ROA	Net income to Total Assets	
Return on Equity	ROE	Net income to Shareholder's Equity	
Net Interest Margin	NIM	Net Interest Income to Avg. Earning Assets	
Independent Variables (Intellectual Capital)			
Human Capital Efficiency	HCE	Ratio of Value Added to Human Capital; Where value added = gross income – operating expenses; Human Capital = total expenses related to employees	+ (positive)
Structural Capital Efficiency	SCE	Ratio of Value Added to Structural Capital; Where Structural Capital = total expenses related to Research and Development	+ (positive)

Relational Capital Efficiency	RCE	Ratio of Value Added to Relational Capital; Where Relational Capital = total expenses related to Marketing	+ (positive)
Bank's Relative Efficiency	BRE	Operating expenses to Net Income	+ (positive)
Control Variables (Bank-Specific)			
Leverage Ratio	LR	Total Debt to Total Equity	- (negative)
Income diversification	ID	Net Interest Income to Gross Income	+ (positive)
Age of the Bank	AoB	Number of years of operating	+ (positive)
Market Share	MKS	Share of assets of each bank to total banks assets	+ (positive)
Insolvency Risks	IR	Z-Score	+ (Positive)
Size of bank	LNTA	Size of bank measured with log of total asset	+ (positive)

Source: Authors' Estimation

3.2 Empirical Models

Multiple regression models are used in this study to meet its aim. Following equations have been used to develop the hypothesis test, which is based on independent and dependent variables.

$$ROA_{it} = \beta_0 + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \beta_3 RCE_{it} + \beta_4 BRE_{it} + \beta_5 LR_{it} + \beta_6 ID_{it} + \beta_7 AoB_{it} + \beta_8 MKS_{it} + \beta_9 IR_{it} + \beta_{10} LNTA_{it} + \varepsilon_{it}$$

$$NIM_{it} = \beta_0 + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \beta_3 RCE_{it} + \beta_4 BRE_{it} + \beta_5 LR_{it} + \beta_6 ID_{it} + \beta_7 AoB_{it} + \beta_8 MKS_{it} + \beta_9 IR_{it} + \beta_{10} LNTA_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \beta_3 RCE_{it} + \beta_4 BRE_{it} + \beta_5 LR_{it} + \beta_6 ID_{it} + \beta_7 AoB_{it} + \beta_8 MKS_{it} + \beta_9 IR_{it} + \beta_{10} LNTA_{it} + \varepsilon_{it}$$

Here, β_0 represents the constant value of the dependent variables as measured by ROA, ROE and NIM. β_1 to β_9 are the coefficients related to the independent variables of the data which will be estimated under all estimation methods and according to that the degree of each variable's coefficient, impact will be analyzed.

According to the premise, econometric models have been created to analyze

the data acquired from various secondary sources. To illustrate the relationship between a bank's profitability (as assessed by ROA, NIM, and ROE) and the previously stated intellectual capital performance factors, the econometric models listed below have been put together:

$$NIM_{it} = \alpha_{it} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \varepsilon_{it} \quad \text{..... (01)}$$

$$ROA_{it} = \alpha_{it} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \varepsilon_{it} \quad \text{..... (02)}$$

$$ROE_{it} = \alpha_{it} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \varepsilon_{it} \quad \text{..... (03)}$$

$$NIM_{it} = \alpha_{it} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \mu_{it} + \varepsilon_{it} \quad \text{..... (04)}$$

$$ROA_{it} = \alpha_{it} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \mu_{it} + \varepsilon_{it} \quad \text{..... (05)}$$

$$ROE_{it} = \alpha_{it} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \mu_{it} + \varepsilon_{it} \quad \text{..... (06)}$$

$$NIM_{it} = \alpha_{it} + \gamma NIM_{i(t-1)} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \varepsilon_{it} \quad \text{.... . (07)}$$

$$ROA_{it} = \alpha_{it} + \gamma ROA_{i(t-1)} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \varepsilon_{it} \quad \text{.... . (08)}$$

$$ROE_{it} = \alpha_{it} + \gamma ROE_{i(t-1)} + \sum_{k=1}^{4} \delta_{it} X_{itk} + \sum_{k=1}^{6} \lambda_{it} C_{itk} + \varepsilon_{it} \quad \text{.... . (09)}$$

