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The impact of the Intellectual Capital Efficiency on Commercial Banks Performance: Evidence from the US

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Highlights

- Intellectual Capital efficiency positively affects banks' financial performance
- Human capital efficiency has a larger impact on banks' financial performance

- Intellectual Capital efficiency helps to achieve managers and policymakers' goals

Abstract.

Using a large sample of 5,749 commercial banks, covering over 40,000 observations over the time window 2005-2012, we find that efficiency in the use of Intellectual Capital (IC) positively affects the financial performance of US banks. In addition, the results show that the human capital (HC) efficiency, a subcomponent of IC efficiency, is found to have a larger impact on financial performance than other IC sub-components. These findings suggest that the development of effective techniques of knowledge management, enabling banks to accumulate the IC necessary to adapt to a constantly changing environment, represents an effective tool of achieving the goals of both bank managers and policymakers.

Keywords – Banks Performance, Intellectual Capital, Human Capital, VAIC^{TM}

> *"Intangibles (intellectual capital) resources are now largely recognized as the most important sources of an organizations' competitive advantage. At the corporate level, intangible investments [...] are now unanimously considered as the most important determinants of performance." World Bank conference, Paris, France, May 28-29, 2009.*

1. Introduction

Intellectual Capital (IC) plays an important role in an organisation's performance. It represents distinctive characteristics that, *ceteris paribus*, can determinate the success or failure of an organisation relative to its peers (see, among others, Pulic, 1998; de Pablos, 2003; El-Bannany, 2008).

Thus, it is not surprising that over the last decades, many researchers from different disciplines (particularly, management, accounting and finance) have devoted substantial attention to IC, examining it from different viewpoints and for various research purposes. While several studies (e.g., Stewart, 1998; Roos *et al.*, 1997; Bontis, 1998; Wu and Tsai, 2005) have defined IC from a theoretical perspective, others have developed effective measures of IC-based performance (Stewart, 1998; Pulic, 2000), exploring the relationship between IC efficiency and some key characteristics of firms, industries and regions (El-Bannany; 2008; Liang *et al.*, 2011; Al-Musalli and Ku Ismail, 2012). Finally, a third strand of literature (which includes Chen *et al.*, 2005; Firer and Williams, 2003; Chen *et al.*, 2014; Curado *et al.,*2014; Janošević *et al.,* 2014 among others) has empirically investigated the relationship between firm IC efficiency and financial performance.

However, although many studies of firm IC exist, empirical evidence regarding the contribution of IC efficiency to firms' financial performance remains confined to certain sectors and geographical areas (Mention and Bontis, 2013). In particular, there appear to be no studies related to bank IC from the US, despite the fact that the US banking system is of notable interest for its size and the role it plays in global economic growth. Indeed, according to OECD data, total assets managed by US banks were $12,610 billion in 2011, a very high value, especially compared with values recorded in the same year by other countries with bank-oriented financial systems, for example, Germany ($11,625 billion) and Japan ($11,651 billion).

The present paper aims to fill this gap, mainly by analysing a unique and distinctive dataset of 5,749 US banks, covering over 40,000 observations over the time window 2005-2012. The dataset, drawn from the Bankscope Bureau Van Dijk database, is designed to respond to the following research question: does IC efficiency positively affect a bank's financial performance?

We are aware that replying this question is of special interest because the banking industry is one of the most knowledge-intensive industries (Firer and Williams, 2003; Mavridis, 2005) and represents an ideal setting for research on IC. Various studies (e.g., Boot 2000; Degryse and Ongena, 2002; Fiordelisi *et al.,* 2013; Sampagnaro *et al.,* 2015) point out that banks can gain valuable competitive advantages by building tight relationships with their customers and making valuable investments in the soft information production. Other studies (among others, Goh, 2005; Kamath, 2007) observe that an efficient utilization of IC is more crucial for achieving success in banking than other industries, because the ability of a bank to provide customers with high quality products and services depends on its investments in items related to IC such as its human resources, brand building, systems and processes. Therefore, it becomes necessary for banks to manage their IC as efficiently as possible.

We provide evidence that the level of IC efficiency positively affects the financial performance of US commercial banks. This result has multiple positive effects for various agents. First, it helps banks to achieve the target of profitability that managers and shareholders expect. Second, it permits the policymaker to accomplish the financial stability goal. This because the banks can achieve a given target of profitability simply by improving IC efficiency that, in turn, would allow to stay away, at least partially, to investing in assets that are particularly risky and for which should be related a good return. Stated differently, banks, that engage to improving IC efficiency, can reach their profit target without further increasing the riskiness of their assets. Consequently, it is not surprising whether a number of bank regulations expressly impose specific training for bank employees, including a) Expedited Funds Availability Act; b) Bank Protection Act; c) Anti-money laundering (AML) and Customer Identification Program (CIP); d) Information Security Standards and, e) Red Flag ID Theft Rules. Given this picture, it is sharable that IC efficiency allows to meeting multiple interests (bank profitability vs. financial stability) of multiple agents (managers,

shareholders vs. policymaker) that are not easy to reach in a so challenging landscape such as banking sector.

