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Intellectual capital in tangible intensive firms: the case of Brazilian real estate companies

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Abstract

Purpose – The purpose of this paper is to clarify whether value created by real estate (RE) companies (tangible intensive firms) can be evaluated better using intellectual capital (IC) elements (human, structural and physical assets) or traditional accounting measures of efficiency (ROIC and profit margins).
Design/methodology/approach – Correlations and cross-sectional OLS regressions with robust standard errors were used to find relationships between variables explaining value creation. Data were collected from 2007 to 2011 for Brazilian RE firms. To measure market risk, the authors used a new approach to deal with low liquidity. VAIC and I_j ratios were used as IC proxies even though both have limitations.
Findings – IC has a significant inverse relationship with market value. The more valuable companies showed lower levels of IC except for CEE which explains value as much as ROIC. Also, IC does not influence market risk caused by size and leverage and does not explain ROIC.
Research limitations/implications – The limitations of this study result from time and proxy variables. IC was measured by a VAIC model using data from a period of intense volatility. To increase the robustness of the conclusions, other variables should be used as proxies for IC and the results compared. The VAIC model has certain deficiencies in measuring IC.
Practical implications – Managers and investors in the RE sector need to change the way they create value and measure value creation. The low level of HC explaining either ROIC or market value is a signal of low innovation which, combined with high CEE, induces a short-term outlook.
Originality/value – This study opens discussion of IC in the Brazilian RE sector. A new methodology for identifying value creation is necessary for better evaluation and determining the fair value of firms.

Keywords Intellectual capital, VAIC, Real estate, Real estate firms, Tangible intensive firms
Paper type Research paper

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Introduction

A variety of models have been designed to evaluate intellectual capital (IC) and its components in knowledge-based firms, especially in intangible intensive corporations such as pharmaceuticals and IT firms. However, firms using intensive capital to create value have had few approaches in the IC community.

Knowledge companies create value from their knowledge assets such as human capital and innovation (Sullivan and Sproule, 1993; Sullivan and O'Shaughnessy, 1999; Sullivan, 1998, 1999a, b), but they may still use large amounts of physical capital. Since IC and physical assets can create barriers, and therefore also competitive advantages, both knowledge and capital assets can be concurrently important.

Although this concept is well known, is has not been applied or empirically tested much for tangible firms, classified as those from industrial sectors or less dependent on knowledge for creating value. Most research focusses on sectors where tangibles are less important than intangibles.

This paper aims to clarify whether real estate (RE) companies (tangible intensive firms) can be better evaluated using their IC components (human, structural and

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physical assets) or traditional accounting measures of efficiency such as return on invested capital (ROIC) and profit margins, to explain the value created by these firms.

Traditional accounting reports and indicators lack the potential to determine the fair value of either tangible or intangible firms. Using the market-to-book indicator to measure the distance between book value and market value, it is noted high ratios for both kinds of firms.

In developing countries, the issue of what creates value and how to measure it is crucial for directing new investments. Known as non-R&D companies, firms in developing countries have in recent years invested greater efforts in IC components, especially in Latin America where natural resources remain the most important driver of value in almost all countries.

In Brazilian companies, the RE sector drives development and can be used as an indicator of growth and government incentives. This sector is known as tangible intensive, although the dispersion of value created in this market in recent years has triggered discussion on how to identify value drivers what cannot be explained only through capital access and use.

For this reason, the first gap in literature is test if financial indicators really do not explain value in tangible firms. The second gap is to see what parts of IC can better explain the value generated by tangible companies, especially capital intensive companies such as RE firms.

Why study IC in RE?

Ever since the 1960s, the RE sector in Brazil has represented more than 10 percent of GDP (IBGE – Brazilian Economy and Census Bureau), with large companies providing services either to the government (infrastructure) or private customers (residential and commercial). However, before 2005, BMF and BOVESPA, the Brazilian stock exchange, did not have any listed RE companies.

Between 2005 and 2008, 27 RE companies went public, raising more than US$8 billion. In the same period, the market-to-book ratio (I_j) reached an average of 4. Although this seems an expected ratio denoting value creation, unclear further studies and simulations found a ratio of two as the most feasible for the sector at that time (Rocha Lima and Gregório, 2006; Rocha Lima, 2007).

