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Intellectual Capital and Performance of Banking and Financial Institutions in Panama: An Application of the VAIC™ Model

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Abstract: In the knowledge era, intellectual capital has been considered a key factor in creating value within organisations. This study examines the relationships and interactions between the components of intellectual capital and the profitability of Panamanian banking and financial institutions listed on the Latin American Stock Exchange (LATINEX) from 2014 to 2020. A theoretical framework based on agency theories, signalling theory, and stakeholder theory was employed to support the results. The Valued-Added Intellectual Coefficient (VAIC)™ model, which evaluates the intellectual capital of organisations based on information from financial statements, was also utilised. In this study, stepwise regression was applied to select the optimal number of predictors to be included in each multiple regression model to examine the relationship between the return on equity (ROE) and the components of the VAIC™ in addition to control variables such as size and indebtedness. The findings confirm this study's hypothesis, demonstrating that the structural capital efficiency (SCE) and company size (SIZE) variables explain 57% of the variance in the ROE for the analysed institutions. The results suggest that the intellectual capital (IC) of financial sector institutions listed on LATINEX is significantly influenced by the SCE coefficient, which shows a negative relationship, suggesting that investment in structural capital does not enhance profitability. On the other hand, larger institutions exhibited higher profitability during the study period. This study was limited to the analysis of two sectors: banking and finance in companies listed on LATINEX. However, its rigorous theoretical and empirical foundation opens the way for future research in which other sectors can be considered, and cross-country comparisons can be made, strengthening the research in this field for Latin America. At the same time, this study offers market regulators a scientific methodology to oversee the activities of issuing companies.

Keywords: intellectual capital; return on equity; added value of intellectual capital; Latin American Stock Exchange

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1. Introduction

Currently, intellectual capital (IC) and financial capital are considered key factors for the profitability of companies (Alipour 2012). In the new knowledge-based economy proposed by Drucker (1993), knowledge has ceased to be just another resource alongside traditional factors of production, such as capital and land, and instead has become the most significant resource. This shift has brought the importance of intangible resources to the forefront, giving them the recognition they deserve (Tiwari 2022). Consequently, IC is now projected as a crucial component in creating value for companies, contributing to a sustainable competitive advantage (Awwad and Qtaishat 2023; Bombiak 2023; Jardon 2015; Shah et al. 2023; Teece et al. 1997; William et al. 2019; Xu et al. 2019). The management of intellectual assets has become essential for generating organisational value (Bontis 1998), with companies increasingly relying on intellectual potential over physical capital (Pulic 1998). In this new economy, intangible assets such as IC are fundamental (Özer and Çam

2016). However, measuring these intangible resources remains a challenge for public administrations (Abdulsalam et al. 2011) since IC continues to be a critical concept for analysing and reflecting the real value of organisations (Arslan and Kizil 2019). Financial statements have limitations in capturing the full value of companies, based on the fact that the source of economic value has shifted from the production of material goods to the creation of IC (M. Chen et al. 2005). Recognising IC as an important business asset is essential, as it can generate sustainable competitive advantages and superior financial results (Barney 1991).

IC is defined as the possession of knowledge and the application of experiences, organisational technology, customer relationships, and professional skills (Edvinsson 1997). According to Stewart (1997), IC is an intellectual material that has been formalised, captured, and leveraged to create wealth through the production of higher-value goods. The IC dimensions comprise three harmonising groups: people, structures, and relationships (Pulic 1998). These intangibles consist of human capital (HC), structural capital (SC), and relational capital (RC) (Edvinsson and Malone 1997; Stewart 1997). These structures are based on the Intellectus Model (EUROFORUM 1998). Based on this model, in the Intellectus Model, HC refers to the knowledge, whether explicit or tacit, individual or social, that people and groups possess. Additionally, it considers their ability to generate benefits for companies (Bueno et al. 2011) through a combination of knowledge, skills, experiences, competencies, creativity, and individual capabilities (Bontis 1999; J. Chen et al. 2004; Edvinsson and Malone 1997; Sveiby 1997). Thus, employees are the carriers of knowledge, which is the crucial substance of products and services (Pulic 2008). SC encompasses the knowledge embedded in the company's internal processes and technological systems, differentiating it from other organisations (Larios Prado 2009). RC can be defined as the knowledge resulting from relationships with market agents and society in general (Bueno et al. 2011).

To enhance the value generated by IC, various measurement models exist. The Value-Added Intellectual Coefficient (VAIC)™ (Pulic 1998, 2000, 2004, 2008) is utilised to measure the value created within an organisation. The VAIC™ model calculates IC based on financial data using the following three components: the human capital efficiency coefficient (HCE), the structural capital efficiency coefficient (SCE), and the capital employed efficiency coefficient (CEE). The VAIC™ indicates the overall state of corporate intellectual capacity, making it possible to measure the performance of intellectual potential and enable management intervention (Pulic 1998). The VAIC™ formula, which uses financials and accounting reports, is considered a suitable tool for measuring IC value creation (Bykova and Molodchik 2012; Pardo-Cueva et al. 2018; Pulic 2000; Shaban and Vijayasundaram 2019; Śledzik 2012; Sumedrea 2013; Villegas González et al. 2017). The VAIC™ is, therefore, considered to be an appropriate tool for this measurement.

