The links between the Intellectual Capital Efficiency Ratio (ICER) and the performance of Polish listed companies from the food industry sector

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Abstract: Currently, intellectual capital (IC) plays an increasing role in value creation for companies. IC-oriented companies are those which create the greatest value for their shareholders. From this point of view, knowledge on the level of a company's intellectual capital and its constituents, in addition to standard company analysis based on information from financial statements, is necessary to obtain the full picture of the firm's standing. Intellectual capital has been a subject of many studies since the first half of 1990s. Initially, the bulk of these studies were related to methods for intellectual capital measurement. Later, interest shifted to the examination of the relationship between the level of a company's intellectual capital and different measures of a firm's performance and its other characteristics. Within the last two decades, the members of the intellectual capital community have proposed a number of methods to measure intellectual capital and its constituents. Alas, none of these methods have been commonly accepted. The problem behind the difficulties in IC measurement results from the fact that it relates to intangibles which are largely not recognized by accounting rules and therefore are not captured in financial statements. The main aim of this article is to present a new method for IC measurement – the Intellectual Capital Efficiency Ratio (ICER). The article also examines the links between the ICER and its constituents and other measures of a firm's performance. This article contributes to the development of intellectual capital theory, but also to the theory of Value-Based Management. Research was conducted based on an unbalanced panel time-series sample of 19 companies and a 72-year observation of companies from the food industry sector listed on the Warsaw Stock Exchange between 2011-2014. This study reveals a strong, significant and positive relationship between the ICER ratio and its constituents with return on assets (ROA) and return on equity (ROE) company performance measures and a significant and positive relationship between the ICER ratio and its components and shareholder value measure – price to book value (P/BV) ratio.

Keywords: Intellectual capital, company performance, intellectual capital efficiency, shareholder value.

1. Introduction

In the transition from an industrial economy to a 'knowledge based economy', intellectual capital (IC) is an important strategic asset that plays a crucial role as a source of competitive advantage and value creation for companies. The creation and efficiency of intellectual capital is crucial both for individual companies and entire economies, since companies and countries which are IC rich are the winners in terms of their capability to enhance value for shareholders' and entire nations (Edvinsson and Malone, 1997; Bounfour and Edvinsson, 2004; Lin and Edvinsson, 2008; Käpylä et.al 2012). Studies on intellectual capital have become crucial, because traditional financial statements are not sufficient for obtaining the full picture of a firm's standing and its prospects for the future. Company performance is connected with the level of its intellectual capital. In consequence, its level and sustainability determines, to a great extent, the market value of a company. However, traditional financial statements do not reflect the market value of the total of a company's assets due to the exclusion of intangible assets and intellectual capital (Roos and Roos 1997; Lev 2001; Wang 2008). Since intangible assets and intellectual capital positively influence value creation in a company and are not included in its book value, it produces a gap between its market value and book value (Roos and Roos 1997; Lev 2001). Thus, intellectual capital explains and closes the gap between the market value and book value of a company (Sveiby 1997).

Intellectual capital has become subject to extensive research which examined the relationship between its risk, value or efficiency and export performance (Pucar 2012), innovation capability (Delgado-Verde et al. 2011), business models (Liang et al. 2013), job rotation (Brunold and Durs, 2012) and board structure (Ho and Williams 2003). This research has confirmed the importance of intellectual capital for modern companies and their shareholders.
A degree of this research is related to examining the links between the intellectual capital level or efficiency and firm performance (Firer and Williams, 2003; Tseng and Goo 2005; Mention and Bontis, 2013; Hu *et al*. 2015; Chahal and Bakshi 2015). Most identify the existence of associations between IC and company performance. Therefore, since the main objective of the company is to maximize shareholder value, the size and "quality" of its intellectual capital may serve as an indirect indicator which reflects the scope within which such an objective is achieved. If this is the case, the quality of managers' actions aimed at the creation of value for shareholders, may be indirectly measured through the assessment of the results achieved in the area of intellectual capital development and efficiency. Such measures are particularly useful for companies which are not listed and therefore are not valued by the market. Intellectual

capital in a company may be measured by means of several ratios. Within the last 20 years, there have been a number of tools developed to measure intellectual capital and its constituents. Alas, none of these tools has been commonly accepted in the intellectual capital circle. This is because the reliability of the proposed instruments is limited due to their industry rooting and objectivity of the data used. One of the most popular methods - the value added intellectual coefficient VAIC™ - commonly used to measure the intellectual capital efficiency, is burdened with a number of faults which substantially restrict its usability as a reliable measuring tool to assess the effectiveness of intellectual capital.
The prerequisite to utilise any given ratio as a reliable tool for the assessment of the efficiency of a company's activities in its pursuit of value creation, is the demonstration of associations between the intellectual capital level or efficiency and the indicators of shareholder value creation.

