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Intellectual capital efficiency and credit risk in Sub-Saharan African banks

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Abstract

The purpose of this paper is to study the relationship between intellectual capital (IC) and credit risk of Sub-Saharan African (SSA) banks and also test the modified models of Value Added Intellectual Coefficient (VAIC^{TM}). The results show no relationship between IC and credit risk. The problem of inadequacy in the reporting IC and its components and the availability of data on various proxies is one of the major challenges in the study. The VAIC^{TM} and the extended r-VAIC^{TM} models can be useful tools in the evaluation of bank performance.

Keywords: intellectual capital (IC); Added Intellectual Coefficient (VAIC^{TM}); bank performance.

Eficiencia intelectual de capital y riesgo de crédito en bancos Africanos Subsaharianos

Resumen

El propósito de este documento es estudiar la relación entre el capital intelectual (IC) y el riesgo de crédito de los bancos del África Subsahariana (SSA) y también probar los modelos modificados del Coeficiente Intelectual de Valor Agregado (VAICTM). Los resultados no muestran relación entre IC y riesgo de crédito. El problema de la insuficiencia en el informe IC y sus componentes y la disponibilidad de datos en varios proxies es uno de los principales desafíos en el estudio.

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Los modelos VAICTM y r-VAICTM extendido pueden ser herramientas útiles en la evaluación del desempeño del banco.

Palabras clave: capital intelectual (CI); Coeficiente intelectual agregado (VAICTM); Desempeño bancario.

1.INTRODUCTION

The increasing credit risk and default on bank loans is something that requires urgent attention of researchers especially that of the developing economies of Sub-Saharan African Countries (SSAC) (Were, Tiriongo, & Secretariat, 2012). The data extracted from the World Bank website as at 17/02/2016 indicates that about 80% of the SSAC with available information on the credit risk indicators were showing a rising non-performing loan (NPLs) in the region (Non-Performing Loans aceessed on 17/12/2016). Credit risk is in the offing when a debtor is unable to make good his obligation of paying back his loans. In this instance, banks being creditors perform the traditional role of collecting customers' deposits for safekeeping and on lending to those with viable investment ideas stand a risk of not being able to receive back in full the entire amount so disbursed as credit (DeYoung & Rice, 2004; Mishkin, 2007). Kargi, (2011) opined that credit creation is the primary revenue generating activity of banks that must be guarded professionally in an efficient manner so as to avoid unnecessary bankruptcies and liquidations in banking. Thus, banks survive mainly on the net interest margins after deducting the interest expense and other overheads to arrive at their net income. That is the business of banks akin to what manufacturing companies do when they buy raw materials for further processing through value adding activities. The result of which is raw-materials conversions

into a semi or finish goods for onward sales with a markup. Thus, no bank is in doubt that the 100% of its credit disbursements will ever return in full (Beck et al., 2010). In fact, the standard practice under the prudential guidelines in banking requires that certain provisions be made by each bank against its total loan portfolio. This is usually based on standard parameters that are expected to take care of probable defaults when they eventually occur such that a devastating effect on the bank's earnings and capital stock can be minimized (Beck et al., 2010).

One cannot discuss credit risk without mention of the 2007/2008 world financial crisis. The world economy was hit by severe system breakdown that resulted from credit exposures of banks primarily due to the activities in the housing market (Alexander, Baptista, & Yan, 2015; Bloom, 2011; Chaudhry, 2015; Greenlaw, Hatzius, Kashyap, & Shin, 2008; Morgan, 2009). Financial/banking system is the driver of the economic wheels of any capitalist economy which represents the engine and propellers in which economic growth and developmental thrive. More so, literature is abound with studies on the role of banks in the attainment of the overall developmental objectives of any nation (Al-Marri, Moneim M. Baheeg Ahmed, & Zairi, 2007; Huang & Pan, 2016; Jones, Sakyi-Dawson, Harford, & Sey, 2016; Lin & Li, 2001; Périlleux, Vanroose, & D'Espallier, 2016; Tobin, 1964).