This work uses the Value-Added Intellectual Coefficient (VAIC)™ to study a sample of companies in the banking and financial sectors, so we reviewed the studies that have used these sectors as samples to measure IC through the VAIC™ model, including (Abdulsalam et al. 2011; Al-Musali and Ismail 2014; Chen Goh 2005; Demuner Flores et al. 2017; Duho 2020; Duho and Onumah 2019; Faruq et al. 2023; García Castro et al. 2021; Mavridis 2004; Meles et al. 2016; Mollah and Rouf 2022; Oppong and Pattanayak 2019; Ozkan et al. 2017; Singh et al. 2016; Soewarno and Tjahjadi 2020; Tran and Vo 2018). In this study, we used the VAIC™ model to analyse the relationship between the return on equity (ROE) and the components of the VAIC™ since this allows for the quantifiable and objective measurement of IC's contribution to companies, particularly the banking sector, which is classified as knowledge-intensive (Oppong and Pattanayak 2019).

In addition to the above, a reason for conducting this study using the VAIC™ model is that the indicators are relevant, useful, and informative for stakeholders, as they identify trends and link with traditional financial indicators (Demuner Flores et al. 2017). In addition, this model allows for comparative analysis between companies in the same competitive sector by using standards that measure their effectiveness. Thus, it provides information on company value, performance, and competitiveness, enabling the measurement of IC

efficiency (Śledzik 2012; Pardo-Cueva et al. 2018). It is also based on a scientific methodology to measure the IC of sectors that use the market for financing. This allows securities market regulators to monitor the activities of the companies that make up the market, which, in the case of Panama, is regulated by the Superintendency of the Securities Market, created through Ley 67 de 1 de Septiembre de 2011 (Presidencia de la República de Panamá 2011).

In recent decades, the banking system in Panama has become one of the most robust financial centres in Latin America because it benefits from clean settlement facilities, a favourable geographical location for commerce, economic growth, and the dollarisation of its economy. The strength of these sectors has been demonstrated through their resilience during global financial crises, such as the COVID-19 pandemic, by maintaining profitability levels like those obtained in previous periods. In the banking sector, IC is considered a key factor for achieving competitiveness (Van Nguyen and Lu 2023) since banks must continuously innovate and remain competitive to survive. Due to their participation in the stock market, the companies analysed are required to publish their financial reports on their websites, providing reliable data (Arslan and Kizil 2019). Due to their position as stock market participants, the companies analysed are obliged to present their financial reports on their website, which allows for the availability of reliable data. As the need for financing requires institutions to offer greater transparency, this reduces the problem of information asymmetry and agency costs and provides the market with adequate signals of their financial situation as well as when investors' interests could be affected.

Financial institutions use the capital market as a means of financing, so these liabilities must be transparent to the market (Herrera Rodríguez and Ordóñez-Castaño 2020). Thus, to facilitate their access to the capital market, firms must provide information to stakeholders and potential capital providers so that they can secure their interests (Ferraz Correia et al. 2011). The transparency of information should reduce costs, according to the assumptions of agency theory (Jensen and Meckling 1976), because of the positive relationship between intangibles (value of growth opportunity) and agency costs (Gaver and Gaver 1993; Smith and Watts 1992). The disclosure of information highly satisfies the need for investors to understand corporate decisions (Abhayawansa and Guthrie 2016). In addition to transparency, signalling theory (Spence 1973) seeks to solve the problem of information asymmetry in markets. Companies using the capital market to finance themselves receive pressure from the market to supply information to their investors because institutions are an ensemble of rights and obligations that affect people's economic lives (Matthews 1986). Each part of the firm aims to maximize its benefits. However, when managers possess more information than investors, the problem of information asymmetry can arise (Akerlof 1970). Because stakeholders are the recipients of information, stakeholder theory seeks to understand how managers can priorities and address stakeholder grievances to enhance the perceived value of stakeholders to the firm (Freeman 1984). This effort is aimed at reducing the problem of information asymmetry and conflicts of interest in firms and their activities.

In this study, the Value-Added Intellectual Coefficient (VAIC™) model was utilised to examine the relationships and interactions between the components of IC and the profitability of Panamanian banking and financial institutions listed on the Latin American Stock Exchange (LATINEX 2024). The dataset contains financial information for a sample of 22 companies, namely 14 from the banking sector and 8 from the financial sector, during the 7-year period from 2014 to 2020, for a total of 168 observations. Data for constructing the VAIC™ model were obtained from balance sheets, income statements, and notes on the financial statements available on the websites of the companies analysed. These data were used to calculate the value-added coefficient and the coefficients related to IC and its components: HCE, SCE, and CEE. This process enabled the calculation of the VAIC™ for each company. This study also included control variables such as the size and the indebtedness.

