

Analysis of the Relationship between Intellectual Capital Components and Firm Value: An Application on Borsa İstanbul Health Industry

BY

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Abstract

In this study, concept of intellectual capital, which is much more useful in providing competitive advantage to companies compared to classical production factors, its importance, characteristics, components and measurement were examined in theoretical framework and studies on intellectual capital published in national and international literature were examined. Intellectual capital components were measured by VAIC method. In the VAIC method, intellectual capital was analyzed on the basis of 3 sub-capital components. The efficiency coefficients of each capital sub-component were calculated and the effect of these efficiency coefficients on firm's M/B ratio was analyzed using Panel Data analysis method. Hausman test was used to determine the econometric model to be established, and as a result of the test, it was deemed appropriate to use the random effects model. GLS regression analysis was used in the analysis, which produces robust estimates against varying variance and autocorrelation problems. In According to the results of analysis, a positive and significant effect of efficiency coefficients of all sub-components of intellectual capital on firm's M/B ratio was determined. According to the findings, it can be said that the efficiency of intellectual capital investments of the companies is positive and it leads to a positive perception especially among the investors. The productivity in the sector has increased as a result of increase in the number and volume of innovation studies in the field of health, especially after Covid-19.

Keywords: Intellectual Capital, VAIC, Knowledge, Human Capital, Structural Capital

1. Introduction

In today's information-centered economy universe, the main purpose of companies is to be a sustainable existence. In order to achieve this goal, companies need to be able to produce information, reach information, share it, and obtain new outputs from it. The production, sharing, and analysis of knowledge are among the financial and operational success factors of companies.

Intellectual capital is the main factor that will implement the above-mentioned 3 basic knowledge economy functions in companies. Intellectual capital is the factor that gives the firm a competitive advantage over classical and relatively easily accessible natural resources, labor, and capital and makes it sustainable. Intellectual capital refers to the cumulative knowledge accumulated by a company by using all its physical and non-

physical assets meaningfully and efficiently and the added value it obtains as a result of this accumulation. This added value can be seen when companies have a market value that is well above their balance sheet or book value. For example, Apple's stock is traded on the NYSE stock market at a price approximately 32 times higher than its book value, according to the closing price of 17.06.2022. In other words, existing investors in the market are willing to pay 32 times higher than the book value for a stock of Apple. It is possible to associate this with the competitive and innovative business model of Apple.

Intellectual capital was only associated with the concept of goodwill in the 1970-1980 periods when it first emerged. In the course of time, it was stated that intellectual capital had a broader

meaning, including the concept of goodwill. There is a consensus that intellectual capital has 3 sub-components: Human Capital (the origin of knowledge), Customer Capital (network power), and structural capital (organizational capabilities) that will make a firm more competitive than its peers.

There is a great deal of interest in the academic community regarding intellectual capital. In most of the studies published in the literature, it has been tried to analyze the measurement and reporting of intellectual capital and especially its effect on firm performance.

Based on the findings obtained from the studies, it can be stated that the contribution of intellectual capital to firm performance is positive.

Although there have been many studies on the subject, the literature on this subject is still developing dynamically.

In this study, an analysis of the measurement of intellectual capital was carried out in order to contribute to the existing literature on the subject. Intellectual capital was tried to be measured and the findings were interpreted by applying the VAIC method on the financials of 5 companies operating in the Health Sub-Sector of Borsa Istanbul for the period 2018-2021.

In the second part of the study, the theoretical framework of the subject was discussed, and in the third part, the studies in the national and international literature on the subject were briefly examined. In the 4th chapter of the study, the VAIC method and its results were reported, and in the last chapter, the 5th chapter, the findings were analyzed and evaluated as a whole.

2. The Concept of Intellectual Capital

If companies want to gain an advantage over other companies in today's competitive conditions, they have to give importance to issues such as brand power, customer relations, technical skill set and productivity rather than physical and financial resources (29). Looking at the rapid technological developments and changes in today's information age, companies that want to survive in the current competitive environment should give more importance to intangible assets that produce added value by using these physical assets.

Physical resources such as labor, capital, and natural resources have lagged behind the power of information today, and cumulative knowledge has become the most important capital element of companies in this century of knowledge economy (26). Peter Drucker stated that labor, capital, and natural resources are relatively easily accessible factors of production and information is what companies need to have for competitive advantage. Similar to Drucker, Nonaka stated that the only power that enables companies to survive in today's uncertainty economy is knowledge that provides core competency (17).

Innovation and the concepts of intellectual capital, which is the power to reveal, change and manage this innovation, come at the beginning of the most discussed topics in the business literature.

The term intellectual is derived from the Latin word *interlectio*,

and while the word *inter* means being between something, *Lectio* refers to the knowledge acquired (3). From this point of view, it can be deduced that the word "intellectual" refers to a learned wise person among the society. In Webster's dictionary, it defined the word intellectual as rational, and the word capital as cumulative stock of goods (17). As a result of these definitions, it is possible to explain intellectual capital as cumulative thinking capacity. Leif Edvinson, the first intellectual capital manager, defined intellectual capital as knowledge that can be converted into value (26).