Instructively, several reforms and measures were immediately undertaken by the regulators in these developed economies to ensure that such dastardly events do not reoccur. Of all the steps taken, the most apparent effort was that which was geared towards the use of intellectual capital & knowledge driven measures such as sound corporate governance

practices and a robust system of internal control and efficiency in the management of financial institutions. This primarily resulted to improved financial position and recovery from the turmoil and the attendant recession that followed the event of the meltdown.

There is an increasing attention towards efficiency of intellectual capital in recent times by many scholars. Most important, however, is how best resources at banks' disposal are harnessed by ensuring an efficient system of operation in the banking industry. Moreover, banking sector, due to the nature of its business being a service provider will naturally have to rely on its total assets (i.e. both tangible and intangible assets) to maximize its market potentials and return on investment. Serving as a hub to the financial nerve center of those with excess liquidity and those with short/longer term requirements of funding, banks invariably give out loans in the form of credit disbursements which might lead to credit risk. However, the success of the banking intermediation depends primarily on the best use of resources including intellectual capital (IC) and physical capital for an important role towards ensuring efficiency of operation due to the minimum collective support. Many studies have therefore proven the relevance of intellectual capital efficiency on corporate performance of Banks empirically (Goh, 2005; Mavridis, 2004a; Mavridis & Kyrmizoglou, 2005; Ante Pulic, 2000a; Tripathy, Sahoo, Kesharwani, & Mishra, 2016; Yalama & Coskun, 2007).

However, there are very limited studies on the role of intellectual capital efficiency on the credit risk management of banks. Thus, the interest of the current study is to understand the role intellectual capital

efficiency on credit risk management in the banking sector with particular attention to SSAC.

Many scholars viewed the concept of Intellectual Capital in a different perspective which eventually earned it several definitions (Fincham & Roslender, 2003; Johanson, Mårtensson, & Skoog, 2001; Kaufmann & Schneider, 2004; Marr, Schiuma, & Neely, 2004; Petty & Guthrie, 2000). The concept was defined by many scholars in different forms i.e. intangible capital, intangible assets, intellectual capital, intangibles, and knowledge resource, etc. Kaufmann and Schneider (2004); Bontis, (2001); Beattie and Thomson (2007); Lev (2001). However, another scholar defined intellectual capital as the aggregate of everything, everyone in an organization that includes material, learning, background, innovation, data that collectively harness value creation (Stewart, 2007).

Many scholars have developed different methods of measuring IC over time. Among the most common methods of measuring IC are; Direct Intellectual Capital Methods (DIC); Market Capitalization Methods (MCM); Return on Assets Methods (ROA); and Scorecard Methods (SC). In this study, one of the ROA methods (i.e. VAICTM method) will be adopted to investigate the relationship between the dependent and independent variables of the study. This study adopts VAICTM model due to its general acceptability by previous studies, especially in the banking industry. The model provides a means for measuring IC by using audited financial statements of banks which have been used to test the relationship between the efficiency of IC and performance of banks in a number of studies (e.g. Al-Musali, Ku Ismail, & Hassan, 2016; Bontis, Wu, Chen,

Cheng, & Hwang, 2005; Bornemann, 1999; do Rosário Cabrita & Vaz, 2005; Goh, 2005; Kujansivu & Lönnqvist, 2007; Mention & Bontis, 2013; Nawaz, Haniffa, & Hudaib, 2014; S. Singh, Sidhu, joshi, Kansal, & Johnson, 2016). The model was developed by an Austrian professor for the measurement of IC by adding up human capital efficiency (HCE) to structural capital efficiency (SCE) to arrive at Intellectual Capital Efficiency (K. Chan, 2009; Firer & Mitchell Williams, 2003; Goh, 2005; Levy & Duffey, 2007; Ante Pulic, 2000a; Yalama & Coskun, 2007). Though the model faces some criticism for its key assumptions of measuring human capital with the total expenditures on the employees (Levy & Duffey, 2007) and not been able to measure the IC but rather the efficiency of IC (Andriessen, 2004) etc, the model still remains the most important tool in the measurement of ICE in banking.