This research is a theoretical and practical contribution to the topic of study, as no studies were found that have analysed the IC of the sampled companies. In addition, companies need to understand the importance of information transparency and the need to

maintain various channels of communication with stakeholders. This would greatly benefit society because they will have better tools to make investment decisions.

This study is divided into five parts. After the introduction, the literature review and formulation of the hypotheses are presented. The third part outlines the model and variables used in the empirical study as well as the sample and the methods of data collection and processing. The fourth part presents the statistical analysis, evidencing the different assumptions that validate the model. Next, the obtained results are discussed. Finally, the main conclusions of the study, its limitations, and future lines of research are presented.

2. Literature Review and Hypotheses Development

For the construction of the hypotheses of this research, different studies that have used the VAIC^{TM} model to measure the efficiency of the IC of companies in the banking sector were reviewed to identify the variables that were contrasted in relation to the subject of the study.

HC is a holistic concept that denotes the organization resources and assets related to a firm's people (Alipour 2012). According to agency theory (Jensen and Meckling 1976), agents in the most profitable firms could achieve higher performance in terms of CH efficiency by meeting stakeholder aspirations, in line with stakeholder theory (Freeman 1984). They would also send signals to the market on their performance, based on signalling theory (Spence 1973). Thus, the relationship between profitability (ROE) and HCE was investigated by Arslan and Kizil (2019), Mehralian et al. (2012), Olarewaju and Msomi (2021), Ozkan et al. (2017), Pardo-Cueva et al. (2018), and Soewarno and Tjahjadi (2020), who obtained a positive relationship between the variables. Therefore, the following hypothesis was formulated:

H_1. *There is a positive relationship between the return on equity (ROE) and the human capital efficiency ratio (HCE) of LATINEX-listed banking and financial companies over the period of 2014–2020.*

Agency theory (Jensen and Meckling 1976) could explain the negative relationship between profitability and the structural capital efficiency ratio (SCE), as companies with higher investments in structures require higher outlays. In addition to this, it could justify the use they would be making of resources to their stakeholders (Freeman 1984), sending signals of the good management of these resources to the market and complying with the budgets of signalling theory (Spence 1973). The research of Celenza and Rossi (2014) and Pardo-Cueva et al. (2018) found a positive relationship between ROE and SCE. For their part, Adesina (2019), Arslan and Kizil (2019), and Oppong and Pattanayak (2019) found a negative relationship, while Al-Musali and Ismail (2014) found no relationship between SCE and ROE. Therefore, the following hypothesis is proposed:

H_2. *There is a negative relationship between the return on equity (ROE) and the structural capital efficiency ratio (SCE) of LATINEX-listed banking and financial companies over the period of 2014–2020.*

The relationship between the capital employed efficiency ratio and profitability was tested using the CEE variable. The agency theory (Jensen and Meckling 1976) could explain the relationship between these variables based on the assumption that companies with greater knowledge accumulated through human capital would obtain greater financial benefits, sending signals to the market about the company's good management, thus fulfilling the precepts of signalling theory (Spence 1973) and, at the same time, meeting the demands of the stakeholders (Freeman 1984). Three studies were found that contrasted the variable *ROE* in relation to *CEE*. These were the studies by Al-Musali and Ismail, 2014; Celenza and Rossi, 2014; and González González, 2017. The results show a positive relationship between the CEE and ROE in their findings. Therefore, the following hypothesis is put forward:

H_3. *There is a positive relationship between the return on equity (ROE) and the capital employed efficiency ratio (CEE) of LATINEX-listed banking and financial firms over the period of 2014–2020.*

Through the VAIC™ model, objective results can be obtained regarding the valuation of companies' IQ. Thus, for the agency theory (Jensen and Meckling 1976), it could be assumed that companies that invest in IC will have a greater competitive advantage and therefore higher company performance (Chen et al. 2014). From the analysed studies where they measured profitability through the VAIC™ model in different contexts, it was shown that IC can improve the performance of companies. These included the studies by Acuña-Opazo and González (2021), Alipour (2012), Al-Musali and Ismail (2014), Arslan and Kizil (2019), Chowdhury et al. (2018), Meles et al. (2016), Pardo-Cueva et al. (2018), and Simarmata and Subowo (2016). Therefore, the following hypothesis was formulated:

H_4. *There is a positive relationship between the return on equity (ROE) and the VAIC™ of LATINEX-listed banking and financial companies over the period of 2014–2020.*

Large companies have greater coverage in the capital markets and are therefore subject to greater scrutiny by capital market participants (Herrera Rodríguez and Macagnan 2016). In this sense, agency theory (Jensen and Meckling 1976) points to the fact that companies of this size would have the possibility of obtaining greater profitability due to the possible access to different markets, sending signals of the company's good performance, thus complying with the precepts of signalling theory (Spence 1973) and, at the same time, meeting the demands of the stakeholders (Freeman 1984). The relationship between the ROE and size was studied in the research of García Castro et al. (2021) and Ozkan et al. (2017), who found no relationship between these variables in the banks studied. The following hypothesis was formulated:

H_5. *There is a positive relationship between the return on equity (ROE) and the size of LATINEX-listed banking and financial firms over the period of 2014–2020.*

A company's indebtedness could indicate that the organisation is planning investments, which would allow it to grow and increase its profits (Herrera Rodríguez and Macagnan 2016). In this respect, agency theory (Jensen and Meckling 1976) could explain why more profitable companies are more indebted to the extent that they use shareholders' money to finance themselves; they must, therefore, satisfy the interests of their stakeholders. According to research (Freeman 1984), this sends signals to the market that they are investing the resources for higher returns, thus complying with the precepts of signalling theory (Spence 1973). Therefore, the following hypothesis was made:

H_6. *There is a positive relationship between the return on equity (ROE) and the indebtedness of LATINEX-listed banking and financial companies during the period of 2014–2020.*

3. Methodology

This study is based on the VAIC™ model (Pulic 1998, 2000, 2004, 2008). This research aimed to analyse the relationship between the ROE and the components of the VAIC™ model for institutions in the banking and financial sectors in Panama listed on the LATINEX between 2014 and 2020. This period was used because, at the time of obtaining the data from the audited financial statements, complete information up to 2020 was available.

The data for constructing the VAIC™ model were obtained from balance sheets, income statements, and notes on the financial statements available on the websites of the companies analysed. These data were used to calculate the value-added coefficients and the coefficients related to IC and its components: HC, SC, and RC. This process enabled the calculation of the VAIC™ for each company following the procedure in Table 1 below.

Table 1. Methodological process for the calculation of the components of the VAIC™.

Step	Purpose of Calculation	Formula	Formula Components
Step 1	Determine the extent to which a company creates added value (VA). VA is calculated based on the difference between income and expenses.	VA = OUT − IN	VA = Added value OUT = Total revenue IN = Expenses, excluding personnel costs
Step 2	Calculate the human capital efficiency coefficient (HCE).	HCE = VA/HC	HCE = Human capital efficiency coefficient VA = Added value HC = Total wages and salary commitments of the company
Step 3	Calculate the structural capital (SC), the second component of IC.	SC = VA − HC	SC = Structural capital VA = Value added HC = Total wages and salary commitments of the company
Step 4	Calculate the structural capital efficiency coefficient (SCE).	SCE = SC/VA	SCE = Structural capital efficiency coefficient SC = Structural capital VA = Added value
Step 5	Determine intellectual capital efficiency (ICE) by combining the human capital efficiency (HCE) and the structural capital efficiency (SCE).	ICE = HCE + SCE	ICE = Intellectual capital efficiency coefficient HCE = Human capital efficiency coefficient SCE = Structural capital efficiency coefficient
Step 6	Since IC alone cannot create value (Pulic 2004), it is essential to also consider financial and physical capital. This involves calculating the capital employed efficiency (CEE).	CEE = VA/CE	CEE = Capital employed efficiency coefficient VA = Added value CE = Book value of the company's net assets
Step 7	To compare the overall efficiency of value creation, the three efficiency indicators are added together.	**VAIC™ = ICE + CEE**	VAIC™ = Value-added intellectual coefficient ICE = Intellectual capital efficiency coefficient CEE = Capital employed efficiency coefficient

Own elaboration based on (Pulic 2008, 1998, 2000, 2004).

Table 2 presents the identification of the variables for the construction of the VAIC™ model, their description, and the sources of data collection.

Table 2. Identification, description, and sources of data collection of variables.

Identification	Description	Source of Data
OUT	Total revenue	Income statements
IN	Expenses	Income statements
OP	Operational costs	Income statements
EC	Employee costs	Income statements
D	Depreciation	Income statements
A	Amortisations	Income statements
HC	Total wages and salary commitments of the company	Balance sheets, income statements, and notes on financial statements
CE	Book value of the company's net assets	Balance sheets and notes on financial statements

Source: Own elaboration.

The study population consisted of 43 companies: 26 companies in the banking sector and 17 in the financial sector. In this document, we worked with the total population under study. Due to the filtering of atypical data and the absence of data for some variables required for the construction of the model, the sample is representative and made up of 22 companies, of which 14 belong to the banking sector and 8 to the financial sector, as shown in Table 3.

Table 3. Study sample.

Banking Sector	Financial Sector
Bac International Bank Inc.	Colfinanza, S.A.
Banco Centro Americano de Integración	Corporación Bellavista de Finanzas, S.A.
Banco General S.A.	Corporación Finanzas del País, S.A. (Panacredit)
Banco Internacional de Costa Rica	Financia Credit S.A.
Banco La Hipotecaria S.A.	Financiera Pacífico Internacional, S.A.
Banco Nacional de Panamá	Hipotecaria Metrocredit S.A.
Banistmo S.A.	Mi Financiera S.A.
BCT Bank International S.A.	
Canal Bank	
Capital Bank Inc.	
MultiBank Inc.	Multi Financiamientos S.A.
Tower Bank International Inc.	
Unibank S.A.	
Banesco S.A.	

Source: Own elaboration.