The aim of this article is to link the efforts made by practitioners and researchers in developing an appropriate, objective and reliable measure of intellectual capital. This study presents the author's proposal for a new ratio for assessing the efficiency of a company's intellectual capital - the Intellectual Capital Efficiency Ratio (ICER). This study is motivated by the conceptual assumption about the link between intellectual capital efficiency and company performance. The article also presents a verification of the ICER as an indicator of the efficiency of intellectual capital through analysis of its associations with selected measures of company performance and shareholder value creation. Research was conducted based on panel data for 19 companies from the food industry sector listed on the Warsaw Stock Exchange for the years 2011-2014. The article begins with a brief literature review of existing methods of intellectual capital measurement methods, followed by critical analysis of VAIC™ ratio - frequently used in much research on the intellectual capital measurement method. The article continues with the presentation of the ICER structure, then the research methodology is introduced, followed by a discussion on the obtained results. The article concludes with a summary of the findings and recommendations regarding further directions of research. This paper contributes to the subject literature by the introduction of a new method for intellectual capital measurement which is based on objective, verified and available inputs from a company's financial statements.

2. Literature review

The issue of intellectual capital measurement is the subject of numerous publications in management and finance literature. In recent years, a range of methods and models have been suggested in this area that can be divided into two major categories. The first one comprises methods and models, often presented in the form of scorecards, which provide information and data on the level of intangible assets and changes in their status by means of financial and non-financial ratios - eg. Scandia Navigator (Edvinsson and Malone 1997) or Intangibles Scoreboard (Lev 2001). The second one contains methods and models assessing the global value of intellectual capital or the value of individual intangible assets - eg. Market to Book Ratio, Valuation Models (Smith and Parr 2000; Reilly and Schweihs 1999). The choice of the specific measurement model is determined by the purpose it is intended to serve as well as the availability of data.

In terms of using intellectual capital measurement methods to manage a company's goodwill and to compare the efficiency of this process in different companies, the most commonly utilised methods are single-ratio models, where assessment is performed on the basis of publicly available information about a company. Many researchers recognize the value of intellectual capital simply as the difference between the market value and book value of a firm (Edvinsson and Malone, 1997; Stewart, 1997). Although this difference (if positive) can be perceived as a sign of the existence of intellectual capital, it cannot be treated as equivalent to its value.

One of the methods most popularly used to research intellectual capital performance in companies is the Value Added Intellectual Coefficient (VAIC) by A. Pulic (2000). Since the VAIC method utilises publicly available data from financial statements, it has been widely used to compare the intellectual capital of various companies in different countries. And yet, the VAIC method as an intellectual capital measurement is burdened with several drawbacks of a methodological nature, which is reflected in the trenchant criticism expressed, for instance, by D. Andriessen (2004).
The structure of the VAIC method raises serious doubts. First of all, the inclusion of labour force costs into value added, which is the measurement of operational efficiency, stands in opposition to the fundamental objective of the company, understood as shareholder value maximisation. Shareholders are interested in the value that they can share (profit), and not in value (value added), which is mainly consumed by the factor of production (labour force). Another source of doubt is the manner in which the constituent ratios of VAIC were developed. The ratio describing the efficiency of the capital employed is the quotient of the value added and the net assets. It is, therefore, a questionable solution to apply capital employed (shareholders' equity capital) as a measuring instrument. While creating the value added on the basis of its operating profit, a company utilises, for its business activity, both its equity (shareholders)

capital and debt to finance its operations. Thus, the return on the capital employed should be calculated in reference to its total value, and not merely to shareholder capital. Otherwise, with different factors constant, companies with a higher level of debt, record greater efficiency of their equity capital employed.