In addition, this is also particularly important because in recent decades, due to financial liberalisation and internationalisation, competition in the banking sector has grown exponentially, and with this development, pressure on bank performance has increased. While in the recent past, banks sought to improve their profitability mainly by increasing the riskiness of their investments, as a result of the financial crisis and the more stringent rules of Basel 3, they now seek solutions that will improve performance without compromising their financial soundness. The results of this paper suggest that banks should not only consider how they select and mix financial assets but also develop specific aptitudes with respect to IC management to establish sustainable operations and increase profitability. Therefore, we can conclude that for the banking industry, it has become crucial to develop effective techniques of knowledge management to accumulate and manage the IC necessary to address an ever-changing environment.

In an effort to shed additional light on the relation between banks' IC and their financial performance we decompose the IC efficiency.

We find that the efficiency in the use of human capital (HC) has a larger impact on financial performance than other components of IC efficiency (i.e. structural capital). This finding, which is consistent with results reported by several studies (among others, El-Bannany, 2008), can be explained by considering that HC management is crucial for banks and other financial service firms. In this sense, it is worth noting that the management of customer relations and the management of financial risk are two key challenges that banks encounter. However, the effective management of both financial risks and costumer relations by banks may not be possible without employees who possess expertise, obtained both through academic and on-the-job training (Armenta, 2007), in these areas.

Our paper also contributes to the existing literature on the determinants of banks' profitability (e.g., DeYoung and Rice, 2004; Bonin *et al.,* 2005; Valverde and Fernández, 2007; Albertazzi and Gambacorta, 2010). Previous papers show that the profitability of a bank depends on both exogenous factors, such as macroeconomic conditions, bank taxation, deposit insurance regulation and banking market structure (among others, Demirgüç-Kunt and Huizinga, 1999; Albertazzi and Gambacorta, 2010; Mirzaei *et al*., 2013) and bank characteristics: size, capital ratio, business models and corporate governance structure (among others, Aebi *et al.,* 2012; Berger and Bouwman, 2013; Lee and Hsieh, 2013; Mergaerts and Vander Vennet, 2016). We extend this literature by documenting that an effective way that banks have, to sustaining their profitability, is to increase their IC efficiency.

The remainder of this paper is organised as follows. Section 2 presents the theoretical background of the study, and section 3 explains how IC efficiency is measured. Section 4 reviews prior literature and discusses the research hypotheses. Section 5 describes the empirical strategy employed. Section 6 presents the empirical results, and a final section concludes.

2. Theoretical background: definition of IC

Over the last two decades, many definitions of IC have been proposed. Here, we examine some of the definitions most widely accepted in the literature. The seminal paper on IC is Itami (1987), who defines IC as intangible assets, such as technology, brand name, royalties, reputation and so on, that are crucial to a firm's competitive power. Consistent with this view, Mavridis (2005) states that IC is *"an intangible asset with the potential to create value for the enterprise and the society itself"*; similarly, Martinez and Garcia-Meca (2005) argue that IC is *"the knowledge, information, intellectual property and experience that can be put to use to create wealth"*. For Brennan (2001), *"IC encompasses intangibles such as patents, intellectual property rights, copyrights and franchises"*. Pulic (2001), by contrast,

favours the notion that IC consists of employees, their organisation and their capability to create added value. In other words, IC is an intangible asset composed of both the knowledge and know-how that characterise an organisation and give it a competitive advantage over other firms. While many definitions of IC have been proposed over the years, there appears to be a consensus regarding its components. According to the literature, IC consists of three main variables: Human Capital, Relational Capital and Structural Capital (see Petty and Guthrie, 2000 and Kujansivu, 2005, among others).

2.1 Human capital (HC)

It is widely recognised in the literature that HC is composed of knowledge possessed by an organisation — knowledge that also is represented by the organisation's employees (see, among other, Bontis *et al.,* 2002). According to some scholars (e.g., Roos *et al.,* 1997; Hudson, 1993), employees create IC through their competence, capabilities and intellectual agility. While competence is primarily shaped by education and capabilities develop mainly through the behaviour of employees, intellectual agility relates to the ability to solve problems with innovative solutions. Another definition of human capital comes from Sveiby (1997), according to whom HC can be defined as *"the capacity to act in a wide variety of situations to create both tangible and intangible assets"*.

2.2 Relational Capital (RC)

RC can be defined as the complex of relationships that any organisation has with the external world, where the external world consists of customers, banks, shareholders and any other agents that may influence the organisation's well-being. Generally, it is important for an organisation to expand its relationships with stakeholders to generate access to new resources; thus, it is important to maintain its relational capital over time. Indeed, one method of measuring relational capital is based on its longevity (Bontis *et. al,* 2002) and on strong and

lasting relationships with stakeholders, as these positively affect an organisation's competitive advantage (Håkansson and Snehota, 1995).

2.3 Structural Capital (SC)

SC is defined as the complex of goods and knowledge of an organisation, including its procedures, databases, routines, hardware and organisational culture. According to Roos *et al.* (1997), structural capital can be defined as *"what remains in the company when employees go home for the night"*. Consistent with these views, examples of structural capital include copyrights, technologies, patents and so on. Bontis (1998) argues that an organisation with strong structural capital will have a supportive culture that allows individuals to try ideas, fail, learn, and try again. If the culture unduly penalises failure, the organisation's success will be minimal.

3. Measurement of IC-based performance

IC is the sum of a firm's hidden resources which cannot be entirely captured on the traditional accounting reports because they are difficult to evaluate. As a consequence, measuring IC value and IC-based firms' performances represents a challenge faced by scholars and practitioners for a long time. Specifically, as highlighted by Clarke *et al.* (2011), several complications arise with most IC measures: (i) the required information is not available to firm outsider; (ii) the information is habitually qualitative and based on judgements; and (iii) it is hard to translate the information into monetary values.