In this study, stepwise regression was applied to select the optimal number of predictors to include in each multiple regression model (Wang et al. 2007). Starting from a constant model, the regression searched for terms to add or remove from the model depending on a predetermined *p*-value. The aim was to determine the relationships among the ROE, the dependent variable of this research, and the components of the VAIC: CEE, HCE, and SCE (explanatory variables). This study also included control variables such as the size, calculated as the natural logarithm of total assets, and the indebtedness, calculated as the ratio of total debt to total assets.

The linear regression model used is given by the following equation (Anderson et al. 1999):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_K X_K + \in \quad (1)$$

The coefficients β_0, $\beta_1, \ldots \beta_k$ denote the magnitude of the effect that the (independent) explanatory variables have on the dependent Y. The coefficient β_0 represents the intercept or constant term of the model and is a constant term of the model; $\in$ denotes the error or residual term of the model.

4. Results and Discussion

4.1. Descriptive Statistics

In relation to profitability, it is evident that, on average, the companies achieved a profitability of 8.54% for the investors' capital. In terms of the human capital efficiency ratio, the companies studied achieved an average of 5.14%, which shows an optimal use of human capital in Panama's banking and financial companies. Regarding the structural capital efficiency ratio, the average remained at 3.78%, which is the contribution of the physical structures of the companies to the VAIC^{TM}. On the other hand, the efficiency coefficient of the capital employed averaged 0.08%, and the VAIC averaged 9%. This shows that the human capital efficiency coefficient is the one that contributes the most, on average, to intellectual capital. On the other hand, on average, the size of the companies studied has an asset value of approximately USD 407 million. The companies show an average debt ratio of 91%. In terms of standard deviation, the variables that were furthest from the mean

were the SCE, VAIC, and ROE. Very close to the average were the CEE, DEBT, and HCE. The results are shown in Table 4.

Table 4. Descriptive statistics.

	Mean	Standard Deviation
ROE	8.54	7.71
HCE	5.14	2.72
SCE	3.78	36.49
CEE	0.08	0.07
VAIC	9.00	36.16
SIZE	19.82	2.51
INDEBTEDNESS	0.91	0.69

Note. The initial database comprised 168 observations and financial institutions. However, after cleaning for outliers and missing data, the sample decreased to 148.

Outliers are extraordinary observations that do not fit the trend in the other data (Anderson et al. 1999). To determine the validity of the model, the assumptions of linearity, independence of errors, homoscedasticity, normality, and non-collinearity were tested.

4.2. Validity of the Model

4.2.1. Linearity

The linearity assumption states that the relationship between the variables is linear (Berenson and Levine 1996). Table 5 shows that there was a significant linear relationship between the ROE and the explanatory variables SIZE, VAIC, and SCE ($p < 0.05$). The results indicate a significant linear correlation between the dependent variable (ROE) and the explanatory variables SCE and VAIC as well as between CEE and INDEBTEDNESS and the logarithm of the SIZE of the assets. The variables CEE, HCE, and INDEBTEDNESS did not show a significant linear relationship ($p > 0.05$) and were therefore not included in the model.

Table 5. Correlation analysis.

		ROE	HCE	SCE	CEE	VAIC	INDEBTEDNESS	SIZE Ln_Assets
ROE	Pearson correlation	1	0.102	−0.740 **	0.144	−0.739 **	0.003	0.270 **
	Sig. (bilateral)		0.215	0.000	0.080	0.000	0.966	0.001
	N	148	148	148	148	148	148	148
HCE	Pearson correlation	0.102	1	−0.155	−0.160	−0.081	−0.003	−0.054
	Sig. (bilateral)	0.215		0.060	0.052	0.327	0.967	0.514
	N	148	148	148	148	148	148	148
SCE	Pearson correlation	−0.740 **	−0.155	1	−0.091	0.997 **	−0.006	−0.133
	Sig. (bilateral)	0.000	0.060		0.271	0.000	0.939	0.107
	N	148	148	148	148	148	148	148
CEE	Pearson correlation	0.144	−0.160	−0.091	1	−0.102	0.558 **	−0.404 **
	Sig. (bilateral)	0.080	0.052	0.271		0.218	0.000	0.000
	N	148	148	148	148	148	148	148
VAIC	Pearson correlation	−0.739 **	−0.081	0.997 **	−0.102	1	−0.006	−0.139
	Sig. (bilateral)	0.000	0.327	0.000	0.218		0.947	0.091
	N	148	148	148	148	148	148	148

Table 5. *Cont.*

		ROE	HCE	SCE	CEE	VAIC	INDEBTEDNESS	SIZE Ln_Assets
INDEBTEDNESS	Pearson correlation	0.003	−0.003	−0.006	0.558 **	−0.006	1	−0.014
	Sig. (bilateral)	0.966	0.967	0.939	0.000	0.947		0.863
	N	148	148	148	148	148	148	148
SIZE Ln_Activos	Pearson correlation	0.270 **	−0.054	−0.133	−0.404 **	−0.139	−0.014	1
	Sig. (bilateral)	0.001	0.514	0.107	0.000	0.091	0.863	
	N	148	148	148	148	148	148	148

** The correlation is significant at the 0.01 level (bilateral).

Based on the results of the linearity assumption, we continued with the analysis of the assumptions, i.e., independence of errors, homoscedasticity, normality, and non-collinearity, for the dependent variable ROE and the explanatory variables SIZE, VAIC, and SCE, which show a significant linear correlation.

