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Intellectual capital of industrial sector Mexican companies measured through the VAIC™ model

Medición del capital a través del modelo VAIC™ en empresas del sector industrial en México

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Abstract:

The purpose of this paper is identified the value of the companies' intellectual capital and their impact on financial performance (ROA) and total labor productivity (TLP), through the financial information of the listed Mexican companies of the industrial sector through the VAIC™ and its components. This research is non-experimental, correlational and cross-sectional.
The results show that the intellectual capital measured through the VAIC™ model and its components, does influence and positively impact key factors such as the financial profitability ROA and as well as the size of the industrial sector of Mexican companies.
The results of this research alows the executives of Mexican companies the to learn about the value of the intellectual capital in their organizations and the relevance of intellectual capital as a key factor in the creation of value added.
The article examines the relationship between intellectual capital performance and financial performance (ROA) and total labor productivity (TLP).

Keywords:

Knowledge management, intellectual capital, Value added intellectual coefficient (VAIC™), competitive advantage, Mexican industrial sector

Resumen:

El propósito de este artículo es identificar el valor intelectual de las compañías, así como su impacto en el desempeño financiero (ROA) y la productividad laboral total (TLP) a través de la información financiera del listado de compañías mexicanas del sector industrial mediante el VAIC™ y sus componentes. Este estudio es no-experimental, correlacional y transversal.
El resultado muestra que el capital intelectual medido con el modelo VAIC™ y sus componentes, influencia e impacta positivamente los factores clave, como la rentabilidad económica ROA al igual que al tamaño del sector industrial de empresas mexicanas.
El resultado de esta investigación permite a los ejecutivos de las empresas mexicanas aprender sobre el valor del capital intelectual en sus organizaciones, así como la relevancia del capital intelectual como factor clave en la creación de valor agregado.
El artículo explora la relación entre el desempeño del capital intelectual y desempeño financiero (ROA) y la productividad laboral total (TLP).

Palabras Clave:

Capital intelectual, rendimiento financiero y productividad

Introduction

The transition and dynamics that have occurred in relation to knowledge throughout history allow to appreciate how it has transformed, through the industrial revolution, productivity revolution and management revolution to the current time, making it clear how initially muscular strength had its value, which was replaced by mechanical force, and then by the electric power, which finally has been substituted by intellectual force, transforming knowledge

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into the main factor of production and a strategic productive resource in companies. The role of knowledge in production has changed greatly over the years, most recently becoming a main factor behind maximizing value and production in companies.

Economists have analyzed how to maximize the value of a company using various theories and models such as the agency and stakeholders have analyzed how to maximize the value of companies and create and distribute value among the different groups involved among them. It is because of this that companies' objectives and goals must reflect promoting the common good so that the different groups can benefit and not only a select group. Among the strategies that contribute to the common good in organizations, the management of knowledge is considered a source in the creation and generation of competitive advantage, for which different models have been developed including the organizational knowledge creation theory by Nonaka and Takeuchi, the theory of resources and abilities by Grant and the theory of intellectual capital, which has sought to measure the efficiency in the creation of value of tangible and intangible assets.1,2

Among the methodologies developed for measuring the companies' intellectual capital, some researchers use the VAIC™, which permits comparison of their profitability, and productivity. In this research VAIC™ is used to compare the industrial sector of Mexican companies that pay contributions to the Mexican Stock Exchange, providing key information about the processes that contribute to their competitiveness and success in creating efficient value of their tangible and intangible assets. The industrial sector represents a guiding principle for growth in Mexico because it uses raw materials, energy, capital and labor, creating jobs, strengthening supply chains, increasing productivity and motivating the service sector, spurring new scenarios of economic development. According to amounts reported by the World Bank in 2014 the Mexican industrial sector contributed 36% of the Gross Domestic Product (GDP) in 2012**.**

Theorical framework

Villarreal states that the era of knowledge and the mindfacture (worker´s knowledge) characterizes the new global economy, where intellectual capital (IC) has become the strategic factor of the new paradigm of competitiveness because of the constant interaction of the systematic capital and organizational and human knowledge within an organization, which must be characterized by being intelligent and with continuous learning, creating productive knowledge, generating an ability to respond to the changes in its environment. 3

Chen points out that the three types of intellectual capital (human, structural and relational) are positively correlated with the competitive advantage of companies their ability to occupy a better position relative to their competitors. 4

