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Examination of Banks' Performance and Intellectual Capital in Cambodia: Utilizing FMOLS and DOLS Methods

Sereyvath Ky[1], Siphat Lim[2]

Abstract

In order to address the potential presence of serial correlation and heteroscedasticity in static panel data models such as Pooled Ordinary Least Square (Pooled OLS), Fixed Effect (FE), and Random Effect (RE) models, the study employed Panel Fully Modified Ordinary Least Squares (FMOLS) and Panel Dynamic Ordinary Least Squares (DOLS) methodologies to evaluate the influence of value-added capital and its specific components - human capital, structural capital, and capital employed - on the performance of banks in Cambodia. The results of the research revealed that intellectual capital significantly impacted the return on assets in a positive manner. Specifically, human capital and capital employed were recognized as crucial elements in determining this connection. Both the FMOLS and DOLS estimation techniques produced reliable outcomes, showing positive slope coefficients that were deemed statistically significant at the 1% level. Conversely, the impact of structural capital on bank performance produced diverse results. While the determined slope was considered extremely significant at the 1% level through the FMOLS technique, the findings were inconclusive. More precisely, the projected coefficient showed a positive value when applying the FMOLS approach, but displayed a negative value when using the DOLS method.

Keywords: *ROA; Human capital; Static panel data models; Panel FMOLS; Panel DOLS.*

Introduction

Return on assets (ROA) plays a vital role in the banking industry as it assesses the effectiveness of a bank in utilizing its assets to produce profits. A heightened ROA signifies that the bank is proficient in generating earnings from its assets, whereas a diminished ROA could imply inefficiency or ineffective asset utilization within the bank. The optimal utilization and administration of both tangible and non-tangible assets are crucial for banks to uphold their competitiveness, enhance profitability, and attain sustainable growth in the ever-changing banking environment of today. Intellectual capital is a valuable intangible asset for banks, encompassing employees' expertise, operational processes, strategic frameworks, accumulated experience, and specialized skills. Effectively managing and leveraging intellectual capital can drive competitiveness, innovation, and long-term success in the banking industry (Hossain et al., 2023). In shaping the triumph and competitive edge of diverse sectors, including banking, the significance of knowledge-based methodologies cannot be overstated in today's world. It is evident that the IC plays a pivotal role in accomplishing these aims (Faruq et al., 2023).

In contrast to previous studies that have explored the impact of intellectual capital on performance in various industries, this research will specifically focus on the banking sector in Cambodia. By honing in on this particular industry, the study aims to provide valuable insights into how value added intellectual capital (VAIC) influences the financial performance of commercial banks operating within the Cambodian market. Through a rigorous analysis of the relationship between VAIC and ROA, this study seeks to contribute to the existing body of knowledge on the subject and offer practical implications for stakeholders in the banking sector.

The method proposed by Marzo (2022) will be utilized to compute the coefficients for the three elements of VAIC: human capital efficiency (HCE), structural capital efficiency (SCE), and capital employed efficiency (CEE). By incorporating these methods into the study, a more comprehensive understanding of the relationship between VAIC and bank financial performance can be achieved. This approach will

[1] Professor, CamEd Business School, Phnom Penh, Cambodia.
[2] Professor, CamEd Business School, Phnom Penh, Cambodia.

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contribute to the existing body of knowledge by extending the application of VAIC measurement beyond its traditional scope.