Another important component of Intellectual Capital in the literature is relational capital which the VAICTM model omitted in its measurement of IC. Banks thrive on good relationships with customers due to the homogeneity of services being rendered by commercial banks globally. Therefore, relationship management is one of the key assets at the disposal of any bank. The current study, therefore, intends to adopt the modified VAICTM model which will include relational capital (RC) in the measurement of ICE as proposed by Ulum, Ghozali, & Purwanto, (2014) and Vishnu & Kumar Gupta, (2014). The model in the study will, therefore, become R-VAICTM with four dimensions, HCE, SCE, RCE, and CEE in the measurement of IC components.

2.BACKGROUND

There are many studies on the concept of intellectual capital (IC) which have earned it several definitions (Fincham & Roslender, 2003; Johanson et al., 2001; Marr et al., 2004). The concept was defined by many scholars in different forms i.e. intangible capital, intangible assets, intellectual capital, intangibles, and knowledge resource, etc. Kaufmann and Schneider (2004); Lev (2001). This study adopts the definition of IC as "the possession of knowledge, applied experience, organizational technology, customer relationships, and professional skills" (Edvinsson, 1997). This definition is apt and has clearly identified all the key elements of IC worthy of mention.

Many scholars have categorized IC into different classes according to their understanding of the concept (Kaufmann and Schneider, 2004). To start with Edvinsson (1997), categories IC into two broad areas; i.e. human and structural capital. But he proceeded to further break structural capital into two other elements; i.e. customer and organizational capital. In the same vein, Sveiby (1997), categorized IC into three component elements of internal structure, external structure and employee competence. Roos and Roos (1997) classified IC into three types; human, organizational and customer/relational capital. Thus, based on the above classifications, European Commission sponsored a study in which three categorizations of IC was championed by Meritum (2002) i.e. Human, Structural and Relational Capital. This classification appears most suitable to many researchers in this area of study.

There are a good number of studies that attempted to provide answers on the relationship between IC and performance of banks (Alhassan & Asare, 2016; Mavridis, 2004b; Young, Su, Fang, & Fang, 2009). Wei Kiong Ting and Hooi Lean (2009) identified a positive relationship between IC and corporate performance. Using the VAICTM model, the researchers, establish a positive correlation between Return on Assets (ROA), which is the measure of profitability and IC of financial institutions in Malaysia. However, due to the limited data in the Malaysian financial sector, the study advised future researchers to consider extended population. Barathi Kamath, (2007) studied Indian banks performance using the same VAICTM model, and the result was also positive. He, however, concluded that the effect differs between local and foreign banks with Indian foreign banks showing greater strength in the relationship. Many of these studies observe significant positive correlation between IC as a whole and human capital as one of the IC constituents and banks' performance. Meanwhile, there are also some other contradictory findings regarding the influence of capital employed and structural capital on bank performance (e.g. (Abdulsalam, Al-Qaheri, & Al-Khayyat, 2011; Firer & Mitchell Williams, 2003; Zéghal & Maaloul, 2010).

However, despite the numerous studies on IC and bank performance in the literature, there was very limited attempt on the impact of intellectual capital, and its components have on credit risk in the banking industry. Lazzolino, Migliano, and Gregorace (2013) studied the impact of IC on Credit Risk Assessment of Italian companies. The study made use Multi Discriminant Analysis (MDA) to analyze both the financial and intellectual capital variables of Human Capital (HC), Structural Capital (SC) and Relational Capital (RC). The research

concludes that IC has the potential of assisting the analyst in credit assessment. Thus, the result indicates the relevance of IC and its components on credit risk evaluation of firms. While examining the relationship between IC and Bank Risk Ghosh and Maj (2014b) used panel data extracted from 41 Indian banks to test the relationship between Insolvency and Credit Risks as two dependent variables and four explanatory variables which included all the three components of IC and Capital Adequacy Ratio (CAR). The result substantiated the researchers' earlier position that IC component especially the HC impact positively on credit risk of banks. The findings are however subject to limited financial information from one country (India) and statistical tools of analysis. It also excluded relational capital which also another key component of IC in the literature. The area of further research suggested by the study includes consideration of additional variables in an extended sample that may explain the relationship further and probably employing more advanced statistical tools of analysis (e.g. quantile regression) over wide statistical data coverage.