Bueno, Salmador and Merino propose a more complete definition about intellectual capital: "accumulation of knowledge that creates value in an organization, composed by a set of intangible assets of nature, which are put into action, along with tangible assets and in line with a certain strategy, that is capable of generating competitive advantages for the organization". Meanwhile, Monagas-Docasal makes a valuation about the definitions expressed by the different authors, pointing out the main aspects:

- It is a set of non-material contributions
- It is the ability to transform knowledge and other intangible assets into wealth-producing resources
- It is the possession of knowledge, applied experiences, organizational technology, customer relationships and professional skills. 5,6

Of all these definitions and concepts, it can be concluded that intellectual capital is a non-transferable and intangible asset that has the power to generate wealth in an organization because of the combination of elements of an intangible nature as well as its human and structural resources, allowing capitalizing experiences and transforming knowledge into a competitive advantage.

Given the importance of intellectual capital in organizations, a series of models for measuring IC have been developed as, completed financial measures alone are insufficient to lead decision-making in business and should be accompanied by non-financial measures to determine those elements that can lead companies to become more competitive.

Sánchez, Melián and Hormiga point out that in recent times a small group of companies including Skandia, Dow Chemicals and the Canadian Imperial Bank linked intellectual capital to an intangible asset, arousing interest in those companies whose benefits derive mainly from innovation and knowledge-intensive services. 7

The Swedish insurance and financial advice company Skandia realized that their accounting tools were not appropriate to register the value of their intangible assets, so they it developed tools that could measure this value, recognizing that their competitive strength consists of not only traditional countable assets but also other intangible factors such as human talent and relationships with customers and suppliers.

When measuring intangible assets, Karl-Erik Sveiby has associated different models that work for such a purpose in four methods or approaches, which are observed in the figure 1. It´s important to note that none can meet all

purpose, so when selecting one model, situation, purpose and/or audience must be considered. 8

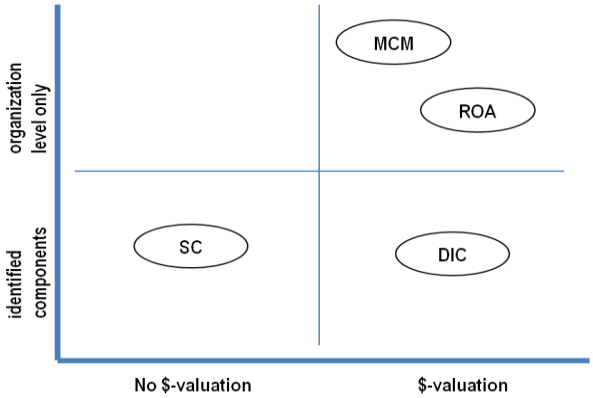

Figure 1. Lorem Intagible assest measuring models

In the case of the return on assets method (ROA), Sveiby points out that it is very useful to carry out comparative analyses, based on established accounting standards, between companies in the same sector and allows for a better way to illustrate the financial value of intangible assets; according to this, classification there are three models which are described in table 1. 8, 9, 10, 11

Approx. year:	Label:	Major proponent:	Description of measure:
1995	Economic Value Added (EVA™)	Stern, Stewart and Chew (1995)	Relationship to three major components: (1) capital employed; (2) human capital; and (3) structural capital.
1998	Value Added Intellectual Coefficient (VAIC™)	Pulic (1998)	$VAIC™_i = CEE_i + HCE_i + SCE_i$
1999	Knowledge Capital Earnings	Lev (1999)	Calculated as the portion of normalised earnings over and above earnings attributable to book assets.

Table1. Return on assets method (ROA)

Of these three models, here the VAIC™ is used to measure the intellectual capital of the industrial sector of Mexican companies that pay contributions in the Mexican Stock Exchange from the period of 2006 to 2012.

