Intellectual capital and bank productivity in emerging markets: evidence from Ghana

Abdul Latif Alhassan
Graduate School of Business, University of Cape Town, Cape Town, South Africa, and
Nicholas Asare
Department of Accounting, Methodist University College Ghana, Accra, Ghana

Received 20 January 2015
Revised 10 April 2015
10 September 2015
22 November 2015
Accepted 10 February 2016

Abstract

Purpose – The purpose of this paper is to examine the effect of intellectual capital on bank productivity in an emerging market in Africa.

Design/methodology/approach – The Malmquist productivity index (MPI) is employed to estimate productivity growth of 18 banks in Ghana from 2003 to 2011 while the Value Added Intellectual Coefficient (VAIC) is used to measure bank intellectual capital performance. The panel-corrected standard errors estimation technique is used to estimate a panel regression model with MPI as the dependent variable. Bank market concentration and bank size are controlled for in the regression analysis.

Findings – The authors find productivity growth to be largely driven by efficiency changes compared to technological changes. The results from the regression analysis indicate that VAIC has a positive effect on the productivity of banks in Ghana. The authors also find human capital efficiency and capital employed efficiency as the components of VAIC that drive productivity growth in the banking industry. Bank size and industry concentration are also identified as significant drivers of productivity in the market.

Practical implications – The study's findings support investments in intellectual capital as a means of improving the performance of banks in emerging markets.

Originality/value – To the best of the knowledge, this is the first study to empirically examine the relationship between intellectual capital and productivity in an emerging banking market in Africa.

Keywords Africa, Ghana, Intellectual capital, Productivity, Banks, Malmquist, VAIC™

Paper type Research paper

1. Introduction

In the current global economy, intellectual capital is progressively being acknowledged as a vital constituent of organizational value. The impetus for this awareness is a sequence of challenges in knowledge-based corporate settings that motivate firms to invest in intellectual capital, given that it has become a key driver of productivity (Goh and Lim, 2004). Intellectual capital represents the knowledge, experience, intellectual property and information that can be put to use to create wealth (Stewart, 1997). From this definition, academics and management practitioners have given substantial attention to the role of knowledge and firm capabilities for global competitiveness and consider intellectual capital as the lever for sustaining competitive advantage and sustainable corporate performance (Mondal and Ghosh, 2012). In many instances,

The authors are very grateful for the constructive comments of Editor Professor Patrick J. Murphy and two anonymous reviewers which greatly improved an initial draft of this paper. All remaining errors are the responsibility of the authors.

Management Decision
Vol. 54 No. 3, 2016
pp. 589-609

0025-1747
DOI 10.1108/MD-01-2015-0025

intellectual capital appears to be vital for decision making both within the firm and for external stakeholders; and have implications on productivity.

The financial services sector, which appears to be dominated by the banking industry in emerging economies, has experienced a competitive environment in recent years due to decades of liberalization policies. As financial intermediaries, banks play an important role in the re-allocation of funds from surplus spending-units to deficit-spending units (Berger *et al.*, 2010). Through this, banks also help in reducing the friction of costs of transactions and information asymmetry through a process of delegated-monitoring on behalf of both borrowers and lenders (e.g. Diamond, 1984; Benston and Smith, 1976). As a services industry, banks are also recognized as an intellectual capital intensive industry sector (Branco *et al.*, 2011) which makes the recognition and development of intellectual capital an important aspect of bank management. Along this line, empirical studies have found evidence to support the role of intellectual capital in helping create competitive advantage in the banking industry (Mondal and Ghosh, 2012). Despite the theoretical and empirical linkages between firm performance and intellectual capital (see Alipour, 2012; Chen *et al.*, 2014), to the best of our knowledge, there have been few attempts to study whether intellectual capital is linked to variations in productivity (Chen *et al.*, 2014)[1]. Alongside, empirical evidence on the contributions of intellectual capital to the dynamics of the value creation process remains rare, exclusively within certain geographic regions and industries (Mention and Bontis, 2013).

Given this background, this study seeks to expand the literature on intellectual capital and performance from the perspective of an emerging banking market. Specifically, the paper examines the effect of intellectual capital on productivity in the Ghanaian banking industry in a three-stage analysis. Using annual data on 18 banks from 2003 to 2011, we employ the value added intellectual coefficient (VAIC)[2] of Pulic (1998, 2001) to estimate intellectual capital performance in the first stage. The VAIC™ measurement method provides a means to measure the efficiency of intellectual capital using three types of inputs: physical and financial capital, human capital and structural capital (Firer and Williams, 2003; Pulic, 2000). In the second stage, we estimate bank productivity using Malmquist productivity index (MPI). The index measures productivity changes over different time periods. The analysis provides management of banks with insights into sources of bank efficiency growth or decline. Hence, well informed policies will be devised to improve productivity. In the third stage, we examine the effect of intellectual capital and other contextual variables on bank productivity using a panel multiple regression analysis. This helps in shedding light on the importance of investments in banks' intellectual capital in improving bank productivity. The rapid changes in Ghana's banking sector driven fairly by technological changes and the express growth and development of competing micro-finance institutions; along with the liberalization of the sector presents an interesting data for testing our hypotheses. The analysis undertaken in this paper provides useful guidance for bank management on how to improve output productivity. Specifically, any evidence of linkages between intellectual capital and productivity over the study period would reinforce the important role intellectual assets play in giving firms the competitive advantage in the market. From our analysis, we find evidence to suggest that investments in human capital are the main driver of intellectual capital efficiency in the banking industry. We also find productivity growth to be attributable to efficiency changes which reflects the ability of inefficient banks to catch-up with efficient ones over the study period. However, we observe a decline in the technological

changes over the study period. The results of the regression analysis validate the relevance of intellectual capital in improving productivity in the banking industry.

The remainder of the paper is organized as follows. The ensuing section provides a brief overview of the banking sector in Ghana. The review of empirical literature and methods adapted in carrying out the research are presented in Sections 3 and 4, respectively. Empirical results are presented in the subsequent section with conclusions and thoughts for further research directions described in the last section.

2. Overview of the banking industry in Ghana

Banks form a key and sensitive part of every economy and thus offer a veritable area for researching into issues on intellectual capital and productivity in the context of economic development. Until the passage of Universal Banking Law in Ghana, banking was conducted along restricted scope as commercial, developmental and merchant banking (Hinson, 2004). The expansion of the banking market has brought about heightened competition resulting in new products development in diverse areas including international funds transfer, consumer/hire purchase loan, travelers' cheque, negotiable certificate of deposit, school fees loans and car loans among several others (Hinson *et al.*, 2006). Two major developments in the industry over the past decades include the Payment Systems Act 2003 (Act 662) and the Credit Reporting Act 2007 (Act 726), resulting in the e-zwich payment system and credit reference bureaus, respectively. Currently in Ghana, there are 27 deposit money banks which are operating as universal banks, made up of 15 foreign-owned banks and 12 domestic-owned banks. Some stylized facts on bank revenue[3] and profitability indicators in the banking industry are presented in Table I. We observe the industry to be highly reliant on revenue from traditional banking activities in lending. Over the period, about two-thirds of banks revenue is generated from interest income from loans and advances compared to the revenue from non-traditional activities in fees and commission. From the profitability indicators, return on shareholders' equity averaged 18.83 percent while return on total assets was 2.35 percent between 2004 and 2011. The average bank expenditure was 65.61 percent of total bank income.