Another doubt is raised by the fact that a company's structural capital is assessed as the difference between value added and cost of labour. In such a measuring method, the human and structural capitals are perceived as substitutes – the more structural capital employed there is, the less human capital, and vice versa. Such an approach results in a different way of calculating human capital efficiency - as the relation of value added to cost of labour, and structural capital efficiency - as the relation of structural capital to value added. This simple trick allows the avoidance of the issue of structural and human capital efficiency ratios changing in reverse directions, together with, for example, the change in a company's operating profit, but without any alternations to other constituents. As pointed out by D. Andriessen (2004), the applied structure of efficiency ratios results in the efficiency ratio of human capital being permanently greater than the efficiency ratio of structural capital, whenever the operating cost is higher than zero. In reality, these two types of capital do not substitute one another in the process of value creation, but they are rather complementary to each other.

Despite the many doubts related to the method, the original VAIC method and its modifications (eg. Chang and Hsieh 2011) have gained substantial popularity and acclaim in the scientific community, where it is used as a universal intellectual capital measurement ratio which is commonly utilized in research on the efficiency of intellectual capital.
It is worth emphasizing the fact that the method is widely applied in statistical analysis, in particular, in scientific publications regarding the emerging markets such as, Russia (Molodchik and Bykova, 2011), Slovakia (Holienka and Pilkova, 2014), Malaysia (Gan and Saleh, 2008), Pakistan (Rehman et. al, 2011) or Bangladesh (Mohiuddin et al. 2006). As far as developed countries are concerned, VAIC is used on a noticeably narrower scale, for example in Great Britain (Zeghal and Maaloul, 2010) or Spain (Díez et al. 2010), Taiwan (Chen et al., 2005), Greece (Maditinos et al. 2011). The lesser popularity of VAIC in developed countries can be explained by their greater information culture, which offers researchers access to more detailed and verified data that can be used to perform analyses of the impact of intellectual capital and its constituents on the creation of company value.

In my opinion, the fundamental faults of the VAIC method outweight its advantages and, in consequence, the application of this coefficient as a reliable measure to assess the efficiency of intellectual capital is questionable. Due to the abovementioned faults, direct application of the VAIC method in accordance with its basic principles renders the acquired analytic results of little reliability, their informative value and, at the same time, their practical usability being greatly limited.

However, this does not mean that the very idea behind the method, which can be defined as the application in calculations of verified publicly available financial data, should be rejected. The development – on the basis of such data – of a simple ratio whose structure shall, to a greater extent than is in the case of the VAIC, follow the rules governing the theory of finance and the theory of intellectual capital management, may lead to the creation of a tool whose informative value and application capacities are far greater.

On the basis of the critical analysis preformed above, it is possible to determine the features which should characterise the ratio assessing the effectiveness of intellectual capital in a company. The structure of such a ratio should be consistent with the fundamental principles of corporate finance theory. In order to be used for the purposes of comparison between companies, the ratio should be relatively straightforward and based on publicly available data from financial statements. Since intellectual capital is a significant source of value creation, the ratio describing its level in a company ought to be associated with the miscellaneous measures of company performance – eg. return on assets (ROA), return on equity (ROE), as well as a measure of shareholder value creation – eg. total annual shareholders return (TSR), market value/book value (P/BV).

3. Defining of the Intellectual Capital Efficiency Ratio (ICER)

The proposed measure - the Intellectual Capital Efficiency Ratio (ICER) - is an attempt to meet the needs for a versatile instrument to measure intellectual capital efficiency which is based on publicly available data comparable for different companies. This requirement limits the range of data on which the instrument may be based to the balance sheet, profit and loss account items and notes.

The value and, indirectly, the efficiency of the company's intellectual capital, is reflected in the price to book value ratio. The better the 'quality' of intellectual capital, the majority of whose constituents are not reflected in the balance sheet, the greater the difference between the company's market value and its book value. This stems from the fact that, according to the Resource Based View of a company (Barney 1991; Grant 1991), tangible or balance sheet assets, due to their similarity and common availability, can generate only 'normal' return on the level of the cost of capital employed for their utilization. In consequence, the excess return – an economic profit – is generated by the off-balance-sheet intellectual capital of the company. The impact of the intellectual capital on a company's value can be analysed with a financial model which identifies the key determinants of value creation. This model is represented by the following equation [Koller et. al. 2005]:

$$value = IC_0 + \frac{Economic\ Profit_1}{wacc - g},$$

where:
IC_0 – invested capital,
Economic $Profit_1$ = IC_0 x (ROIC – wacc)
ROIC – return at invested capital,
Wacc –weighted average cost of capital,
g – operating profit growth rate.