Intellectual capital does not only express human capital but also refers to the structure of the enterprise and the information relationship network consisting of the people and institutions with which the enterprise is in contact (12). In summary, intellectual capital refers to the cumulative knowledge gained through the management of all relationship networks (6).

The concept of intellectual capital does not have a static feature, it has a dynamic structure applied in line with the needs of the company (22).

Studies on intellectual capital were started by John Kenneth Galbraith and Human Assets accounting and Hermanson in the 1960s and continued by Michael Kalecki in the 70s (3). The concept of intellectual capital was first defined by Thomas Stewart in the article titled Brain Power published in 1991 (29). According to Stewart, intellectual capital is defined as cumulative knowledge that provides a competitive advantage to the firm and is shared at the organizational level (24). Intellectual capital refers to the difference between the book value of a company and the value that willing and conscious investors are willing to pay under market conditions to acquire the company (8). Depending on this definition, it can be stated that intellectual capital is an added value produced from the assets of the firm (2).

In the light of the explanations above, the characteristics of intellectual capital can be summarized as follows (21):

- * Intellectual capital is the sum of intangible assets that cannot be fully derived from the firm's balance sheet.
- * It is essential in terms of making the competitive advantage of the companies sustainable.
- * The management of intellectual capital is an important managerial responsibility.
- * Intellectual performance is the increase or decrease in intellectual capital, which is measurable and comparable.

The concept of intellectual capital was used synonymously with the concept of intangible assets, especially goodwill, until the end of the 1980s, and methods for its measurement were developed. However, developments related to intellectual capital in the modern sense took place in the 90s. The Intellectual Capital Report published in 1995 by the Skandia company operating in the insurance sector in Scandinavia provided everyone to be informed about this concept and its importance (26). Today, many international companies such as Xerox and Hewlett Packard have established information centers in order to benefit from the intellectual capital element more efficiently, and it is possible to cite Koç Sistem, a part of Koç Holding from Turkey, as an example (26).

Shareholders and managers are among the most important persons related to intellectual capital and its elements (17). Shareholders consider intellectual capital as an asset of a business and are interested in the effective use of this capital. Managers, on the other hand, are people who manage intellectual capital. The main goal of managers is to increase the cash-generating power of intellectual capital.

Intellectual capital has two basic components: human capital and structural capital (14). According to another distinction, intellectual capital has three basic components: human capital, structural, that is, organizational capital, and customer capital (11).

Human capital has been defined as the basic component of intellectual capital in all of the Technological Stockbroker Model, Intangible Assets Tracking Model, and Skort-Kart models developed for measuring intellectual capital in the literature (7). The human dimension of intellectual capital is the most important element that brings innovation to the firm and provides added value to the firm by organizing the physical assets of the firm and interacting with an external stakeholders. It is very difficult to set limits on the potential power of the human factor. The human factor is indispensable for sustainability as the corporate intelligence, social and human aspects of the company. The critical success factor in intellectual capital is to turn the implicit knowledge of the employees in the company into an open knowledge accumulation where they are shared professionally with all the participants at the organizational level (7). The measurement of the added value that is expected to be produced by the human capital within the firm is based on two criteria: quality and quantity (7). The definition, collection, subjectivity of data in attribute-based measurement and associating it with the financial and operational outputs of the firm is quite difficult. In the literature, the contribution of the human factor to the intellectual capital is generally measured quantitatively with financial ratios. Market Value / Book Value (M / B) ratio comes first among the ratios used in the literature.

Intellectual capital assets can be summarized under four groups (29).

Trademark: Patent refers to licensing, industrial design, and copyright intellectual property assets.

Consumer Loyalty: It can be achieved with the power created by the synergy of all internal and external stakeholders of a company that expresses the loyalty of consumers to the company.

Recurring Jobs: Information provided by employees to the firm, operational capabilities, organizational capabilities, effective IT systems, etc. identifies such entities.

Strategy and Tactics: It covers the management of assets based on human capital and includes topics such as know-how, learning by doing, and training.

2.1 Components of Intellectual Capital

2.1.1. Human Capital

In its simplest terms, human capital refers to the total human capabilities a firm uses in solving problems (15). Human capital encompasses the entire physical and mental skill set, network of

relationships, and innovative features of employees in a company in order to carry out their assigned workloads. Human capital also includes the values that make up the business, the culture, and philosophy of the organization (11). Know-How, Education, Professional competence, Studies for knowledge production, Entrepreneurial enthusiasm, innovation and rejecting abilities, and change management can be summarized as components of human capital (17). Human capital belongs to the firm as long as the human is in the firm, by the nature of the human, therefore, human capital cannot be bought but can be rented (18).