The VAIC™ model

Pulic considers that the traditional models of performance measurement in organizations are not appropriate enough in the context of the knowledge economy, pointing out that the basic indicators of industrial economy do not reveal how much value and if it has actually been created, identifying that value creation is the main nucleus of modern business and accounting systems are not capable of providing information related to this value added. Using the VAIC™ method, it is possible to measure and supervise the efficiency in the value creation of a company using the reported amounts in accounting, associated to each component of intellectual capital and the capital employed (physical and financial capital); the most efficient creation is based on human capital as a factor of creation of decisive value of modern business. 12

Pulic, Kujansivu and Lonnqvist, Laing, Dunn and Hughes-Lucas have established six methodological steps to reach the VAIC™, which are explained in table 2. 13, 14, 15,

Step	Calculate	Formula
1	Value added VA	VA = Output - Input Output = total income from all the products and services sold on the market Input = material costs incurred in earning the revenues
2	Human capital efficiency HCE	HCE = VA / HC VA = value added HC = payroll cost (human capital)
3	Structural capital efficiency SCE	SCE = SC / VA SC = structural capital SC = VA - HC VA = value added
4	Intelectual capital efficiency ICE	ICE = SCE + HCE SCE = structural capital efficiency HCE = human capital efficiency
5	Capital employed efficiency CEE	CEE = VA / CE VA = value added CE = book value of firm´s net assets
6	Value added intellectual coefficient VAIC™	VAIC™ = ICE + CEE ICE = intelectual capital efficiency CEE = capital employed efficiency

Table 2 Calculate the value-added intellectual coefficient VAIC™

Methodology

The methodology that is used is holistic research, providing a logical representation of the relationships between the knowing and the known, focusing on the goal achievement in this research. 16

This study is correlational-causal because 9 hypotheses have been formulated to demonstrate the relationship between the VAIC™ and its components, HCE, SCE and CEE, as exogenous variables, with the ROA as financial measure, TLP and productivity, having as a variable of control the size of Mexican companies that form the sample, with an explanatory level, suggesting a sense of understanding of the relationships between such variables (see figure 2).

The analysis of quantitative data is parametric because proofs are carried out such as correlation coefficient of Pearson and the linear regression that allow for describing the relationship between the variables, estimating the

effect of one variable on another, as well as the proofs of heteroskedasticity and multicollinearity. 17

The literature has shown the results generated in studies of intellectual capital and as derived from it, there is a greater financial return as well as increased market capitalization, increased share value is obtained and the total labor productivity increases. Shiu measured the efficiency of value creation in eighty companies listed on the Taiwan Stock Exchange through VAIC ™ methodology, demonstrating the increased efficiency of value creation, which influenced the profitability and ROA, showing that the technology industry in Taiwan has become intangible assets with high added value in both goods and services. 18

Similarly, Wah Hang and Wu following the VAIC ™ methodology, discussed how the intellectual capital that had an impact on the performance of companies and the way in which the components of intellectual capital associated with financial indicators. Based on the annual reports published by all the companies comprising the Hang Seng stock index in Hong Kong for the years of 2001-2009 constructed regression models to examine the relationship between intellectual capital and corporate financial performance indicators. The study found evidence to suggest that intellectual capital, as measured by the VAIC ™, is positively associated with corporate profitability ROA. 19

Molodchik and Bykova used the model of VAIC ™ in three hundred fifty Russian industrial enterprises from 2005 to 2007, the results corroborated the hypothesis that the intellectual capital of a company significantly influences their performance and competitiveness. The VAIC ™ model was significantly associated with the performance of a company which is measured by the total labor productivity TLP, which was appropriated to express the analysis of the intellectual capacity of enterprises. 20

As it has been confirmed from different studies, intellectual capital has a positive relationship with corporate performance and is crucial to generate competitive advantage. The VAIC™ and its components (HCE, SCE, ICE and CEE) have been proposed as indicators for measuring the intellectual ability of companies, from which the following six hypotheses are proposed:

- H1a. The Mexican companies of the industrial sector with a high level of VAIC™ have a higher financial profitability (ROA).
- H1b. The Mexican companies of the industrial sector with a high level of VAIC™ are more productive (TLP).
- H2a. The Mexican companies of the industrial sector with a high level of ICE have a higher financial profitability (ROA).
- H2b. The Mexican companies of the industrial sector with a high level of ICE are more productive (TLP).
- H3a. The Mexican companies of the industrial sector with a high level of HCE, CEE and SCE have a higher financial profitability (ROA).
- H3b. The Mexican companies of the industrial sector with a high level of HCE, CEE and SCE are more productive (TLP).