According to this equation, a company's value equals the book value of its invested capital plus the present value of all future economic profits. Intellectual capital positively influences a company's profitability (ROIC) and, consequently, its economic profit in the future. The higher the economic profits the higher the company's market value in relation to its book value. Thus, the methods to verify the ICER as a measure of the efficiency of intellectual capital could be the analysis of its association with market value/book value ratio as well as with the return on assets (ROA) and return on equity (ROE).

The Intellectual Capital Efficiency Ratio (ICER) methodology relies on the concept by L. Edvinsson (Edvinsson and Malone 1997), in which a company's intellectual capital is divided into human and structural capital[1]. Hence, relational capital is omitted here as a separate constituent of intellectual capital, mainly due to the requirement of simplicity of the methodology and the fact that the method should be based on publicly available data (there is no data directly referring to relational capital in a company's financial statements). Thus, the assumption is made that the relational capital constitutes part of a company's structural capital. A theoretical extended balance sheet of a company, including all constituents forming its value, has been presented in table 1:

Table 1: Extended balance sheet of a company

Assets	Liabilities
Fixed assets	Book equity capital
Current assets	Debt
Human capital (off-balance-sheet)	Excess value of equity capital
Structural capital (off-balance-sheet)	

In this representation, a company's intellectual capital constitutes its assets which are responsible for the 'excess' in the market value of equity capital over its book value. Balance-sheet assets (fixed and current) together with intellectual capital contribute to the creation of a company's value added.

The total value added (VA) generated annually by all a company's assets can be calculated by means of the following equation:

$$VA = EBIT + depreciation = EBITDA$$

where

[1] The methodology of ICER calculation was first proposed by Urbanek in the paper presented during ECIC Conference in Venice held at Ca' Foscari University, San Giobbe Campus on the 12th – 13th of May

EBIT - earnings before interest and tax,
EBITDA – earnings before interest, tax and depreciation.

Value added defined in such a way is identical to cash flows generated by a company, without financing its growth. The inclusion of income tax in the VA calculation stems from the fact that the subject of analysis is the generated value (added), regardless of its beneficiary (shareholders, lenders or state).

Contrary to the VAIC ratio, in the case of the Intellectual Capital Efficiency Ratio (ICER), labour expenses are not treated as a part of value added. This results from the fact that shareholder value maximisation is assumed to be a fundamental criterion of the assessment of a company's business operational efficiency. The shareholders are interested in the value that they can distribute between themselves (after meeting claims of debtholders and tax obligations), and not in the value which, from their point of view, constitutes a cost (employees' salaries).

Certain models used to assess intellectual capital determine it by excluding from the total value added generated by all a company's assets (on and off balance sheet), the part of value added which is allocated to balance sheet assets with respect to the amount of risk associated with a given type of assets (Smith and Parr 2000; Lev 2001). For this purpose, they use the concept of the required rate of return on a given type of asset (eg. physical and financial) employed by a company. However, calculation of the required rate of return for a given type of asset is, to large extent, arbitrary and difficult to justify based on the theory of asset pricing. Therefore, what appears to be more appropriate is to perform an analysis on the total value added figure, having in mind the fact that it is generated by both - balance-sheet assets and intellectual capital.

In the ICER measure, the generated value added (VA) refers to the variables which describe the level of human and structural capital engagement in a company's operations. As stated previously, the fundamental requirement behind the ICER measure is that it is based on verified, standardised and publicly available data. Therefore, for the construction of ICER, it is only acceptable to utilise information from financial statements, i.e. balance sheet, profit and loss account and notes. Since human and structural capital are not disclosed on the company balance sheet, figures that can serve as proxies of their engagement in a company's operations have to be found. It is assumed therefore, that the amount (value) of a given type of asset engaged is related to the level of annual costs incurred by a company which could be assigned to these assets. In other words, the level of expenses related to the given type of assets is a proxy of their value. In reference to all types of a company's assets (on and off-balance sheet), the corresponding types of costs may be assigned. It is worth remembering that the assignment of specific costs by type to particular types of assets is, apart from the cost of employees, approximate by nature. These costs are related mainly, but not exclusively, to a given type of asset – table 2.