Human capital encompasses all of the employees' trust in the organization, their commitment to the organization, their problem-solving abilities, their level of knowledge and experience, and effective knowledge sharing. Today, companies do not see investments in human capital as a cost and provide support, especially all kinds of training, to improve the talent pool of their employees. The fact that Microsoft has a market value of 2 Trillion Dollars against the total physical assets of approximately 10 Billion Dollars shows the added value of its intellectual capital.

2.1.2. Structural Capital

Structural capital is all kinds of hardware, technical equipment, software, databases, organizational structure, and patents arising from their use, which are used by employees in the business process and increase their productivity. covers all intellectual property rights (11). Since structural capital is not personal, it can be specific to the company and used within the commercial structure of the business. Structural capital also includes customer capital established with strategic customers. Contrary to human capital, structural capital refers to the information that does not leave the organization at the end of the working hour but remains within the company (26).

According to Saint-Onge, structural capital is defined as the ability of the enterprise to meet market expectations, while according to Boints, it is the structure that supports the employees for optimum intellectual performance and accordingly ensures the optimum performance of the enterprise (17).

Structural capital can be defined as a whole consisting of information and communication technologies, software and information systems, business models, methods, and organizational identity.

Structural capital can be subdivided into organizational capital, process capital, and innovation capital due to the different components it contains (14). Organizational capital includes all organizational capabilities, philosophies, and systems that will increase a firm's capacity to do business. Process capital, on the other hand, includes all methods, techniques, and programs that enable all goods and services production and distribution activities to create added value for customers. Innovation capital consists of all intellectual property rights and intellectual assets created by the firm in order to provide sustainable competitive advantage.

2.1.3 Customer Capital

Since the 90s, the share of the service sector in the general economy has increased significantly all over the world, with the

effect of globalization, the economic convergence between countries has increased significantly, even today it can be accepted that there are no economic borders anymore, and as a result of all these, customer-centered economic systems have begun to be built. The basis of the customer-centered philosophy is the protection of existing customers and the creation of customer loyalty. According to many marketing studies, it is more costly to acquire new customers than to retain existing customers (20).

The main subject of customer capital, also known as relationship capital, is the information obtained through marketing channels and customer relations. Customer capital is the sum of all assets that regulate and manage the relations of the enterprise with its close and distant environment (4).

In terms of value, customer capital is more significant than human and structural capital, considering the cash flows related to payments from customers (22).

The most basic starting point of the customer-centered economy is to manage the customer's expectations, and this includes the creation and analysis of databases on customers and their purchasing processes and preferences (11). Relationships with current and potential customers, which are the most critical external shares of the company, are evaluated within the scope of customer capital. Customer capital includes the profiles of current customers, their purchasing behavior and trends, and the distribution channels used to reach customers. Customers should be seen as an investment that will create added value through mutual relations, not individuals or organizations that are contacted for temporary purposes.

The methods used in the measurement of intellectual capital are shown below (11).

- * Market Value / Book Value Method,
- * Balanced Scorecard Method,
- * Knowcorp Method,
- * Tobin Q Method,
- * Intangible Asset Indicator Method
- * Skandia AFS Business Researcher Method,
- * Intangible Balance Sheet Method,
- * Economic Added Value Method,
- * Intellectual Capital Index Method,
- * Technology Broker Method,
- * Return on Assets Method,
- * Market Capitalization Method,
- * Direct Intellectual Capital Method,
- * Financial Measurement Method of Intangible Assets,
- * Citation Weighted Patents Method,
- * Human Resources Accounting Method,
- * Knowledge Capital Score Card Method,

2.2 Intellectual Capital Calculation Methods

Since the Market Value / Book Value method and the Intellectual Capital, Value Added Coefficient method are used in the application part of this study, only these two methods will be examined in detail.

2.2.1 Market Value / Book Value Method

In this method, the relationship between the market value of a firm on a certain date and its book value is examined. If the market value of a firm is more than its book value, then it is possible to talk about the existence of intellectual capital in that firm and its positive contribution to the business value. While the market value shows the value that the investors are willing to pay for the company's stocks in circulation, the book value shows the value obtained as a result of deducting the liabilities from the assets in the balance sheet of the company (4).

According to this method, intellectual capital is calculated as follows (4).

Intellectual Capital = Market Value - Book Value

Intellectual capital is calculated by dividing the Market Value by the Book Value. In this method, it is calculated how many times the market value is more or less than the book value. If the market value is above the book value, it can be accepted that the positive added value is intellectual capital, and when it is below, it can be accepted that there is not enough investment in the intellectual capital and its elements within the company (4).

The Market Value / Book Value method has some problems in practice. It is possible to examine these problems under 3 headings (4).

* Stock prices, are more volatile due to the higher level of risk to fixed-income securities such as bonds, etc. Therefore, the M/B ratio will constantly vary. Since most of the changes in stocks occur as a result of events outside the company (for example, the global monetary policies led by the US central bank FED), it is very difficult to directly associate this change with intellectual capital.