4.2.2. Independence from Errors

The assumption of independence of errors requires that the error (the residual difference between an observed and a predicted value of Y) be independent of each value of X (Berenson and Levine 1996, p. 737). This effect can be measured with the Durbin–Watson (D-W) statistic (Berenson and Levine 1996, p. 741). The error is considered independent if the D-W statistic is close to 2 (Seddighi et al. 2000). For the model of this research, the result of the D-W statistic was 2.065, indicating that the errors were independent. The variable VAIC did not show significance and did not contribute to the model, so it was excluded in the regression table. These results are shown in Table 6.

Table 6. Model summary and error independence test (D-W).

Model Summary [c]						Durbin–Watson
Model	**R**	**R^2**	**Adjusted R^2**	**Standard Estimate Error**	**Change Statistics**	
					Change in R^2	
1	**0.740** [a]	**0.547**	**0.544**	**5.19296**	0.547	
2	0.759 [b]	0.576	0.570	5.04183	0.029	**2.065**

[a] Predictors: (Constant), SCE. [b] Predictors: (Constant), SCE, SIZE. [c] Dependent variable: ROE.

4.2.3. Homoscedasticity

The assumption of homoscedasticity implies that the residuals do not show any systematic pattern with respect to the predictions but should be uniform over the whole range of predicted values. This assumption can be checked in the point cloud of the scatter plot between the errors and the predicted scores, which should have an appearance of randomness in a band parallel to the abscissa axis (Cañadas Osinski and Costas 2018). To verify this, a scatter plot was used with standardised predicted values (ZPRED) and standardised residuals (ZRESID). The scatter plot shows no clear pattern of association, linear or otherwise, indicating that the assumption of homoscedasticity is met, as illustrated in Figure 1.

To confirm this result, an analysis was conducted to calculate the correlation between the absolute values of the residuals and the predicted values. The results indicate no significant relationship between the residuals and the predicted values ($p > 0.05$), as shown in Table 7.

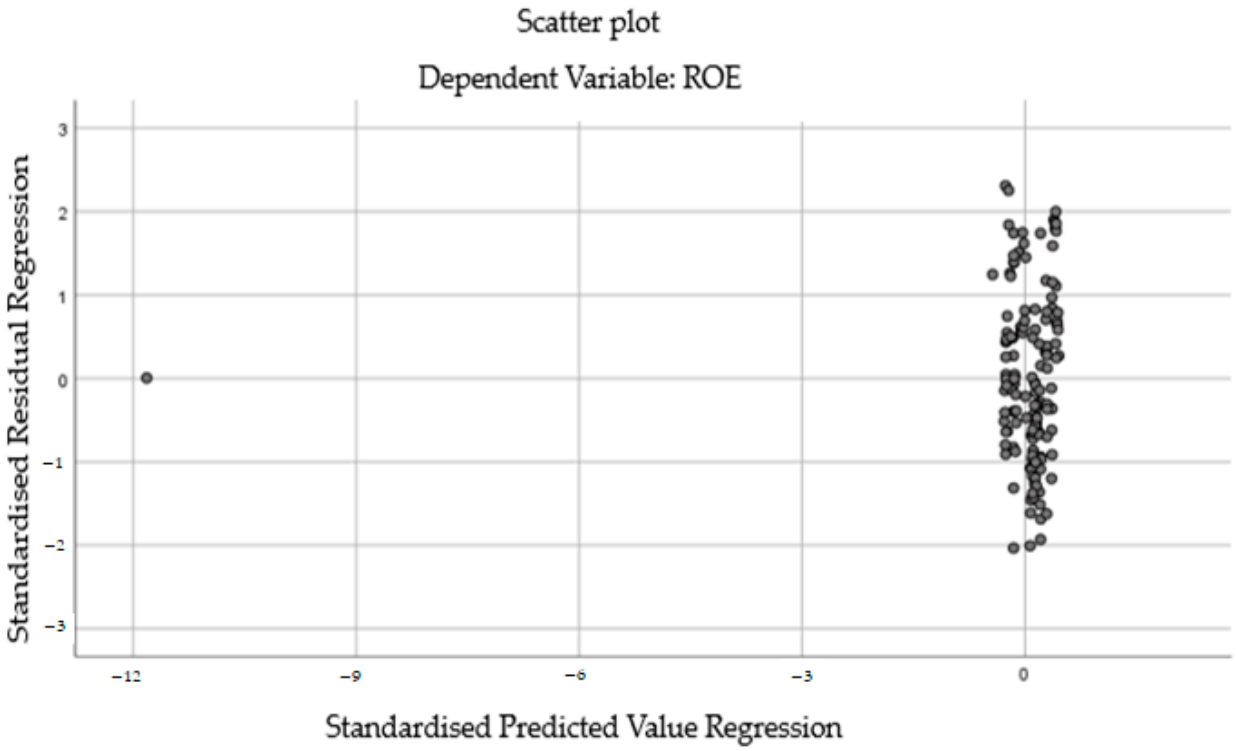

Figure 1. Scatter plot (ZPRED = standardised predicted values; ZRESID = standardised residuals).