The primary objective of this paper is to access the impact of intellectual capital efficiency on bank credit risk. To achieve this, an extended VAICTM model will be adopted to the effect of the variables of the study. The extended model will incorporate the relational capital which is key to the business of banking especially when we look at the importance of the term know-your-customer (KYC). The relevance of the cordial relationship between a bank and its customers' needs not to be overemphasized as banks products are homogenous in nature and what separate 'Bank A' from 'Bank B'' is the service and good customer relationship.

Empirical literature suggests that a lot has been documented in the field of research regarding the relationship between intellectual capital and company's performances in many countries around the globe. For example studies in the Sub-Saharan Africa (Alhassan & Asare, 2016; Chidiebere Ekwe, 2013; Firer & Mitchell Williams, 2003), North America (Bontis, 1998; Chidiebere Ekwe, 2013), Europe (Bozzolan, Favotto, & Ricceri, 2003; Ozkan, Cakan, & Kayacan, 2016; Vergauwen, P., Bollen, L., & Oirbans, E., 2007), Asia (Al-Twaijry, 2009; Chen Goh, 2005; Pew Tan, Plowman, & Hancock, 2007; Santoso, 2011) and lots of other regions have all demonstrated the relevance of intellectual capital efficiency on corporate performance. However, with the entire significant milestone on the relevance of ICE on performance, little attempt was documented on the importance of ICE on credit risk in banks. There is quite an understanding among scholars that sound credit risk management aids performance of banks but what is seldom tested is the relationship between ICE and credit risk management.

This study, therefore, examines the relationship between intellectual capital and credit risk of banks through the test of the following hypothesis;

H1. IC is negatively associated with bank credit risk of the Sub-Saharan African banks.

Since companies are registered to create wealth, and wealth can only be created through value adding activities, then the VAIC model remains one of the best tools for the measurement of the impact of intellectual capital on corporate performance (Bhatia & Aggarwal, 2015;

Volkov, 2012). Human capital efficiency, structural capital efficiency and capital employed are the three fundamental determinants of company performance under VAIC model (Ante Pulic, 2000a) which the literature is abundant with studies so far on performance. Human capital drivers, for example, worker aptitudes, instruction, capacities, training and development, commitment are considered valuable towards value creation of a firm (Beattie & Smith, 2010). After human capital, every other capital in an organization is structural. In effect, a human being can achieve virtually little without physical assets. Studies have highlighted the importance of structural capital in an organization towards the achievement of the overall goal (Abdolmohammadi, 2005; Abeysekera, 2007; Brennan, 2001). In the banking sector, relational/customer capital is very vital due to the homogeneity of banking products and services. Banks can quickly lose its customers to its rival competitor and with the customer not losing much from the uniformity of services in the banking industry. Therefore, banks are increasingly becoming concerned about the relationship that exists with its customers so as to forestall the avoidable loss of customer's confidence (Gardener & Molyneux, 1990).

Thus, this study therefore examines the relationship between the components of intellectual capital and credit risk of banks through the test of the following hypothesis;

H2. IC components are negatively associated with bank credit risk in the Sub-Saharan Africa.

Vivek, S. D., Beatty, S. E., & Morgan, R. M. (2012) however observed that the traditional VAIC model has one limitation of not being

able to measure all the three components of IC conclusively. The traditional VAIC model restricts itself to the two main components of IC, i.e. human capital and structural capital.

Recent studies have recommended that introducing additional variable like relational capital (RC) in the VAICTM model would enhance the explanatory powers of the model by providing a better explanation of the subsisting relationships in the model. Such relationship was tested in some studies on IC and performance (e.g. Clarke, Seng, & Whiting, 2011; Ulum et al., 2014; Vishnu & Kumar Gupta, 2014).

In their study of Intellectual Capital and Indian Pharmaceuticals companies, Vishnu & Kumar Gupta (2014) adopted the extended VAIC model to test the relationship between ICs and Corporate Performance of pharmaceutical companies in India. Relational Capital RC was incorporated into the model to understand the relationship existing between the variables of the study. The study finds that the extended model better explains the relationship between the variables of the study.