3. Literature review

Since the second half of the 1980s, the attainments of knowledge firms have motivated academics and professionals to pinpoint new methods to determine a firm's value and

	Net interest income	Fees and commission income	Return on equity	Return on assets	Cost to income ratio
2004	0.7080	0.2920	0.0228	0.0025	0.5111
2005	0.7338	0.2662	0.2292	0.0289	0.8334
2006	0.7242	0.2758	0.1509	0.0165	0.8801
2007	0.6634	0.3367	0.1948	0.0240	0.6542
2008	0.6921	0.3079	0.2625	0.0388	0.6179
2009	0.7315	0.2685	0.1967	0.0170	0.6304
2010	0.7477	0.2523	0.2153	0.0333	0.5742
2011	0.7185	0.2815	0.2350	0.0274	0.5478
Average	0.7149	0.2851	0.1883	0.0235	0.6561

Source: Author's estimation from Research Data

Table I. Stylized facts on Ghanaian Banks (2004-2011)

to know the features of the process of creating value (Pedrini, 2007). Studies on firms' knowledge capabilities and value creation have thus become prominent subjects within the business management field (Delgado-Verde *et al.*, 2011). According to the resource-based theory, firms gain competitive advantage and superior performance through the acquisition, holding and subsequent use of strategic assets (Wernerfelt, 1984). The assets include both tangible physical assets as well as intangible assets/intellectual capital that have been internalized by the firm and used effectively and efficiently to implement specific competitive and profitable strategies (Riahi-Belkaoui, 2003). Hence, investments in intellectual capital as an important resource in services oriented-market like the banking industry, which drive the productive capacity of industry players.

Along these lines, empirical studies on intellectual capital have placed prominence on the effects of intellectual capital and its components/constituents on corporate performance, building on preceding studies about the cause-effect perspective among constituents of intellectual capital (Ng, 2006). From a stakeholder perspective, Pulic (2001) developed the VAIC as a measure of the efficacy with which a firm uses its intellectual capital, physical and financial capital to improve stakeholder value (Clarke *et al.*, 2011). As organizations exist because of Stakeholders, the VAIC presents an attempt to offer an appropriate measure of intellectual capital for use by stakeholders. In a reflection on the past and vision in respect of the future of intellectual capital, Edvinsson (2013) acknowledges that intellectual capital is still for many an invisible fuzzy dimension or mainly an accounting issue *vis-à-vis* what others also believed as a growing strategic ecosystem for sustainable value creation. Following previous studies, the VAIC combines the three components of intellectual capital coupled with other nominal values to extract surrogates of intellectual capital performance. The VAIC as adopted for this study has the following components; structural capital efficiency (SCE), human capital efficiency (HCE) and capital employed efficiency (CEE). These measures as used in the existing literature are geared toward the assessment of the performance of firms and more specifically efficiency of firms in the lenses of intellectual capital.

Evidence from empirical literature appear to be focussed on intellectual capital from the perspective of disclosure indices (see Ax and Marton, 2008; Guthrie *et al.*, 2009; Abeysekera, 2010; Branco *et al.*, 2011; Haji *et al.*, 2012; Wagiciengo and Belal, 2012; Asare *et al.*, 2013) and its performance and/or efficiencies using the VAIC model (see Makki *et al.*, 2008; Kamath, 2008; Abdulsalam *et al.*, 2011; Clarke *et al.*, 2011; Chu *et al.*, 2011; Maditinos *et al.*, 2011; Lu *et al.*, 2013). Few studies have empirically examined the effect of intellectual capital on firm performance. For instance, Bornemann (1999) applies the VAIC model to identify a positive relationship between intellectual capital performances of firms in Austria. Empirical evidence by Phusavat *et al.* (2011) corroborates the findings of Bornemann (1999) that intellectual capital has positive effect on the performance of manufacturing companies in Thailand. Using four proxies of firm performance in growth in revenues; returns on assets and equity and employee productivity, the authors find a positive relationship with VAIC, their proxy of intellectual capital. The findings from a study by Chu *et al.* (2011) suggest that intellectual capital, as measured by VAIC, also has positive association with performance of listed Chinese firms. The authors also employ four performance indicators in market valuation, return on assets, returns on equity and asset turnover. Specifically, CEE was identified as the significant predictor of all four performance indicators.

In respect of the banking industry, studies by Mavridis (2004), Goh (2005), Cabrita and Vaz (2006), Yalama and Coskun (2007), Saengchan (2007), Abdulsalam *et al.* (2011), Mondal and Ghosh (2012) among several others have employed the VAIC to analyze

the performance of banks focussing on intellectual capital. For example, Mavridis (2004) employs quarterly data from 2000 to 2001 to examine the intellectual capital performance of five banking groups in Japan. In the Malaysian banking industry, Goh (2005) finds evidence which suggests a dominant effect of HCE of intellectual capital to reinforce the role of staff knowledge resources on the value creation practices of banks. The human factor is the brain behind the structural capital, relational capital, physical and financial capital of every firm. Dividing Kuwaiti banks into commercial and non-commercial banks for a ten years period from 1996 to 2006, Abdulsalam *et al.* (2011) find that the non-commercial banks were outperformed by almost all the commercial banks in terms of the three value efficiency indicators, HCE, CEE.

In assessing the relationship between intellectual capital and the performance of some banks in Europe, Saengchan (2007) found intellectual capital to be a major source of corporate advantage among banks from a strong association between intellectual capital and performance of banks in Thailand. In another European study, Cabrita and Vaz (2006) established a dynamic relationship between the components of intellectual capital (structural and relational capital) and the performance of 53 banks in Portugal. Yalama and Coskun (2007) also studied the relationship between VAIC and the performance of banks in Turkey over a ten-year period from 1995 to 2004. The inconclusive evidence of Yalama and Coskun (2007) on the relationship between intellectual capital and banks profitability was inconsistent with the findings of Cabrita and Vaz (2006) and Saengchan (2007). It must however be noted, the disparities in the settings and study periods.

From the Asian context, Mondal and Ghosh (2012) used data from of 65 Indian banks in from 1999 to 2008 to examine the relationship between intellectual capital and financial performance. The authors found varying relationship between the different measures of financial performance and the components of intellectual capital. Their result indicates a significant positive relationship between intellectual capital and firm performance. Using data drawn from Bank of Thailand and the Stock Exchange of Thailand, a study by Saengchan (2007) had earlier supported the effect of intellectual capital in the performance of the banking industry. These findings suggest that, the appropriate utilization of intellectual capital creates competitive advantage for firms and is likely to differentiate one bank from the other in terms of their performance.

One key indicator of performance is productivity; which could be underpinned by intellectual capital in the context of service firms such as banks and insurance firms. Studies on bank performance in emerging markets are shifting focus from the profitability ratios to economic measures in efficiency and productivity measures. Evidence on the effect of intellectual capital on economic measures of performance appears non-existent. As far as we are aware, only Chen *et al.* (2014) have provided evidence on the empirical relationship between VAIC and productivity in an insurance market. Chen *et al.* (2014) suggests that general insurers should invest in intellectual capital, including improving their managerial skills, to gain sustainable growth in productivity.

The above review of the empirical literature highlights the relevance of intellectual capital in relation to value creation and emphasize why knowledge resources should be managed in firms within a strategic framework. With respect to this study and to the best of our knowledge, few studies have been undertaken with regards to the application of VAIC in the banking sector, especially in the context of Africa. This present study adds to the existing literature by exploring the intellectual capital of banking industry in Ghana and how it relates to the productivity of firms in the

industry. In this study, not only is the intellectual capital performance captured but how it influences productivity of banks in Ghana. Studies on the Ghanaian banking industry by authors such as Buchs and Mathisen (2008), Biekpe (2011), Isshaq and Bokpin (2012), Aboagye (2012), Ohene-Asare and Asmild (2012), Saka *et al.* (2012), and Alhassan *et al.* (2014), Alhassan (2015), and Alhassan and Biekpe (2015)[4] have not explored issues relating to either productivity or intellectual capital. This study is original in the application of the VAIC to evaluate intellectual capital in banking sector in Africa. We also provide the first empirical link on the relationship between bank productivity and intellectual capital.