Table 2: Assignment of the costs by type to the class of assets

Type of assets	Related costs by type
Fixed and current assets	Depreciation and amortization Costs of materials and energy
Human capital	Remunerations and benefits
Structural capital	Subcontracting Fees and taxes Other costs by type

The total ICER ratio is the sum of human capital efficiency ratio and structural capital efficiency ratio less balance sheet assets efficiency ratio. The first step in estimating the ICER ratio is the calculation of the human capital efficiency ratio. It is not feasible to reliably allocate the total value added created by a company between balance sheet assets and the two types of intellectual capital assets – human capital and structural capital - since value added is "produced" jointly by all types of a company's assets in the process of complex interactions. However, the efficiency of both types of intellectual capital and balance sheet assets could be assessed based on total value added. As far as human capital is concerned, its efficiency (HCIE) can be calculated by directly relating the generated value added to the costs incurred on human capital in a given year, using the following equation:

$$HCIE = \frac{VA}{HCC}$$

where HCC stands for the cost of remunerations and benefits.

The HCIE ratio can be interpreted as the amount of value added for each unit invested in the payment for human capital in the form of remuneration and benefits paid to employees. The higher the HCIE ratio, the greater the efficiency of human capital.

The calculation of the efficiency of structural capital is, however, substantially more complicated than in the case of human capital. This is because no direct information on the costs incurred by a company on its structural capital can be found in its financial statements. Such expenditures which constitute part of a company's operating costs are for example: IT purchases, investments in R&D, marketing expenses, the costs of the maintenance of its IT infrastructure. If such data were available, the structural capital efficiency ratio could be based on the costs directly related to structural capital. Due to the lack of data, structural capital efficiency has to be calculated indirectly, through the reference of the value added generated by a company to the costs by type, which include the following items: subcontracting, fees and taxes and other costs by type. Adoption of the proposed procedure to calculate the efficiency of structural capital can be justified in the following logic. Structural capital constitutes mainly off-balance sheet factors such as brands, technological knowledge and know-how, customer relationships, procedures, developed codes of practice, etc. These factors are a company's assets in an economic sense, i.e. they have the ability to create financial benefits for the company, which is reflected in the value added. Therefore, the more effective the structural capital, the greater the value added of a company and the higher the ratio of value added to the costs related to structural capital incurred by the company. This stems from the fact that the constituents of structural capital trigger an increase in the efficiency of a company's activity in terms of the relation between results and expenses. For instance, a strong brand or marketable patent allow the company to generate additional income which is greater than patent fees or the expenses incurred to maintain the market position of the brand.

Thus, the structural capital efficiency (SCIE) is calculated using the following equation:

$$SCIE = \frac{VA}{OCLSD}$$

where OCLSD stands for costs by type connected with structural capital.

The SCIE ratio should be interpreted in the following manner – it is the value added for each unit of costs related to structural capital. Despite the fact that the denominator is related to a broader range of costs, going beyond the costs of structural capital, it is justified to assume that the higher the SCIE ratio, the greater the structural capital efficiency of a company.

When assessing a company's activity on the basis of the structural capital efficiency calculated in that manner, one should bear in mind a special case in which a company with small structural capital makes intensive investments to develop and expand this type of intellectual asset. Since there is a delay between the expenditures for structural capital and the achieved results, the structural capital efficiency ratio decreases (the value added in the numerator decreases, whereas the value of the selected costs by type in the denominator increases). This means that the lower value of the ratio accurately reflects reality – a company is developing its structural capital, and thus, its current efficiency is low, despite this, the assessment of a company's activity should be positive, because the company is creating a base to improve its position in the future.