Where,

ROA = Return on Assets that acts as a determinant of the profitability of selected private conventional banks,

NIM = Net interest Margin ratio also a proxy for the profitability of private conventional banks,

ROE = Return on equity that serves as a proxy for the profitability of private

conventional banks in Bangladesh,

$\sum X$ = all of the independent variables assessing the intellectual capital performance included in the models,

$\sum C$ = all bank-specific control variables

$ROA_{(t-1)}$ = 1-year lagged return on assets used as an endogenous variable due to its correlation with the model's previous and current error term,

$NIM_{(t-1)}$ = 1-year lagged net interest margin used as one of the endogenous variables due to its correlation with the model's previous and current error term,

$ROE_{(t-1)}$ = 1-year lagged return on equity also used as an endogenous variable due to its correlation with the model's previous and current error term,

ε_{it} = within entity error/ error term,

μ_{it} = between entity error and

α_{it} = constant.

To estimate the coefficients in equations 01, 02, and 03, the fixed-effects technique was utilized to highlight the association between ROA, NIM, and ROE and the drivers of intellectual capital performance indicated as regressors in the model. In Fixed-effects, it's considered that certain individual variables may impact or bias the regressors or dependent factors; therefore it's natural to infer that the entity's error term followed by (ε_{it}) is connected to the independent variables. To further compare the outcomes of the approaches, cross sectional Generalized Least Square or GLS Technique and Pooled Ordinary Least Square (OLS) have been used to depict the coefficients included in the models.

Moreover, Random-effects technique was utilized to show the causality between ROA, NIM, and ROE and other regressors in equations 04, 05, and 6. The assumption that variation within the entities (commercial bank) is uncorrelated and random with the explanatory components of the estimations supports the random effects technique.

Additionally, Arellano-Bond dynamic panel data estimation was utilized to estimate the coefficients in equations 07, 08, and 09 using one-step system generalized methods of moments. This was done to cope with unobserved heterogeneity and endogeneity when predictors are coupled with error terms.

Data type, analytic technique, and the tools and software such as STATA 12.0 utilized to conduct the study were discussed in detail in this chapter. The results of the rigorous analysis will be described in full in the following section.

4.0 Empirical results with Discussion

This chapter might be referred to as the paper's central point of focus. It is comprised of the most important portion of the whole paper. This chapter analyzes data from 10 conventional private banks' annual reports spanning 13 years. After several evaluations, we've reached the most crucial conclusions. Chapter contains statistical models. On the data, summary statistics, normality test, regression analysis, multicollinearity test, model specification test using Hausman test and B/P LM test, group heteroskedasticity test, test of independence, autocorrelation test (Wooldridge test), unit root tests, and one step system Arellano Bond GMM approach were performed.

Summary Statistics

The statistical breakdowns of the dependent and explanatory or predictor variables are presented below. NIM, ROA, and ROE are three separate metrics that may be used to assess a bank's profitability, which is the dependent variable. All of the independent factors evaluated in this study are bank-specific variables.

Table 2 Summary Statistics of the Variables

Variables	Observations	Mean	Std. Deviation	Minimum	Maximum
ROA	130	.01193	.0055279	.0020	.0319
NIM	130	.03570	.0118448	.0086	.0675
ROE	130	.14860	.0679637	.0230	.3530
Human Capital Efficiency	130	3.4621	.0554320	0.164	1.294
Structural Capital Efficiency	130	1.6223	.0225471	.0108	.0651
Relational Capital Efficiency	130	2.6483	.0594301	.0740	2.410
Bank's Relative Efficiency	130	2.7109	1.693283	.8458	10.64
Leverage Ratio	130	.06870	.0132074	.0053	.1023
Income diversification	130	.44642	.1357509	.1072	.7064
Age of the Bank	130	19.400	7.881487	7.000	44.00
Insolvency Risks	130	.19069	.0541830	.0869	.3552
Market Share	130	.02156	.0726404	.0146	.0838
Size of bank	130	12.066	.5927111	10.55	13.10

Source: Authors' Estimation Based on results generated by STATA 12.0

As can be seen in the table above, with the exception of the levels of intellectual capital and bank age, the statistical summaries are consistent across all categories, with fewer standard deviations and narrower ranges for variables as indicated by minimum and maximum values. All variables' descriptive means are positive. Age of the bank has the greatest mean but ROA has the lowest mean. No extreme

values are reported in this study; hence the data are likely not normally distributed.