In view of the foregoing, this study intends to test the 3rd hypothesis to provide an answer by comparing the result of the original VAICTM model and the extended model adopted from Ulum et al., (2014) and Vishnu & Kumar Gupta (2014).

H3. The extended VAIC model depicts a stronger relationship between IC and credit risk than the original VAICTM model in the Sub-Saharan Africa.

3. METHODOLOGY

This section deals with the definition and measurement of variables of the study, models development and data source.

4. DEPENDENT VARIABLE

The defendant variable of the study is credit risk exposure in banks. Credit risk is one of the major risks bedeviling the affairs of banking activities. It usually results from the non-recovery of outstanding loans advanced by banks to its customers. Thus, the ratio of non-performing loans (NPLs) to loan stock is used by many scholars to identify and measure bank credit risk (Fungáčová & Solanko, 2009). Though some other researchers used total loans to total assets ratio, while some others preferred the use of loan loss provision to total assets (Eng & Nabar, 2007; Rahman, Ibrahim, & Meera, 2009). According to Bhayani (2006), the ratio of net NPLs to net advances is the best indicator for estimating credit risk of banks. Kargi (2011) in his study of credit risk and the performance of banks in Nigeria employ two different measures of credit risk, i.e. the ratio of non-performing loans to loan & advances and ratio of loan and advances to total deposits. Also, Kolapo et al., (2012) used similar measurement as employed by Kargi (2011) except for the introduction of an additional measurement i.e. the ratio of loan loss provision to the classified asset. Thus, this study adopts the two most popular measure of credit risk

NLA: Non-Performing Loan to Loan & Advance ratio (NPL/LA).

LTA: Loan & Advances to Total Assets ratio (LA/TA).

a. Independent Variables

The defendant variables of the study encompass the basic components of IC under the VAICTM model plus the newly introduced relational capital (RC) component that was excluded hitherto in the original VAICTM model.

The Value Added Intellectual Coefficient (VAIC™), which is otherwise called the Austrian Approach, was ushered into the field of learning by Prof Public during his stay at the Centre for Austrian Intellectual Capital Research between 1998 and 2002 (Chan, 2009; Yalama & Coskun, 2007). Pulic (1998) contends that prior IC estimation methods contain excessive subjectivities in assessment which does not give room for comparison. He, therefore, argued that there is a high need for a straightforward quantitative approach for measuring IC. What differentiated the VAIC™ model from others is its ability to collect audited financial information from companies' annual accounts and assemble a standard test that can be used across the divide for comparison (K. Chan, 2009; Ante Pulic, 2000b). Thus, VAIC™ can be measured by combining the three individual components i.e.: human capital efficiency (HCE), structural capital efficiency (SCE), and physical capital efficiency (CEE) to arrive at the aggregate position by expressing the position in an equation below (K. Chan, 2009; Chen Goh, 2005; Firer & Mitchell

Williams, 2003; Levy & Duffey, 2007; A Pulic, 2005; Yalama & Coskun, 2007).

VAIC™ = ICE + CEE

ICE = HCE + SCE

Where ICE ⟹ Intellectual Capital Efficiency

HCE ⟹ Human Capital Efficiency

SCE ⟹ Structural Capital Efficiency

CCE ⟹ Capital Employed Efficiency

According to VAICTM model, firm's ability to generate value for its stakeholders is expressed in terms of Value Added (VA). The difference between the input and the output is what is termed as value added and is calculated by adding up net operating income to employee cost and depreciation/amortization (Clarke et al., 2011; Pew Tan, Plowman, & Hancock, 2007). Thus;

HCE = Value Added (divided by) Human Capital (HC = personnel cost)

SCE = Structural Capital (divided by) Value Added (VA) (SC is the residue of value added after deducting HC element).