The average results of I_j, Value Added Intellectual Capital (VAIC), IRE (the RE stock market index) and ROIC between 2007 and 2011 are found in Figure 1. The market-to-book average ratio (I_j) drops to 1.41 in March of 2012,

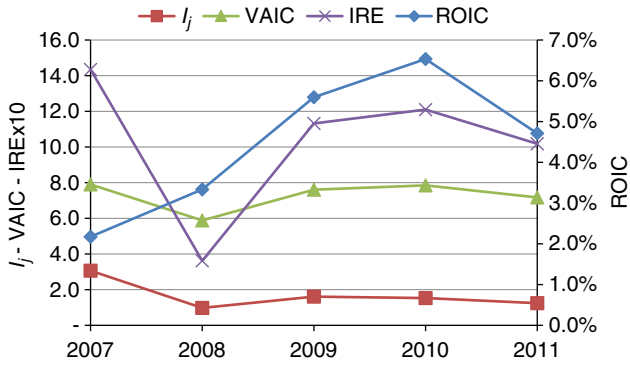

Figure 1.
Financial and IC performance of Brazilian real estate companies (2007-2011)

although the reasons given by RE executives vary. Changes in business models, wrong decisions, and higher costs of construction were the main reasons proffered. Regardless of the causes, identifying the fair value of RE companies is a challenge for investors.

There are two different kinds of RE companies. The first group consists of developing companies (RRE), mainly focussed on producing residential units and office spaces. These companies identify demand in specific areas and build for the right customers with the right funding system. A mixture of direct funding and financial instruments are used.

The second group, termed Income Real Estate Companies (CRE), comprises companies that exploit the income from RE developments such as shopping malls and commercial building. Investors need to identify the value creation process of each company and its IC, or the efficiency with which the companies use their resources to create value. Whether IC or financial performance better explains value creation, the findings can shape further analysts and suggest to investors how to measure and evaluate firms in the sector.

The traditional finance literature cannot explain value in the sector as the financial indicators show and either IC frameworks were tested before to identify what is more important to create value in the sector.

Market analysts perceive difficulty in determining the fair value of a RE firm (Rocha Lima and Gregório, 2006). Using indirect ways to measure firm value as price-earnings ratios or looking at the past as profitability ratios are broadly recognized as weak measures of value creation (Copeland *et al.*, 2005). The investors can be not recognizing the fair value of a RE company, as in the following Hypothesis:

H1. Financial performance (ROIC and profit margins) explains value in RE firms.

IC literature review

Since the 1990s, many models have been proposed to measure, identify and evaluate IC, but they are based on the same principles with different terminology or few practical additions, as pointed out by Bontis (2001).

Andriessen (2004) attempts to clarify these models by creating a matrix to classify the proposed models along two dimensions:

(1) why measure (motivation); and

(2) how to measure.

The "why" axis was divided into the three main motivations the authors had in creating the models.

The first reason was "improving internal management." This motivation should not be confused with management by management itself, but is a clear and meaningful purpose as described by Kaplan and Norton (1992) using the balanced scorecard (BSC) – translating business strategy into action – for getting better tools to create incentive design among employees and executives. Economic value added (EVA) is used largely for this purpose.

Apart from internal management, the motivation can be to improve external reporting. In this category there are studies on IC, such as Skandia Navigator (Edvinsson and Malone, 1998) or the market-to-book index, which tries to find the reasons for the difference between market value and book value. The third motivation proposed by Andriessen (2004) is "transactional and statutory motives." This dimension includes models to help transactions where the asset involved is intangible, such as intellectual property rights.

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The "how" axis of Andriessen's (2004) classification shows the output of each model. The author divides the models into monetary terms (financial valuation), items which reflect the value and can be observed, although not in monetary terms (value measurement), those that cannot be observed and need a judgment (value assessment), or those that do not reflect value (measurement).

To identify IC and direct new investments, the model proposed must be correlated to the firm value and have data available. All models classified by Andriessen (2004) fail in this important aspect. EVA, proposed by Stewart (1991), has so far been used as an incentive for executives and has a low correlation with market value (Copeland *et al.*, 2005). EVA was proposed to show economic profit rather than to evaluate IC.

Skandia Navigator (Edvinsson and Malone, 1998) is no longer used for several reasons. The indicators created do not show direction or correlation with value, and investor analysis is difficult so they prefer to use traditional financial ratios. The absence of comparison with other companies is also a barrier to using Skandia as a measure of IC (Bontis, 2001).

The BSC and other internal models can be very useful for managers. In this case, how investors and shareholders evaluate the impact of these models in terms of firm value is a difficult problem. Besides, as with EVA, the models are not intended to measure IC and models such as the BSC have features that prevent empirical testing. Only in-depth case studies can measure the effectiveness of the model in measuring IC.

Emadzadeh *et al.* (2013) tested the BSC and its relation to creating value. The authors created a relationship between two frameworks, the BSC and IC factors (human, relational, and structural) and surveyed employees to determine the relationship between knowledge of the companies' strategy and financial performance.

Even though the authors found a relationship, this indirect way to measure IC has several failings, as it counts on opinions, not disclosure data, to identify value. This fact goes to the wrong way of what investors, analysts, and the stock exchange commission of any country desire (Copeland *et al.*, 2010; Mindlin, 2012).

Marr and Schiuma (2004) emphasize the importance of IC in creating value and of applying rigorous research methods to measure the effectiveness of each existing model. The VAIC model (Pulic, 2000, 2004) has the main characteristic of being simple to test empirically, as it uses disclosure data from financial statements.