An investigation was carried out in Cambodia to evaluate the influence of value added intellectual capital and its three components (human capital, structural capital, and capital employed) on the performance of commercial banks. This empirical study utilized static panel data models, specifically the Pooled Ordinary Least Square (Pooled OLS), Fixed Effect (FE), and Random Effect (RE) models. The findings from these models indicated that there was a positive impact of value added intellectual capital and its components on bank performance (Lim, et al., 2024). The study conducted previously did not account for the challenges linked to serial correlation and heteroscedasticity. To broaden the scope of the research, Panel Fully Modified Ordinary Least Square (FMOLS) and Panel Dynamic Ordinary Least Square (DOLS) techniques have been applied to address these specific issues. The main objective of Panel FMOLS is to tackle the issues of serial correlation and heteroscedasticity in a model without directly incorporating lagged variables. On the other hand, Panel DOLS explicitly incorporates lagged dependent variables in the regression model to capture the dynamic characteristics of the data. By including lagged variables, DOLS effectively addresses potential problems related to endogeneity and autocorrelation that may arise in dynamic panel data models. An intriguing aspect of this study lies in its purpose, which involves conducting panel unit root tests and panel cointegration tests. These tests serve to gauge the long-term association between variables within the models under examination. By exploring this enduring relationship, the study aims to shed light on the intricate dynamics at play within the research domain.

Literature Review

Akhter's (2020) research underscored the significance of corporate knowledge management in driving economic growth through the effective utilization of value-added intellectual capital (VAIC), comprising capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). The study, spanning from 1999 to 2008, concentrated on 33 Malaysian banks, resulting in a comprehensive analysis based on 237 observations. The efficiency scores of these banks were determined using non-parametric data envelopment analysis, which considered both input and output factors. In addition, Sufian and Kamarudin (2016) conducted a bootstrap regression analysis to examine how the predicted scores correlated with various bank characteristics, as well as macroeconomic and financial market indicators, and the banks' origins. The findings from this empirical study demonstrated that the size, capitalization, and non-interest income of banks played a significant role in determining their productive efficiency. This study provides a basis for understanding the relationship between VAIC and financial performance in the banking sector.

A study conducted by Poh et al. (2018) aimed to further investigate the impact of VAIC on the financial performance of ten local Malaysian banks over a ten-year period from 2007 to 2016. The study focused on examining the influence of capital employed, human capital, and structural capital efficiency on the banks' financial performance. To measure financial performance, indicators such as ROA, ROE, and LEV were utilized. The results obtained through multiple regression analyses indicated that both structural capital and human capital efficiency significantly influenced the financial performance of the banks. However, it is important to note that the sample size for this research was relatively small, which raises concerns regarding the robustness of the empirical findings. Furthermore, certain assumptions, including autocorrelation and heteroscedasticity, were not evaluated, potentially impacting the reliability of the statistical tests conducted to test the hypotheses. The absence of unit root tests also raises doubts about the validity of the findings. Therefore, future studies should aim to incorporate larger sample sizes and thoroughly assess assumptions to enhance the reliability of the findings.

Nawaz and Haniffa (2017) delved into the impact of VAIC, CEE, HCE, and SCE on ROA through a pooled OLS model, examining data from 64 Islamic Financial Institutions (IFIs) in 18 different countries over a five-year span from 2007 to 2011. Various control variables, including banks' size, risk, listing status, and subsidiary, were carefully considered in the analysis. The results of the study indicated that each

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component of VAIC had a notable influence on IFIs, aligning with the outcomes of prior research by Hasan et al. (2017) and Mollah and Rouf (2022).

The role of human capital in organizations cannot be overstated, as it significantly influences their productivity and effectiveness (Sardo et al., 2018). A comprehensive study conducted by Xu & Liu (2020) examined a vast sample of 953 manufacturing companies in South Korea over a five-year period from 2013 to 2018. The findings of this study highlighted the critical importance of human capital in enhancing firms' performance. This conclusion is consistent with the earlier research conducted by Smriti and Das (2018), which demonstrated a positive relationship between higher levels of human capital within firms and increased productivity. Furthermore, an evaluation of the financial performance of banks in Bangladesh, conducted by Amin (2020), revealed a strong positive correlation between investments in human capital and overall financial performance, particularly for publicly traded banks. These studies collectively underscore the crucial role of human capital in driving organizational performance, including within the banking industry.

Furthermore, empirical research in the banking sector has shed light on the relationship between different components of VAIC and financial performance. Studies by Kweh et al. (2019), Soewarno & Tjahjadi (2020), Singla (2020), and Wang et al. (2021) have all highlighted the importance of efficiency of capital employed in determining the financial performance of banks. These findings provide valuable insights for stakeholders in the banking industry.