CEE = Value Added (divided by) Capital Employed (CE)

One of the greatest advantages of Value Added Intellectual Coefficient (VAIC™) model developed by Pulic (1998) is that its preference by many scholars due to its choice of quantitative financial data (Chan, 2009). However, the model was criticized for its non-inclusion of relational capital which is the third most important element of the IC in the literature (Ståhle, Ståhle, & Aho, 2011). This is what this study address by introducing the RC into the model due to its perceived importance in credit risk management in the banking sector.

b. Model 1

This study developed and tested three different models using multiple regression equation to find the relationship between the variables of study. The models were developed and tested by Vishnu & Kumar Gupta, (2014) in their study on IC and performance of Indian pharmaceutical firms. They recommended that researchers should test their models in future studies of IC.

Thus, the new equation to adopt is;

$$r\text{-}VAIC^{TM}{}_1 = (HCE_1 + SCE_1 + RCE_1) + CEE_1 \ldots\ldots\ldots\ldots\ldots\ldots\text{Model 1}$$

Where $r\text{-}VAIC^{TM}{}_1$ is the modified $VAIC^{TM}$ model (including RC component of IC); HCE_1 equals value added divided by personnel cost; RCE_1 equals value added divided by marketing/selling/advertising expenses; SCE_1 equals residue of value after deducting HC and RC; and

CEE_1 equals value added divided by capital employed. For the purpose of this study value added is defined as net operating income plus employee cost, depreciation and amortization (Ante Pulic, 2000b).

c. Model 2

The arguments against the overbearing influence of the use of value added by several studies in the past and the need to consider the nature of banking business that is highly capital intensive require the need to adopt the position of Vishnu & Kumar Gupta, (2014). This study adopts banks' deposit base of as a measure of turnover in the banking industry. Nazari, (2010) and subsequently Vishnu & Kumar Gupta, (2014) provided an alternative numerator in the determination of VAICTM components. Thus;

r-VAICTM2 = (HCE2 + SCE2 + RCE2) + CEE2……..Model 2

where r-VAICTM2 is the modified VAICTM model; HCE2 equals deposit divided by personnel cost; RCE2 equals deposit divided by marketing/selling/advertising expenses; SCE2 equals residue of value after deducting HC and RC; CEE2 equals to deposit divided by capital employed.

d. Model 3

Finally, the intensity measure for the constituents of VAICTM model was equally tested against the deposit base of banks. The model was borrowed from the works of Vishnu & Kumar Gupta, (2014) to

determine the extent of intensity of the VAICTM components in the management of credit risk management;

r-VAICTM3 = HCE3 + SCE3 + RCE3 + CEE3……..Model 3

Where r-VAICTM is the modified VAICTM model; HCE3 equals personnel cost divided by deposit; RCE3 equals marketing/selling/advertising expenses divided by deposit; SCE3 equals residue of value after deducting HCE and RCE; CEE3 equals capital employed divided by divided by deposit.

e. Results and Discussions

The Table 2elow is a summary of Multicollinearity and Variance inflation factors (VIF) tests in respect of the variable of the study. These tests measure the extent to which variance in the estimated regression coefficients inflate as compared to when the independents variables are not linearly related. It is used to explain how much amount multicollinearity (correlation between predictors) exists in a regression analysis.

Table 1: Collinearity & Variance Inflation Factors (VIF)

Model	Coefficients[a]	Collinearity Statistics	
		Tolerance	VIF
1	HCE1	.996	1.004
	SCE1	.999	1.001
	RCE1	1.000	1.000
	CCE1	.997	1.003
2	HCE2	.871	1.148
	SCE2	.995	1.005
	RCE2	.999	1.001
	CCE2	.868	1.152

3	HCE3	.014	73.998
	SCE3	.020	50.720
	RCE3	.061	16.356
	CCE3	.986	1.014

From the Table 1 above, and using the standard of VIF value of 10 and above to indicate a multicollinearity, it can be conclude that, except for model three variables of HCE3, SCE3 and RCE3 there is no evidence of multicollinearity in the models Neter, J., W. Wasserman, and M. H. Kutner. (1989). This is supported by the rule of thumb that if {\displaystyle \operatorname {VIF} ({\hat {\beta }}_{i})>10}VIF>10 then multicollinearity is high. However, at the on-set of the model formulation, the study foresaw the multicollinearity in model three because it was an inverse relationship of model two that was used to measure intensity of the VAIC components in the study. The question of high VIF may not necessarily introduce threats unless practically visible as supported by Greene (2003).