VAIC is classified in the Andriessen (2004) matrix as "improving external reporting" and "value measurement." Because of its features, VAIC has been applied to measure IC and value creation in a variety of industries such as pharmaceuticals (Mehralian *et al.*, 2012; Kamath, 2008), hospitality (Laing *et al.*, 2010), food (Khani *et al.*, 2011), finance and banking (Ahmadi *et al.*, 2011; Joshi *et al.*, 2010; Ting and Lean, 2009), higher education (Helm Stevens, 2011), manufacturing (Phusavat *et al.*, 2011) and textiles (Pal and Soriya, 2012).

However, finding the fair value from current disclosure data are not classified by Andriessen (2004), although this is discussed by Pulic (2000). Lev (2001) argues that the traditional accounting system fails in this respect and proposes an accounting model based on value drivers rather than on assets and liabilities.

Although it does not show fair value, Pulic (2000) uses a model based on the efficiency of resources to explain the value creation process. Through empirical tests of more than 1,000 European companies, Pulic (2004) finds that there is sometimes an inverse relationship between the IC index (the author uses VAIC as a measure of IC) and current performance.

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These findings suggest that traditional financial ratios measure past value creation by firms, while IC ratios show future value (cash flow). Companies that use less IC to create value, such as RE firms, can explain their values with traditional financial ratios.

Some researchers, including Stahle *et al.* (2011) and Iazzolino *et al.* (2013), criticize VAIC as a measure of IC, classifying the model as a measure of a company's labor and capital investment efficiency. The question arises whether a company which has a greater level of IC has a greater level of efficiency and if the efficiency can be measured by financial indicators.

VAIC fails as the only way to measure IC if used to compare several distinct business models or industries (Stahle *et al.*, 2011). This paper evaluates one kind of business model, residential RE companies, supporting the use of VAIC as a proxy of IC.

Even with VAIC limitations, there are important relations between some parts of the VAIC model and market value or financial performance, Zéghal and Maaloul (2010) find in high-tech UK companies. Maditinos *et al.* (2011) test whether IC measured by VAIC has a relationship with market value and financial performance in Greek companies.

The answer to the second issue of the use of VAIC as IC proxy is relatively simple. Financial indicators are reliable to evaluate a company's efficiency due the fact that finance measures the impact of managers' decisions. IC impacts financial indicators, and must be measured. Greater levels of IC and its sources (human capital, relational capital and structural capital) affect the efficiency of a company and VAIC is an efficiency measure related to IC.

Nevertheless, market value is controlled by expectations about the future (Copeland *et al.*, 2005; Copeland and Dolgoff, 2008), and even if EVA is high or ROIC is low, the market value can show no signs of turbulence this performance was already expected.

If expectations guide the market (Copeland *et al.*, 2005), more IC means greater future value, and the model proposed by Pulic (2004) captures the effect of value creation even if VAIC cannot.

The following hypotheses then arise and are validated if the market evaluates IC in projections, at least indirectly, by considering brand, reputation, strategic alliances, and other value drivers in the analysis:

H2. Greater IC indicates better financial performance (ROIC) in RE firms.

H3. Greater IC indicates better market value (I_j) of RE firms.

Lev (2001), however, suggests that one of the most important issues concerning the difference between the fair value and what is actually calculated is the effect of information asymmetry, as if the market were using a rearview mirror to determine the future.

Whether RE firms use more capital than IC to create value, and how the accounting system discloses typical assets rather than value drivers, the hypothesis of Lev (2001) that information asymmetry occurs can be measured by VAIC as in the following hypothesis:

H4. Companies with low IC have lower risk (β).

The use of disclosure data are important when market value is discussed. The use of causal maps (Montemari and Nielsen, 2013) or relations between the BSC and market value (Emadzadeh *et al.*, 2013) could broadcast major problems in corporate governance.

The first problem is the fact of causal maps or strategic maps must be shape for unique business models. Patterns are an important field in corporate governance.

The second problem is disclosure internal process and data putting in risk some competitive advantages avoiding the will of managers in to do so.

Research methodology

Data

A sample of 31 Brazilian RE companies (Table I) was studied over a five-year period (2007-2011). This sample corresponds to all the public companies in this sector in Brazil. The financial data are extracted from Comissao de Valores Mobiliarios (CVM)[1] and the stock prices are compiled from ComDinheiro.com and the available data corresponding to the 21 companies.

The data for companies that have undergone M&A or no longer exist are included in the sample, although many of them did not operate for the whole period. The database includes companies with low liquidity and a new methodology for calculating the β's is applied and described below.