Table 7. Correlation between the absolute values of the residuals and the predicted values.

		Absolute Residual	Unstandardised Predicted Value
Absolute Residual	Pearson correlation	1	**0.156**
	Sig. (bilateral)		**0.059**
	N	148	148

Source: Own elaboration.

4.2.4. Normality

The Kolmogorov–Smirnov (K-S) goodness-of-fit test is an alternative way of testing whether a sample is from a continuous (normal) distribution. This procedure is based on the comparison of the empirical cumulative distribution function with that of a theoretical continuous distribution, calculating the maximum distance between the two distributions (Salafranca Cosialls et al. 2005, p. 213). The results in Table 8 for the Kolmogorov– Smirnov (K-S) test show that the hypothesis that the residuals have a normal distribution cannot be rejected (p = 0.200).

Table 8. Results of Kolmogorov–Smirnov normality test.

	Kolmogorov–Smirnov [a]			Shapiro–Wilk		
Test	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Unstandardised residual	0.059	149	**0.200** *	0.981	149	0.042

* This is a lower limit of true significance. [a] Lilliefors correction of significance.

4.2.5. Non-Collinearity

The variance inflation factor (VIF) and tolerance are both widely used measures of the degree of multi-collinearity of the independent variable with the other independent variables in a regression model (O'brien 2007). For there to be no multicollinearity, tolerance values must be high (greater than or equal to 0.10). The VIF is the reciprocal of tolerance since lower VIF values indicate lower multicollinearity. Greater VIF values suggest serious

collinearity problems. The results indicate that the assumption of non-collinearity is verified (tolerance > 0.10 and VIF < 10 in all cases), as shown in Table 9.

Table 9. Collinearity diagnostics for models.

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	SCE	1.000	1.000
2	(Constant)		
	SCE	0.982	1.018
	SIZE	0.982	1.018

Dependent variable: ROE.

4.2.6. Goodness of Prediction

The mean values obtained for the ROE and its estimate were 8.54 and 8.60, respectively, as shown in Table 10. Additionally, there was a significant linear correlation ($p < 0.05$) between the means of these variables. To verify the goodness of the estimate, a Z-test was applied for the means of two samples, which were considered significant for $p < 0.05$ values. Finally, it can be observed that there were no statistically significant differences between the mean values of the ROE and their estimates ($p = 0.94$), as can be seen in Table 11.

Table 10. Descriptive statistics and correlation between ROE and estimation.

	N	Minimal	Maximum	Mean	Standard Deviation	Correlation	Sig.
ROE	148	−60.43	21.01	8.54	7.71	0.760	0.000
ESTROE *	148	−59.69	11.27	8.60	5.80		

* ROE estimate.

Table 11. Z-test for two-sample means.

	ROE	*TROE*
Mean	8.54	8.60
Variance (known)	59.45	33.68
Observation	148	148
Hypothetical difference in the means	0	
Z value	−0.07	
p-value (two-tailed)	0.94	
Critical Z value (two-tailed)	1.96	

Source: Own elaboration.

4.2.7. Model Goodness of Fit

According to the model summary, the adjusted R^2 was equivalent to 0.570 (model 2), indicating that the SCE and SIZE variables explained 57% of the variance in the ROE. On the other hand, the F-statistic value of 99.156 indicates that this linear relationship was significant ($p < 0.05$), according to the results shown in Table 12.

Table 12. Summary and ANOVA for models.

Model	R	R^2	Adjusted R^2	Standard Error of Estimate	Change Statistics Change in R^2
1	0.740 [a]	0.547	0.544	5.19296	0.547
2	0.759 [b]	0.576	**0.570**	5.04183	0.029

Table 12. *Cont.*

ANOVA						
Model		**Sum of Squares**	**df**	**Mean Square**	**F-Statistic**	**Sig.**
1	Regression	4788.318	1	4788.318	177.563	0.000 [b]
	Residual	3964.119	147	26.967		
	Total	8752.437	148			
2	Regression	5041.113	2	2520.556	99.156	0.000 [c]
	Residual	3711.324	146	25.42		
	Total	8752.437	148			

[a] Dependent variable: ROE. [b] Predictors: (Constant), SCE. [c] Predictors: (Constant), SCE, SIZE.

4.3. Multiple Linear Regression Model

This section presents the results of the estimated model. Based on the results shown in Table 13, the regression equation for the raw scores is as follows:

$$\widehat{ROE} = -\mathbf{1.34} + \mathbf{0.53} * \mathbf{SIZE} - \mathbf{0.15} * \mathbf{SCE}$$

Table 13. Multiple linear regression model.