* Since the market value is the price formed as a result of supply and demand in the market, the macro events and psychological pricing mentioned above play a role in determining the stock price. In addition, as a result of the company management's use of various initiatives such as earning management practices in calculating and reporting the book value, the book value can be reported in higher or lower amounts than it is.

* With this ratio, it is not possible to obtain information other than the value of only intangible assets. According to this ratio, there is no intellectual capital contribution, or it is positive or negative.

2.2.2 Intellectual Capital Value-Added Coefficient method

The Intellectual Capital Value Added Coefficient method (VAIC) was developed by Ante Public in 1998 and is calculated as shown in equation 1 below (18).

$$VAIC_i = CEE_i + HCE_i + SCE_i \quad (1)$$

The explanation of the notations in the equation is as follows:

VAIC_i = Intellectual Capital Value Added Coefficient,

CEE_i = Coefficient of efficiency of firm i capital employed,

HCE_i = Human capital efficiency coefficient of firm i,

SCE_i = Structural capital efficiency coefficient of firm i.

According to the expression in Equation 1, VAIC has 3 subcomponents: Physical Capital Value Creation Coefficient,

Human Capital Value Creation Coefficient, and Structural Capital Value Creation Coefficient.

VAIC is an analytical method that can reveal quantitative results in the measurement of intellectual capital and considers the firm as a dynamic subsystem that is constantly changing (4).

3. Literature Review

In this part of the study, studies conducted on intellectual capital in international literature will be briefly examined.

Many of the studies on intellectual capital in the literature have focused on the measurement, classification, reporting of intellectual capital and its effect on firm value.

Different approaches have been developed by many authors in the literature on the definition and classification of intellectual capital. Studies on the classification of intellectual capital are summarized in Table 1 below.

Table1.Classification for the Concept of Intellectual Capital

Source: Örgün and Kalay (2018)

Author	Country	Classification
Edvinsson & Malone (1997)	Sweden	Structural Capital Human Capital
Bontis (1998)	Canada	Human Capital Customer Capital Structural Capital
Stewart (1997)	US	Human Capital Customer Capital Structural Capital
Saint-Onge (1996)	Canada	Human Capital Network Capital Structural Capital
Sveiby (1997)	Australia	Competencies of Employees External Structure Internal Structure
Van Buren (1999)	US	Human Capital Process Capital Customer Capital Innovation Capital
Roos vd. (1998)	UK	Human Capital Relational Capital Structural Capital
O'Donnell ve O'Regan (2000)	Ireland	Employees External Structure Internal Structure

In this part of the study, the most recent published studies on intellectual capital in the literature will be examined.

Sullivan (1999) drew a theoretical framework about intellectual capital in his article. He researched the definition of intellectual capital, the benefits it can provide to the firm, the roles that the

portfolio of intellectual capital assets can play, and how firms can benefit from these portfolios. The study explains the value creation steps of firms and discusses the methods of managing the firm's intellectual capital assets. The theoretical issues mentioned in the study are explained through the ICM Gathering Group Company. It explains how the Gathering firm defines intellectual capital and how its member firms use their knowledge for the benefit of their organizations.

Bozburu and Toraman (2004) developed a model for the measurement of intellectual capital in their study. In their models, intellectual capital is defined as human capital, organizational capital, and relationship capital. In the model, the relationship between M/B ratios and intellectual capital of firms in Turkey has been examined. Likert type questionnaire method was used in the analysis. According to the results of the analysis, a positive and significant relationship was determined between the human and relationship capitals of the companies and their market values. In addition, a strong and positive relationship was found between the firm's organizational capital and its human and relationship capital.

Karacaer and Aygün (2009) analyzed the relationship between intellectual capital and firm performance in their study. In the analysis, profitability, productivity, and market value were used as firm performance criteria. VAIC analysis, correlation, and regression analyzes were carried out by using the 2007 data of 50 companies traded in Borsa Istanbul. According to the results of the analysis, a positive and significant relationship was found between the intellectual capital coefficient and firm performance, except for the structural capital efficiency coefficient.

Clarke et.al. (2011) examined the effect of intellectual capital on firm performance on Australian firms. For this purpose, analysis was carried out using the VAIC method on a sample consisting of companies listed in the Australian stock market in the period 2004-2008. According to the results of the analysis, it has been determined that there is a direct relationship between VAIC and firm performance. In particular, it has been observed that human capital efficiency is more effective than capital employed efficiency. In addition, a positive relationship was found between human capital efficiency and structural capital efficiency.