Various regions have conducted studies to examine the impact of VAIC on bank performance. In Turkey, for instance, the intellectual capital of banks, particularly capital employed efficiency and human capital efficiency, demonstrated a positive and significant influence on bank performance (Pilatin et al., 2023). Similarly, a study utilizing a panel vector autoregressive model found similar results for Turkish banks (Vuslat, 2020). The evaluation of Kuwaiti Islamic Banks also revealed that the efficiency of capital employed had a significant impact on bank performance (Nawaz & Haniffa, 2017; Ozkan et al., 2017; Buallay, 2019). These studies shed light on the relationship between VAIC and bank performance across different regions.

The study carried out by Ousama et al. (2020) shed light on the significant impact of VAIC on the financial performance of Islamic banks. This observation aligns with the findings of Akkas and Asutay (2022), indicating a consistent trend in the research. Furthermore, a study spanning from 2014 to 2018 emphasized the crucial role of capital employed and human capital efficiency in influencing the financial performance of Islamic banks, as highlighted by Asutay & Ubaidillah (2023).

The research conducted by Marsintauli et al. (2023) aimed to examine the relationship between intellectual capital and the financial performance of banks listed on the Indonesian Stock Exchange. The findings of the study indicated that intellectual capital had a notable impact on the return on assets and net interest margin of these banks. However, the study did not find any significant influence of intellectual capital on the capital adequacy ratio. To ensure the credibility of their results, the researchers utilized multiple regression analysis and considered control variables, which further strengthened the validity of their findings. This research sheds light on the importance of intellectual capital in enhancing the financial performance of Indonesian banks.

Previous research has utilized panel data analysis to investigate the correlation between VAIC and financial performance, with many studies relying on pooled OLS analysis. However, it is crucial to take into consideration the distinct impacts of individual banks, which can be assessed through the utilization of random and fixed effect models (Faruq et al., 2023). By employing these models, a more thorough comprehension of the connection between VAIC and financial performance can be achieved, while also acknowledging the specific attributes of each bank.

The available literature on the correlation between VAIC and financial performance in the banking sector offers valuable insights. These studies have investigated the influence of VAIC, encompassing CEE, HCE, and SCE, on financial performance. The results indicate that both human capital and structural capital efficiency have a significant impact on determining the financial performance of banks, although this may

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vary depending on the specific context and region. However, it is important to acknowledge certain limitations, such as small sample sizes and the exclusion of certain statistical tests and assessments. To address these limitations, this study aims to contribute to the existing literature on the relationship between VAIC and financial performance in commercial banks in Cambodia by utilizing panel data models, specifically the Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) approaches.

Methodology

The objectives of the study are accomplished through the analysis of panel data using two econometric techniques, namely Panel Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS). The estimated coefficients are computed using the grouped-mean (GM) FMOLS approach, as described in equation (1). This method was first introduced by Pedroni (2000, 2001) and builds upon the earlier research conducted by Phillips and Hansen (1990). In the realm of dynamic panel data settings, FMOLS stands out as an indispensable tool for estimating long-run relationships, especially in the presence of non-stationary variables and cointegration. Its significance is particularly notable in the fields of economics and finance, where it enables researchers to delve into the analysis of relationships that undergo changes over time. By employing FMOLS, researchers can gain valuable insights into the evolving dynamics of various economic and financial phenomena.

$$\hat{\beta}_{FMOLS,GM} = \frac{1}{N}\sum_{i=1}^{N}\left\{\left(\sum_{t=1}^{T}\tilde{Z}_{it}\tilde{Z}'_{it}\right)^{-1}\sum_{t=1}^{T}\left(\tilde{Z}_{it}\check{y}_{it} - \hat{\lambda}'_{12i}\right)\right\} \quad (1)$$