One easily obtainable measure for IC efficiency that does not suffer from these issues as it uses only publicly available, quantitative, and audited information (Chan, 2009a) is the value added intellectual coefficient (VAIC^{TM}), developed by Pulic (1998; 2004). Taking a stakeholder perspective, VAIC^{TM} can be considered as a measure of the efficiency with which a firm uses its physical, financial and intellectual capital to enhance stakeholders' value (e.g.,

Clarke *et al*., 2011; Iazzolino and Laise, 2013). Stated differently, this method tries to capture the contribution of human, structural, physical and financial resources to create value added for an organization. The VAIC^{TM} methodology has been used in studies that analyse the impact of IC efficiency on both bank and non-bank industry performance (Bornemann, 1999; Cabrita and Vaz, 2005; Chen *et al.,* 2005).

For its computation, the VAIC^{TM} model follows a number of phases by using balance sheets and income statements. The first phase aims to evaluate the organization's ability in creating value added (VA). As such, it concludes by calculating the VA as difference between output and input:

$$VA_{i,t} = OUT_{i,t} - IN_{i,t} \quad (1)$$

Where, the output (OUT) is the total revenue generated by the services provided by bank to the clients; and the input (IN) includes all the expenses incurred during the production by the bank, without consider the employee costs that are treated as investment in the present model. Stated differently, the VA is calculated as sum between Profit before tax and payroll expenses, where Profit before tax is the result of the following summation: Net Interest Revenue + Net Gains (Losses) on Trading and Derivatives + Net Gains (Losses) on Assets at fair value through Income Statement + Net Fees and Commissions + Remaining Operating Income – Overheads(including overall payroll) – Loan Loss Provisions. In addition, *i* denotes a bank (i = 1, 2, …, 5,749), and *t* the time window 2005-2012. The meaning of these subscripts remains unchanged for the other phases described below.

The second phase aims to evaluate the relationship between the VA and HC, as defined in section 2.1. Specifically, it estimates the human capital efficiency (HCE) by showing the marginal contribution per each unit of employee expenses to the value added. The key aspect that leaves this statement makes sense is the fact that in the Pulic's (2004) model the employees expenses are processed as an investment rather than as simply cost of production.

HCE, that simply captures the ability – efficiency – of HC to generate VA, is computed as follows:

$$HCE_{i,t} = \frac{VA_{i,t}}{HC_{i,t}} \quad (2)$$

Where VA is the value added, as computed in the first phase, and HC is the human capital expenses based on bank's overall payroll.

The third phase aims to evaluate the relation between the VA and SC, as defined in section 2.3. Specifically, this phase estimates the structural capital efficiency (SCE) and measures its contribution to the value added. SC is calculated by subtracting HC from VA. Hence, as is easily untestable from the equation below, there is a reverse relation between HC and SCE. This means that a higher value of HC, the smaller value of SCE. Formally, SCE is computed as follows:

$$SCE_{i,t} = \frac{SC_{i,t}(=VA_{i,t}-HC_{i,t})}{VA_{i,t}} \quad (3)$$

Table 1 reports the relation between HC, HCE and SCE. Specifically, the first column on the left reports the reference values of HC and the second and third columns report its effect on HCE and SCE, respectively. The main aspect that rises by observing the table is that as HC decreases, in relation to VA, HCE and SCE increase. In other words, this means that for a given value of VA, the smaller is HC the much larger is the efficiency both human capital and structure capital.

The fourth phase aims to evaluate the efficiency of intellectual capital (ICE) simultaneously generated both by human capital (HCE) and structural capital (SCE) that, as will be discussed in the next paragraph, are the only two components of IC efficiency that the VAIC^{TM} model is able to capture. The ICE is simply obtained by summing HCE and SCE.

$$ICE_{i,t} = HCE_{i,t} + SCE_{i,t} \quad (4)$$

The fifth phase aims to evaluate the relation between VA and physical and financial capital (CA). This latter is the book value of a bank's net assets (i.e. the difference between

the total assets and intangible assets). The idea behind this consideration is that the IC cannot generate value added without the instruments: physical and financial capital. For this scope, the VAIC^{TM} model proposes to take into account also the relation between VA and CA. This relation is measured by the capital employed efficiency (CEE) that indicates the marginal contribution per each unit of physical and financial capital to the value added. Stated differently, the CEE reveals the ability – efficiency – of physical and financial capital to generate value added for an organization. Formally, the CEE is defined as follows:

$$CEE_{i,t} = \frac{VA_{i,t}}{CA_{i,t}} \quad (5)$$

Finally, the sixth phase concludes by estimating the VAIC^{TM}. It aims to evaluate the combined contribution that comes from each resource to generating value added. In line with this, VAIC^{TM} is the result by summing ICE and CEE. A higher VAIC^{TM} value indicates a higher capability in value creating by organization's resources (human, structural, physical and financial capital). Formally, the VAIC^{TM} is computed as follows:

$$VAIC_{i,t}^{TM} = ICE_{i,t} + CEE_{i,t} \quad (6)$$

3.1 VAIC^{TM}: Weaknesses

We are aware that VAIC^{TM} shows several drawbacks (for details Ståhle *et al.,* 2011; Iazzolino and Laise, 2013), mainly because the information it uses cannot be completely attributed to IC efficiency (e.g., the employees cost, which is considered to be an investment in human capital). Furthermore, Ståhle *et al.* (2011, p.536) state that *"the formula for structural capital and human capital contain perfect superimposition and dependency stemming from their definition"*. For the authors, another issue is related to the computation of SC that seems to mistaking the use of cash flow and capitalized entities. Finally, as described in section 2, it is widely recognised that IC is the added value created from intangibles (i.e. HC, SC, and RC) but, VAIC^{TM} does not include RC efficiency in its calculation. However,

consistent with Iazzolino and Laise (2013), the main weakness point of Pulic's proposal is not related to the VAIC^{TM}'s calculation but to its attempt to qualify VAIC^{TM} as a criterion for performance measurement that is alternative to the existing ones (e.g., Economic Value Added - EVA). In fact, as they note, rivalry among VAIC^{TM} and others performance indicators does not exist, because VAIC^{TM} measures a dimension of performance that is not considered by other traditional measures, that is the value created by IC. As such, it is not surprising that, despite its limitations, a growing number of studies have used, and still use, VAIC^{TM} (among others: Cabrita and Vaz, 2005; Chen *et al.,* 2005; Clarke *et al*., 2011). Nevertheless, some researchers have tried, more recently, to overcome VAIC^{TM} limitations by modifying the original model (e.g., Ulum *et al.,* 2014; Nimtrakoon, 2015). In particular, in order to define a more comprehensive IC-based performance measure, Nimtrakoon (2015) has included marketing costs in the VAIC^{TM} computation to estimate RC.

4. Literature Review and Research Hypotheses

4.1 Literature Review

HC, RC and SC are very important to an organisation, as they represent the distinctive characteristics that, *ceteris paribus*, determine the success or failure of an organisation relative to its peers. Thus, it is not surprising that the magnitude, impact, and role of IC in an organisation's performance have long been investigated.

One line of research has highlighted the positive relationship between IC efficiency and organisational operating performance. A pivotal study is Pulic (2004), who investigates the Australian banking sector, documenting a strong role of IC efficiency in corporate success. In particular, the author observes that banks with higher levels of expenditure on IC exhibit better financial performance, e.g., in terms of profitability, than other banks. Other scholars have obtained similar results in analyses of other countries. Using a sample of commercial banks, Goh (2005) examines the relationship between IC efficiency and bank performance in Malaysia during the 2001-2003 period. With respect to the components of IC, the author finds that the efficiency in the use of HC significantly explains an organisation's financial performance. In addition, the author reveals that domestic banks are less likely to invest in IC efficiency than foreign banks. A study, appearing two years later of Indian banks, by Kamath (2007), confirms Goh's findings: there is a large difference in IC performance of Indian banks compared to foreign banks, with the latter achieving better financial performance. Moreover, scholars have shown that the most important component of IC is HC. Thus, HC should strongly influence organisational performance (see, among others, Goh, 2005; Kamath, 2008; Gan and Saleh, 2008; Maditinos *et al.,* 2011; Veltri and Silvestri, 2011).

Unfortunately, although the literature has emphasised the positive effects of IC on organisational performance, some studies have challenged this hypothesis. Using the VAIC^{TM} methodology as a measure of IC efficiency, Yalama and Coskun (2007) analyse the impact of IC on bank profitability in a study of Turkish banks. On the one hand, their findings appear to

confirm an explanatory role of IC efficiency in banks' financial performance. On the other hand, the authors cannot generalise these results due to instability across their sample. In other words, they find that only a portion of Turkish banks exhibit a positive correlation between financial performance and IC efficiency. In the same way, Puntillo (2009) analyses the Italian market and finds no significant relationship between ROA (return on assets), ROE (return on equity) and IC efficiency (VAIC^{TM}). However, the worst-case scenario is found in Chang and Hsieh (2011). The authors examine the role of innovation capital on value creation in an organisation. The results document a negative relationship between capital used in innovation and organisational financial performance.

Given this literature picture, it is clear that the question of whether the efficiency in the use of IC can explain the financial performance of organisations and, in particular, the financial performance of banks remains open. This motivates the present study to undertake an empirical analysis in order to re-examine this relationship in a large and complex market — that of the US.

4.2 Hypotheses development

A body of literature (see section 4.1) has highlighted that key to the success of an organisation is its ability – efficiency – to use and exploit IC. One of the seminal papers on this issue is Barney (1991), who observes that common organisational financial performance measures can capture IC effects and those of the IC components, HC, RC and SC. Consequently, in this study, we examine the effects of IC efficiency and its components on banks' financial performance, using ROAA (return on average assets) and ROAE (return on average equity) as measures of financial performance. Specifically, in consideration of Barney's arguments, we hypothesise the following:

H1. IC efficiency positively influences banks' financial performance, as measured by ROAA and ROAE.

In the literature, it is widely recognised that HC, which can be summarised as the knowledge, skills, experience and abilities of members of an organisation, is the most important component of IC (Edvinsson and Malone, 1997; Roslender and Fincham, 2004). If so, HC efficiency has the largest impact, relative to other IC components, on banks' financial performance.

Following these indications, the next hypothesis can be summarised as follows:

H2. HC efficiency positively influences banks' financial performance, as measured by ROAA and ROAE, and has the largest impact, relative to other IC components, on banks' financial performance.