Firm	Ticker	Type	ROIC (%)	I_j	VAIC	HCE	SCE	CEE
Residential real estate								
Abyara	ABYA3	RRE	3.20	1.32	8.55	7.65	0.82	0.07
Agra	AGIN3	RRE	1.72	1.22	4.92	4.24	0.63	0.06
Brookfield	BISA3	RRE	4.99	1.16	7.86	6.92	0.84	0.10
CCDI	CCIM3	RRE	1.62	1.12	2.87	2.90	−0.11	0.08
CR2	CRDE3	RRE	0.22	1.45	7.44	6.52	0.83	0.09
Cyrela	CYRE3	RRE	5.35	1.68	6.01	5.10	0.80	0.12
Direcional	DIRR3	RRE	8.54	1.90	2.85	−0.30	3.16	−0.01
Even	EVEN3	RRE	5.56	1.57	5.20	4.28	0.76	0.17
EzTec	EZTC3	RRE	9.14	1.74	8.98	7.87	0.87	0.24
Gafisa	GFSA3	RRE	4.60	1.82	5.99	4.97	0.79	0.22
Helbor	HBOR3	RRE	4.92	1.27	16.87	15.81	0.93	0.13
JHSF	JHSF3	RRE	9.87	1.80	8.05	7.63	0.87	0.20
Klabin	KSSA3	RRE	3.89	1.27	10.07	9.09	0.87	0.10
MRV	MRVE3	RRE	6.12	2.24	5.99	4.97	0.79	0.22
PDG	PDGR3	RRE	4.71	1.68	8.05	7.10	0.85	0.09
Rodobens	RDNI3	RRE	2.30	1.63	1.77	−0.02	1.99	−0.01
Rossi residencial	RSID3	RRE	3.04	1.83	7.00	5.36	0.80	0.15
Tecnisa	TCSA3	RRE	6.99	2.18	5.61	4.72	0.79	0.10
Tenda	TEND3	RRE	−0.19	1.42	3.09	2.66	0.30	0.12
Trisul	TRIS3	RRE	2.71	1.09	5.35	4.48	0.77	0.09
Viver	VIVR3	RRE	−1.63	1.17	0.96	1.30	−0.43	0.10
			4.18	1.55	6.36	5.39	0.85	0.12
Commercial real estate								
Aliansce	ALSC3	CRE	4.16	1.48	9.25	8.30	0.88	0.07
BHG	BHGR3	CRE	−0.04	3.27	1.10	1.14	−0.08	0.04
BR malls	BRML3	CRE	4.93	1.37	10.03	9.07	0.89	0.07
BR properties	BRPR3	CRE	6.25	1.07	13.78	12.79	0.92	0.06
Cyrela commercial properties	CCPR3	CRE	0.81	1.99	6.20	5.27	0.80	0.12
General shopping	GSHP3	CRE	3.97	1.37	1.59	−0.77	2.37	−0.01
Iguatemi	IGTA3	CRE	5.94	2.17	8.74	7.72	0.87	0.16
Multiplan	MULT3	CRE	4.83	1.96	12.40	11.34	0.91	0.15
São Carlos	SCAR3	CRE	8.17	1.80	12.29	11.22	0.91	0.17
Sonae-Sierra	SSBR3	CRE	7.56	1.09	11.53	10.53	0.90	0.10
			4.66	1.76	8.69	7.66	0.94	0.09

Table I.
Sample firms and the average financial results and IC components for 2007-2011

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Methodology

The VAIC model and its components proposed by Pulic (2004) were used as a proxy for IC. The market-to-book ratio (I_j) was assumed to represent value, with a greater I_j indicating that a company is more valuable. The methods for testing the hypotheses are shown in Table II.

VAIC model. The VAIC model is largely used as a proxy variable of IC and represents how much new value has been created per invested monetary unit in each resource (Nazari and Herremans, 2007). The IC of a company can be measured by human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE). These efficiency is given by how much resources were employed to generate value added (VA). A company that spends fewer resource to generate VA is more efficient compared to other companies with larger expenditures. According to Pulic (2000, 2004), VA is the difference between output (revenues) and input (cost of brought-in materials, components and services) as follows:

$$\mathrm{VA} = \mathrm{OUT} - \mathrm{IN} = \mathrm{OP} + \mathrm{EC} + \mathrm{D} + \mathrm{A}$$

where OP stands for operating profit, EC is employee costs, D is depreciation and A is amortization. The terms can be rearranged defining VA as follows:

$$\mathrm{VA} = \mathrm{NR} - \mathrm{CGS} + \mathrm{EC} - \mathrm{REO}$$

where NR is net revenues, CGS is cost of goods sold and REO refers to other brought-in materials, energy and outsourced services. Pulic (2004) and other authors who use the VAIC model to explain IC efficiency do not discuss the relevance of financial revenues. In developing countries financial revenues can be representative, given the high interest rates supporting the monetary system. In the tests of VA created by the core business of the firms, financial revenue was not considered as VA.