Table 1. Measurement of Variables

Names	Variables	Measurement	Data Sources
Return on Assets	ROA	$ROA = \frac{Net\ Income}{Total\ Assets}$	National Bank of Cambodia
Net Value Added	VA	$VA = i + t + ni + w$ Where, $i: Interest\ Expense$ $t: Taxes$ $ni: Net\ Income$ $w: Salaries\ and\ Wages\ Expense$	Data related to i, t, and ni are collected from the National Bank of Cambodia, while w is collected from Commercial Banks' Annual Reports
Human Capital Efficiency	HCE	$HCE = \frac{VA}{Salaries\ and\ Wages\ Expense}$	National Bank of Cambodia and Commercial Banks' Annual Reports
Structural Capital Efficiency	SCE	$SCE = \frac{VA - Human\ Capital\ Employed}{VA}$	National Bank of Cambodia and Commercial Banks' Annual Reports
Capital Employed Efficiency	CEE	$CEE = \frac{VA}{Total\ Assets - Intangible\ Assets}$	National Bank of Cambodia and Commercial Banks' Annual Reports
Value-Added Intellectual Coefficient	VAIC	$VAIC = HCE + SCE + CEE$	National Bank of Cambodia and Commercial Banks' Annual Reports

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Fixed Asset	FA	$FA = \frac{Fixed\ Assets}{Total\ Assets}$	National Bank of Cambodia
Banks' Size	SIZE	$SIZE = Log(Total\ Assets)$	National Bank of Cambodia

The estimation of the DOLS GM can be calculated utilizing the function (2) below, with the lag and lead of the model being established by the Akaike Information Criterion (AIC). The application of this technique proves to be highly advantageous in situations where there is a suspicion that the connections between variables are not fixed but rather change over time. In such cases, conventional panel data approaches such as Pooled Ordinary Least Square (Pooled OLS), Fixed Effect, and Random Effect models may fall short in accurately capturing the dynamic nature of these relationships.

$$\begin{bmatrix} \hat{\beta}_{DOLS,GM} \\ \hat{\gamma}_{DOLS,GM} \end{bmatrix} = \frac{1}{N} \sum_{i=1}^{N} \left\{ \left(\sum_{t=1}^{T} \tilde{V}_{it} \tilde{V}'_{it} \right)^{-1} \sum_{t=1}^{T} \tilde{V}_{it} \tilde{y}'_{it} \right\} \tag{2}$$

The return on asset is the performance indicator of a bank. While the VAIC measurement method was originally designed for manufacturing companies, this study specifically examines the performance of commercial banks. To determine the HCE, SCE, and CEE coefficients, which are the three components of VAIC, the method developed by Marzo (2022) is employed. FMOLS and DOLS models incorporate two control variables: fixed assets (FA) of banks, which is calculated by subtracting intangible assets from total assets, and the size (SIZE) of banks, which is measured by the logarithm of total assets. Moreover, the variable i denotes individual banks, with i ranging from 1 to 23, and the variable t represents the time period, ranging from 2011 to 2022. The process of determining the variables under investigation and the sources from which the data is collected is presented in Table 1. To standardize the dataset, SCE applies the cube transformation, while CEE utilizes the square root.

Empirical Results

This section has been divided into three distinct parts. The first section presents descriptive statistics for all variables investigated in the study. Parts two and three elaborate on the research's empirical findings. The second section includes an analysis and interpretation of the estimated results from panel data models. These models investigate the effect of the value-added intellectual coefficient on asset utilization efficiency, as measured by return on assets. The value-added intellectual coefficient is calculated by taking into account the efficiency of human, structural, and employed capital. An empirical investigation using panel data models is conducted to assess the impact of these indicators on asset return. The third part of this section presents the findings of this analysis.