5. Empirical Analysis

5.1 Data, Sample and Variables

In this section, we provide detailed information about the data, the sample and the variables used in the empirical analysis.

Data and sample description

To test our research hypotheses, we have constructed a very large sample of 5,749 US commercial banks with a time window that spans across 2005-2012, covering over 40,000 observations. More specifically, the data useful to compute our measures of IC efficiency, dependent and independent variables come from the Bankscope Bureau Van Dijk, which contains information mainly related to bank balance sheets.

Dependent variables

To measure the profitability of banks, we use two proxies that are widely utilised in the financial literature (see, among others, Chen *et al.,* 2005; Shiu, 2006; Chang *et al.,* 2007; Gan

and Saleh, 2008; Ting and Lean, 2009; Pal and Soriya, 2012; Besharati *et al.,* 2012), which can be summarised as follows:

1) ROAA (Return on Average Assets): measured as the ratio of net income to average total assets recorded over one year;
2) ROAE (Return on Average Equity): measured as the ratio of net income to average-equity computed as the sum of equity value at the beginning and end of each year, divided by two.

Independent variables

To address our first hypothesis (H1), we use, as a proxy for IC efficiency, the variable VAIC^{TM}, computed as described in Section 3. In the model, we control for five variables: size, measured as the natural logarithm of a bank's total assets; loan loss provisions on total loans, which is an indicator of credit risk that shows how much a bank provisions in year *t* relative to its total loans; a measure of liquidity, calculated as total loans to total assets and indicating what percentage of the assets of a bank are tied up in loans in year *t*; and the GDP growth rate between two consecutive years. Furthermore, in an effort to capture additional factors at the regional level that could affect bank financial performance, we add the variable State, a dummy variable set to 1 if the headquarter of the bank is located in the corresponding State and 0 otherwise. In line with our hypothesis (H1), we expect the coefficient for VAIC^{TM} to be positive and significant. Following researchers (e.g., de Pablos, 2003; El-Bannany, 2008) who have analysed the impact of IC efficiency on organisational performance and in accordance with our hypothesis (H2), we split the VAIC^{TM} variable into its sub-components. Using the same control variables used to test hypothesis H1, we expect HC efficiency to have the largest impact on financial performance compared to other IC efficiency components.

5.2 Empirical models

This section introduces the econometrical models that we refer to test the hypotheses previously presented. In particular, we specify two linear models, one for each hypothesis, that investigate how IC efficiency and its subcomponents determine the banks' performance. Model 1 tests H1, where the dependent variable $y_{i,t}$ (i.e., ROAA $_{i,t}$ and ROAE $_{i,t}$) is a function of the aggregate measure of IC efficiency (VAIC^{TM}) and various other bank-specific characteristics, which are summarised in the independent variables section and table 1. Leaving unchanged the meanings of the control variables and the dependent variables, we test hypothesis H2 using Model 2. Specifically, we split the variable VAIC^{TM} into its main sub-aggregates: HCE and SCE.

Model 1

$$y_{i,t} = \alpha + \beta_1 VAIC_{i,t}^{TM} + \delta X_{i,t} + \varepsilon_{i,t}$$

Model 2

$$y_{i,t} = \alpha + \beta_1 HCE_{i,t} + \beta_2 SCE_{i,t} + \delta X_{i,t} + \varepsilon_{i,t}$$

The subscript i denotes a bank (i = 1, 2, …, 5,749), the subscript t denotes the time dimension (time window 2005-2012), X is a vector of control variables and ε is the error term.

6. Results

The purpose of this paper is to investigate the impact of IC efficiency, measured through VAIC^{TM} methodology and its sub-components, such as HCE and SCE, on US commercial banks' performance. Table 3 reports descriptive statistics for the IC efficiency measures, banks' financial performance and some variables related to bank characteristics, referred to the time period 2005-2012

Does IC efficiency positively influence banks' financial performance? If so, does HC efficiency have a greater impact compared to others subcomponents?

Table 4 reports estimation results for models constructed on the basis of models 1 and 2 using pooled *OLS* for panel data. The table contains 8 columns, each presenting the results of a test of one of our hypotheses. More specifically, columns 1 and 5 address hypothesis H1, with dependent variables, ROAA and ROAE, respectively. In an effort to understand whether location in a different state affects a bank's financial performance, we also replicate the analysis without the dummy variable State (columns 2 and 6). The results do not differ significantly to the previous one. Columns 3 and 7 address hypothesis H2, while columns 4 and 8 address the same hypothesis but without the State dummy.

We conduct the multivariate analysis by controlling for various (internal and external) factors, such as LLP/L, LOANS/TA, SIZE and GDP, that the literature commonly treats as explanatory variables with respect to banks' financial performance. Additionally, we add variables — namely, VAIC^{TM}, HCE, and SCE— that mainly allow testing our hypotheses.

Below, we discuss the signs and the relationships of these variables to banks' financial performance and related theoretical interpretations.

First, the coefficient for VAIC^{TM} is positive and significant (see table 4, columns 1, 2, 5 and 5). This result is fully in line with our expectations and confirms hypothesis H1: IC efficiency positively affects and helps explain bank financial performance. Thus, this paper suggests that banks should not only consider how they mix financial assets but also develop an aptitude for IC management, enabling them to achieve sustainable operations and thereby increase profitability.