The other components of VAIC and how to calculate them is defined as follows:

VAIC	HCE + SCE + CEE
HCE	Human Capital Efficiency; VA/HC
HC	Employee expenses (salary, wage, and taxes)
SCE	Structural Capital Efficiency; SC/VA
SC	Structural capital for the company; VA−HC
CEE	Capital employed efficiency coefficient; VA/CE
CE	Book value of the net assets; assets−cash−suppliers

Hypotheses	Dependent variable	Independent variable (expected signal)
H1: financial performance explains value in real estate firms	I_j	ROIC(+) %NOPAT(+)
H2: greater IC indicates better financial performance in real estate firms	ROIC	VAIC(+) HCE(+) SCE(+) CEE (+)
H3: greater IC indicates better market value in real estate firms	I_j	VAIC(+) HCE(?) SCE(+) CEE(+)
H4: real estate companies with less IC have less risk	β_j	VAIC(−) HCE(?) SCE(−) CEE(−)

Table II.
Hypotheses and variables

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Dependent variables. The intangibility ratio proposed by Chung and Pruitt (1994) and used by Kayo *et al.* (2006) is a simplification of Tobin's q. According to Chung and Pruitt (1994), the calculation is simpler and has an explanation capacity of 96.6 percent of the more complex Tobin's q, as calculated by the methodology proposed by Lindenberg and Ross (1981). Thus, the coefficient of intangibility, I_j, is given by:

$$I_j = \frac{MV_{on,j} + MV_{pn,j} + D_j}{A_j}$$

where $MV_{on,j}$ is the market value of ordinary shares, $MV_{pn,j}$ is the market value of preferred shares, D_j is the debt net value, and A_j is the asset's net value. Although Chung and Pruitt (1994) propose I_j to measure intangibility, if a company is valuable then the difference between book value and market value is expected to be high. Thus I_j is used as a proxy variable for market value, with a greater I_j indicating a greater perceived market value.

ROIC is one of the most common ratios for measuring financial performance (Copeland *et al.*, 2005; Ross *et al.*, 1995; Van Horne, 1995). It suggests that investment capital has evolved to the appropriate asset value premium, the NOPAT (net operating profit after taxes), as follows:

$$ROIC_{j,t} = \frac{NOPAT_{j,t}}{A_{j,t} - S_{j,t} - C_{j,t}}$$

$A_{j,t}$ are the assets of company j in period t, $S_{j,t}$ are the debts owed to suppliers (with no interest) and $C_{j,t}$ is cash and cash equivalents.

β (β_j) is the measure of risk and is calculated over a period of 360 days. Where fewer data are available, at least 90 days were considered, and other values were filtered from the database.

The most obvious problem when calculating β in developing countries is low liquidity. There are two ways to calculate β in this case. The first is simply to exclude the pairs of returns, automatically done by the major statistical packages. To avoid changes in the slope, this method is not recommended when large amounts of data are excluded. This is a feature of capital markets in developing countries.

The second approach is to exclude the pair of prices (not returns) in both dates and consider the market index, in this case IBOVESPA, which does not have the price either. Using this approach, the averages of return are changed but the slope is not, which is desirable for calculating the beta.

Independent variables

%NOPAT	NOPAT/Revenues
ROIC	In some models, the variable ROIC can be used as independent or dependent
TYPE	Dummy variable for Commercial RE (1) or Residential RE (0)

Control variables

Size (lnINVC)	Log of book value of the net assets
Debt (End)	Debt/equity ratio

Results

We first analyze the correlations among the variables as shown in Table III. VAIC is strongly correlated with HCE and ROIC is moderately correlated with %NOPAT, VAIC and HCE. Due to the effects of the correlations, %NOPAT and ROIC will be used as

independent variables in different regression models as much as VAIC and HCE as dependent variables.

To test *H1*, whether financial performance explains value perception in RE firms, the authors carried out a cross-sectional OLS regression of market value (I_j) on the explanatory and control variables as follows:

$$I_j = \beta_1 \text{ROIC} + \beta_2 \ln \text{INVc} + \beta_3 \text{END} + \beta_4 \text{TYPE (model 1)}$$

$$I_j = \beta_1 \%\text{NOPAT} + \beta_2 \ln \text{INVc} + \beta_3 \text{END} + \beta_4 \text{TYPE (model 2)}$$

The variable %NOPAT was used in a different model than ROIC, given the correlation between them. The variables lnINVc and END are control variables for size and debts. The results are reported in Table IV.