The independent variables are the VAIC™ and its components (HCE, SCE, ICE and CEE) calculated from published and audited data by companies in the study. 12

- HCE: human capital efficiency, indicator of the value-added efficiency VA of human capital
- SCE: structural capital efficiency, indicator of the value-added efficiency VA of structural capital
- ICE: intellectual capital efficiency, the sum of the indicator of the value-added efficiency VA of the human capital and the structural capital
- CEE: capital employed efficiency, indicator of the value-added efficiency VA of the capital employed.
- VAIC™: value added intellectual coefficient. Designed Methodology to provide information about the company efficiency and its intellectual capital in the creation of value added of the tangible and intangible assets

Dependent variables are the ROA and the TLP, which reflect the financial results of each company. 21, 20

- ROA: Return on Assets, measures the profitability of assets of a company
- TLP: Total labor productivity, measures the productivity from the value-added VA.

Also, the control variable was size, taken from the value of total sales

The sample is integrated by the thirty-two companies of the industrial sector are enumerated based on the subsector to which they belong. It is important to note that only the companies that have published the accounting line item of wages and salaries in their financial statement were selected, because this information is required to calculate the VAIC™.

The averages of amounts from 2006 to 2012 were used, including, as a primary source, the audited amounts in the loss and profit statements, balance sheets and the Notes to the financial statements published by the companies as information for their shareholders.

Empirical results

For the present study nine models of linear regression were designed with their respective statistical description and analysis of correlation, validating the assumptions

through the statisticians Durbin-Watson, White and VIF (variance inflation factors), accepting and/or rejecting totally or partly the hypotheses initially proposed, which are described below.

The six models of linear regression (see table 3) have been designed in order to compare the association of the VAIC™ and its components with the results in the financial performance and production of the companies that make up the sample as originally established in the nine research hypotheses.

Model	Regression equation	
1	ROAi	= β + β1VAIC™ + β2 size + εi
2	TLPi	= β + β1VAIC™ + β2size + εi
3	ROAi	= β + β1ICE + β2CEE + β3size + εi
4	TLPi	= β + β1ICE + β2CEE + β3size + εi
5	ROAi	= β + β1HCE + β2SCE + β3CEE+ β4size + εi
6	TLPi	= β + β1HCE + β2SCE + β3CEE+ β4size + εi

Table 3 Models of regression equation

Models 1 to 2 examine the relationship between the rate of the VAIC™ and the financial indicators of profitability and productivity value. In models 3-4, the rate of the ICE is used, while in 5-6 the analysis with the components of the VAIC™ are performed separately.

In table 4 are the descriptive statistics of the independent, dependent and control variables of the Mexican companies of the industrial sector from 2006 to 2012.

	CEE	HCE	SCE	ICE	VAIC™	ROA	TLP
Minimum	0.04	0.84	-5.14	-3.24	-3.16	-0.15	4.57
Maximum	1.35	15.34	0.93	16.27	16.54	0.17	8.64
Median	0.29	3.41	0.33	3.74	4.03	0.04	6.42
SD	0.24	2.88	1.05	3.35	3.39	0.07	0.94

Table 4 Descriptive statistics of the independent, dependent and control variables for 2006-2012 of Mexican industrial companies

This table includes the median values, minimum and maximum average balances of different coefficients calculated for determining the VAIC™. According to the amounts that make up the database of the 32 companies under study and based on the median value of the VAIC™ (4.03), 10 companies are above the median (31.25%) and the other 22 (68.75%) are below. Among the companies that report the highest rate in the average of the years 2006-2012 are CMOCTEZ with 16.5415, HOMEX with 10.082 and HERDEZ with 8.7924. The companies that have the lowest rates are HOGAR with -3.1615, SANLUIS with 0.7299 and ICA with 0.8468. This indicates that the behavior of the value-added intellectual coefficient marks the same trend in each of its components and, therefore, in the companies already mentioned. Regarding the dependent variables, the ROA has a median value of 0.04, above this there are 18 companies (56.25%) and 14 are below (43.75%); among the companies that report the higher financial profitability are CMOCTEZ with 0.1688, GMEXICO with 0.1575 and PEÑOLES with 0.1554. The ones with the lowest financial profitability are HOGAR with -0.1509, COLLADO with -0.0248 and SANLUIS with -0.0162.

Next, the results are presented by carrying out the analysis of the correlation matrix, which determines the correlation coefficient called r between the independent, dependent and control variables, expressed as a number that can be 0 to 1, or 0 to –1, measuring in this way the interdependence and associated relationships of the variables, all at the same time. Table 5 shows the correlation analysis of Pearson which reveals that 1 of the correlations is significant to the level of 0.1; 16 correlations are significant to the level of 0.01; and 5 are significant to the level of 0.05; the variables that have less significance are TLP and CEE.