Table 2. Summary Statistics

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
ROA	276	1.3703	1.3360	-7.9240	4.3729
VAIC	276	8.6803	6.1303	1.5228	41.0189
HCE	276	7.3909	6.1546	-2.0050	39.7927
SCE	276	0.9834	0.0221	0.8560	1.1215
CEE	276	0.2017	0.0425	0.0591	0.3377
FA	276	0.0246	0.0337	0.0009	0.2454
SIZE	276	6.2758	0.5416	5.1746	7.5688

The study ran from 2011 to 2022, which was a span of 12 years. Throughout this period, a total of 23 commercial banks provided comprehensive datasets. Time series data from 2011 to 2022 were combined

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with cross-sectional data from these 23 commercial banks, yielding a total of 276 observations. The empirical examination is conducted using seven variables: return on asset, value-added intellectual coefficient, human capital efficiency, structural capital efficiency, capital employed efficiency, fixed asset, and commercial bank total asset. The statistical summary is shown in Table 2.

This study examines two models. The initial model, represented by equation (1), aims to assess the influence of the value-added intellectual coefficient on ROA. This influence is determined by two factors: banks' fixed asset and size. Equation (2), on the other hand, is designed to evaluate the impact of the value-added intellectual capital coefficient's three components (human capital, structural capital, and capital employed efficiency coefficients) on asset return. This model is further governed by two variables: fixed asset and bank size. As a result, prior to running any regression models, it is critical to assess the correlation between independent variables to avoid multicollinearity. Multicollinearity occurs when there is a high or perfect correlation between independent variables in the model, reducing the statistical significance of an independent variable.

The correlation coefficients between VAIC and FA (-0.2173) and VAIC and SIZE (0.2128) are both low, indicating that the independent variables in equation (1) do not exhibit high or perfect multicollinearity. In equation (2), all of the correlation coefficients between the independent variables (HCE, SCE, CEE, FA, and SIZE) are less than |0.5|, indicating that there is no high or perfect collinearity among these variables. It should be noted that there is a perfect positive correlation between VAIC and HCE, as the correlation coefficient is equal to 1. This underscores the rationale for not implementing the model that combines VAIC and its three components to assess the influence of banks' ROA.

Table 3. Correlation Matrix

Variables	VAIC	HCE	SCE	CEE	FA	SIZE
VAIC	1					
HCE	1	1				
SCE	0.3771	0.3727	1			
CEE	0.2724	0.2653	0.3258	1		
FA	-0.2173	-0.2175	-0.1604	0.013	1	
SIZE	0.2128	0.2091	0.2745	0.4988	-0.0744	1

In order to determine the stationarity or non-stationarity of the panel data used in this study, four panel unit root tests have been conducted. These tests include the Levin, Lin and Chu t*, Im, Pesaran and Shin W-stat, Augmented Dickey-Fuller (ADF) and Fisher Chi-square, as well as the Phillips-Perron (PP) and Fisher Chi-square tests (Levin et al., 2002 and Im et al., 2003). It is important to highlight that the null hypothesis for each test is that the panel data possesses a unit root. According to the test results outlined in Table 4, it can be inferred that there is no unit root in the individual panel data.

The initial findings from the panel unit root tests indicate the possibility of a sustained association between the various variables analyzed in the panel data. To delve deeper into this observation, the Pedroni residual cointegration test is employed to explore the potential long-run relationship among the variables under study. In order to achieve its objectives, the research plan involves the implementation of two separate dynamic panel data models. The first model aims to investigate the impact of valued added intellectual capital on the performance of banks. Meanwhile, the second model focuses on evaluating the influence of banks' human capital, structural capital, and capital employed on their performance.

As a result, two distinct cointegration tests will be conducted to analyze the relationships. It is crucial to note that both models will include two control variables, namely banks' fixed assets and size, to ensure a comprehensive analysis. The null hypothesis for the Pedroni residual cointegration test posits that there is no cointegration present among the variables being examined. Furthermore, there exist two different alternative hypotheses to consider: the first being the alternative hypothesis involving common AR coefficients within the same dimension. This hypothesis is evaluated using four statistical tests, namely the

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Panel v-Statistic, Panel rho-Statistic, Panel PP-Statistic, and Panel ADF-Statistic. The second hypothesis is related to individual AR coefficients across different dimensions. This hypothesis is assessed through three statistical tests, which are the Group rho-Statistic, Group PP-Statistic, and Group ADF-Statistic. It is important to highlight that the Akaike Information Criterion (AIC) is utilized to automatically select the optimal lag length for the test. This criterion is of significant importance as it aids in determining the most suitable number of lags to be considered in the analysis. By employing this criterion, the process of lag length selection becomes more efficient and accurate.