The output of OLS regression with robust standard errors is reported when the studentized Breusch-Pagan test was significant at the 5 percent level, which occurred in both models. The same was reported for all hypotheses. The coefficient of profitability (%NOPAT) and return on investment (ROIC) are significant and related to market value ($p < 0.01$) in opposite ways, negatively for NOPAT and positively for

	%NOPAT	VAIC	HCE	SCE	CEE	ATO	β	lnINVC	End	I_j
ROIC	0.467	0.483	0.429	0.212	0.351	0.121	−0.064	0.153	−0.015	−0.019
%NOPAT		0.350	0.354	0.035	−0.148	−0.347	−0.149	0.225	−0.064	−0.165
VAIC			0.955	0.240	0.365	−0.268	−0.193	0.123	0.001	0.241
HCE				−0.073	0.399	−0.258	−0.152	0.134	0.015	0.142
SCE					−0.122	−0.078	−0.237	−0.027	−0.034	0.328
CEE						0.289	0.310	0.108	−0.202	0.283
ATO							0.242	−0.080	−0.023	−0.077
Beta								0.464	0.038	−0.069
lnINVC									0.242	−0.198
End										−0.256

Table III.
Correlations among independent, dependent and control variables

	Model 1				Model 2			
	β	E	t-value	$Pr(>\|t\|)$	β	E	t-value	$Pr(>\|t\|)$
Financial measures (independent variables)								
ROIC	3.931**	1.308	3.005	0.003				
%NOPAT					−0.151**	0.050	−2.995	0.004
Control variables								
Size (INVc)	−0.019	0.051	−0.370	0.713	0.007	0.054	0.130	0.897
Debt (End)	−0.018	0.056	−0.320	0.750	−0.058	0.058	−1.000	0.320
ATO	0.159	0.268	0.592	0.555	−0.017	0.367	−0.047	0.962
Type (0 = RRE)	0.204****	0.122	1.669	0.099	0.268*	0.133	2.022	0.046
	$\hat{u}$: 0.4645 on 90 df				$\hat{u}$: 0.4823 on 90 df			
	R^2: 0.15, adjusted R^2: 0.11				R^2: 0.09, adjusted R^2: 0.04			
	F-statistic: 3.27 on 5 and 90 df				F-statistic: 1.723 on 5 and 90 df			
	p-value: 0.009				p-value: 0.138			

Notes: ***,**,*,****Significant at 0.001, 0.01, 0.05, 0.1 levels, respectively

Table IV.
Results of cross-sectional OLS with market value (I_j) as the dependent variable

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ROIC, as expected, partially confirming *H1*. The companies with low profitability in terms of %NOPAT reached high levels of market value.

To test *H2*, the following models were constructed:

$$\text{ROIC}_j = \beta_1 \text{VAIC} + \beta_2 \ln \text{INVc} + \beta_3 \text{END} + \beta_4 \%\text{NOPAT} \text{ (model 1)}$$

$$\text{ROIC}_j = \beta_1 \text{HCE} + \beta_2 \text{SCE} + \beta_3 \text{CEE} + \beta_4 \ln \text{INVc} + \beta_5 \text{END} + \beta_6 \%\text{NOPAT} \text{ (model 2)}$$

The first model tests IC (VAIC) and the second tests its components. IC and its components showed different levels of significance (Table V), but all were significant and positively related at least 5 percent of confidence, supporting *H2*.

To test *H3*, the relationship between IC and market value, the same model structure was built as follows, with the first model testing IC (VAIC) and the second its components:

$$I_j = \beta_1 \text{VAIC} + \beta_2 \ln \text{INVc} + \beta_3 \text{END} + \beta_4 \text{ROIC} \text{ (model 1)}$$

$$I_j = \beta_1 \text{HCE} + \beta_2 \text{SCE} + \beta_2 \text{CEE} + \beta_3 \ln \text{INVc} + \beta_4 \text{END} + \beta_5 \text{ROIC} \text{ (model 2)}$$

ROIC is used as a control variable to explain value in RE firms. Surprisingly, IC is significant and negatively correlated in explaining value creation ($p < 0.01$), so greater IC indicates a lower market value. The IC components showed different levels of significance (Table VI). CEE is significant (positive, $p < 0.05$), while SCE and HCE are negatively correlated with market value ($p < 0.1$).

The arguments of Lev (2001) are reflected in *H4* for testing how IC influences market risk. The models were constructed as follows:

$$\beta_j = \beta_1 \text{VAIC} + \beta_2 \ln \text{INVc} + \beta_3 \text{END} \text{ (model 1)}$$

$$\beta_j = \beta_1 \text{HCE} + \beta_2 \text{SCE} + \beta_3 \text{CEE} + \beta_4 \ln \text{INVc} + \beta_5 \text{END} \text{ (model 2)}$$

The results support *H4* (Table VII). The expectation is that IC influences risk negatively, which is what happened in the sample. VAIC, HCE, SCE (positive) and CEE