Normality Test

A normal distribution may be derived from data with a P-value of >0.05, indicating no statistical significance. If the P-value is less than 0.05, the distribution does not meet the normality assumption.According to the table 3, among all the variables, the P-value of two variables namely net interest margin (NIM) and insolvency risks have a non-significant result that is, P-value is greater than 5 percent level of significance, indicating that these two variables follow the normal distribution.

Table 3 Test for Normal Data included in the Model

Shapiro-Wilk W Test for Normal Data					
Variables	Observations	W	V	z	Prob>z
NIM	130	0.99192	0.832	-0.415	0.66089
ROA	130	0.95750	4.377	3.3220	0.00045
ROE	130	0.96190	3.924	3.0760	0.00105
Human Capital Efficiency	130	0.97620	2.451	2.0170	0.02185
Structural Capital Efficiency	130	0.73442	27.35	7.4450	0.00000
Relational Capital Efficiency	130	0.24837	77.40	9.7850	0.00000
Bank's Relative Efficiency	130	0.97395	2.682	2.2200	0.01320
Leverage Ratio	130	0.97826	2.239	1.8130	0.03488
Income diversification	130	0.95960	4.160	3.2070	0.00067
Age of the Bank	130	0.90606	9.674	5.1060	0.00000
Insolvency Risks	130	0.98336	3.714	1.2120	0.11281
Market Share	130	0.94459	5.707	3.9190	0.00004
Size of bank	130	0.95660	4.201	3.5610	0.01462

Source: Authors' Estimation Based on results generated by STATA 12.0

On the other hand, the P-value of all other variables is less than 0.05. So, as a whole, the data set deviates from the normality assumption. There were no notable variations from the assumption of normality of the error terms in this investigation because of the huge sample size.

4.1 Empirical Results of Multiple Regression Analysis

Based on equations 01 and 04 from the methodology section, we used fixed effects, random effects, GLS, and pooled OLS to determine the coefficients of a number of intellectual capital ratios that explain variations in the Net Interest Margin (NIM) of private conventional commercial banks (PCCBs).

Table 4 Results of Coefficients included in the Models (under equation 01 and 04)

Dependent Variable (NIM)		Estimation of Methods			
		Fixed Effects (FE)	Random Effects (RE)	Pooled OLS	Generalized Least Square (GLS)
Explanatory Variables	HCE	1.6734*	3.7869***	3.7869***	3.7869***
	SCE	0.0397**	0.0143	0.0143	0.0143
	RCE	0.0251***	0.0253**	0.0253**	0.0253**
	BRE	0.5300***	0.5433***	0.5433***	0.5433***
	LR	-2.1608*	-1.6126**	-1.6126**	-1.6126**
	ID	0.0245	0.0059	0.0059	0.0059
	AoB	0.0033	0.0028**	0.0028**	0.0028**
	MKS	0.3392	0.9824***	0.9824***	0.9824***
	IR	0.8933	0.2608***	0.2608***	0.2608***
	LNTA	6.2428*	3.7492**	3.7492**	3.7492**
	Constant	0.4232	0.0081	0.0081	0.0081
N		130	130	130	130
R^2		0.8614		0.8892	
F		21.2268**		27.8406**	
rho		0.7934	0		
sigma_u		0.0834	0		
sigma_e		0.0518	.0518		
chi-square			193.2679***		211.8643***

Source: Authors' Estimation Based on results generated by STATA 12.0
Note: *, **, *** denote 10%, 5%, and 1% level of significance respectively.

As the table illustrates, HCE (human capital efficiency), SCE (structural capital efficiency), RCE (relational capital efficiency), BRE (bank's relative efficiency), Leverage ratio, AoB (Age of Banks), MKS (market share), Insolvency risk (IR) and LNTA (Bank size) are statistically significant at the chosen level when articulating the variance in dependent variable evaluated by NIM of banks which is also found in the investigations contributed by (Marr & Moustaghfir, 2005), El-Bannany (2008) and Meressa (2016).Estimated Coefficients show that except leverage ratio, all other significant explanatory variables arepositively connected to NIM ratio which is espoused by Ozkan, et al., (2017) and Morariu (2014). Inversely linked leverage ratios reveal that banks with higher core capital to sustain losses during a financial crisis or downturn will have lower NIM ratio, as indicated by (Saona, 2016).In contrast, Positive insolvency risks result in a better Z-score and a healthier bank, which is also supported by HERSUGONDO,

et al., (2021).Age of Banks (AoB)also favorably affects Nim of the selected banks(Ismail, et al., 2015).