Wang et. al (2014) analyzed the effect of knowledge sharing on firm performance and the mediating role of intellectual capital. The data used in the analysis were obtained from a survey conducted on a sample of 228 high-tech firms in China. The tests and methods used in the analysis are the same as the previous studies in the literature. It has been determined that implicit capital sharing has an impact on all components of intellectual capital, including human, structural and relational capital. It has been determined that open information sharing has an effect only on human and structural capital. They stated that the effect of knowledge sharing on firm performance is mediated by intellectual capital. According to the results of the analysis, the authors concluded that human, structural and relational capital increase both operational and financial performance of firms. In addition, they stated that explicit information sharing has more impact on financial performance than operational performance, and tacit information sharing has more

impact on operational performance than financial performance.

Inkinen (2015) analyzed whether intellectual capital has an effect on firm performance. A systematic review procedure was used as a research method in the study. The results of the analysis reveal that intellectual capital affects firm performance through interactions, mergers, and intermediation. In addition, it has been determined that there is a significant relationship between the innovation performance and intellectual capital of the firm.

Castro et. al. (2019) carried out a quantitative analysis of the studies in the literature on intellectual capital. For this purpose, 553 cited documents in the JCR-SSCI database between 1990 and 2016 were examined. These studies were analyzed in three main periods to show the interactions between different studies. In addition, current and future research areas related to the theory have been identified. In this way, the 3 main stages of the evolution of intellectual capital, the main topics, and research frameworks are defined. Finally, 4 important current and future development areas of intellectual capital have been identified, such as the measurement of intellectual capital, intellectual capital in new business models, intellectual capital reporting, and the role of intellectual capital in social capital and human resources practices.

Kadim et. al. (2020) tried to validate the values of the companies by using financial ratios, intellectual capital, and dividend policy components on 11 companies traded in the automotive sector in the Indonesian Stock Exchange (IDX) during the period of 2010 – 2019. Data analysis methods, classical assumptions test, linearity test, total determination and estimation coefficient, and Sobel test were used in the analysis. In the model they used, it was investigated how much financial ratios and intellectual capital affect firm value through dividend policy. According to the results of the analysis, it has been determined that liquidity, solvency, and profitability ratio do not significantly affect the dividend policy, but the dividend policy has a significant effect on the firm value.

Vrontis et. al. (2020) explores the effects of knowledge sharing and intellectual capital on the success rate of equity crowdfunding campaigns in the Italian market. In their analysis, the relationship between information sharing, intellectual capital, and equity crowdfunding success was examined by panel regression method. Social network analysis was used to measure CR in the Twitter user network for the equity crowdfunding campaign. They calculated the success rate of equity crowdfunding campaigns by dividing the number of positive campaigns for each platform by the total number of campaigns. It has been found that the success rate of equity crowdfunding campaigns is positively correlated with intellectual capital and significantly and positively correlated with the number of connections equity platforms have.

Secundo et. al. (2020) prepared a literature review on the strategic role of intellectual capital in achieving sustainable development goals. For this purpose, studies published between 2003 and 2018 in the international literature were examined. In many of the empirical and theoretical studies in the literature, it has been underlined that there is a positive relationship between intellectual capital and sustainability. As a result of the studies in the literature,

they determined that there is a serious convergence between intellectual capital and sustainability.

Ahmed et. al (2020) investigated the effect of intellectual capital and its components on the performance of firms. Partial least square-structural equation modeling method was used to determine the effects of the dimensions of intellectual capital on firm performance. The data used in the analysis were obtained from 192 company managers through a questionnaire consisting of Likert scale items. The absorptive capacity variable used in the study was measured as the transformation and use of knowledge. According to the test results, it was determined that the potential absorptive capacity did not interfere with the relationship between the components of intellectual capital and the components of job performance. However, it has been determined that absorptive capacity plays a positive mediating role in the relationship between the dimensions of intellectual capital and the dimensions of business performance.

Alvino et. al. (2021) conducted a review of the literature analyzing the role of intellectual capital in the sustainability of firms. The study discusses whether intellectual capital has an impact on entrepreneurial activities for the creation of sustainable business models specified in the agenda of sustainable development goals through the knowledge management function. For this purpose, bibliometric analysis was performed based on a database containing 45 articles published in English between 1990 and 2019. According to the results of the analysis, it was concluded that intellectual capital is related to the concept of long-term value. For this reason, it has been stated that the development potential of intellectual capital is linked to the sustainable development 2030 agenda.

4. Methods

In the study, first of all, the financial items required for the calculation of the intellectual capital components were obtained from the independently audited financial statements of the companies published on the Public Disclosure Platform (KAP) for the 2018-2021 analysis period. The market value information required for the calculation of the Market Value / Book Value (M/B) ratio used in the analysis was obtained from the isyatirim.com, and the annual average closing prices of the stocks were obtained from the www.investing.tr

The analysis will be applied to health institutions and pharmaceutical companies whose stocks are traded in Borsa Istanbul. As of the date of the analysis, the number of companies in the Health Sub-Sector listed in Borsa Istanbul is 11. 5 of these companies were excluded from the analysis because they did not have enough data for analysis since they were offered to the public in 2021. Since the data range of 1 of the remaining 6 companies did not match with the others, it was also excluded from the analysis. The remaining 5 companies in the final sample were included in the analysis.