	CEE	HCE	SCE	ICE	VAIC	ROA
HCE	0.094	1				
SCE	0.257	0.295	1			
ICE	0.162	.954*	.568*	1		
VAIC	0.229	.948*	.578*	.998*	1	
ROA	.452*	.534*	.620*	.654*	.677*	1
TLP	-0.099	.356**	0.165	.358**	0.346***	.394**

Table 5 Correlation analysis of independent, dependent and control variables from 2006 to 2012 of Mexican industrial companies

The results presented in table 6 show that the coefficient of the intellectual capital efficiency ICE keeps the highest and the most significant correlation in regard to the VAIC™ (.998*) followed by the coefficient of the human capital efficiency HCE (.948*); regarding the coefficient of the structural capital efficiency SCE, the correlation is relatively weak but significant (.578*), different from the coefficient of the capital employed efficiency CEE (0.229) whose relation is insignificant. The VAIC™ has a moderately high impact on the financial profitability ROA (.677*), the coefficient of the intellectual capital efficiency ICE (.654*) and the coefficient of the structural capital efficiency SCE (.620*). The coefficient of the intellectual capital efficiency CEE is the only one that slightly impacts the productivity TLP (.358*).

The coefficient of the structural capital efficiency SCE keeps the highest correlation according to the capital employed efficiency CEE (.588**) and the VAIC™ (.562**).

These analyses confirm the results obtained by Wah, Hang and Wu (2011) in their study about companies that pay contribution to the Stock Exchange of Hong Kong. They emphasize the importance that structural capital has in business management (which correlates with the greatest number of variables).

Mod	R	R2	Adju R2	F	Sig.	Durbin-Watson
1	.772 a	0.596	0.568	21.374	.000	1.786
3	.444 c	0.197	0.141	3.553	.042	1.385
4	.745 d	0.555	0.525	18.045	.000	1.764
6	.451f	0.203	0.148	3.694	.037	1.4
7	.845 g	0.715	0.672	16.908	.000	2.063
9	.488i	0.238	0.126	27	0.107	1.601

a.Predictors: (Constant), SIZE (SALES VOLUMES), VAIC™. Dependent variable: ROA. b. Predictors: (Constant), SIZE (SALES VOLUMES), VAIC™. Dependent variable: TLP. c. Predictors: (Constant), SIZE (SALES VOLUMES), ICE. Dependent variable: ROA. d. Predictors: (Constant), SIZE (SALES VOLUMES), ICE. Dependent variable: TLP. e. Predictors: (Constant), SIZE (SALES VOLUMES), CEE, HCE, SCE. Dependent variable: ROA. f. Predictors: (Constant), SIZE (SALES VOLUMES), CEE, HCE, SCE. Dependent variable**:** TLP.

Table 6 Linear regression analysis results for years 2006-2012 of Mexican industrial companies

In table 7 are the results obtained in each of the nine models of linear regression. In model 1 the predictor variables are the rate of the intellectual coefficient of value added and the size of the company, together they explain the 56.8% of the variance of the financial profitability.

The intellectual capital efficiency and the size of the company, as formative and control variables, together explain in model 3 52.5% of the variance of the financial profitability, while in model 4 sparingly 14.8% of the total labor productivity.

In model 5 the independent and control variables are, the coefficients of the capital employed efficiency, the human capital efficiency and the structural capital efficiency as well as the size; together they explain 67.2% of the variance of the financial profitability, while in model 8 only 58.7% and in model 9 barely 12.6%. In a study by Joshi et al. (2013) applied to the financial sector of Australia, the VAIC™ and its components only explained 28.5% of the variance of the financial profitability. When compared with the result obtained with the Mexican companies, Mexico has a higher percentage and influence.