Both RE (chi^2 = 171.45674) and GLS method (chi^2 = 185.7448) demonstrate the combined importance of all intellectual capital elements in the model in explaining the variations in banks' profitability as evaluated by NIM. The R^2 values of 0.8614 and 0.8892 calculated using FE and pooled OLS methods, respectively. This means fixed effects and ordinary least squares models explained 86.14% and 88.92% of the variance in the dependent variable, NIM ratio, illustrating the correlation between intellectual capital variables and bank profitability.The FE and OLS models provide F-values of 21.2264 and 27.8406 respectively proving that all of the regression coefficients in these two methods are statistically significant in influencing fluctuations in the NIM ratio measuring bank's profitability. The intra-class correlation or rho valueshows panel differences account for 79.34 percent of NIM ratio fluctuation across the research period.

Table 5 Results of Coefficients included in the Models (under equation 02 and 05)

Dependent Variable (ROA)		**Estimation Methods**			
		Fixed Effects (FE)	Random Effects (RE)	Pooled OLS	Generalized Least Square (GLS)
Explanatory variables	HCE	0.5114	0.3029	0.3029	0.3029
	SCE	0.1074***	-0.1047***	-0.1047***	-0.1047***
	RCE	0.7016*	0.5096	0.5096	0.5096
	BRE	-0.4652	-0.7486***	-0.7486***	-0.7486***
	LR	-0.1656*	-0.0701	-0.0701	-0.0701
	ID	-0.0554	-0.0144**	-0.0144*	-0.0144**
	AoB	0.0001	-0.0002	-0.0002	-0.0002
	MKS	0.5079***	0.4846***	0.4846***	0.4846***
	IR	1.0257***	0.9451***	0.9451***	0.9451***
	LNTA	-1.9346*	-3.7492**	-3.7492**	-3.7492**
	Constant	0.1090	0.1503*	0.1503*	0.1503*
N		130	130	130	130
R^2		0.7980		0.7554	
F		48.7296***		41.1695***	
rho		0.5178	0		
sigma_u		0.0256	0		
sigma_e		0.0247	0.0247		
chi-square			370.5263***		401.4035***

Source: Authors' Estimation Based on results generated by STATA 12.0
Note: *, **, *** denote 10%, 5%, and 1% level of significance respectively.

Based on Table 5, the estimated coefficients for the Random effects, GLS, and OLS methods show that the SCE (structural capital efficiency), BRE (bank's relative efficiency), income diversification (ID), size (LNTA), insolvency risk (IR), and leverage ratios (LR) of the selected banks are significant in predicting the variance in the dependent variable evaluated by ROA.SCE (structural capital efficiency), RCE (relational capital efficiency), LR (leverage ratio), insolvency risks (IR), and market share (MKS) are statistically significant at the chosen level of significance under the fixed effects modelin articulating the changes in the ROA of banks.

ROA is inversely affected to banks' relative efficiency (BRE), income diversification and bank size. ID (Income Diversification) and bank size had the expected sign of correlation because higher operating expenses restrict lending and investing capacity and increase total expenses, which affect net income of banks.Tan (2017) also found thatChinese bank profitability drops dramatically as bank size increases. The reason is that thelarge banks can enjoy economies of scale up to a point. Further growth reduces profitability owing to inefficiency and bureaucracy(Yao, et al., 2018).Contrary to predictions, we found that return on assets (ROA) correlates negatively with a bank's relative efficiency. Bank efficiency is determined by dividing operational expenses by net income, therefore more expenses mean lower net income and less profitabilitywhich is also supported byMuh, et al.(2012). Intellectual capital components such as HCE, SCE and RCE along with other bank specific variables including income diversification, bankruptcy risks, and leverage ratios are also favorably associated to ROA. Hang, et al., (2017) found that when banks diversified, their profitability increased. The predicted Intellectual capital components sign means banks have more intellectual capital due to their larger market capitalization, economies of scale, and brand awareness. Insolvency risks as assessed by the Z-score match our predictions. Higher Z-scores indicate stronger financial stability, which boosts bank ROA. Leverage ratio, has been inversely correlated with return on assets (ROA) which is also found by Meressa (2016), Sullivan (2000) and Morariu (2014) as High leverage ratio limits banks' ability to lend and invest in profitable initiatives, limiting bank's profitability.in contrast, High core capital or tier 1 capital boosts a bank's trustworthiness, minimizes the need for external funding, and promotes depositor protection amid difficult macroeconomic situations according to Sufian & Kamarudhin (2012).