	Model 1				Model 2			
	β	e	t-value	$Pr(>\|t\|)$	β	E	t-value	$Pr(>\|t\|)$
Independent variables								
Intellectual capital (VAIC)	0.004***	0.001	4.348	0.000				
Human capital (HCE)					0.001*	0.001	2.277	0.025
Structural capital (SCE)					0.013***	0.004	3.303	0.001
Capital employed (CEE)					0.286***	0.060	4.754	0.000
Control variables								
Size (INVc)	−0.001	0.004	−0.389	0.698	−0.004	0.003	−1.047	0.298
Debt (End)	−0.004	0.003	−1.582	0.117	0.002	0.003	0.746	0.458
Profitability (%NOPAT)	0.019***	0.007	2.784	0.007	0.029***	0.009	3.183	0.002
	$\hat{u}$: 0.0324 on 91 df				$\hat{u}$: 0.02729 on 89 df			
	Multiple R^2: 0.38, adjusted R^2: 0.35				Multiple R^2: 0.57, adjusted R^2: 0.54			
	F-statistic: 13.91 on 4 and 91 df				F-statistic: 19.71 on 6 and 89 df			
	p-value: 6.813e-09				p-value: 1.643e-14			

Table V.
Results of cross-sectional OLS with ROIC as the dependent variable

Notes: ***,**,*,****Significant at 0.001, 0.01, 0.05, 0.1 levels, respectively

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	Model 1				Model 2			
	β	E	t-value	$Pr(>\|t\|)$	β	E	t-value	$Pr(>\|t\|)$
Independent variables								
Intellectual capital (VAIC)	0.011	0.012	0.953	0.343				
Human capital (HCE)					0.003	0.012	0.261	0.795
Structural capital (SCE)					0.144***	0.025	5.786	0.000
Capital employed (CEE)					2.198**	0.731	3.005	0.003
Control variables								
Size (INVc)	−0.020	0.051	−0.396	0.693	−0.014	0.046	−0.299	0.766
Debt (End)	−0.049	0.059	−0.827	0.410	−0.017	0.060	−0.288	0.774
Return on investment (ROIC)	3.475*	1.529	2.273	0.025	1.453	1.456	0.998	0.321
	$\hat{u}$: 0.3934 on 57 df				$\hat{u}$: 0.3793 on 55 df			
	Multiple R^2: 0.5246				Multiple R^2: 0.5736			
	adjusted R^2: 0.4912				adjusted R^2: 0.5271			
	F-statistic: 15.72 on 4 and 57 df				F-statistic: 12.33 on 6 and 55 df			
	p-value: 9.996e-09				p-value: 9.644e-09			

Notes: ***,**,*,****Significant at 0.001, 0.01, 0.05, 0.1 levels, respectively

Table VI.
Results of cross-sectional OLS with market value (I_j) as the dependent variable

	Model 1				Model 2			
	β	E	t-value	$Pr(>\|t\|)$	β	E	t-value	$Pr(>\|t\|)$
Independent variables								
Intellectual capital (VAIC)	−0.018**	0.006	−2.964	0.004				
Human capital (HCE)					−0.029***	0.005	−5.336	0.000
Structural capital (SCE)					−0.068*	0.029	−2.315	0.023
Capital employed (CEE)					2.236***	0.406	5.511	0.000
Control variables								
Size (INVc)	0.177***	0.044	3.998	0.000	0.162***	0.043	3.772	0.000
Debt (End)	−0.014	0.024	−0.604	0.547	0.027	0.018	1.495	0.139
	$\hat{u}$: 0.3171 on 90 df				$\hat{u}$: 0.2822 on 88 df			
	Multiple R^2: 0.22, adjusted R^2: 0.20				Multiple R^2: 0.40, adjusted R^2: 0.36			
	F-statistic: 8.58 on 3 and 90 df				F-statistic: 11.63 on 5 and 88 df			
	p-value: 4.52e-05				p-value: 1.23e-08			

Notes: ***,**,*,****Significant at 0.001, 0.01, 0.05, 0.1 levels, respectively

Table VII.
Results of cross-sectional OLS with market volatility (β_j) as the dependent variable

and size (negative) are significant in explaining volatility. That is, greater size and less IC equate to a lower risk. CEE is highly related to volatility and it is the only component of VAIC model with an unexpected signal.

Conclusion

The awareness of IC and its potential to create value by improving the capacity of firms to develop competitive advantages have been recognized by some authors although the results of this research find the opposite in some ways (see Table VIII).

Pulic (2004) finds no relationship between IC and return on investment but finds evidence for value creation. The findings suggest that VAIC and its components influence the return on investment and do not influence market value in RE firms and it is clearly relating CEE and ROIC.

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Hypotheses	Dependent variable	Independent variable (expected signal)	Results[a]
H1: financial performance explains value in real estate firms	I_j	ROIC (+) %NOPAT (+)	ROIC (+) %NOPAT (–)
H2: greater IC indicates better financial performance in real estate firms	ROIC	VAIC (+) HCE (+) SCE(+) CEE (+)	VAIC (+) HCE(ns) SCE(+) CEE (+)
H3: greater IC indicates better market value in real estate firms	I_j	VAIC (+) HCE(?) SCE(+) CEE (+)	VAIC (ns) HCE(ns) SCE (+) CEE (+)
H4: real estate companies with less IC have less risk.	β_j	VAIC (–) HCE(?) SCE(–) CEE (–)	VAIC (–) HCE(–) SCE (–) CEE (+)

Table VIII.
Summary of results

Note: [a]ns, non-significant

The low or non-significance of human capital in explaining market value should open important discussions in the RE sector whether is discussed human capital or human efficiency, because both affect market value.