The first hypothesis developed in this study which stated that IC is negatively associated with bank credit risk in the Sub-Saharan African banks was tested using regression, and the result is summarized in Table 1 below;

Table 2: Regression result of IC and Credit Risk of Banks

Dependant Variables	Model	R2	F Value	p-value
NLA	1	0,001	0,28	0,6002
	2	0,001	0,26	0,6072
	3	0,004	0,85	0,3565

LTA	4	0,000	0,10	0,7487
	5	0,000	0,09	0,7606
	6	0,006	1,50	0,2212

From the above table, we can interpret statistically that all the three models in each of the dependent variables (NLA and LTA) do not show any significant relationship between ICE and credit risk in banks. The coefficient of determination (R2) which is an absolute determinant of a relationship in a regression model is less than 0.01 in all of the 6 cases. The closer the coefficient of determination is to one (1) the better the relationship between the independent and dependent variables. The F-Value outcome is also supportive of the same position. Except for model no 3 in LTA dependent variable, all F-values in the remaining five (5) models are less than one (1). To signify stronger relationship, the F-value should navigate towards 100 in a regression model. The implication of the above findings is that we are to reject our null hypothesis and accept the alternate hypothesis which states that IC is not negatively associated with bank credit risk in the Sub-Saharan African banks (Hashim et al., 2018).

Table 2, on the other hand, is the summary of regression results that will aid this study in addressing the second hypothesis. The second hypothesis states that IC components are negatively associated with bank credit risk in the Sub-Saharan African Banks. The result come is 12 different equations, six with the introduction of control variables of the

study and the remaining six without them. For each of the equation, only those variables that have shown some level of significance were captured in the result table.

Table 3: Regression result of IC Components and Credit Risk of Banks

Dependant Variables	Model	Control in the Model	Singnificant Variables	Coofficient	p-value
NLA	1	(a) Yes	Talg	-0.0118	0.000
		(b) No	HCE1	-0.0026	0.009*
	2	(a) Yes	Talg	-0.0104	0.000
		(b) No	HCE2	-0.0006	0.000
	3	(a) Yes	Talg	-0.0124	0.000
		(b) No	Constant	0.0431	0.000
LTA	4	(a) Yes	Talg	-0.0052	0.000
		(b) No	Constant	0.0250	0.000
	5	(a) Yes	Talg	-0.0047	0.000
		(b) No	HCE2	-0.0002	0.002*
	6	(a) Yes	Talg	-0.0555	0.000
		(b) No	Constant	0.0217	0.000

In all, among the six models that control variable was not introduced, model 2(b) seems to have the highest significance indicator.

The coefficient of determination (R2), though very low (i.e. 6.85%), is greater than in all of the five other models. It has a corresponding F-Value of 5.78 and a p-value of 0.001 (at $\alpha = 5\%$). Another interesting thing about this model is that HCE2 is found to be statistically significant with a coefficient of -0.00063 and a t-value of 0.000. This implies that among all the components of IC, HCE is the only component that has some explanatory powers on credit risk of banks. HCE has been consistent in model 1 & 2 in NLA dependent variable while in LTA dependent variable HCE only show some level of significance in model 2.

With the introduction of control variables of bank size (proxied by the log of total assets) and GDP growth rate, the result improved in all cases. The impact of bank size was found to be very significant on credit risk in commercial banks. Model 2 (a) got a better explanatory power of 15.15% coefficient of determination and a corresponding 8.36 F-value. All the six models under this group have shown some level of significance due to the impact of the dominant control variable in the equation (i.e. bank size). Bank size was found to be the only significant variable in all the six models displacing even the HCE that was found to be significant in the previous section of the study.

The newly introduced variable, RCE has not shown any level of significance in any of the 12 models of this study thereby leading us to conclude statistically that the variable does not have any impact on the dependent variable of the study. Thus, we can conclude that except for HCE which have shown some level of significance in three (3) of the six models without the control variables, all other components of IC are not statistically related to credit risk in commercial banks.