Second, the results are also in line with the hypothesis H2. Specifically, the sub-aggregate HCE of VAIC^{TM} has the largest impact on financial performance among other ones (see Table 4, columns 3, 4, 7 and 8). This finding, which is consistent with El-Bannany (2008), can be

explained by reference to the fact that HC management is a key point in the banking industry. Stated differently, it is essential for banks engage employees with strong expertise in this area, both in terms of academic training and on-the-job skills (e.g., Armenta, 2007).

Although the models proposed in our analysis are widely used in literature to test the banks' performance (e.g., Pasiouras and Kosmidou, 2007), we perform an additional tests to control for endogeneity, i.e. the reverse causality between dependent and independent variables, that could affect our results. The robustness check is conducted by using one time lagged independent variables. Specifically, as previous one, the Table 5 contains 8 columns, each presenting the results of a test of one of our hypotheses.

Overall, as shown in Table 5, the results are resilient and completely in line with those presented and discussed in Table 4. Specifically, VAIC^{TM} coefficient takes positive sign and is highly significant. In the same way, the coefficient and significance of HCE supports the hypothesis H2.

7. Conclusions

In this study, we have provided empirical evidence regarding the contribution of IC efficiency and its sub-components to explain banks' financial performance, using the US market as an experimental setting. IC efficiency of banks was measured using the VAIC^{TM} methodology. The study was conducted on a sample of 5,749 US banks over the time period 2005-2012. Overall, the empirical findings, which are based on multivariate regressions of conventional banks' financial performance measures on VAIC, using panel data with over 40,000 observations, highlight that IC efficiency plays an important role in bank performance. However, when the measure of IC efficiency is decomposed into its sub-components, the efficiency of HC, in particular, is shown have a major positive effect on banks' returns.

Additionally, we find that State dummies have no particular impact on profitability. In other words, the coefficients and significance levels of the independent variables are invariant with respect to the inclusion of State dummies.

Our analysis may have important implications for bank managers and policymakers. While the former seek to improve banks' financial performance, the latter seek to ensure that such efforts do not inordinately increase the risk that banks take on. Specifically, the findings of this paper suggest that the development by banks of effective techniques of knowledge management, enabling them to accumulate the IC necessary to address an ever-changing environment, can represent an effective means of achieving the goals of both bank managers and policymakers.

We are aware that our study could be affected by bias before any generalisation of the results can be made. Specifically, we conduct empirical tests on a large US sample, which raises the question: what about other countries? Further research should be undertaken in other countries to obtain a more generalizable result and to capture differences that may exist between different countries.

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Table 1. The relation between HC, HCE and SCE

HC values	HCE	SCE
HC > VA	< 1	< 0
HC = VA	1	0
HC < VA	> 1	> 0
HC = 0	+ ∞	1

Table 2. Variables.

This table shows the variable description and Pearson pairs-wise correlation matrix. Bold texts indicate statistically significant at 1% level or more.

	Variables	Description	1	2	3	4	5	6	7
1	VAIC™	IC efficiency measure[a];	**1.0000**						
2	SCE	Structural Capital efficiency[a];	---	**1.0000**					
3	HCE	Human Capital efficiency[a];	---	0.0013	**1.0000**				
4	LLP/L	Loan loss provisions on total loans. An indicator of credit risk, showing how much bank provisions in year *t* relative to its total loans[a];	0.0099	0.0000	0.0096	**1.0000**			
5	LOANS/TA	A measure of liquidity, calculated as total loans/total assets. The ratio indicates what percentage of the assets of the bank are tied up in loans in year *t*[a];	-0.0080	-0.0026	-0.0046	**-0.0182**	**1.0000**		
6	SIZE	The natural logarithm of the accounting value of the total assets of a bank in year *t*[a];	**0.0709**	-0.0028	**0.0723**	0.0027	**0.2065**	**1.0000**	
7	GDP	GDP growth rate between two consecutive years[b];	**0.0335**	**0.0126**	**0.0331**	0.0010	**-0.0565**	**-0.0273**	**1.0000**
	STATE	Dummy variables, equal to 1 if a bank's headquarters is located in the corresponding State and zero otherwise[a].							

Source: [a] Bankscope Bureau Van Dijk database; [b] World Bank data

Table 3. Descriptive statistics.

This table contains descriptive statistics of the banks' profitability, size and IC efficiency measures. The statistics are provided for each year and for the whole 2005-2012 time period, for all the sample of commercial banks.