4. Methodology

This section details the three-stage empirical strategy employed in testing our hypothesis. In the first stage, we describe the value added intellectual capital of Pulic (2001) while the second stage involves the description of the proxy for productivity employed. The third stage involves an outline of the regression model employed to test our hypothesized effect of intellectual capital on productivity.

4.1 Measuring intellectual capital: VAIC

The measurement of intellectual capital continues to pose a challenge to both academics and practitioners at the micro and macro levels. At the macro level, there is a limited ability of the system of public sector accounting to offer a precise representation of investments and economic growth; and at micro level, given the limited scope for recognizing intellectual capital in the financial statements (Bismuth and Tojo, 2008).

This study follows empirical literature (see Mavridis, 2004; Goh, 2005; Ting and Lean, 2009; Mondal and Ghosh, 2012; Chen *et al.*, 2014) and adopts the value added intellectual capital of Pulic (1998, 2001) to measure intellectual capital performance in the banking industry of Ghana. The VAIC method assumes that intellectual capital is vital for value creation in organizations and is made up of the sum of HCE, SCE and CEE (VAIC = HCE + SCE + CEE). The HCE describes the value added by investments in employees and related capabilities. For instance, it shows the extent to which investments in occupational health and safety; labor union relations and activities; education and training; new methods, ideas and important acts; issues on employee commitments and zealousness, etc. have resulted in improving firm performance. On the other hand, the SCE depicts the use of structural capital in adding value to firm worth. This measure shows the extent to which investments in building corporate culture, information systems/technology, intellectual property (patents, copyrights and trademarks), management processes and organizational learning capacity create value for a firm. The CEE also measures the value addition made by capital invested by shareholders. The capital outlays usually underlie the firms' capabilities as enshrined in the components of intellectual capital. The combination of the three capitals thus forms the overall intellectual capital efficiency (i.e. VAIC) of a firm. The mathematical formulae for calculating the VAIC is presented in Appendix 1. In spite of the few criticism of VAIC as a method/model for evaluating the intellectual capital efficiency of firms (e.g. Stahle *et al.*, 2011); it still remains the most profound method being used in extant studies to value intellectual capital. Joshi *et al.* (2010) alluded to the view that, at this juncture, there is no impeccable method existing for measuring intellectual capital. Also, a key argument in favor of it use is its superiority in terms of its practical validity as the model can be derived from quantitative data as enshrined in audited financial statements (Clarke *et al.*, 2011;

Zéghal and Maaloul, 2010); and as such its reliability, simplicity and comparability makes it an ideal measure (Joshi *et al.*, 2010). Hence, the query about the reliability of VAIC is sturdily linked to the context of erstwhile research; as the perceived failure of VAIC is credited, not to the inefficiency of VAIC itself, but on the disregard of intellectual capital by firms especially in emerging and developing countries and the imperfect functioning of the capital markets in these economies (Maditinos *et al.*, 2011). This present study portrays the evidence as it relates to a significant sector (i.e. banking) in Ghana, an emerging economy.

4.2 Measuring productivity: MPI

In estimating bank productivity, this study employs the Malmquist total factor productivity index. The Malmquist index estimates the changes in output arising out of input changes over different time periods. The index is made up of technological changes and efficiency changes. The technological changes also referred to as the frontier shifts reflects improvements in performance driven by new product developments and innovations while efficiency changes reflects the ability of inefficient banks to "catch-up" with best practice ones. The efficiency change is decomposed into pure efficiency change and scale efficiency under the assumptions of variable returns to scale. The values of the Malmquist index greater than 1 indicate productivity growth between period's t *and* $t+1$ while values less than 1 denote declines in productivity. To identify the sources of productivity changes, a comparison is made between the values of efficiency changes and technological changes. Higher values for technological changes compared with efficiency changes indicate that productivity changes are driven by technological changes or improvements and vice versa. The mathematical model for the estimation of productivity growth is presented in Appendix 2.

In the estimation of bank productivity, we follow the intermediation approach which assumes that banks acts as financial intermediaries. Under the approach, the inputs used by banks in the production process are made up of customer's deposits, non-current assets (fixed assets) and staff expenses to generate outputs in loans, investment income and fees and commission income. The summary statistics of both input and output variables are shown in Table II.

4.3 Empirical model

Following Lu *et al.* (2013), we estimate the regression model to test the effect of intellectual capital on bank productivity in Ghana. The model for testing the

	Mean	SD	Min	Max
Output variables				
Investment	104,728,226.71	251,290,720.03	121,927.60	2,204,136,732.00
Loans and advances	293,447,556.86	331,729,421.04	6,392,300.00	2,065,056,490.00
Fees and commission	12,943,289.56	13,665,228.66	21,000.00	61,150,098.61
Input variables				
Fixed assets	19,807,316.15	22,657,175.18	480,581.00	141,602,595.00
Deposits	456,968,358.78	606,473,391.67	13,917,700.00	4,284,732,561.00
Staff expenses	16,020,400.60	19,575,478.45	23,362.72	94,760,008.11

Source: Author's estimation from Research Data

Table II.
Input and output variables

relationship is shown in Equations (1) and (2) below:

$$MPI_{i,t}(EFFCH_{i,t}; TECHCH_{i,t}) = \beta_1 VAIC_{i,t} + \beta_2 CRL5_{i,t} + \beta_3 SIZE_{i,t} + \mu_i + \phi_{i,t} \quad (1)$$

$$MPI_{i,t}(EFFCH_{i,t}; TECHCH_{i,t}) = \gamma_1 HCE_{i,t} + \gamma_2 SCE + \gamma_3 CEE + \gamma_4 CRL5_{i,t} + \gamma_5 SIZE_{i,t} + \zeta_i + \vartheta_{i,t} \quad (2)$$

where i and t denotes bank and year, respectively. *MPI* is the Malmquist productivity index, *EFFCH* is the catch-up effect of efficiency changes; *TECHCH* is the technical changes of frontier shifts; VAIC™ is the intellectual capital efficiency; *CEE* is capital employed efficiency; *HCE* is human capital efficiency; *SCE* is structural capital efficiency; *CRL*5 is the 5 bank loan concentration ratio; *SIZE* is the natural logarithm of total assets. μ_i and ζ_i represents the firm invariant fixed effect while $\phi_{i,t}$ and $\vartheta_{i,t}$ are time-variant error term, respectively.

4.3.1 Hypotheses development. The theoretical linkages between the independent variables and productivity are discussed below.

Intellectual capital (VAIC). Intellectual capital combined with other assets play key role in enhancing firm performance. Moreover, the drivers of value creation (corporate value and growth) in modern competitive business environments thus lie more in a firm's intellectual capital rather than its physical capital (An *et al.*, 2011). Hence, intellectual capital can be seen as an important resource and strategic asset for improving performance and competitive advantage (Wernerfelt, 1984). Some studies do find significance evidence to support the change in performance of firms that is attributable to VAIC (see Cabrita and Vaz, 2006; Saengchan, 2007; Mondal and Ghosh, 2012); even though Yalama and Coskun (2007)'s findings is contrary. In this study, we expect VAIC and its constituents HCE, SCE and CEE to positively influence bank performance measured by the productivity indices. We therefore test the following hypotheses:

H1. value added intellectual capital drives greater bank productivity.

H2. HCE drives greater bank productivity.

H3. SCE drives greater bank productivity.

H4. CEE drives greater bank productivity.

Market structure. The "quiet-life" hypothesis of Hicks underlines theoretical relationship between market structure and performance. As per the theory, management of firms in concentrated markets enjoys a "quiet-life" free from competition. This induces an inefficient behavior and negatively impacts firm performance. We therefore hypothesize that:

H6. Increases in market concentration results in bank productivity declines.

Firm size. According to industrial organization literature, the size of a firm can either have a positive or negative effect on performance. A positive effect of size on performance is attributed to the economies of scale advantages enjoyed from large scale of operations. On the other hand, the operation of large scale sizes also comes with monitoring challenges and resource duplication. This could explain any negative effect

of size on performance. We follow the arguments of Biekpe (2011) on the existence of economies of scale advantages for large Ghanaian banks and hypothesize that:

H5. Increases in firm size drives greater bank productivity.