Finally, since balance sheet assets are responsible for the creation of a part of value added (VA), their influence has to be included in the calculation of the intellectual capital efficiency ratio (ICER). Otherwise, the ICER level would be overestimated as a result of the fact that the "share" of balance sheet assets in value added is not taken into account. The question here is, how to estimate this "share" in the overall efficiency of a company. The direct reference of total value added into costs associated with balance sheet assets (as done in the case of human capital and structural capital efficiency ratios) would not work correctly. This is because the efficiency of balance sheet assets is "fixed" and does not depend on the level of value added created by a company. Balance sheet assets are "standardized" across different companies and they can generate only standard (fixed) returns. The differences in returns between various companies are the result of differences in the level and efficiency of their intellectual capital. Because there is no

"natural" rate of return that can be assigned to balance sheet assets, it has to be estimated indirectly, based on proxy measures. In the proposed approach, the balance sheet assets efficiency ratio (BSE) is calculated using the following equation:

$$BSE = \frac{BSC}{TCT}$$

Where BSC stands for costs connected with balance sheet assets (costs of materials and energy and costs of depreciation and amortization). TCT stands for total costs by type incurred by a company. BSE modifies the ICER ratio in order to include the effect of the influence of balance sheet assets on value added. The higher the BSE ratio (which means the higher the share of costs connected with the balance sheet assets in a company's costs structure) the lower the combined efficiency of structural and human capitals - the ICER ratio.
The total value of the ICER ratio can be calculated with the following equation:

$$ICER = HCIE + SCIE - BSE$$

It is worth noticing that the HCIE and SCIE constituents of the formula will change as a matter of principle in the same direction, which is coherent with the assumption that the two constituents of intellectual capital, i.e. human and structural capital, complement and strengthen one another in the process of value creation. A higher quality of human capital results in an improvement of internal processes in a company, whereas improved internal processes, an appropriate organizational culture, etc. trigger the growth of human capital productivity. The growth of value added (VA) may result from an improvement in the level of a company's operations (higher sales) or efficiency (a decrease in various categories of operating costs). For example, the employment of additional staff (or wage growth) will translate into an increase of intellectual capital efficiency only if it is accompanied by an appropriate increase of value added. Analogically, the growth of expenses connected with structural capital which is related to a company's intensified business activity, will cause an increase in intellectual capital efficiency if it is related to sufficient growth of value added.
The ratio of intellectual value added is structured to meet the preliminary conditions stipulated in the previous paragraph for the universal ratio of a company's intellectual capital. Firstly, it is based on the data published in the financial statements of companies. Secondly, it is consistent with the views on creating value by intellectual capital, according to which intellectual capital is 'responsible' for a return higher than the threshold required for the employed balance sheet assets. And finally, the structure of the ratio is consistent with the principles of asset valuation and exclusively takes into consideration the operating activities of a company.

4. Research hypotheses and research method

4.1 Hypotheses

In order to verify the ICER ratio and its components as an appropriate measure of intellectual capital efficiency, four hypotheses were tested:

Hypothesis 1: *There is a positive association between the ICER ratio and company performance measures – ROA, ROE.*

Hypothesis 2: *There is a positive association between the ICER ratio and shareholder value creation measures – annual total shareholders return, P/BV.*

Hypothesis 3: *There is a positive association between the SCIE and HCIE ratios and company performance measures – ROA, ROE.*

Hypothesis 4*: There is a positive association between the SCIE and HCIE ratios and shareholder value creation measures – annual total shareholder return, P/BV.*

4.2 Sample

The sample consists of 19 companies listed on the Warsaw Stock Exchange for the years 2011-2014. This results in an unbalanced panel sample of 19 companies and a 72 firm-year observation. Data was derived from annual reports and annual financial statements. The sample concentrates only on companies from the food industry, since this industry is perceived as intangibles-rich, due to intensive utilization of brands.

4.3 Variables

The following model is used for testing the hypothesis:

$$Y_i = \alpha_i + \beta X_i + \gamma Z_i + \varepsilon_i$$

where: the Y_i vector contains the dependent variables. i.e., return on assets (ROA) – model 1, return on equity (ROE) – model 2, total shareholder return (TSR) – model 3, and price / book value ratio (P/BV) – model 4. The X_i vector includes independent variables, i.e. the Intellectual Capital Efficiency Ratio (ICER), the Human Capital Efficiency Ratio (HCIE) and the Structural Capital Efficiency Ratio (SCIE). The Z_i vector consists of the control variables which can have an influence on company performance, specifically company size (total assets transformed with a natural logarithm - LnA), while ε_{it} describes random disturbance.