The fixed effect and OLS models reveal F-values of 48.729655 and 41.169596, respectively, which suggest that all of the regression coefficients in these two models are statistically significant in influencing variations in banks' return on assets (ROA) ratio. Intellectual capital factors in the model help explain variability in bank profitability as measured by ROA, with chi^2 values of 370.52636 for random effects and 401.40356 for GLS techniques.

Table 6 Results of Coefficients included in the Models (under equation 03 and 06)

Dependent Variable (ROE)		Estimation Methods			
		Fixed Effects (FE)	Random Effects (RE)	Pooled OLS	Generalized Least Square (GLS)
Explanatory variables	HCE	19.6660**	18.8323***	18.8323***	18.8323***
	SCE	0.1657***	0.1395***	0.1395***	0.1395***
	RCE	0.0099*	0.0080**	0.0080**	0.0080**
	BRE	0.5980	0.4657	0.4657	0.4657
	LR	-1.4716	-1.3542	-1.3542	-1.3542
	ID	-0.1097	-0.1338	-0.1338	-0.1338
	AoB	0.0061	0.0033	0.0033	0.0033
	MKS	5.3252***	6.2912***	6.2912***	6.2912***
	IR	2.4265	-3..2256	-3..2256	-3..2256
	LNTA	3.4682	9.3467	9.3467	9.3467
	Constant	2.8869	2.8562**	2.8562**	2.8562**
N		130	130	130	130
F		28.1355**		25.7691**	
rho		0.3078	0		
sigma_u		0.0252	0		
sigma_e		0.0378	0.0378		
chi-square			231.9224***		251.2492***

Source: Authors' Estimation Based on results generated by STATA 12.0

Note: *, **, *** denote 10%, 5%, and 1% level of significance respectively.

As can be seen from Table 6, using random effects, GLS, and OLS methods, we find thatthree components of intellectual capital of banks such as HCE, SCE, RCE are statistically significant at the when articulating the variance in ROE of our sampled banks. In addition, market share (MKS) is also statistically significant in affecting the ROE of banks. Moreover, Intellectual capital and insolvency risks boost the ROE of banks asthe coefficients of all these methods share the same expected signs for these variables. A bank's efficiency and profitability increase with its intellectual capital. Z-score helps determine the financial health of banks, and a moderate value suggests a lower likelihood of financial trouble(HERSUGONDO, et al., 2021).

The values of chi^2 demonstrate the combined relevance of all intellectual capital elements in the model in articulating variations in ROE of PCCBs. Significantly,

the R2 values reveal that the fixed effects model explained 70% of the variation in the dependent variable, ROE ratio, whereas the OLS model explained 66% of the variance. The F-value of 28.135581 and 25.769157 shows that all of the regression coefficients in FE and OLS models are statistically significant in determining the fluctuation of ROE for banks.

Based on equations one through six, almost all of the models constructed and mentioned in the previous section are regarded to be the best convivial models since banks' profitability and intellectual capital are associated by nine out of ten statistically significant explanatory factors. Thus, we must employ all models to explain the variance in dependent variables, such as NIM, ROA, and ROE, which evaluate profitability due to changes in intellectual capital as independent variables. Now the diagnostic tests of all models have been incorporated below.

4.2 Model Specification Test

In this section, Hausman and Breusch and Pagan Lagrangian Multiplier Tests for random effects are used to investigate how intellectual capital performance affects PCCBs' ROA, NIM, and ROE.

i. Random Effect vs. Fixed Effect (Hausman Test)

The Hausman test compared fixed-effects with random-effects panel studies. Regarding this test, the "null hypothesis" asserts that coefficient differences are not systematic, suggesting that the Random Effects Model is preferable to the Fixed Effects Model, while the alternative hypothesis favors the Fixed Effects Model. According to H0, there is no association between ui and predictors.