The descriptive statistics of the independent variables in the regression models are presented in Table III. We find the average CEE of 0.0525, HCE of 1.5406 and SCE of 0.5005. This implies that the value addition of banking intellectual investments is greater for human capital compared to both capital employed and structural capital. This finding is contrary to Clarke *et al.* (2011) who find CEE as the major driver of intellectual capital. Over the period, we find an average VAIC of 2.0877.

4.4 Data

The data used for this study was sourced from the Banking Supervision Department of the Bank of Ghana. It covers annual financial statements from 2003 to 2011. Specifically, inputs from the income and balance sheets statements are extracted to estimate intellectual capital and productivity variables. The period selected for the study is limited by data availability. The final sample for the study includes 18 out of the 27 banks with available data for all the nine-year study period.

5. Empirical results

The results of bank productivity (MPI) and its components of efficiency change and technical change over the period are presented in Table IV. Overall, we had a mean productivity growth of 6.97 percent. The growth was largely driven by efficiency changes of 6.72 percent compared to a decline in technical change of 0.44 percent. The efficiency

Variables	Symbols	Mean	Median	SD	Min	Max
Intellectual capital efficiency	VAIC™	2.0877	1.9381	2.3915	−3.3437	16.4499
Capital employed efficiency	CEE	0.0525	0.0325	0.0889	−0.0475	0.7503
Human Capital Efficiency	HCE	1.5406	1.4474	1.6085	−4.0028	13.6348
Structural capital efficiency	SCE	0.5005	0.3952	1.8917	−3.5736	16.5146
Concentration	CRL5	0.5327	0.5576	0.0926	0.3815	0.6594
Bank size	SIZE	19.8017	19.8632	1.1276	16.6679	22.4514

Source: Author's estimation from Research Data

Table III. Summary statistics

	MPI	EFFCH	TECHCH	PECH	SECH
2003/2004	1.0998***	0.9686***	1.1353***	0.9350***	1.0508***
2004/2005	0.6824***	1.1054***	0.5759***	1.0178***	1.0853***
2005/2006	1.1189***	1.0639***	1.0029***	1.1277***	0.9338***
2006/2007	1.0721***	1.0841***	1.0131***	1.0137***	1.0746***
2007/2008	1.2161***	1.0211***	1.1680***	0.9485***	1.0408***
2008/2009	1.2329***	1.0628***	1.1176***	0.9915***	1.0943***
2009/2010	1.0465***	1.2731***	0.8037***	1.1457***	1.1166***
2010/2011	1.0887***	0.9583***	1.1486***	1.0036***	0.9481***
2003-2011	1.0697***	1.0672***	0.9956***	1.0235***	1.0428***

Notes: MPI, Malmquist productivity index; EFFCH, efficiency change; TECHCH, technical change. ***Denotes that indices are significantly different from one at 1 percent

Table IV. Bank productivity indices

changes, reflects the ability of less efficient firms to improve their efficiency to the levels of efficient one's, has led to general improvements in the industry efficiency. The efficiency changes progress was attributable to improvements in scale efficiency change of 4.28 percent compared to a growth of 2.35 percent in pure technical efficiency change. This implies that banks in Ghana are more able to maximize their resource usage to improve their efficiency. The shifts in frontier (technical change) which results from innovative investments in technology have rather been in decline over the period. The period-to-period productivity analysis reveals that productivity improvements were experienced in seven-year intervals out of the eight-year. Averagely, banks are becoming productive due to their ability to improve their performance to levels of the most productive competitors.

In order to test whether the independent variables are not strongly correlated, we estimate the correlation coefficients among the independent variables. The results presented in Table V indicate that using all the independent variables in the regression models would not lead to any multicollinearity which may bias our model coefficients. All correlations coefficients are below the 0.70 threshold of Kennedy (2008) that indicates multicollinearity.

5.1 Intellectual capital and bank productivity

The results of the relationship between intellectual capital and productivity are presented in Tables VI and VII. In Table VI, the VAIC is regressed on the productivity

	VAIC	CEE	HCE	SCE	CRL5	SIZE
VAIC	1.000					
CEE	0.070	1.000				
HCE	0.617***	0.165*	1.000			
SCE	0.737***	−0.089	−0.076	1.000		
CRL5	−0.050	−0.124	−0.135	0.054	1.000	
SIZE	0.074	−0.223***	0.203**	−0.067	−0.251***	1

Notes: CEE, capital employed efficiency; HCE, human capital efficiency; SCE, structural capital efficiency. VAIC = intellectual efficiency; CRL5 = 5 bank loan concentration ratio; SIZE = natural logarithm of total assets. *,**,***Denotes significance at 10, 5 and 1 percent, respectively

Table V.
Correlation matrix

	MPI		EFFCH		TECHCH	
	Coef.	*z*	Coef.	*Z*	Coef.	*z*
Constant	0.989** (0.494)	2.00	0.835*** (0.102)	8.2	2.417*** (0.907)	2.67
VAIC	0.029** (0.013)	2.26	0.001 (0.006)	0.13	0.036** (0.018)	2.07
CRL5	−1.199*** (0.407)	−2.95	−0.108* (0.065)	−1.67	−2.002*** (0.495)	−4.05
SIZE	0.036* (0.021)	1.71	0.013** (0.005)	2.38	−0.012 (0.041)	−0.29
R^2	0.6833		0.8625		0.555	
Wald χ^2 (3)	14.88		13.35		22.03	
Prob > χ^2	0.0019		0.0039		0.0001	
Banks	18		18		18	
Observations	125		125		125	

Notes: MPI, Malmquist productivity index; EFFCH, efficiency change; TECHCH, technical change. VAIC = intellectual efficiency; CRL5 = 5 bank loan concentration ratio; SIZE = natural logarithm of total assets. Standard errors in parentheses are robust to serial correlation or heteroscedasticity. *,**,***Denotes significance at 10, 5 and 1 percent, respectively

Table VI.
Intellectual capital and bank productivity

	MPI		EFFCH		TECHCH	
	Coef.	z	Coef.	Z	Coef.	Z
Constant	1.601** (0.714)	2.24	0.991*** (0.137)	7.23	2.733*** (0.957)	2.85
CEE	0.584 (0.533)	1.10	0.213** (0.105)	2.03	0.754 (0.0673)	1.12
HCE	0.050* (0.027)	1.89	0.014* (0.009)	1.68	0.060** (0.030)	2.00
SCE	0.021 (0.016)	1.33	−0.003 (0.006)	−0.57	0.027 (0.020)	1.34
CRL5	−1.294*** (0.314)	−4.12	−0.109* (0.057)	−1.91	−2.103*** (0.497)	−4.23
SIZE	0.008 (0.032)	0.26	0.004 (0.007)	0.64	−0.025 (0.043)	−0.58
R^2	0.6792		0.8606		0.5641	
Wald χ^2 (5)	24.08		23.28		25.02	
Prob > χ^2	0.0002		0.0003		0.0001	
Banks	18		18		18	
Observations	125		125		125	

Notes: MPI, Malmquist productivity index; EFFCH, efficiency change; TECHCH, technical change; CEE, capital employed efficiency; HCE, human capital efficiency; SCE, structural capital efficiency. CRL5 = 5 bank loan concentration ratio. SIZE = natural logarithm of total assets. Standard errors in parentheses are robust to serial correlation or heteroscedasticity. *,**,***Denotes significance at 10, 5 and 1 percent, respectively

Table VII. Components of intellectual capital and bank productivity

growth (MPI) and its components of efficiency change and technical change. All models were estimated using the panel-corrected standard errors to correct for the non-sphericity[5] of error term. The model diagnostics indicates that the model variables significantly affect bank productivity while the R^2 points to high-explanatory power of the model coefficients.