5. Results

5.1 Descriptive statistics

Table 2 presents the descriptive statistics and correlation matrix for the variables considered. The mean of return on assets is 0.0488 with standard deviation of 0.1267 and the mean of return on equity is -0.0681 with standard deviation of 0.7512. The mean of total annual shareholder return (TSR) is 0.0511 with standard deviation of 0.5513. The mean of P/BV ratio is 1.1432 with standard deviation of 1.0257. The average level of P/BV ratio above unit means that, on average, companies in the sample possess some intellectual capital (excess of market value over book value). The mean of the Intellectual Capital Efficiency Ratio (ICER) across the entire sample is 1.3433. The mean of human capital efficiency (HCIE) is 1.0257 and the mean of structural capital efficiency (SCIE) is 0.9659.

Correlation analysis provides an initial preview for the analysis of associations between dependent and independent variables. Table 2 shows the results of Pearson pair-wise analysis. It indicates that the ROA and ROE ratios are significantly positively associated ($p<0.01$ or $p<0.01$) with the ICER, HCIE and SCIE indicators of intellectual capital efficiency, the P/BV ratio is significantly positively associated ($p<0.05$) only with the HCIE indicator, while the TSR measure is not significantly associated with the ICER, HCIE and SCIE indicators respectively. Consequently, the results of correlation analysis entirely support hypotheses 1 and 3, partially support hypothesis 4, while rejecting hypothesis 2.

Table 2: Descriptive statistics and correlation matrix

	Mean	S.D.	ROA	ROE	P/BV	TSR	ICER	HCIE	SCIE	LnA
ROA	0.0488	0.1267	1.00							
ROE	-0.0681	0.7512	0.811**	1.00						
P/BV	1.1432	1.0257	0.317**	0.167	1.00					
TSR	0.0511	0.5513	0.149	0.157	0.349**	1.00				
ICER	1.3433	2.5814	0.654**	0.301*	0.187	0.097	1.00			
HCIE	1.0257	1.1624	0.701**	0.274*	0.251*	0.092	0.967**	1.00		
SCIE	0.9659	1.5101	0.589**	0.304**	0.144	0.095	0.981**	0.912**	1.00	
LnA	12.6711	0.9031	0.245*	0.332**	-0.200	0.159*	-0.148	-0.047	-0.194	1.00

Note: Significant at $p < 0.05^{*}$; $p < 0.01^{**}$.

5.2 Regression analysis

After the initial testing of the proposed hypotheses with correlation analysis, the next step is testing the hypotheses through linear multiply regression models. As the subject of analysis are time series data, to estimate the parameters of the model, panel analysis (with a fixed effect) has been used. The correlation coefficients between explanatory variables used in individual models are not high. They range from a low of -0.194 to a high of -0.047. This allows us to presume the absence of any multicollinearity. Table 3 reveals the results of the regression coefficients for all explanatory variables, including control variable – size, as defined in natural logarithm of total assets.

Table 3: Results of the estimation of parameters for the sample

	Dependent variables											
	Model 1 ROA			Model 2 ROE			Model 3 TSR			Model 4 P/BV		
	Panel A	Panel B	Panel C	Panel A	Panel B	Panel C	Panel A	Panel B	Panel C	Panel A	Panel B	Panel C
Constant	-0.810*** (0.168)	-0.716*** (0.164)	-0.817*** (0.184)	-5.473*** (1.295)	-5.155*** (1.317)	-5.687*** (1.303)	-0.292 (0.972)	-0.180 (0.968)	-0.383 (0.979)	-1.077 (.905)	-0.782 (1.850)	-1.26 (1.944)
ICER	0.034*** (0.004)			0.094*** (0.033)			0.034 (0.025)			0.128** (.048)		
HCIE		0.76*** (0.009)			0.168** (0.074)			0.065 (0.054)			0.319*** (0.104)	
SCIE			0.056*** (0.008)			0.168*** (0.058)			0.064 (0.043)			0.207** (0.086)
Ln (Total Assets)	0.064*** (0.013)	0.054*** (0.013)	0.068*** (0.014)	0.417*** (0.102)	0.388*** (0.103)	0.431*** (0.102)	0.023 (0.076)	0.013 (0.076)	0.029 (0.077)	0.162 (0.149)	0.126 (0.145)	0.174 (0.152)
N	72	72	72	72	72	72	72	72	72	72	72	72
Adjusted R-squared	0.611	0.622	0.542	0.305	0.268	0.310	0.037	0.027	0.042	0.129	0.164	0.111

Note: † $p < 0.1^{*}$; $p < 0.05^{**}$; $p < 0.01^{***}$. Standard error is given in brackets.