Variable	Year	Obs.	Mean	Stand.dev.	Percentile		
					25%	50%	75%
Total Assets (th. $)							
	2005-2012	45,992	1,688,691	3.41e+07	67,687	139,982.5	310,086.5
	2005	5,749	1,163,213	2.30e+07	53,828	109,545	245,609
	2006	5,749	1,331,053	2.71e+07	58,601	119,430	266,631
	2007	5,749	1,520,386	3.10e+07	62,968	130,353	284,112
	2008	5,749	1,725,146	3.58e+07	67,403	141,082	311,448
	2009	5,749	1,752,233	3.47e+07	71,814	150,093	332,378
	2010	5,749	1,878,527	3.69e+07	74,641	154,290	338,549
	2011	5,749	2,013,080	3.94e+07	77,381	158,781	352,555
	2012	5,749	2,125,893	4.11e+07	81,589	167,108	367,042
ROAA (%)							
	2005-2012	45,992	0.901	2.940	0.455	0.883	1.297
	2005	5,749	1.149	2.401	0.751	1.086	1.461
	2006	5,749	1.188	2.283	0.719	1.067	1.466
	2007	5,749	1.178	3.160	0.635	1.008	1.395
	2008	5,749	0.807	3.251	0.335	0.796	1.230
	2009	5,749	0.465	2.715	0.092	0.619	1.071
	2010	5,749	0.649	2.730	0.258	0.701	1.142
	2011	5,749	0.807	3.346	0.373	0.782	1.198
	2012	5,749	0.961	3.335	0.479	0.863	1.256
ROAE (%)							
	2005-2012	45,992	7.548	13.620	4.223	8.278	12.642
	2005	5,749	11.092	8.720	7.031	10.655	14.788
	2006	5,749	11.037	8.584	6.671	10.442	14.757
	2007	5,749	10.122	9.906	5.821	9.583	13.762
	2008	5,749	6.806	12.664	3.071	7.490	11.729
	2009	5,749	3.415	15.889	0.898	5.843	10.186
	2010	5,749	4.806	15.752	2.487	6.695	11.005
	2011	5,749	5.803	16.416	3.449	7.294	11.415
	2012	5,749	7.302	15.696	4.427	7.795	11.798

Table 3. *Continued*

Variable	Year	Obs.	Mean	Stand.dev.	Percentile		
					25%	50%	75%
VAIC™							
	2005-2012	45,959	2.168	27.910	1.637	2.141	2.641
	2005	5,745	2.365	13.861	1.951	2.365	2.836
	2006	5,746	2.330	11.281	1.895	2.330	2.800
	2007	5,744	2.409	5.683	1.802	2.251	2.708
	2008	5,743	1.892	9.898	1.513	2.035	2.541
	2009	5,746	0.844	74.563	1.293	1.884	2.430
	2010	5,743	2.205	8.0513	1.437	1.967	2.523
	2011	5,746	2.323	11.589	1.544	2.040	2.556
	2012	5,746	2.158	4.549	1.653	2.114	2.597
HCE							
	2005-2012	45,986	1.802	5.573	1.317	1.675	2.057
	2005	5,749	2.163	11.501	1.539	1.852	2.222
	2006	5,749	2.076	5.660	1.513	1.831	2.199
	2007	5,748	1.972	4.700	1.449	1.774	2.125
	2008	5,747	1.665	3.593	1.227	1.598	1.976
	2009	5,749	1.396	3.465	1.043	1.461	1.853
	2010	5,747	1.598	3.959	1.172	1.535	1.935
	2011	5,749	1.721	3.390	1.255	1.600	1.990
	2012	5,748	1.822	3.087	1.342	1.666	2.034
SCE							
	2005-2012	45,984	0.335	27.331	0.273	0.420	0.530
	2005	5,748	0.622	7.714	0.364	0.468	0.559
	2006	5,749	0.577	9.765	0.342	0.456	0.549
	2007	5,748	0.401	3.127	0.314	0.438	0.533
	2008	5,747	0.198	9.180	0.228	0.392	0.512
	2009	5,749	-0.576	74.446	0.179	0.373	0.517
	2010	5,746	0.579	7.052	0.214	0.383	0.520
	2011	5,749	0.573	11.101	0.240	0.396	0.518
	2012	5,748	0.304	3.251	0.269	0.407	0.518

Table 3. *Continued*

Variable	Year	Obs.	Mean	Stand.dev.	Percentile		
					25%	50%	75%
LOANS/ASSETS (%)							
	2005-2012	45,992	61.972	16.193	52.900	64.426	73.624
	2005	5,749	62.385	16.698	80.903	64.910	74.346
	2006	5,749	63.735	15.983	55.318	66.464	75.019
	2007	5,749	64.667	16.012	56.262	67.258	76.079
	2008	5,749	65.128	16.260	56.600	68.151	76.818
	2009	5,749	62.898	15.655	54.582	65.691	74.051
	2010	5,749	60.900	15.417	52.379	63.219	71.937
	2011	5,749	58.581	15.690	49.682	60.604	69.905
	2012	5,749	57.487	16.125	47.870	59.229	69.284