The summary information of the companies that make up the sample is shown in Table 2 below:

Table 2. Summary Information of the Sample Firms

Equity Code	Firm Title	Closing Price (TL)	Market Value (mn TL)	Market Value (mn \$)	Free Float %	Paid-Up Capital (mn TL)
DEVA	Deva Holding	30,48	6.096,60	352,00	17,8	200
ECILC	Eczacıbaşı İlaç	9,19	6.297,50	363,60	18,8	685,3
LKMNH	Lokman Hekim Engurusag	16,8	604,80	34,90	58,5	36
MPARK	MLP Sağlık Hizmetleri	33,74	7.019,20	405,20	33,4	208
SELEC	Selçuk Ecza Deposu	14,65	9.097,70	525,20	14,9	621
			29.115,80	1.680,90		1.750,30

Source: www.isyatirim.com

It is observed that the sample companies have close values to each other in terms of capital amount and especially market value, except for LKMNH. In this way, it can be stated that the sample presents a more homogeneous structure. For this reason, there may be a cross-section dependency in the analysis to be made. For this purpose, it would be appropriate to apply the Pesaran (2004) cross-sectional dependency test in order to determine which test methods to apply before proceeding with the analysis.

Value Added Intellectual Capital (VAIC) method was used to calculate the intellectual capital. In this method, intellectual capital is obtained by calculating each sub-component separately. In the VAIC method, the 3 sub-components of intellectual capital are shown in equation 2 as follows (Çolak, 2012):

$$VAIC = CEE + HCE + SCE \quad (2)$$

The explanation of the notations in Equation 2 is as follows;

VAIC : The intellectual value-added coefficient of the firm,

CEE : The efficiency of the capital used in the business,

HCE : Human capital efficiency,

SCE : It shows the structural capital efficiency.

As shown in Equation 2, in the VAIC method, intellectual capital consists of 3 sub-components: human capital, structural capital, and physical capital. The efficiency of each sub-component of capital gives the added value coefficient created by intellectual capital. Therefore, in the analysis, first of all, each subcomponent will be calculated separately.

The added value (Value Added – VA), which is considered to be created by intellectual capital, is calculated as in equation 3 below (Çolak, 2012):

$$VA = \text{Operating Profit} + \text{Depreciation} + \text{Total Personnel Expenses} \quad (3)$$

Unlike in the previous literature, operating profit is included in the analysis as net operating profit after deducting other operating income and expenses. In this way, the effect of income and expenses that are not related to the main activity of the enterprise or that are not sustainable are eliminated.

Human capital (HC) includes all personnel expenses incurred

during the relevant fiscal year in line with the previous literature.

Structural capital (SC) is calculated as the difference between intellectual capital-added value and human capital as shown in Equation 4:(Çolak, 2012):

$$SC = VA - HC \quad (4)$$

The efficiency coefficients of the 3 sub-capital components used in the calculation of the intellectual capital-added value are shown in Table 3 below:

Table 3. Intellectual Capital Component Coefficients

Intellectual Capital Component Coefficients	Formula	Explanation
CEE	VA / CE	It is the monetary expression of the added value created by each 1 unit of capital used in the business.
HCE	VA / HC	It shows how much each unit investment made in human capital affects the total added value.
SCE	SC / VA	It shows the total structural capital obtained as a result of the added value produced.

Source: Akpınar (2012).

All intellectual capital components shown in Table 3 above are considered as independent variables in this study. The M/B ratio was used as the dependent variable in this study. B is considered to the equity belonging to the parent company in a firm's balance sheet. PD is calculated by multiplying the annual average closing price of the firm with the number of outstanding shares. The Asset Total (firm size) variable of the sample firms was also used as a control variable in the analysis.

The STATA (STATA Inc. version 17. Software, Lakeway Drive, Texas, USA) was used for statistical analysis.

In the study, after calculating and interpreting the effectiveness of the intellectual capital sub-components with the VAIC method, the relationship between each capital sub-component and the M/B ratio will be analyzed statistically. For this purpose, Panel data analysis method will be used. Hausman test was applied in the selection of the econometric model to be applied, and according to the results of this test, it was decided to apply the random effects model.