Table 4. Panel Unit Root Tests

Methods	ROA	VAIC	HCE	SCE	CCE	FA	SIZE
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Levin, Lin & Chu t*	-12.4676***	-6.72014***	-7.00053***	-27.9158***	-5.19292***	-10.2536***	-8.78947***
Im, Pesaran and Shin W-stat	-4.7173***	-2.76037***	-2.64718***	-9.92735***	-1.90379**	-4.98122***	-1.95864**
ADF - Fisher Chi-square	98.4623***	76.672***	75.4015***	121.125***	63.5174**	100.744***	71.3548***
PP - Fisher Chi-square	90.4581***	83.7057***	87.5355***	151.534***	80.9022***	109.852***	92.5931***

***,**, and * are statistically significant at 1%, 5%, and 10%, respectively.

In the analysis of the first model, the examination of VAIC, FA, and SIZE's influence on ROA was conducted using the Pedroni residual cointegration test, as presented in Table 5. The results of this test indicated that the four variables are cointegrated or possess a long-run relationship. Among the seven statistical tests performed, four of them, namely Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic, and Group ADF-Statistic, provided evidence to reject the null hypothesis. This suggests that there is a significant relationship between the variables under consideration.

Table 5. Pedroni Residual Cointegration Test, between VAIC, FA, SIZE and ROA

Alternative hypothesis: common AR coefficients (within-dimension)				
			Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-0.8744	0.8091	-2.0390	0.9793
Panel rho-Statistic	1.1294	0.8706	1.6690	0.9524
Panel PP-Statistic	-4.4797	0.0000	-4.4887	0.0000

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Panel ADF-Statistic	-5.6000	0.0000	-5.8971	0.0000
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	3.5624	0.9998		
Group PP-Statistic	-6.2467	0.0000		
Group ADF-Statistic	-5.5645	0.0000		

The second model's cointegration test, which assesses the influence of HCE, SCE, CEE, FA, SIZE on ROA, yielded consistent findings with the first model. The null hypothesis was strongly rejected, as evidenced by the four statistical tests conducted (Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic, and Group ADF-Statistic).

Table 6. Pedroni Residual Cointegration Test, between HCE, SCE, CEE, FA, SIZE and ROA

Alternative hypothesis: common AR coefficients (within-dimension)				
			Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-1.3723	0.9150	-3.3021	0.9995
Panel rho-Statistic	3.4289	0.9997	4.3774	1.0000
Panel PP-Statistic	-7.2260	0.0000	-3.5075	0.0002
Panel ADF-Statistic	-5.8011	0.0000	-2.6654	0.0038
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	6.4160	1.0000		
Group PP-Statistic	-9.6670	0.0000		
Group ADF-Statistic	-3.5568	0.0002		

In this study, two distinct panel data models have been employed, each employing group estimation techniques. The first model, known as panel fully modified ordinary least square, and the second model, referred to as panel dynamic ordinary least square, utilize different methods to estimate the data. By utilizing these models, the research aims to gain a comprehensive understanding of the subject matter and draw meaningful conclusions from the analysis. The Bartlett kernel and Newey-West fixed bandwidth are the long-run covariance estimates used in FMOLS. On the other hand, in DOLS, which is employed for individual coefficient covariances, the estimation of long-run variances also utilizes the Bartlett kernel and Newey-West fixed bandwidth. Furthermore, the specification of leads and lags in DOLS is determined based on AIC. The empirical findings of Model 1 and Model 2, obtained through the FMOLS and DOLS estimation methods, can be found in Table 7.