Consistent with the findings of Bollen *et al.* (2005), and Chen *et al.* (2014), VAIC has significant positive relationship with all three proxies of bank productivity in MPI, efficiency change and technical change. However, the relationship is only significant with overall productivity and technical change at significance level of 5 percent. This indicates that intellectual capital underlines the progress in banks technical change, which reflects innovative investments in technology to enhance productivity. This reinforces the relevance of intellectual capital of banks in improving their innovative capabilities to drive productivity and invariably increase profits.

On the control variables, we find bank market concentration to have significant negative relationship with bank productivity. This indicates that increasing market concentration results in productivity declines. This supports the "Quiet-Life" hypothesis of Hicks that monopoly rents enjoyed by banks in concentrated markets are disincentive to managerial efforts to improve performance. On bank size, we find significant positive relationship with MPI and efficiency change at 10 and 5 percent, respectively. This indicates that large banks are more productive than small banks and reflects the economies of scale and scope enjoyed by large Ghanaian banks (Biekpe, 2011).

In Table VII, we examine the individual effects of the components of VAIC in CEE, HCE and SCE on the three proxies of bank productivity. We find CEE to have positive relationship with productivity growth, efficiency changes and technical changes. The relationship is however only significant with efficiency changes at 5 percent. This implies that employing higher investments in capital are very important in improving the "catch-up" effect among banks in Ghana. This results could serve to justify the initiatives of the Bank of Ghana in December 2012 to increase the minimum capital requirement of banks to GH¢60million. For HCE, a significant positive relationship is

found with productivity growth, efficiency change and technical change. This suggests that the value added effect of human capital investments improves bank productivity. For SCE, we do not find any significant impact on bank productivity. The results of the control variables are consistent with the results in Table VI.

6. Conclusion

This study examines the effect of intellectual capital on productivity in the banking industry in Ghana. Using annual bank data on 18 banks from 2003 to 2011, we estimate intellectual capital and productivity using the VAIC and MPI, respectively. We then estimate a panel regression model to examine the relationship between the intellectual capital and productivity of our sampled banks. The key findings of the study include:

- Based on the VAIC, we find that the values of banks' intellectual capital investments are mostly from investments in human capital. This is not out of place as human capital is generally seen as the resource that eventually drives all the other components of intellectual capital. In line with the resource-based theory which provides arguments for intangibles as a basis for firm competitive advantage, our results provides an indication that human capital constitutes the lifeblood of banks. Human capital with its capabilities is mostly intangible and their values have been barely quantified in monetary terms and captured in firm financial statements.
- On the results of the productivity analysis, the average productivity improvement was attributable to efficiency changes compared to technical changes. The efficiency change, which represents the ability of less efficient firms to "catch-up" with efficient ones, has led to general improvements in the industry efficiency. This reflects investments in investment planning, risk management policies and management experience of the banks. One of the objectives of the resource-based theory is to help managers to appreciate why competences can be perceived as firms' most valuable assets and at the same time to understand how those assets can be used to improve performance (Caldeira and Ward, 2001). Hence, from a resource-based view, there is an inherently high risk to a bank from failing to establish and nurture personnel to contribute to, and improve value creation to augment stakeholder relationships.
- The results of the panel-corrected ordinary least squares estimations to examine the effect of intellectual capital on bank productivity indicates that VAIC and its individual components except SCE, are positive and significantly related to variations in productivity. From a resource-based perspective, bank management have to make substantial investments in intellectual capital and efforts geared toward encouraging career progress or development among employees; additional non-financial benefits such as health insurance and salary improvement of employees must continually be pursued. General working culture; management or technical procedures and processes implemented to achieve precise results; firm and employee participation in community-based activities; overall satisfaction of customers and relations with suppliers should all gain considerable attention and capital injections from banks and the regulators. These and many other issues of intellectual capital can be recognized as the basis for superior productivity and business performance. The efforts of the central bank that increased the minimum capital requirements of all banks will

subsequently contribute to the efficiency of intellectual capital in the sector and as such ought to be commended. Many of such initiatives from the regulator are expected to help foster improved productivity to grow the banking sector. The regulator should also continue to ensure that banks operate with certain caliber of managers and employees i.e. with minimum standard qualifications, competencies and experience; and systems, before granting accreditation and license to carry out certain businesses. These initiatives should trickle down to micro-finance institutions that are springing up in the country.

6.1 Practical implications of findings

This study's multifaceted conceptualization of bank intellectual capital and productivity using the VAIC and MPI offers a more robust methodical approach to provide a comprehensive understanding of bank performance and intellectual capital in the context of an emerging market. Touching on an antecedent of performance (i.e. productivity) along with the three key intellectual capital performance constituents, namely, human, structural and financial capital efficiency in the models employed contributes to practice from different facets:

- To enhance value creation in banks, it is imperative to analyze the efficiency of intellectual capital resources. Appropriately, using intellectual capital measurement methods can enable the banks to clearly depict the value of their intellectual capital and subsequently create competitive advantage and lead to the development of the whole company.
- In maximizing bank performance, the various constituents of intellectual capital as captured in this study provides managerial guidance to managements in assessing and managing knowledge resources and firm capabilities. The relative significance of bank intellectual capital measurements observed in this study highlight ways for managerial strategies and policies in showing the right direction toward effective and appropriate resource allocation. Consequently, management of banks will have to strive to recognize, measure and manage intellectual capital. A strive toward perfect embodiment of varied kinds of intellectual capital resources as key drivers of organizational performance will results in value creation to all stakeholders of the firm. Invariably, intellectual capital in its various forms as evidenced from this study should be well integrated with financial capital to boost performance of banks. This will provide a robust system in order to measure and capture intellectual capital and the generated performance (Molnar, 2004).
- Earlier studies have mainly emphasized merely assessed intellectual capital using VAIC and its effects on performance of banks. In contrast, components of the VAIC on a specific performance variable as productivity have been overlooked in the literature. This study offers a more comprehensive set of empirical evidence to shed light on the role of intellectual capital in increasing desirable organizational productivity. The efficiency of banks is subject to the quality of intellectual capital as such current efforts by most banks must focus on improving their intellectual capital performance through substantial investments in intellectual capital and successful intellectual capital mechanisms tailored to maximize productivity. HCE achieved through progress or development among management and employees articulated by findings of this study have to underpin efforts by banks to be more

productive. SCE, evidenced in general working culture; management/technical processes implemented periodically to achieve specific results coupled with overall satisfaction of customers and all other stakeholders are becoming hall mark of successful banks. Financial capital efficiency normally enhanced by injections of funds from the shareholders and the regulators usually becomes the pivot of superior productivity and bank performance.

- Initiatives from the regulators and identification, measurement, management and disclosure of intellectual capital by banks are necessary to help speed growth and development of the banking sector in Ghana. Banks' information systems should be structured to enhance interactions among employees and stakeholders especially with customers, support management and employees' productivity and convert employees' knowledge into structural capital. The central bank can take actions toward developing banks' intellectual capital performance and in turn maximizing value creation. These initiatives should encompass the whole financial sector in the country.

6.2 Limitations and suggestions for future research

Notwithstanding its contributions, this study is subject to some latent limitations. The generalizability of this study is to some extent limited to the banking and finance sector; and essentially there will be the necessity to conduct a cross-industry study. Banks generally operate under different regulatory environment relative to non-financial firms and as such may have peculiar results. In Ghana, subsequent to the recapitalization of the banks in 2012, studies could be undertaken to assess the intellectual capital performance of the banks. Future research could also embark on a survey in order to investigate and confirm the causality and interrelationships among factors affecting intellectual capital and productivity of banks which are pivotal to bank development.

Although, there are several intellectual capital measurement methods aside the VAIC; it must be noted that calculated intellectual capital value irrespective of the method used might not be precise. Like the VAIC, most of the methods are difficult to apply as they require considerable information. Other methods tend not to be numerical as they only offer a reference of intellectual capital.