Regarding model 1, adjusted R^2 for panel *A* is 0.611, for panel *B* 0.622 and for panel C 0.542. This shows that the explanatory power of model 1 is the highest among all tested models. In model 1, all independent variables ICER (panel A), HCIE (panel B) and SCIE (panel), have a positive and significant impact on the return on assets ROA ratio (respectively: ICER=0.034 p<0.001; HCIE=0.760 p<0.001; SCIE=0.056 p<0.001). In all three panels, significant and positive associations between control variable Ln Assets, constant and the ROA variable have been identified. Results from model 1 support hypotheses 1 and 3. The explanatory power of model 2 is respectively: 0.305 for panel A, 0.268 for panel B and 0.310 for panel C. In model 2, in all three panels independent variables ICER, HCIE and SCIE, have a positive and significant impact on the return on equity ratio ROE (respectively: ICER=0.094; SCIE=0.168; HCIE=0.168). In all panels of model 2, a significant association was found between the Ln total Assets control variable, constant and all dependent variables. Results from model 2 support hypotheses 1 and 3. In the case of model 3, its explanatory power is the lowest among all models and equals to, respectively: 0.037, 0.027 and 0.042 for panels A, B and C. No significant association was identified between the ICER, SCIE and HCIE independent variables and the TSR dependent variable. Results from model 3 rejects hypothesis 2 and 4. In the final tested model, 4, its explanatory power equals 0.129, 0.164 and 0.111 for panels A, B and C respectively. In all three panels, independent variables ICER, HCIE and SCIE have a positive and significant impact on the price to book value ratio P/BV. Additionally, in all three panels of model 4, both the control and constant variable have no significant impact on the P/BV ratio. Results from model 4 partially support hypothesis 2 and partially hypothesis 4.

6. Discussion and conclusions

Today, intellectual capital is a main source of value creation for many companies. However, traditional accounting models do not measure the intellectual capital of a company. This paper presents a proposition for a new method to measure the intellectual capital efficiency – an ICER coefficient. Given that other specially designed for IC measurement models regularly fail the test of compliance with theory and practice of management and finance, an alternative measure of IC, a method which is free from defects is presented in this paper. The ICER method is based on publicly available data from financial statements and can be used for listed and private companies. Thus, its advantage is that, at the moderate expense of accuracy, it allows the measurement of IC for different types of companies and the conducting of comparative analysis between industries and countries.

In order to verify the appropriateness of the method, four hypotheses were tested on associations between the ICER ratio (and its constituents) and different measures of company performance (ROA, ROE) and shareholder value creation measures (TSR, P/BV). The results of this study show a significantly positive association between the intellectual capital efficiency ratio (ICER) and its components – the human capital efficiency ratio (HCIE) and the structural capital efficiency ratio (SCIE) and company performance measures, respectively: return on assets, return on equity. This study also shows a positive and significant association between the ICER ratio (and its constituents) and

the shareholder value creation measure P/BV. It indicates that the ICER ratio is associated not only with the current period of profitability of a company, but also is a good proxy of the long term shareholder value creation measure (P/BV), which is determined by expectation about future company performance. However, this study does not confirm strong links between ICER and the annual total shareholder return measure. This last conclusion is not in contradiction with the previous one on the P/BV ratio. Shareholder return is usually volatile, partially because it depends not only on a company's fundamentals, but also on current market sentiment, which is determined by behavioral factors. In other words, intellectual capital efficiency and shareholder return for a given year could be detached, one from the other. Supposition could be done here, that if the analysis was undertaken for longer period of time (eg. ten years), a link between the ICER and TSR measure, would be more likely identifiable.

The results of this research contribute to the development of intellectual capital measurement and corporate finance theory and could have several practical implications. Primarily, managers can apply the ICER method as a tool to better manage firms for value creation, not only with regard to their IC. ICER may also be used as a benchmark against competitors. Investors can utilize ICER as an indicator which is useful for selecting investment objectives.

The results of this study are also subject to limitations associated mainly with the data on which the results are based and the selection of control variables. Research was conducted based on time-series data for only four years and covered companies from just one industry. Further verification of the ICER model should be based on data extended beyond one industry and market. Inclusion of other control factors should also be considered.

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