The panel data model is implemented by applying the GLS

regression robust estimator. The econometric model to which the analysis is applied is shown in Equation 5 below:

$$PD/DDit = \beta_0 + \beta_1 CEEit + \beta_2 HCEit + \beta_3 SCEit + \varepsilon it \quad (5)$$

5. Results

5.1 Calculation of Efficiency Coefficients of Intellectual Capital Components

The results regarding the efficiency coefficient variable of the intellectual capital sub-components are shown in Table 4 below on the basis of the sample companies:

Table 4. Intellectual Capital Components' Efficiencies by Sample Firms

Firm Equity Code	Intellectual Capital Components' Efficiencies	2018	2019	2020	2021
DEVA	CEE	0,60	0,62	0,55	0,45
DEVA	HCE	2,70	3,25	4,15	3,63
DEVA	SCE	0,63	0,69	0,76	0,72
ECILC	CEE	0,03	0,05	0,04	0,03
ECILC	HCE	1,92	3,39	3,17	2,24
ECILC	SCE	0,48	0,70	0,68	0,55
LKMN	CEE	2,91	3,07	2,01	1,66
LKMN	HCE	1,24	1,25	1,54	1,60
LKMN	SCE	0,20	0,20	0,35	0,38
SELEC	CEE	0,34	0,40	0,37	0,43
SELEC	HCE	2,08	2,58	2,22	2,62
SELEC	SCE	0,52	0,61	0,55	0,62
MPARK	CEE	0,86	3,52	3,34	2,51
MPARK	HCE	735,17	1.246,98	1.468,58	1.480,21
MPARK	SCE	1,00	1,00	1,00	1,00

Source: Author's Own Calculations

The interpretation of the intellectual capital efficiency coefficients for each firm is done as follows:

The CEE coefficient shows the added value produced by the capital used by the firm and shows the added value created for each 1 unit of capital. The higher the ratio, the higher the added value produced.

Among the sample companies, the highest rate was observed in MPARK and the lowest rate was observed in ECILC companies. The CEE coefficients of all companies except SELEC show a decreasing trend during the analysis period. It is possible to associate this with the Covid-19 outbreak and the subsequent macroeconomic outlook. The decrease observed in the capital efficiency coefficients can be considered normal, especially due to increased capital costs.

HCE is a coefficient that shows the effectiveness of investment in human resources. It shows the contribution of each 1-unit investment made in human resources to the added value. The rate is expected to be high as in CEE. While the company with the highest rate was MPARK company, the lowest rate was observed for LKMN company. The ratio showed improvement for all sample firms during the analysis period. However, as in CEE, the effect of the Covid -19 epidemic in the 2020-2021 period can be seen in HCE.

SCE shows the contribution of the organizational capabilities of the company to the added value. It is expected that the ratio will be high as in the other two ratios. While the highest rate was observed in MPARK company, the lowest rate was observed in LKMN company. Except for MAPRK, the SCE coefficients of all companies improved during the analysis period.

5.2 Test Results

The descriptive statistics of the intellectual capital components coefficients and M/B ratios of the firms in the sample are shown in Table 5 below:

Table 5: Descriptive Statistics

	M/B	SCE	CEE	HCE	SIZE
Mean	3,041726	0,632319	1,189481	248,526	9,471505
Median	1,466718	0,624101	0,571074	2,660987	9,654542
Maximum	12,53884	0,999324	3,52068	1480,209	10,10408
Minimum	0,428277	0,196179	0,025035	1,244058	8,457426
Std. Dev.	3,801105	0,245699	1,232835	523,5499	0,507029
Skewness	1,687922	-0,032363	0,80766	1,714655	-0,936863
Kurtosis	4,250772	2,368055	2,046024	4,148272	2,575111
Jarque-Bera	10,80063	0,336286	2,932773	10,89892	3,076149
Probability	0,004515	0,845233	0,230758	0,004299	0,214794
Sum	60,83451	12,64639	23,78963	4970,519	189,4301
Sum Sq. Dev.	274,5196	1,146995	28,87777	5207985	4,884491
Observations	20	20	20	20	20

Source: Author's Own Calculations

Considering the skewness and kurtosis values, it can be stated that the series are generally within the reference range (-2 - +2) recommended for the normal distribution.

The tests performed before performing the regression analysis are shown below in order.

Pesaran cross-section dependency test (2004) was applied in order to test whether there is cross-sectional dependence among the companies in the sample.

Hypotheses of the Test:

H0: $Cov(U_{it}, U_{jt}) = 0$ (Cross section is not dependent)

HA: $Cov(U_{it}, U_{jt}) > 0$ (Cross section is not dependent)

The results of the Pesaran (2004) test are shown in Table 6 below.

Table 6. Pesaran (2004) CADF Test

Test	Statistic	p-value
LM-CD	1.542	0,1231
Average absolute value of the off-diagonal elements = 0.528		

Source: Author's Own Calculations

According to the P-value result, it can be concluded that there is no cross-section dependency between sections.

The tests performed to determine whether there are autocorrelation and heteroscedasticity problems in the series used in the analysis and the results obtained are shown in Table 7.

Table 7. Heteroskedasticity and Autocorrelation Test

Test	Test Statistic	p-value
Heteroscedasticity	chi2= 2.85	0.0916

Autocorrelation	F (1,4) = 16769	0.0149
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Source: Author's Own Calculations

In the test results, there is no heteroskedasticity problem in the series, but autocorrelation problem has been detected.