Coefficients [a]						
Model		**Non-Standardised Coefficients**		**Standardised Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	9.11	0.43		21.29	0.00
	SCE	−0.16	0.01	−0.74	−13.33	0.00
2	(Constant)	−1.34	3.34		−0.40	0.69
	SCE	−0.15	0.01	**−0.72**	−13.18	0.00
	SIZE	0.53	0.17	**0.17**	3.15	0.00

[a] Dependent variable: ROE.

The standardised coefficients (β) in model 2 indicate that the variables providing significant information ($p < 0.05$) for explaining the ROE, in order of their weight from highest to lowest, are $\beta_{est.SCE} = -0.72$ and $\beta_{est.SIZE\ Ln\ Assets} = 0.17$. This means that the SIZE Ln_Assets variable has a positive trend, and the SCE has a negative trend.

The results of the regression model show, according to the unstandardised coefficients (model 2), that on the one hand, if the asset size is held constant, a USD 1 increase in the SCE would cause a USD 0.15 decrease in the ROE. Based on these results, the hypothesis (H_2) regarding the existence of a negative relationship between the return on equity (ROE) and the structural capital efficiency ratio (SCE) is confirmed. These results are consistent with those obtained by Adesina (2019), Arslan and Kizil (2019), and Oppong and Pattanayak (2019), who found a negative relationship between the ROE and SCE variables. These findings ratify the assumptions of agency theory (Jensen and Meckling 1976) since companies with greater investments in structures require greater disbursements, thus decreasing their profitability. This is because they would be investing with the aim of generating greater futures and justifying to stakeholders what they are using the resources for, thus ratifying the precepts of stakeholder theory (Freeman 1984), sending signals of the good management of these resources to the market, and fulfilling the assumptions of signalling theory (Spence 1973).

Regarding the size variable, the results show that holding the SCE constant and a 1% increase in asset size results in an increase of approximately 1% (0.53/100%) in the ROE. These results confirm the hypothesis (H_5) that posits the existence of a relationship between the return on equity (ROE) and the size of the banking and financial firms co-listed in LATINEX during the period of 2014–2020. These results ratify the assumptions of

agency theory (Jensen and Meckling 1976), as companies with more assets are more likely to increase their profitability. In this way, they send signals to the market regarding the company's performance, thus ratifying the precepts of signalling theory (Spence 1973) and generating trust through the satisfaction of stakeholders' interests (Freeman 1984).

No relationship was found for hypothesis (H_4) regarding the relationship between the ROE and the VAIC. As for hypotheses H_1, H_3, and H_6, these were not included in the regression model, as the corresponding variables (CEE, HCE, and DEBT) did not show a linear, significant relationship ($p > 0.05$) in accordance with the linearity assumption.

5. Conclusions, Limitations, and Future Perspectives

In this study, we analysed the relationship between the components of IC and the profitability of Panamanian banking and financial companies listed on the Latin American Stock Exchange during the 2014–2020 period. This study was based on the VAICTM model and its HCE, SCE, and CEE coefficients, and we analysed how IC affects the financial performance of these firms. Variables such as size and indebtedness were also studied. This study makes significant contributions by including 22 companies, of which 14 belong to the banking sector and 8 to the financial sector.

The hypothesis (H_2) regarding the existence of a negative relationship between the return on equity (ROE) and the structural capital efficiency coefficient (SCE) was confirmed. The same results were found in the research by Adesina (2019), Arslan and Kizil (2019), and Oppong and Pattanayak (2019). Additionally, the hypothesis (H_5) that suggested the existence of a relationship between the return on equity (ROE) and the size of the listed banking and financial companies was also confirmed in this study. Both results are in accordance with the assumptions of agency theory (Jensen and Meckling 1976), signalling theory (Spence 1973), and stakeholder theory (Freeman 1984).

The results of this study suggest that the IQ of companies in the financial sector listed on LATINEX is mainly affected by the structural capital efficiency coefficient (SCE), with a negative relationship showing that investment in structural capital does not contribute to the profitability of companies. On the other hand, larger companies achieved higher profitability during the study period.

In this way, this study provides a significant contribution to the scientific community because the results reinforce the assumptions of agency theory (Jensen and Meckling 1976), signalling theory (Spence 1973), and stakeholder theory (Freeman 1984). In addition, the results in terms of the profitability of companies, as measured through an objective instrument, allow regulatory bodies to monitor the performance of organizations, safeguarding the interests of stakeholders.

This study was limited to a sample of companies in the banking and financial sectors listed on LATINEX. For future research, other sectors of companies listed on LATINEX could be considered. Additionally, comparisons could also be made among different sectors on LATINEX and companies listed on other stock exchanges globally, thus providing more robust conclusions. Extending the study period to analyse the effects before and after the COVID-19 pandemic would also be beneficial. It is suggested that future studies employ other IC measurement methods such as Skandia, M-VAIC, and Intellect and compare the results with different methods. In addition, other profitability metrics such as market value and Tobin's Q could also be considered. Finally, this study serves as an important reference point for the development of future research.

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