Model:		**Unstandar coefficients**		**Standar coefficie**	**t**
		β	**Stándar error**	**β**	
1	(Constant)	-0.287	0.088		-3.265*
	VAIC™	0.013	0.003	0.596	4.934*
	Size	0.017	0.006	0.38	3.144*
2	(Constant)	3.413	1.592		2.144**
(	VAIC™	0.079	0.047	0.286	1.68
	Size	0.166	0.1	0.284	1.666
3	(Constant)	-0.285	0.091		-3.122*
	ICE	0.012	0.003	0.571	4.57*
	Size	0.017	0.006	0.383	3.062*
4	(Constant)	3.454	1.587		2.176**
	ICE	0.083	0.048	0.298	1.752***
	Size	0.164	0.099	0.28	1.65
5	(Constant)	-0.294	0.085		-3.45*
	CEE	0.109	0.033	0.351	3.274*
	HCE	0.01	0.003	0.383	3.557*
	SCE	0.019	0.008	0.271	2.233**
	Size	0.017	0.005	0.362	3.201*
6	(Constant)	3.152	1.784		1.767
	CEE	-0.471	0.696	-0.119	-0.676
	HCE	0.111	0.057	0.343	1.951
	SCE	-0.03	0.177	-0.034	-0.171
	Size	0.187	0.108	0.32	1.732

*. Significant < 0.01, **. Significant < 0.05, ***.Significant <0.1

Table 7 Regression model results for years 2006-2012 of Mexican industrial companies

In table 7 are the results obtained from the regression coefficients of the six models which aim to explain the impact that exogenous and control variables have on the endogenous formulated variables in the designed hypotheses. In model 1, the rate of the value added intellectual coefficient (β=0.596*) and the size of a company (β=0.38*) have a positive influence on the financial profitability of the industrial sector of Mexican companies, the first, being the most important, while in model 2, neither the rate of the value added intellectual coefficient (β=0.286) nor the size of the companies (β=0.284) has influence on the total labor productivity. In model 3 the intellectual capital efficiency (β=0.571*) and the size of the company (β=0.383*) have a positive influence on the financial profitability of the industrial companies in Mexico, the first being the most important; while in model 4, only the intellectual capital efficiency (β=0.298***) has a small influence in the total labor productivity. In model 5 the capital employed efficiency (β=0.351*), the human capital efficiency (β=0.383*) and the structural capital efficiency (β=0.271**) as well as the size (β=0.362*) have a positive influence on the financial profitability of the industrial sector of Mexican companies, structural capital efficiency being the least important of the four, finally in model 6 neither the capital employed efficiency (β=-0.119), human capital efficiency (β=0.343), structural capital efficiency (β=-0.034) nor the size (β=0.32) have influence on the total labor productivity of these companies.

These results highlight the positive impact that the exogenous variables, VAIC™, ICE, CEE, HCE and SCE, have on the endogenous ROA, with the exception of having no significant influence on the TLP. Empirical studies that were carried out in foreign companies and different economies have shown the influence of the

VAIC™ and its components on the financial profitability of the companies that were studied, whose results show high, medium sized and low correlations and significant values. Different from the study made by Molodchik and Bykova where the VAIC™ and its components proved to keep a strong relationship with the total labor productivity. In the Mexican companies of the industrial sector, it can be proved that this relationship does not exist, so it can be confirmed that the VAIC™ and its components do not have influence on the total labor productivity in the industry of Mexico. 15, 18, 19, 20

After analyzing the nine models of linear regression, in table 12 is a compilation of the results, where hypotheses 1a, 2a, 2b and 3a are totally accepted, while variable 3b is partially accepted and hypotheses 1c and 3c are entirely rejected.

Research Hypothesis	Hypothesis substantiated	Model	Explanatory power at the variation (Adjusted R2)
H1a. A higher level of VAIC™, higher ROA	Yes	1	0.568*
H1b. A higher level of VAIC™, higher TLP.	No	2	0.141***
H2a. A higher level of ICE, higher ROA	Yes	3	0.525*
H2b. A higher level of ICE, higher TLP	Yes	4	0.148**
H3a. A higher level of HCE, CEE Y SCE , higher ROA	Yes	5	0.672*
H3b. A higher level of HCE, CEE Y SCE, higher TLP	No	6	0.126

Table 8 Mexican industrial companies 2006-2012. Summary of hypothesis testing results based on regression models

In order to ensure the validity of the models used as well as the basis for the acceptance and rejection of the hypotheses, the assumptions of independence have been validated starting with the Durbin-Watson statistics, homoscedasticity using the diagram of residues and the White statistics and non-collinearity for the statistical tolerance level and the variance inflation factors (VIF). It is important to mention that prior to the application, the models were transformed (natural logarithm) to the control size variable determined from the sales and to the dependent variable total labor productivity TLP.