Hausmann test was used to determine the econometric model to be established. As a result of the test, it was deemed appropriate to apply the Random Effect model. GLS regression analysis was used in the analysis, which produces robust estimations to Heteroscedasticity and Autocorrelation problems. Analysis results are shown in Table 8 below.

Table 8. GLS Regression Analysis

Random-effects GLS regression					Number of obs	=	20
Group variable: code					Number of groups	=	5
R-sq:					Obs per group	:	
within = 0.7985					min	=	4
between = 0.9996					avg	=	4.0
overall = 0.9808					max	=	4
					Wald chi2(4)	=	67876.77
					Prob> chi2	=	0.0000
(Std. Err. Adjusted for 5 clusters in code)							
M/B	Coef.	Robust Std. Err.	z	P>z	[95% Conf. Interval]		
CEE	1.284.205	0.503777	2.55	0.011		.2968198	2.271.589
HCE	.0035799	.0014093	2.54	0.011		.0008178	.006342
SCE	4.396.146	1.917.657	.229	0.022		.6376067	8.154.685
SIZE	0,4257673	.5701679	0.75	0.455		-.6917412	1.543.276
_cons	-6.187.936	616.121	-1.00	0.315		-1.826.369	5.887.814
sigma_u	0						
sigma_e	.65876786						
rho	0						
(fraction of variance due to u_i)							

Source: Author's Own Calculations

According to the results of the regression analysis, it has been determined that all the efficiency coefficients of the components of intellectual capital have a positive and significant effect on the firm's M/B ratio, in line with our antecedent expectations and the previous literature. In other words, if these coefficients increase, the M/B ratio will also increase. As a result, the value of the company in the eyes of investors will increase.

6. Discussion

In the study, the coefficients of the intellectual capital components, which are the independent variables, were determined as positive. Based on this result, it can be said that there is a positive and statistically significant relationship between the intellectual capital components and the value of the firm. It has been observed that SCE has the most impact on firm performance with a value of approximately 4.37. In Wang et.al (2014) study, it was determined that the effect of SCE has more effect than other IC components.

According to many studies published in the previous literature, a positive relationship has been found between intellectual capital and firm value and financial performance. Therefore, these findings are compatible with the results of studies published in the previous literature.

The overall results obtained in this study are similar to the results of the Bozbura and Toraman (2004), Wang et. al (2014), Inkinen (2015), Kadim et. al. (2020) ve Ahmed et. al (2020).

However, the findings obtained in terms of IC components differ from the literature. In terms of IC components, the ones with the highest impact on firm value were determined as SCE, CEE and HCE, respectively. Contrary to many studies in the literature, it has been determined that the effect of CEE on firm value is greater than that of HCE.

7. Conclusion

According to the results of the analysis, a positive and significant effect of the efficiency coefficients of all sub-components of intellectual capital on the M/B value was determined. The results are consistent with previous literature findings. The increase in the intellectual capital sub-components will increase the value of the firm.

Based on the findings, it can be stated that the investment made by the firms in intellectual capital contributes positively to the firm value. Since M / B indicates the company's stock is traded in the market how many times higher than its book value, it can be concluded that investments to be made in intellectual capital will also positively affect the perception of current and potential investors about the company, based on the results of the analysis.

The aim of this study is to contribute to the existing literature on the subject. In order to measure intellectual capital and observe its effects, Borsa İstanbul health sub-sector has been selected. Especially since the need for innovation in the health sector has been revealed much more clearly after the Covid-19 global epidemic, it is very important to determine and reveal the human capital that will carry out this innovation and the added value it creates in terms of the health sector. The only limitation in the creation of the study is that the number of companies in the health sub-sector traded in Borsa İstanbul is 5 as of the date of analysis. The generalizability of the results obtained on the sample consisting of such a small number of companies can be questioned. It is thought that more meaningful and general results can be obtained if the study is applied on a larger sample group in terms of both the number of periods and the number of sections.

Importance of the Study

The aim of this study is to contribute to the existing literature on the subject. In order to measure intellectual capital and observe its effects, Borsa İstanbul health sub-sector has been selected. Especially since the need for innovation in the health sector has been revealed much more clearly after the Covid-19 global epidemic, it is very important to determine and reveal the human capital that will carry out this innovation and the added value it creates in terms of the health sector.

Limitations and Suggestions for Further Studies

The only limitation in the creation of the study is that the number of companies in the health sub-sector traded in Borsa İstanbul is 5 as of the date of analysis. The generalizability of the results obtained on the sample consisting of such a small number of companies can be questioned. It is thought that more meaningful and general results can be obtained if the study is applied on a larger sample group in terms of both the number of periods and the number of sections.

Ethics

Ethics Committee Approval: The study does not require any ethics committee approval, as there are no surveys and studies such as human and animal experiments.

Peer-review: Externally peer-reviewed.

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