Data for this study was collected in a single country (i.e. Ghana). Potential regulatory and legislative limitations should be noted, especially the differences in regulatory regimes of various central banks among developing and developed countries that influence intellectual capital accounting practices and productivity. The subsequent framework of further studies could include samples from other countries to enhance the generalizability of our findings. Further studies especially in Africa are needed to substantiate our findings and contribute to the extant literature using other industries as a case. Finally, researchers could also explore other contextual variables such as corporate governance on mediating the effect of intellectual capital on bank productivity. Such analysis was not permitted due data unavailability.

Notes

1. Chen *et al.* (2014) is the only exception that examines the relationship between intellectual capital and productivity in the insurance market.
2. VAIC™ is a registered trademark of Pulic (2001).
3. Net interest income and fees commissions are ratios of total bank income.

4. The only exception is Alhassan and Biekpe (2015) who examined the determinants of bank productivity in Ghana. However, the linkage between intellectual capital and bank productivity was not explored by the author.
5. This indicates the presence of serial correlation or heteroscedasticity. The results are unreported but available on request. The description of the estimation technique is presented in Appendix 3.

References

Abdulsalam, F., Al-Qaheri, H. and Al-Khayyati, R. (2011), "The intellectual capital performance of Kuwaiti Banks: an application of VAIC™1 model", *iBusiness*, Vol. 3, pp. 88-96.

Abeysekera, I. (2010), "The influence of board size on intellectual capital disclosure by Kenyan listed firms", *Journal of Intellectual Capital*, Vol. 11 No. 4, pp. 504-518.

Aboagye, A.Q.Q. (2012), "Bank concentration and economic costs of deposit mobilization and credit extension in Ghana", *Journal of Development Areas*, Vol. 46 No. 2, pp. 351-370.

Alhassan, A.L. (2015), "Income diversification and bank efficiency in an emerging market", *Managerial Finance*, Vol. 41 No. 12, pp. 1318-1335.

Alhassan, A.L. and Biekpe, N. (2015), "Explaining bank productivity in Ghana", *Managerial and Decision Economics*. doi: 10.1002/mde.2748 (forthcoming).

Alhassan, A.L., Kyereboah-Coleman, A. and Andoh, C. (2014), "Asset quality in a crisis period: an empirical examination of Ghanaian Banks", *Review of Development Finance*, Vol. 4 No. 1, pp. 50-62.

Alipour, M. (2012), "The effect of intellectual capital on firm performance: an investigation of Iran insurance companies", *Measuring Business Excellence*, Vol. 16 No. 1, pp. 53-66.

An, Y., Davey, H. and Eggleton, I.R.C. (2011), "The effects of industry type, company size and performance on Chinese companies' IC disclosure: a research note", *Australasian Accounting Business and Finance Journal*, Vol. 5 No. 3, pp. 107-116.

Asare, N., Onumah, J.M. and Simpson, S.N.Y. (2013), "Exploring the disclosure of intellectual capital in Ghana: evidence from listed companies", *Journal of Accounting and Marketing*, Vol. 2 No. 3, pp. 1-7. doi: 10.4172/2168-9601.1000107.

Ax, C. and Marton, J. (2008), "Human capital disclosures and management practices", *Journal of Intellectual Capital*, Vol. 9 No. 3, pp. 433-455.

Beck, N. and Katz, J.N. (1995), "What to do (and not to do) with times-series cross-section data in comparative politics", *American Political Science Review*, Vol. 89 No. 3, pp. 634-647.

Benston, G.J. and Smith, C.W. Jr (1976), "A transactions cost approach to the theory of financial intermediation", *Journal of Finance*, Vol. 31 No. 2, pp. 215-231.

Berger, A.N., Molyneux, P. and Wilson, J.O.S. (2010), "Banking: an overview", in Berger, A., Molyneux, P. and Wilson, J. (Eds), *The Oxford Handbook of Banking*, Oxford University Press, Oxford, pp. 1-36.

Biekpe, N. (2011), "The competitiveness of commercial banks in Ghana", *African Development Review*, Vol. 23 No. 1, pp. 75-87.

Bismuth, A. and Tojo, Y. (2008), "Creating value from intellectual assets", *Journal of Intellectual Capital*, Vol. 9 No. 2, pp. 228-245.

Bollen, L., Vergauwen, P. and Schnieders, S. (2005), "Linking intellectual capital and intellectual property to company performance", *Management Decision*, Vol. 43 No. 9, pp. 1161-1185.

Bornemann, M. (1999), "Empirical analysis of the intellectual potential of value systems in Austria according to the VAIC method", available at: www.measuringip.at/Opapers/Bornemann/Empirical/EmpiricalAnalysisAustria (accessed August 21, 2014).

Branco, M.C., Delgado, C., Sousa, C. and Sa, M. (2011), "Intellectual capital disclosure media in Portugal", *Corporate Communications: An International Journal*, Vol. 16 No. 1, pp. 38-52.

Buchs, T. and Mathisen, J. (2008), "Bank competition and efficiency in Ghana", in Aryeetey, E. and Kanbur, R. (Eds), *The Economy of Ghana: Analytical Perspectives on Stability, Growth and Poverty*, James Currey, London, pp. 173-194.

Cabrita, M. and Vaz, I. (2006), "Intellectual capital and value creation: evidence from the Portuguese banking industry", *Journal of Knowledge Management*, Vol. 4 No. 1, pp. 11-20.

Caldeira, M.M. and Ward, J.M. (2001), "Using resource-based theory to interpret the successful adoption and use of information systems and technology in manufacturing small and medium sized enterprises", *The 9th European Conference on Information Systems, Bled, June 27-29*.

Chen, F.-C., Liu, Z.-J. and Kweh, Q.L. (2014), "Intellectual capital and productivity of Malaysian general insurers", *Economic Modelling*, Vol. 36, pp. 413-420.

Chu, S.K.W., Chan, K.H. and Wu, W.W.Y. (2011), "Charting intellectual capital performance of the gateway to China", *Journal of Intellectual Capital*, Vol. 12 No. 2, pp. 249-276.

Clarke, M., Seng, D. and Whiting, R.H. (2011), "Intellectual capital and firm performance in Australia", *Journal of Intellectual Capital*, Vol. 12 No. 4, pp. 505-530.

Delgado-Verde, M., Castro, G.M. and Navas-Lopez, J.E. (2011), "Organizational knowledge assets and innovation capability: evidence from Spanish manufacturing firms", *Journal of Intellectual Capital*, Vol. 12 No. 1, pp. 5-19.

Diamond, D.W. (1984), "Financial intermediation and delegated monitoring", *Review of Economic Studies*, Vol. 51 No. 3, pp. 393-414.

Edvinsson, L. (2013), "IC 21: reflections from 21 years of IC practice and theory", *Journal of Intellectual Capital*, Vol. 14 No. 1, pp. 163-172.

Fare, R., Grosskopf, S., Norris, M. and Zhang, Z. (1994), "Productivity growth, technical progress, and efficiency changes in industrialized countries", *American Economics Review*, Vol. 84 No. 1, pp. 66-83.

Firer, S. and Williams, S.M. (2003), "Intellectual capital and traditional measures of corporate performance", *Journal of Intellectual Capital*, Vol. 4 No. 3, pp. 348-360.

Goh, P.C. (2005), "Intellectual capital performance of commercial banks in Malaysia", *Journal of Intellectual Capital*, Vol. 6 No. 3, pp. 385-396.

Goh, P.C. and Lim, K.P. (2004), "Disclosing intellectual capital in company annual reports: evidence from Malaysia", *Journal of Intellectual Capital*, Vol. 5 No. 3, pp. 500-510.

Guthrie, J., Steane, P. and Farneti, F. (2009), "IC reporting in the Australian Red Cross blood service", *Journal of Intellectual Capital*, Vol. 10 No. 4, pp. 504-519.