Table 4. Results from OLS regressions starting from Model 1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$ROAA_t$	$ROAA_t$	$ROAA_t$	$ROAA_t$	$ROAE_t$	$ROAE_t$	$ROAE_t$	$ROAE_t$
$VAIC^{TM}{}_t$	0.113***	0.113***			0.536***	0.556***		
	(5.14)	(5.19)			(3.49)	(3.57)		
HCE_t			0.109***	0.110***			0.526***	0.546***
			(4.88)	(4.95)			(3.53)	(3.61)
SCE_t			-0.000	0.000			-0.001	-0.000
			(-0.08)	(0.08)			(-0.37)	(-0.11)
LLP/L_t	0.037***	0.039***	0.037***	0.039***	0.008	-0.016	0.009	-0.015
	(8.61)	(8.64)	(8.65)	(8.70)	(0.17)	(-0.32)	(0.19)	(-0.30)
$LOANS/TA_t$	-0.693**	-0.832***	-0.697**	-0.834***	3.207***	0.197	3.187***	0.189
	(-2.44)	(-3.29)	(-2.44)	(-3.29)	(3.88)	(0.27)	(3.83)	(0.25)
$SIZE_t$	0.053***	0.007	0.054***	0.008	0.762***	0.179***	0.765***	0.180***
	(6.35)	(0.96)	(6.20)	(0.99)	(11.80)	(3.03)	(12.03)	(3.08)
GDP_t	0.076***	0.075***	0.077***	0.075***	0.892***	0.865***	0.894***	0.867***
	(12.62)	(12.37)	(12.72)	(12.47)	(24.97)	(23.50)	(25.16)	(23.67)
STATE	Yes	No	Yes	No	Yes	No	Yes	No
_cons	0.181	0.933***	0.179	0.937***	-6.310***	2.917***	-6.309***	2.947***
	(1.21)	(6.95)	(1.21)	(7.00)	(-8.25)	(4.57)	(-8.31)	(4.65)
Obs.	45,657	45,657	45,676	45,676	45,657	45,657	45,676	45,676
$AdjR^2$	0.0875	0.0734	0.0837	0.0695	0.1227	0.075	0.1208	0.0686
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Panel regression analysis of banks' financial performance of a sample of 5,749 commercial banks is reported. Dependent variables: *ROAA* is defined as ratio of the net income divided by the average total assets recorded over one year and *ROAE* is defined as ratio of net incomes divided the average-equity computed as the sum of the equity value at the beginning and end of each year, divided by two. $VAIC^{TM}$ is the IC efficiency measure; *HCE* is a measure of human capital efficiency; *SCE* is a measure of structural capital efficiency; *LLP/L* is the ratio loan loss provisions on total loans and is an indicator of credit risk, which shows how much a bank is provisioning in year *t* relative to its total loans; *LOANS/TA* is a measure of liquidity, calculated as total loans on total assets. The ratio indicates what percentage of the assets of the bank is tied up in loans in year *t*; *SIZE* is the natural logarithm of the accounting value of the total assets of the bank in year *t*; *GDP* is the GDP growth rate between two consecutive years; *STATE* is a set of dummy variables each equal to 1 if the bank's headquarter is located in the corresponding State and zero otherwise. *, **and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Table 5. Results from OLS regressions starting from Model 1: One time lagged independent variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$ROAA_t$	$ROAA_t$	$ROAA_t$	$ROAA_t$	$ROAE_t$	$ROAE_t$	$ROAE_t$	$ROAE_t$
$VAIC^{TM}_{t-1}$	0.098***	0.099***			0.411***	0.436***		
	(4.14)	(4.28)			(3.88)	(3.88)		
HCE_{t-1}			0.095***	0.096***			0.402***	0.428***
			(3.90)	(4.05)			(3.95)	(3.94)
SCE_{t-1}			-0.000	-0.000			-0.002	-0.001
			(-1.13)	(-0.54)			(-1.48)	(-0.76)
LLP/L_{t-1}	0.054***	0.055***	0.054***	0.055***	0.114***	0.090***	0.115***	0.091***
	(24.47)	(24.21)	(24.61)	(24.43)	(4.79)	(3.37)	(4.83)	(3.42)
$LOANS/TA_{t-1}$	-1.102***	-1.218***	-1.105***	-1.220***	-1.056	-3.984***	-1.071	-3.985***
	(-3.43)	(-4.26)	(-3.42)	(-4.25)	(-1.11)	(-4.66)	(-1.13)	(-4.65)
$SIZE_{t-1}$	0.042***	-0.002	0.043***	-0.001	0.682***	0.093*	0.685***	0.094*
	(4.33)	(-0.20)	(4.26)	(-0.15)	(11.27)	(1.66)	(11.44)	(1.68)
GDP_{t-1}	0.078***	0.076***	0.078***	0.077***	0.917***	0.890***	0.919***	0.891***
	(13.22)	(12.92)	(13.25)	(12.96)	(25.46)	(23.90)	(25.60)	(24.01)
STATE	Yes	No	Yes	No	Yes	No	Yes	No
_cons	0.547***	1.295***	0.545***	1.299***	-3.116***	6.422***	-3.126***	6.445***
	(3.33)	(8.68)	(3.32)	(8.72)	(-3.87)	(9.38)	(-3.91)	(9.47)
Obs.	39,949	39,949	39,949	39,949	39,949	39,949	39,949	39,949
$AdjR^2$	0.0772	0.0633	0.0742	0.0602	0.1070	0.0532	0.1057	0.0519
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Panel regression analysis of banks' financial performance of a sample of 5,749 commercial banks is reported. Dependent variables: *ROAA* is defined as ratio of the net income divided by the average total assets recorded over one year and *ROAE* is defined as ratio of net incomes divided the average-equity computed as the sum of the equity value at the beginning and end of each year, divided by two. $VAIC^{TM}$ is the IC efficiency measure; *HCE* is a measure of human capital efficiency; *SCE* is a measure of structural capital efficiency; *LLP/L* is the ratio loan loss provisions on total loans and is an indicator of credit risk, which shows how much a bank is provisioning in year *t* relative to its total loans; *LOANS/TA* is a measure of liquidity, calculated as total loans on total assets. The ratio indicates what percentage of the assets of the bank is tied up in loans in year *t*; *SIZE* is the natural logarithm of the accounting value of the total assets of the bank in year *t*; *GDP* is the GDP growth rate between two consecutive years; *STATE* is a set of dummy variables each equal to 1 if the bank's headquarter is located in the corresponding State and zero otherwise. *, **and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.