Table 7 Output of Hausman Test of NIM

Hausman Specification Test			
	NIM	ROA	ROE
Chi-square value	33.17	4.22	207.67
P-Value	0.00	0.89	0.00

Source: Authors' Estimation Based on results generated by STATA 12.0

The Hausman test of NIM, ROA and ROE in table 7 can distinguish fixed or random effects. The chi2 value of net interest margin (NIM) and return on equity (ROE)33.17 and 207.67 are statistically significant at the 5% level, and the p-valuesare 0.001 and 0.000, respectively. The fixed-effects model is preferable than the random-effects model, thus we should reject the null hypothesis.in contrast, because the p-value for ROA is 0.8967, which is over 0.05, the Chi2 value of 4.22 does not reach the 5% significance criterion. The random-effects

model is superior to the fixed-effects model; hence we must accept the null hypothesis.

ii. Random Effect vs. Pooled OLS (B/P LM Test)

The B/P LM test is used to select between the Random Effect model and the Pooled OLS model. The test's null hypothesis, which assumes there is no substantial variation among units, asserts that the variance across estimations is equal to zero.

Table 8 Output of B/P LM Test

Breusch and Pagan Lagrangian Multiplier Test for random effectss						
	NIM		**ROA**		**ROE**	
	nim[banks,t] = Xb + u[banks] + e[banks,t]		roa[banks, t] = Xb + u[banks] + e[banks,t]		roe[banks,t] = Xb + u[banks] + e[banks,t]	
	var	sd =√(var)	var	sd = √(var)	var	sd = √(var)
	0.00140	0.11844	0.00306	0.05527	0.04619	0.67963
e	0.00026	0.05184	0.00001	0.02471	0.01430	0.37821
u	0	0	0	0	0	0
Test: Var(u)	0		0		0	
Chi-square value	0.00		0.00		0.00	
P-value	1.0000		1.0000		1.0000	

Source: Authors' Estimation Based on results generated by STATA 12.0

Table 8 displays the results of the B/P LM tests for the ROA, NIM, and ROE dependent variables.NIM, ROA, and ROE all have Chi2 values of 0.00, which is statistically insignificant at 5% significance level as p-value 1.000 surpasses 0.05. We must accept the null hypothesis and declare there is no significant difference between panels. Pooled OLS gives a more realistic estimate than Random-effects.

4.3 Other Diagnostic Tests

As part of the process to validate the models, a number of diagnostic tests have also been executed.

i. Test for Multicollinearity

Variance inflation factor measures multicollinearity in multiple linear regression variables. The variance of a regression model variable is the difference between the overall model variance and the single independent variable variance. A high

VIF in multiple regression models suggests that the independent variable is very collinear. More VIF means worse model reliability. If a variable's VIF is over 5, multicollinearity exists.

Table 9 Output of Variance Inflation Factor

Variables	VIF	1/VIF
HCE	2.33	0.428670
SCE	1.87	0.535358
RCE	1.75	0.570964
BRE	1.63	0.613766
LR	1.54	0.649740
ID	1.44	0.693564
AoB	1.40	0.711746
MKS	1.39	0.718778
IR	1.28	0.778955
LNTA	1.59	0.628930
Mean VIF	1.63	

Source: Authors' Estimation Based on results generated by STATA 12.0

Insolvency risks have the highest VIF value in the model, 2.33, which is much lower than 5, showing that even the variables with the greatest VIF values are unlikely to generate a multicollinearity problem in the data. As a result, there is no concern with multicollinearity in the regression model.

ii. Test for group Heteroskedasticity

The modified Wald test for group-wise heteroskedasticity in the fixed-effects model of NIM shows that Chi-square is 1.72, indicating group-wise heteroskedasticity. We must accept the null hypothesis that the error variance will stay constant, thus we may infer that the fixed-effects model does not have a non-constant error variance.