Table 7. Panel Data Regression Results

Model 1		
	FMOLS	DOLS
VAIC	0.3709***	0.3698***

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	[14.5276]	[7.8297]
FA	4.2030	88.9722**
	[0.4527]	[2.1679]
SIZE	-1.1680***	-1.6056
	[-4.8256]	[-3.5389]***
Model 2		
	FMOLS	DOLS
HCE	0.1278***	0.1231***
	[5.9050]	[3.4718]
SCE	4.4920***	-9.2245***
	[2.8498]	[-5.8596]
CEE	20.4685***	64.8013***
	[17.1325]	[45.4756]
FA	-21.5267***	-60.3838***
	[-5.7790]	[-4.5467]
SIZE	-1.1732***	-0.8980***
	[-4.5334]	[-3.5248]
t-Statistics are in bracket.		
***,**, and * are statistically significant at 1%, 5%, and 10%, respectively.		

According to the findings of Model 1 using the FMOLS method, it was observed that value added intellectual capital has a positive impact on the performance of banks at a significant level of 1%. Additionally, when considering the same model, it was found that out of the two control variables, only the size of the bank had a statistically significant influence on the performance of banks. It is worth highlighting that the performance of banks is significantly influenced by their fixed assets and size. The statistical analysis conducted in Model 1, using either FMOLS or DOLS estimation method, reveals a positive relationship between the investment in value-added intellectual capital and the overall performance of banks. This suggests that banks that allocate more resources towards enhancing their intellectual capital tend to achieve better performance outcomes.

The impact of human capital, structural capital, and capital employed on the overall performance of banks was investigated using Model 2, and the empirical results were obtained. The results derived from the FMOLS approach indicate that the performance of banks is positively impacted by human capital, structural capital, and capital employed, with a high level of statistical significance at 1%. Additionally, despite the negative signs observed in the slopes of the two control variables, they remain significant at a 1% level. The estimated results from DOLS analysis demonstrate that both human capital and capital employed have a significant and positive effect on the performance of banks, with a significance level of 1% for each variable. These findings shed light on the importance of these components of value added intellectual capital in enhancing the overall performance of banks. In contrast, while structural capital does have a statistically significant effect on bank performance at the 1% level, this impact is negative. Furthermore, the negative influence of banks' fixed assets and size on bank performance is also observed at the 1% level.

Conclusion

In this study, it was found that all the panel data employed did not possess a unit root. This conclusion was drawn based on the rejection of the null hypothesis using different statistical tests, including Levin, Lin and Chu t*, Im, Pesaran and Shin W-stat, Augmented Dickey-Fuller (ADF) and Fisher Chi-square tests, as well as the Phillips-Perron (PP) and Fisher Chi-square tests. In addition, the Pedroni residual cointegration test was utilized to evaluate the presence of cointegration among value added intellectual capital, fixed asset,

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and total asset, as well as return on asset of commercial banks. Similarly, the test was also employed to examine the cointegration between human capital, structural capital, and capital employed, fixed asset, and total asset, along with return on asset of commercial banks. The results of four out of the seven statistical tests, namely Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic, and Group ADF-Statistic, indicated the existence of a long-term relationship among all variables considered in the study.

In order to address the potential presence of serial correlation and heteroscedasticity in static panel data models such as Pooled OLS, FE, and RE models, the study employed FMOLS and DOLS techniques to evaluate the influence of value added capital and its components on the performance of banks. The findings from the study indicated that intellectual capital had a notable positive influence on return on assets. In particular, human capital and capital employed were identified as key factors in this relationship. Both the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimation methods yielded consistent results, with positive slope coefficients that were statistically significant at the 1% level. On the other hand, the influence of structural capital on bank performance yielded varied outcomes. Although the calculated slope was deemed highly significant at the 1% level using the FMOLS method, the results were mixed. Specifically, the estimated coefficient was positive when employing the FMOLS method, but negative when utilizing the DOLS method.

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