It is important to validate the independence between the residues in the models of linear regression, even more so when the information follows a temporal trend as it was seen in this research, which indicates the independence of the predictor variables. For this the Durbin-Watson statistics provide information about the degree of independence between them. According to Beals, the value of the Durbin-Watson (DW) statistic must be close to two in order to assume that it auto-relation does not exist; based on the above, it can be seen that models 1, 3, and 5 keep the statistics DW close to two, while models 2 and 4 are slightly below 1.5 (some authors such as Valderrey accept that values such as 1.3 can be considered close to 2 and evidence of interdependence); however, their lower level of correlation helps to deduce the existence of independence in the predictor. 22, 23

Regarding homoscedasticity, which ensures that the variance of the residues of each value of the combination of the independent variables is constant, it has been found that in all the models, except model 4, which sets out as a dependent variable financial profitability (ROA) and as independent variables the performance of intellectual capital (ICE) and the size of the company (sales amount), the value of the probability associated with the statistic F is closer to 0.05, so the invalid hypothesis is accepted concluding that there are no problems of heteroskedasticity. It is clear that model 3 was corrected determining the inverse of the standard deviation of the company size, using the statistical system E-views in order to achieve the compliance of the homoscedasticity assumption. Thus it is also important to say that model 6 it is not considered because it did not have significant correlation between the variables.

To validate the assumption of non-collinearity and confirm that there is not an exact linear relationship between the independent variables the collinearity diagnosis is used. In this exercise the tolerance values in all the models that are not close to 0, while the variance inflation factors (VIF) are lower than 10. Due to the above, it is concluded that there is not collinearity.

Conclusions

Intellectual capital is a non-transferable intangible asset that has the virtue of being a generator of wealth in the Mexican companies of the industrial sector, which resides in its human capital, structural capital and relational capital, capitalizing with their experiences and transforming knowledge into a competitive advantage.

The application of the VAIC™ model in empirical research has proven a useful tool for generating information about efficiency in the creation of the value of tangible and intangible assets of companies, recognizing that the intellectual capital of a company has a positive influence on its performance, profitabilitythus its competitiveness. The VAIC™ through its three components measures the structural capital efficiency, human capital efficiency and capital employed efficiency, and by means of this study it can be proved that human capital is the main source of intellectual capital and creation factor of value added in Mexican companies of the industrial sector.

It has been found that the VAIC™ along with its components ICE, CEE, HCE and SCE have a positive impact on key factors such as the financial profitability

ROA of Mexican industrial sector companies as well as the size of these ones. The six hypotheses that affirm such influence and impact are also confirmed and accepted. However, they do not have influence or a positive impact on the total labor productivity TLP of the Mexican companies of the industrial sector, subject to the ICE, so the three hypotheses that affirm such influence and impact are rejected.

The results obtained in this research provide the managers of the listed Mexican companies of the industrial sector with the opportunity to know the value that intellectual capital has in its organizations, its relevance as a key factor in the creation of value added considering that a company that has high rates of intellectual capital – measured through the VAIC™ model – has a competitive advantage with relation to others and therefore has high rates of financial profitability ROA, yet not in total labor productivity (TLP).

In Mexico, according to the studies carried out in the Mexican industrial sector, the company Corporación Moctezuma, SAB de CV, CMOCTEZ, belonging to the subsector of materials for construction is the company with the highest rate of value added intellectual coefficient and therefore, the company that has the highest financial profitability (ROA). The company Consorcio Hogar SA de CV, of the real estate subsector, has the lowest rate of value added intellectual coefficient and thus reports lower financial profitability.

In recent years (from 2006 to 2012) the indicator of the intellectual capital value of Mexican companies of the industrial sector has fallen. Thus, it is evident that for this company the human factor as part of their intangible assets has not been appreciated and valued; for this reason, their managers must restructure their strategies where human capital will be recognized as an important resource and a generator of knowledge, which, when it is applied and incorporated in all their activities, will create value and generate a competitive advantage thereby allowing these indicators to rebound.

According to the stakeholder theory, the common good of various groups of interests has not been reached because of the human-workers – human resources – have not been appreciated as an intangible key within the organization.

Appling the VAIC™ model can present some problems as seen in this research because not all of the listed Mexican companies of the industrial sector publish the accounting line item of wages and salaries in their financial statements, and this is an essential element for the application of this methodology, so this study´s range was limited to only a percentage of the total original sample.

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