Although most articles about IC maintain that the disclosure of information is critical for better evaluating companies, the main challenge for RE companies is how to innovate in terms of business process and models, technology and project management in a market with high levels of capital investment. Human capital is the most relevant part of IC (e.g. Sullivan, 2000; Sveiby, 1997) because the capacity to innovate creates value.

What can explain the process of value creation such as profitability, market value, and market risk, and show different relationships with HCE? There are two possible explanations for this effect. The first is that HCE is inadequate as a proxy for the efficiency of human capital, which invalidates the use of the VAIC model when the capital invested is intense, as in the case of RE firms and other tangible companies. This is a difficult issue for RE firms given that the amount of capital employed is very high, so the market gives more attention to the relationship between investment and return than to what will sustain efficiency in the future.

Second is that RE firms do not invest their attention and resources in creating value using HC. As in Stewart (1997) and Pindyck and Rubinfeld (2000), with no differentiation, the value created is null given the investment and capital cost required. That is, EVA equals zero.

Another important finding is the lack of relationship between IC and market value, except for the IC components related to capital efficiency (SCE and CEE). The market punishes companies with high levels of IC if it does not result in high levels of financial performance. This short-term outlook can be cruel for the whole sector, which is dependent on long-term building processes.

The case of leverage in RE firms is on the edge. Debt, which is an important funding source for the whole sector, has no relationship to financial performance. If the stock market punishes firms that invest resources in HC and does not recognize debt as a source of value, executives will be encouraged to trigger the short-term outlook allied to value destruction. There are commercial RE companies where almost all assets are long term and financed, and so the business model of RE companies must be revised.

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Market risk was expected to have an inverse relationship with IC, given that greater IC without data disclosure leads to greater information asymmetry (Lev, 2001). The results show a contradiction analyzing the IC components. While CEE showed the expected signal (greater CEE means riskier firm), HCE and SCE showed that if the firm presents more IC the risk is lower. Investing in IC reduces the market value, on the other hand, reduce risk.

IC and its components should be given more attention both by executives in terms of investment and disclosure and by investors in terms of RE drivers, otherwise value will be driven by opportunity strategies, government incentives and disruptions in regulation or the demand market.

Implications for researchers and practitioners

It is not clear what explains IC in RE firms. The discussion about the business model using traditional accounting standard is at a cross-roads. Despite the many models and taxonomies that have been developed, it is now necessary to ascertain the relationships between models and value creation.

For those who study RE markets, adapting taxonomies to the business model of the sector is critical for understanding value creation. More research that focusses on tangible intensive firms or identifying the value of different levels of investment is important, as a single model cannot explain everything.

The study results may encourage managers to create new models for understanding the value creation process. RE managers need to give more attention and investment to what really matters, namely human capital and innovation. In this sector, innovation can be extrapolated to products and funding, reducing the dependence on size and leverage to reduce risk and increase market value.

Limitations of the study and future research

The limitations of this study are focussed on time and proxy variables. IC was measured by VAIC model using data from a period of intense volatility. To increase the robustness of the conclusions, other variables should be used as proxies for IC and the results compared. Stahle *et al.* (2011) point out that the VAIC model has certain deficiencies in measuring IC.

The authors suggest understanding the VAIC model as a measure of labor and capital intensity efficiency. However, it is reasonable to relate efficiency with IC, does not invalidate VAIC as a proxy of IC.

Stock market valuation is influenced by international markets, which experienced intense crises during the period studied, especially in developing countries. However, the Brazilian RE sector underwent a period of market expansion at the same time that the US RE market was failing.

Cross-border studies may increase the robustness of the conclusions by testing whether the limitations are specific to Brazil, Latin America, developing countries, or whether the theory is robust for the whole market.

Suggested future areas of research

Disclosure data of public companies must be expanded for other data available beyond financial indicators or measures. The almost exclusive use of financial ratios to measure performance can create bias in understanding how IC influences value.

Using the main structure of VAIC model (human, capital and structural) but changing the indicators should be more feasible than creating a new model to

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measure IC. VA statements have been used in Brazil since 2008 to disclosure the value (profit) created for government (society), employees, lenders and owners. Nevertheless, few studies exist relating how VA is generated and IC.

Causal maps built around RE companies create another way to relate business models to value created and can be more appropriate to measure IC when the study is conducted using one specific industry. There are several studies about what RE companies must do for competitive advantage, but none of them discusses the importance of IC in an industry with high levels of capital invested.

Note

1. CVM is the Federal Agency similar to the Securities and Exchange Commission (SEC).

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