Haji, A.A., Gombak, J. and Mubaraq, S. (2012), "The trends of intellectual capital disclosures: evidence from the Nigerian banking sector", *Journal of Human Resource Costing & Accounting*, Vol. 16 No. 3, pp. 184-209.

Hinson, R. (2004), "The importance of service quality in Ghana's banking sector", *The Marketing Challenge*, Vol. 7 No. 3, pp. 16-18.

Hinson, R., Amidu, M. and Mensah, R. (2006), "Determinants of Ghanaian bank service quality in a universal banking dispensation", *Banks and Bank Systems*, Vol. 1 No. 2, pp. 69-81.

Isshaq, Z. and Bokpin, G.A. (2012), "Expansion and efficiency in banking: evidence from Ghana", *Managerial and Decision Economics*, Vol. 33 No. 1, pp. 19-28.

Joshi, M., Cahill, D. and Sidhu, J. (2010), "Intellectual capital performance in the banking sector: an assessment of Australian owned banks", *Journal Human Resource Costing Accounting*, Vol. 14 No. 2, pp. 151-170.

Kamath, G.B. (2008), "Intellectual capital and corporate performance in Indian pharmaceutical industry", *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 684-704.

Kennedy, P. (2008), *A Guide to Econometrics*, 6th ed.., Blackwell Publishing, Oxford.

Khani, A.H.A., Ahmadi, F. and Homayouni, G. (2010), "The impact of intellectual capital on performance of Iranian food firms", *Interdisciplinary Journal of Contemporary Research*, Vol. 2 No. 10, pp. 315-326.

Lu, W., Wang, W. and Kweh, Q. (2013), "Intellectual capital and performance in the Chinese life insurance industry", *Omega*, Vol. 42 No. 1, pp. 65-74.

MacKinnon, J.G. and White, H. (1985), "Some heteroskedasticity-consistent covariance matrix estimators with improved finite sample properties", *Journal of Econometrics*, Vol. 29 No. 3, pp. 305-325.

Maditinos, D., Chatzoudes, D. and Tsairidis, C. (2011), "The impact of intellectual capital on firms' market value and financial performance", *Journal of Intellectual Capital*, Vol. 12 No. 1, pp. 132-151.

Makki, M.A.M., Lodhi, S.A. and Rahman, R. (2008), "Intellectual capital performance of Pakistani listed corporate sector", *International Journal of Business and Management*, Vol. 3 No. 10, pp. 45-51.

Mavridis, D.G. (2004), "The intellectual capital performance of the Japanese banking sector", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 92-115.

Mention, A. and Bontis, N. (2013), "Intellectual capital and performance within the banking sector of Luxembourg and Belgium", *Journal of Intellectual Capital*, Vol. 14 No. 2, pp. 286-309.

Molnar, M.J. (2004), "Executive views on intangible assets: insights from the accenture economist intelligence unit survey", Accenture Research Note Intangible Assets and Future Value, No. 1, April.

Mondal, A. and Ghosh, S.K. (2012), "Intellectual capital and financial performance of Indian banks", *Journal of Intellectual Capital*, Vol. 13 No. 4, pp. 515-530.

Ng, A.W. (2006), "Reporting intellectual capital flow in technology-based companies case studies of Canadian wireless technology companies", *Journal of Intellectual Capital*, Vol. 7 No. 4, pp. 492-510.

Ohene-Asare, K. and Asmild, M. (2012), "Banking efficiency analysis under corporate social responsibilities", *International Journal of Banking, Accounting and Finance*, Vol. 4 No. 2, pp. 146 -171.

Pedrini, M. (2007), "Human capital convergences in intellectual capital and sustainability reports", *Journal of Intellectual Capital*, Vol. 8 No. 2, pp. 346-366.

Phusavat, K., Comepa, N., Sitko-Lutek, A. and Ooi, K. (2011), "Interrelationships between intellectual capital and performance, empirical examination", *Industrial Management & Data Systems*, Vol. 111 No. 6, pp. 810-829.

Pulic, A. (1998), "Measuring the performance of intellectual potential in knowledge economy", available at: www.vaic-on.net/download/Papers/Measuring%20the%20Performance%20of%20Intellectual%20Potential.pdf (accessed July 2, 2014).

Pulic, A. (2000), "VAIC an accounting tool for IC management", *International Journal of Technology Management*, Vol. 20 Nos 5-8, pp. 702-714.

Pulic, A. (2001), "Value creation efficiency analysis of Croatian Banks", 1996-2000, available at: www.vaic-on.net/start.htm (accessed July 2, 2014).

Ray, S.C. and Desli, E. (1997), "Productivity growth, technical progress, and efficiency change in industrialized countries: comment", *American Economic Review*, Vol. 87 No. 5, pp. 1033-1039.

Riahi-Belkaoui, A. (2003), "Intellectual capital and firm performance of US multinational firms; a study of the resource-based and stakeholder views", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 215-226.

Saengchan, S. (2007), "The role of intellectual capital in creating value in banking industry", *Journal of Knowledge Management*, Vol. 3 No. 2, pp. 15-25.

Saka, A.N.A., Aboagye, A.Q.Q. and Gemegah, A. (2012), "Technical efficiency of the Ghanaian banking industry and the effects of the entry of foreign banks", *Journal of African Business*, Vol. 13 No. 3, pp. 232-243.

Stahle, P., Stahle, S. and Aho, S. (2011), "Value added intellectual coefficient (VAIC): a critical analysis", *Journal of Intellectual Capital*, Vol. 12 No. 4, pp. 531-551.

Stewart, T.A. (1997), *Intellectual Capital: The New Wealth of Organizations*, Doubleday Dell Publishing Group, Inc, New York, NY.

Ting, I.W.K. and Lean, H.H. (2009), "Intellectual capital performance of financial institutions in Malaysia", *Journal of Intellectual Capital*, Vol. 10 No. 4, pp. 588-599.

Wagiciengo, M.M. and Belal, A.R. (2012), "Intellectual capital disclosures by South African companies: a longitudinal investigation", *Advances in Accounting, Incorporating Advances in International Accounting*, Vol. 28 No. 1, pp. 111-119.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5 No. 2, pp. 171-180.

White, H. (1980), "A heteroskedasticity-consistent covariance matrix and a direct test for heteroskedasticity", *Econometrica*, Vol. 48 No. 4, pp. 817-838.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, MA.

Yalama, A. and Coskun, M. (2007), "Intellectual capital performance of quoted banks on the Istanbul stock exchange market", *Journal of Intellectual Capital*, Vol. 8 No. 2, pp. 256-271.

Zéghal, D. and Maaloul, A. (2010), "Analyzing value added as an indicator of intellectual capital and its consequences on company performance", *Journal of Intellectual Capital*, Vol. 11 No. 1, pp. 39-60.

Further reading

Banker, R.D. and Natarajan, R. (2008), "Evaluating contextual variables affecting productivity using data envelopment analysis", *Operations Research*, Vol. 56 No. 1, pp. 48-58.

Bhasin, M.L. (2011), "Intellectual capital disclosure scenario in India: an empirical study of IT corporations", *Review of Economics and Finance*, pp. 58-68.

Bose, S. and Thomas, K. (2007), "Applying the balanced scorecard for better performance of intellectual capital", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 653-654.

Buchs, T. and Mathisen, J. (2005), "Competition and efficiency in banking: behavioral evidence from Ghana", Working Paper WP=05=17, IMF, Washington, DC.

Bukh, N.P. and Johanson, U. (2003), "Research and knowledge interaction; guidelines for intellectual capital reporting", *Journal of Intellectual Capital*, Vol. 4 No. 4, pp. 576-587.

Dumay, J.C. (2009), "Intellectual capital measurement: a critical approach", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 190-210.