Table 10 Output of Wald Test

Modified Wald Test for group Heteroskedasticity in FE regression model			
	NIM	ROA	ROE
Null hypothesis, Ho: $\sigma 2i = \sigma 2$ for all i			
Chi-square value	1.72	23.35	193.64
P-Value	0.18	0.00	0.00

Source: Authors' Estimation Based on results generated by STATA 12.0

At a 5% significance level, ROA and ROE had Chi square values of 23.35 and 194.64 respectively. We may thus reject the null hypothesis that error variance is constant and conclude that the fixed-effects model has nonconstant error variance.

iii. Pesaran's Test of Independence

Cross-sectional dependency is a barrier for macro-panel data, especially for 20- or 30-year time series. We conducted Pesaran's test of independence, with the null hypothesis asserting that residuals from various entities do not correlate. Table 11 reveals that Pesaran's test of cross-sectional independenceof NIIM and ROAare 2.259 and 5.999 respectively, which are statistically significant at the 5% level because the p-value is less than 0.05. The associated residuals across entities show cross-sectional dependence, leading us to reject the null hypothesis

Table 11 Output of Pesaran's Test of Independence

Pesaran's Test of Independence			
	NIM	ROA	ROE
Pesaran's test of cross-sectional independence	2.259	5.999	1.903
P-Value	0.023	0.000	0.057

Source: Authors' Estimation Based on results generated by STATA 12.0

In contrast, residuals from distinct entities for ROE are not associated, as the test of independence generated a ROE of 1.903, which is not statistically significant, indicating no cross-sectional dependence.

iv. Wooldridge Test for Autocorrelation

We used the Wooldridge (2002) test to check if the models have first-order autocorrelation. The null hypothesis, H0, claims there is no first-order autocorrelation. This suggests neither a positive nor a negative autocorrelation. Table 12 shows the findings of first-order autocorrelation.

Table 12 Output of Wooldridge test for Autocorrelation

Wooldridge test for Autocorrelation in Panel Data			
	NIM	ROA	ROE
Null hypothesis, Ho: There is no first order autocorrelation			
F-value (1, 9)	14.349	8.255	11.094
P-Value	0.004	0.018	0.008

Source: Authors' Estimation Based on results generated by STATA 12.0

F-values of ROA, NIM, and ROE are statistically insignificant at 0.1% level, hence we could not reject null. The panel data models do not suffer from the first order autocorrelation problem, as a result.

v. Test of Unit Root

Using the Null hypothesis H_0, which states that the panel contains Unit Root or is non-stationary, we conduct LLC tests to determine if the variance, covariance, and mean of the panel are stationary; if the p-value of the LLC tests is less than the significant level of significance for the particular test, H_0 is rejected.[3]

Table 13 Results of Unit root test (LLC)

Variables	Adjusted t*	P-value	Stationary
NIM	-2.9522	0.0016	Yes
ROA	-3.4741	0.0003	Yes
ROE	-5.2841	0.0000	Yes
HCE	-2.7809	0.0027	Yes
SCE	-1.7308	0.0417	Yes
RCE	-2.6649	0.0039	Yes
BRE	-4.0000	0.0000	Yes
LR	-1.3805	0.0837	No
ID	-6.2247	0.0000	Yes
AoB	-21.021	0.0000	Yes
MKS	-1.7374	0.0412	Yes
IR	-5.6174	0.0000	Yes
LNTA	-4.5546	0.0001	Yes

Source: Authors' Estimation Based on results generated by STATA 12.0

Because the adjusted t-values of ROA, NIM, and ROE are -3.4741, -2.9522, and -5.2841 in the previous table is statistically significant at the 5% level, we reject H_0 and deduce that the dependent variables exhibit a non-stochastic trend or are stationary.

Adjusted t-values ofcoefficients of all independent variables along with control variables except leverage ratioare statistically significant at the 5% level, so we may reject H_0 and infer that the independent variables with control variables except leverage ratio are stationary. One of the factors, leverage ratio, is negligible at 5% significance level, therefore the null hypothesis cannot be rejected and it is concluded that the panel data includes unit roots.

[3] We have also performed the unit root test considering Im, Pesaran & Shin along with Breitung unit root test statistic and found stationary corresponding to the variables at level form.