Table 4:Comparison between Extended and Traditional VAIC™ Models

Dependant Variables	Model	R2	F Value	p-value	Singnificant Variables	Coofficient	t-value
NLA	1(a)	3.13%	1.90	0.1111	Constant	0.0505	0.000
					HCE1	-0.0026	0.010*
	2(a)	7.60%	4.83	0.0009	Constant	0.0683	0.000
					HCE2	-0.0006	0.001*
	3(a)	1.49%	0.89	0.4697	Constant	0.0406	0.000
	VAIC (a)	3.30%	2.46	0.0632	Constant	0.0504	0.000
					HCE1	-0.0026	0.010*
LTA	1(b)	3.17%	1.92	0.1008	Constant	0.0251	0.000
					HCE1	-0.0012	0.014*
	2(b)	4.29%	2.63	0.0351	Constant	0.0303	0.000
					HCE2	-0.0002	0.008*
	3(b)	2.50%	1.51	0.2004	Constant	0.1818	0.000
	VAIC (b)	3.31%	2.54	0.0569	Constant	0.0251	0.000
					HCE1	-0.0012	0.014*

Table 4 above compares regression results of the extended and traditional model of the VAIC™ models in this study. The difference between the models is the introduction of the RC in the extended model for its perceived relevance in the banking sector which was hitherto not recognized by the traditional model developed by Ante Pulic.

Out of the 6 Models in the study, only 2(a) and 2(b) extended models show greater coefficient of determination of 7.6% and 4.29% than the corresponding traditional VAICTM model result of 3.30% and 3.31% respectively.

In Table 4, results of the third hypothesis, i.e. comparative performance of the three proposed models vis-a`-vis the VAIC model, have been shown. For NLA as the measure of credit Risk, the VAIC model has the highest R2 value of 3.3 per cent out of ⅔ of the models while ⅓ suggest that the extended modified model is better-off by recording an R2 of 7.6%. When the LTA was used as the dependent variable, the VAIC model has remain with the highest R2 value of 3.31 per cent still in ⅔ of the models while ⅓ suggests that the extended modified model is better-off by recording an R2 of 4.29%.

Thus, analyzing the results in Table 4, the study finds weak relationship explaining the degree to which IC explains Credit Risk as enunciated above. Drawing inference from the conclusion of the second hypothesis testing which supports the fact that introducing RC in the model has no direct bearing on the dependent variable in all the 12 different models tested, then, is logical to conclude that original VAIC model has better predictive powers than the extended version of the VAIC model (Tentama et al., 2019).

6. CONCLUSION

This research work is an attempt to study the impact of IC on credit risk of commercial banks in the Sub-Saharan African countries. The study adopted VAICTM model as a tool for measuring IC in the banking sector with little modification as proposed by Vishnu & Kumar Gupta, (2014) and Ulum et al., (2014). Due to shortcomings of the original VAICTM model of not incorporating RC and especially due to the perceived importance of relationship management in banking, this study adopted the

proposed model to test the relationship between IC and credit risk of banks (Zulkifli & Bintiali, 2017).

Financial information was sourced from 12 countries in the region based on the established criteria and out of it 45 banks were obtained and further pruning on the availability of data reduced their numbers to 40 which gave the study 240 number of observations. The two measure of the dependent variable were NLA & LTA while the ICE components were made up of HCE, SCE, and RCE. The VAICTM, on the other hand, include CCE as an additional variable.

The result indicates that no relationship between ICE and credit risk of banks in the SSAC. The result is contrary to the findings of Ghosh and Maj (2014b) which finds an inverse relationship existing between the dependent and independent variable. However, on the relationship between the components of IC and credit risk, the study finds evidence to suggest that HC is negatively associated with the credit risk of banks. This result was equally supported by the study of Ghosh and Maj (2014b) and Maji & De, (2015). On the comparative analysis between traditional VAICTM and extended VAICTM model, the study finds that the extended model is a better measure in the models. The finding is contrary to the findings of Vishnu & Kumar Gupta, (2014) which implies that the traditional VAICTM model is a better measure.

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