Hervas-Oliver, J., Rojas, R., Martins, B. and Cervelló-Royo, R. (2011), "The overlapping of national IC and innovation systems", *Journal of Intellectual Capital*, Vol. 12 No. 1, pp. 111-131.

Kweh, Q.L., Chan, Y.C. and Ting, I.W.K. (2013), "Measuring intellectual capital efficiency in the Malaysian software sector", *Journal of Intellectual Capital*, Vol. 14 No. 2, pp. 310-324.

Levine, R. (1998), "The legal environment, banks, and long run economic growth", *Journal of Money, Credit and Banking*, Vol. 30 No. 3, pp. 596-613.

Lynn, B. (1998), "Intellectual capital", *CMA Magazine*, February, pp. 10-15.

Price Water house Coopers (2008), "Raising the bar: increase in the minimum capital requirements, and implications for the Industry", Ghana Banking Survey, Accra, available at: www.pwc.com/gh (accessed January 2, 2015).

Price Water house Coopers (2013), "Harnessing the SME potential", Ghana Banking Survey, Accra, available at: www.pwc.com/gh (accessed January 2, 2015).

Pulic, A. (2004), "Intellectual capital: does it create or destroy value? Measuring intangible assets – the state of the art", *Journal of Business Performance*, Vol. 8 No. 3, pp. 62-68.

Rajan, R.G. and Zingales, L. (1998), "Financial dependence and growth", *American Economic Review*, Vol. 88 No. 3, pp. 559-586.

Roslender, R. and Fincham, R. (2004), "Intellectual capital accounting in the UK; a field study perspective", *Accounting, Auditing and Accountability Journal*, Vol. 17 No. 2, pp. 178-209.

Tan, H.P., Plowman, D. and Hancock, P. (2008), "The evolving research on intellectual capital", *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 585-608.

Vafaei, A., Taylor, D. and Ahmed, K. (2011), "The value relevance of intellectual capital disclosures", *Journal of Intellectual Capital*, Vol. 12 No. 3, pp. 407-429.

Zahn, J.-L.W.M., Singh, I. and Heniro, J. (2007), "IC disclosure is there an association between intellectual capital disclosure, under-pricing and long-run performance?", *Journal of Human Resource Costing & Accounting*, Vol. 11 No. 3, pp. 178-213.

Appendix 1. Value added intellectual coefficient (VAIC)

The VAIC model measures intellectual capital as the value addition of the variance between outputs and inputs of a firm. The value addition, *VA* of a firm is given by:

$$VA = OUT - IN \tag{1}$$

where *OUT* is the total bank revenue made up of interest income and fees and commission income and *IN* refers to bank operational cost made up of interest, finance and administration expenses (excluding personnel expenses, which are treated as investments but not cost).

VAIC calculates the efficiency of human, structural and financial capital. The equation for computing human capital efficiency (*HCE*) is given by:

$$HCE = \frac{VA}{HC} \tag{2}$$

where *VA* is value added defined in Equation (1) and *HC* is the total compensation (salaries and wages) for a bank.

The equation for bank structural capital (*SC*) is computed as follows:

$$SC = VA - HC \tag{3}$$

VA and *HC* are as defined in Equations (1) and (2). The equation for structural capital efficiency (*SCE*) is given in the following equation:

$$SCE = \frac{SC}{VA} \tag{4}$$

The equation for efficiency of the financial capital employed is defined as:

$$CEE = \frac{VA}{CE} \tag{5}$$

where *CEE* refers to the capital employed efficiency coefficient and *CE* is the book value of the net assets of the firm.

Generally, the value creation efficiency is simply the sum of all value creation efficiency indicators as given in the following equation:

$$\text{VAIC}^{\text{TM}} = HCE + SCE + CEE \tag{6}$$

Appendix 2. Malmquist productivity index (MPI)

The MPI was developed by Fare *et al.* (1994) as an indicator of productivity change between base technology period and the reference technology period under the assumption of constant returns to scale. This is mathematically denoted in the following equation:

$$MPI = \left(\frac{d^{t+1}(x^{t+1}, y^{t+1})}{d^{t}(x^{t}, y^{t})}\right)\left[\frac{d^{t}(x^{t+1}, y^{t+1})}{d^{t+1}(x^{t+1}, y^{t+1})} \times \frac{d^{t}(x^{t}, y^{t})}{d^{t+1}(x^{t}, y^{t})}\right]^{0.5} \tag{7}$$

where x^t and y^t, respectively represents the input and output vectors while $d^t(x^t, y^t)$ describes the distance from time t to $t+1$. The expression in parenthesis captures the "catch-up" effect arising from imitation of most productive firms by less productive ones. It is referred to as efficiency change (*EFFCH*) while the expression in the squared brackets measures productivity improvements arising from shifts of the technology frontier (*TECHCH*). Equation (7) is thus broken down into Equations (8) and (9) for *EFFCH* and *TECHCH*, respectively:

$$EFFCH = \left(\frac{d^{t+1}(x^{t+1}, y^{t+1})}{d^{t}(x^{t}, y^{t})}\right) \tag{8}$$

$$TECHCH = \left(\frac{d^{t}(x^{t+1}, y^{t+1})}{d^{t+1}(x^{t+1}, y^{t+1})} \times \frac{d^{t}(x^{t}, y^{t})}{d^{t+1}(x^{t}, y^{t})}\right)^{0.5} \tag{9}$$

The *EFFCH* is further decomposed into pure technical efficiency change (*PECH*) and scale efficiency change (*SECH*) (Ray and Desli, 1997). The relationship is mathematically represented in the following equation given below:

$$EFFCH = PECH \times SECH \tag{10}$$

Appendix 3. Model Estimation

In the estimation of the panel regression models, we employ ordinary least squares panel-corrected standard errors (OLS-PCSE) technique of Beck and Katz (1995). While the estimation of panel data models has generally favoured the fixed and random effects techniques, Beck and Katz (1995) propose an estimation of the covariance matrix that corrects for the presence either of serial correlation or heteroscedasticity. This represents an improvement on heteroscedasticity consistent estimators of White (1980) and MacKinnon and White (1985) which do not consider the structure of panel data models. The presence of serial correlation and heteroscedasticity are examined by the Wooldridge (2002) test of no first order autocorrelation and Breusch-Pagan/Cook-Weisberg Lagrange multiplier test for heteroscedasticity, respectively.

About the authors

Abdul Latif Alhassan is a PhD Candidate at the Graduate School of Business, University of Cape Town, Cape Town, South Africa. His research focusses on the industrial organization of financial services industry. He has published articles in the *Review of Development Finance*, *Geneva Papers on Risk and Insurance–Issues and Practice*, *Research in International Business and*

Finance, *Managerial and Decision Economics*; *Managerial Finance*, *Economic Change and Restructuring*, *International Journal of Emerging Markets* and has forthcoming articles in the *International Journal of Social Economics* and *African Journal of Economics and Management Studies*. He undertakes ad-hoc refereeing for *Review of Development Finance*, *African Development Review*, *Applied Economics*, *Research in International Business and Finance*, *The Journal of International Trade and Economic Development*, *Managerial and Decision Economics*, *African Finance Journal*, the *Journal of Risk Finance*, *Journal of African Business*, *Journal of International Trade Law and Policy*, *Knowledge Management Research and Practice*, *International Journal of Emerging Markets* and *Measuring Business Excellence*. Abdul Latif Alhassan is the corresponding author and can be contacted at: lateef85@yahoo.com

Nicholas Asare is a Qualified Accountant and Lecturer in Accounting at the Methodist University College and PhD Candidate at the University of Ghana Business School. He has extensive experience in teaching accounting at the undergraduate and graduate levels at the Methodist University College Ghana and the University of Ghana Business School. His research interests include management accounting, corporate financial reporting with specific interest in intellectual capital and sustainability accounting and has published in the *Journal of Accounting and Marketing*, *Research Journal of Finance and Accounting*.