4.4 One-step System GMM Approach

One-step system Generalized Methods of Moments were used to estimate the dynamic impact of bank-specific intellectual capital determinants on selected commercial banks in Bangladesh. The following table depicts the results of the one-step GMM technique applied to the dependent variables ROA, NIM, and ROE, with the 1-year lagged ratios of ROA, NIM, and ROE as independent variables shown in the model.

Table 14 Results of Coefficients (using One-step system GMM Approach)

Variables	Estimation of GMM Model		
	NIM (07)	**ROA** (08)	**ROE** (09)
L_1. NIM	1.5936**		
L_1. ROA		1.3672*	
L_1. ROE			2.151258**
HCE	1.0409	-0.5719	-13.43688
SCE	6.2648	0.1035***	0.150659***
RCE	0.0022***	0.6284	0.964315
BRE	0.5049***	-0.0274	-0.464921
LR	0.0228	-0.2262**	-2.195713
ID	-0.0536	0.0665**	0.471938
AoB	0.6618	0.7861*	0.522041
MKS	0.2173	0.3540***	3.445902*
IR	-0.3436	1.0496***	-3.544853
LNTA	2.4469	2.8761	1.849342
Constant	0.6837	0.7137**	6.749208
N	110	110	110
Wald Chi^2	196.7300***	425.2100***	251.1300***
P-value	0.0000	0.0000	0.0000
Number of instruments	75	75	75

Source: Authors' Estimation Based on results generated by STATA 12.0
Note: *, **, *** denote 10%, 5%, and 1% level of significance respectively.

The dynamic nature of the models is illustrated by the significant coefficients of the lagged profitability shown in Table 14. This finding suggests that banks' prior year's performance had a consistent impact on their performance this year.RCE, BRE being the components of intellectual capital are found statistically significant in explaining the variation of NIM ratio which is also supported by Saengchan, (2007), Ozkan, et al., (2017). Again, SCE along with all control variables are

aslo found statistically significant in changing the ROA of our sampled banks which is also supported by Hang, et al., (2017), Meressa (2016) and Sullivan (2000). Moreover, estimating equation 09 using GMM approach, it is revealed that only SCE being the component of intellectual capital and market share are found statistically significant at chosen level of significance in explaining the changes of ROE which is also supported bySaengchan, (2007), Mondal & Ghosh (2012)and Firer & Williams, (2003). The Wald Chi^2 values of 196.73, 425.21, and 251.13 under equations 07, 08, and 09, respectively, show that the models are jointly significant at the 5% level of significance, indicating that all of the explanatory factors portray the changes in dependent variables assessed by ROA, NIM, and ROE of the selected banks.

5.0 Conclusion

This research has so far achieved the goal and hypothesis set at an earlier stage, which was to establish a causal relationship between profitability measures such as NIM ratio, ROA, and ROE of selected private commercial banks and a number of intellectual capital components like human, structural, relational and bank relative efficiency through establishing econometric models estimatedwith fixed effects, random effects, GLS, Pooled OLS, and cross-sectional GLS, followed by dynamic panel data models using one-step system GMM techniques.According to the models' predicted outputs, most intellectual capital metrics or explanatory variables along with their control variables are responsible for changes in bank profit margins. This reveals the relevance of intellectual capital components that encompass all metrics in their computation. Several components of Intellectual capital such as HCE, SCE, RCE and BRE described earlier along with insolvency risks and income diversifications contribute to financial stability which helps banks enhance profit margins. Size and efficiency may not necessarily lead to higher future profitability as their size of assets expands; they always incur more costs that work against them. Notwithstanding, the decision on the capital structure, as assessed by the ratio of equity capital to total assets, is critical in bringing about changes in bank profitability, as high equity financing will burn up banks' profit margins due to a negative association between banks' leverage and money market competition. However, increasing bank profit margins may lead to higher leverage ratios, depending on how banks utilize their core capital. This paper is a good starting point for managers of private commercial banks operating in Bangladesh by revealing that they need to maintain the components of Intellectual capital of banks as they are the main drivers of competitive advantages as well as improvement in productivity of banks. The positive impact of HCE (human capital efficiency) enables the managers of bank to appoint more trained employees and develop the systematic mechanism to espouse the internal operations of banks. As RCE (relationship capital efficiency) is another crucial

component of intellectual capital of banks, the management of commercial bank must ensure close relationship with depositors and borrowers to maintain a well-established corporate reputation for holding customer loyalty.

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