REPUBLIC OF TURKEY

ADANA ALPARSLAN TÜRKEŞ SCIENCE AND TECHNOLOGY UNIVERSITY

INSTITUTE OF GRADUATE SCHOOL

DEPARTMENT OF MANAGEMENT INFORMATION SYSTEMS

AN EXAMINATION OF INTELLECTUAL CAPITAL FOR INFORMATION TECHNOLOGY FIRMS IN TURKEY

BÜŞRA DORUK

MASTER OF SCIENCE

ADANA 2023

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PROF. DR. FATMA NUR İPLİK

ADANA 2023

I hereby declare that all information in this thesis has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all information that is not original to this work.

[Signature]

Büşra DORUK

ABSTRACT

AN EXAMINATION OF INTELLECTUAL CAPITAL FOR INFORMATION TECHNOLOGY FIRMS IN TURKEY

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The aim of this thesis is to study the coefficient of intellectual capital of the information technology and telecommunication firms listed on Borsa Istanbul between 2002 and 2021 and to explore how this coefficient has evolved during the Covid-19 period.

The coefficient of intellectual capital is calculated for these firms using the market-to-book ratio (MV /BV) and Tobin's Q ratio. The results show that the coefficient of intellectual capital for these companies is generally low before the pandemic, while this coefficient continues to decrease during the pandemic. It can also be observed that the value of intellectual capital is quite heterogeneous for the firms considered in this study.

This thesis is expected to contribute to the related literature in determining the intellectual capital of information technology and telecommunications firms. It is also expected to contribute to the literature on the impact of the pandemic period on the intellectual capital of these firms.

Keywords: Intellectual capital, Information technology and Telecommunication firms, Borsa Istanbul firms

ÖZET

TÜRKİYE'DEKİ BİLGİ TEKNOLOJİ FİRMALARININ ENTELLEKTÜEL SERMAYESİNİN İNCELENMESİ

Büşra DORUK

Yönetim Bilişim Sistemleri Anabilim Dalı

Danışman: Prof. Dr. Fatma Nur İPLİK

Nisan 2023, 70 sayfa

Bu tezin amacı Borsa İstanbul'a kote olmuş bilgi teknolojileri ve telekomünikasyon firmalarının 2002 ile 2021 yılları arasındaki entellektüel sermaye katsayısını incelemek ve Covid-19 döneminde bu katsayının nasıl bir seyir izlediğini araştırmaktır.

Piyasa Değeri/Defter Değeri (PD/DD) ve Tobin Q rasyosu vasıtasıyla entellektüel sermaye katsayısı bu firmalar için hesaplanmıştır. Elde edilen sonuçlar bu firmalar için entellektüel sermaye katsayısının pandemi dönemi öncesinde genellikle düşük olduğunu gösterirken pandemi sırasında bu katsayının daha da azaldığını göstermektedir. Bu çalışmada ele alınan firmalar için entellektüel sermaye değerinin oldukça heterojen olduğu da görülmektedir.

Bu tezin ilgili literatüre bilgi teknolojileri ve telekomünikasyon firmalarının entellektüel sermayesinin saptanması noktasında katkı sağlaması beklenmektedir. Aynı zamanda pandemi döneminin bu firmaların entellektüel sermayesine etkisi çerçevesinde de ilgili literatüre katkı sağlaması beklenmektedir.

Anahtar Kelimeler: Entellektüel sermaye, Bilgi teknolojileri ve Telekomünikasyon firmaları, Borsa İstanbul firmaları

To Karen, my little daughter,

To İbrahim, my father

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First of all, I would like to thank the Department of Management Information Systems and my thesis advisor Prof. Dr. Fatma Nur İplik for providing me with a lot of information about entrepreneurship and for teaching me various things in this field. I would like to thank my husband Assoc. Prof. Ömer Tuğsal Doruk for his support and endless. Finally, I would like to thank my dear daughter for her understanding and the playtime I stole from her.

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NOMENCLATURE

VAIC	:Value Added Intellectuel Capital
HCE	:Human Capital Efficiency
SCE	:Structural Capital Efficiency
CEE	:Capital Employed Efficiency
MV	:Market Value
BV	:Book Value
IT	:Information Technology

1. INTRODUCTION

The word "globalization", which has been familiar to us since the early 1990s, has become more important to businesses as technology has developed (Awuah & Amal, 2011).

The fact that technology enables serious cost advantages during and after the production phase shows that technology has a crucial importance for companies. Technology is shown to have a direct impact on factors such as companies' sustainable competitive advantage, cost advantages, and profitability (Black & Lynch, 2001; Dewan & Kraemer, 2000).

The fact that technology is an important production factor when it comes to cost savings can give companies a serious understanding of the competition. For this reason, technological tools, equipment and facilities owned by enterprises are important for enterprises to seriously compete. Therefore, the intangible capital of enterprises is an important factor that stands out for competition (Black & Lynch, 2001; Dewan & Kraemer, 2000). The nexus between intangible capital and competition, which is generally observed to affect book value, is analyzed in this study using intellectual capital.

Intellectual capital makes an important contribution to the firm in the form of human capital, social capital, and structural capital owned by the firms. Intellectual capital reflects, to some extent, the technical and innovative capacity of enterprises. The impact of this capacity on market value gives companies a significant profit and competitive advantage. Intellectual capital, in other words, reflects the technical and innovative capacity of companies. The contribution of this capacity to market value provides companies with a profit and competitive advantage.

In this thesis, intellectual capital is considered as an intangible asset that exceeds the book value of the firm and gives the firm a competitive advantage in terms of market value. Therefore, this thesis analyzes the market value in relation to the book value and Tobin's Q for individual listed information technology companies (IT) at Borsa Istanbul. The purpose of individual intellectual capitalization in this work is to consider heterogeneity at the firm level. Therefore, this work focuses on the sector IT, where intellectual capital is very important for competition. Moreover, this work analyzes the intellectual capital of IT companies comparatively by considering the pandemic, which is an important exogenous shock, before and after the pandemic. Consequently, this thesis aims to contribute to the literature on developing countries by analyzing intellectual capital in the technology-intensive sector in an important developing country: Turkey.

A review of the Turkish and international literature on intellectual capital shows that studies focus on different dimensions of intellectual capital. In the existing literature, studies on intellectual capital in general:

(i) they focus on firms other than IT,

(ii) They do not address the pandemic period; or

(iii) There are studies that focus on a single time horizon, usually cross-sectional analyzes or analyzes of the current period.

A detailed review of this literature can be found in Chapter 2 of this thesis. In this literature review, this thesis aims to make an original contribution to this literature by analyzing the reflection of intellectual capital in financial markets in a firm-specific structure over a 15-year period for IT and telecommunication companies, which are technology-intensive firms in Turkey, a major emerging market, in the pre- and post-pandemic periods.

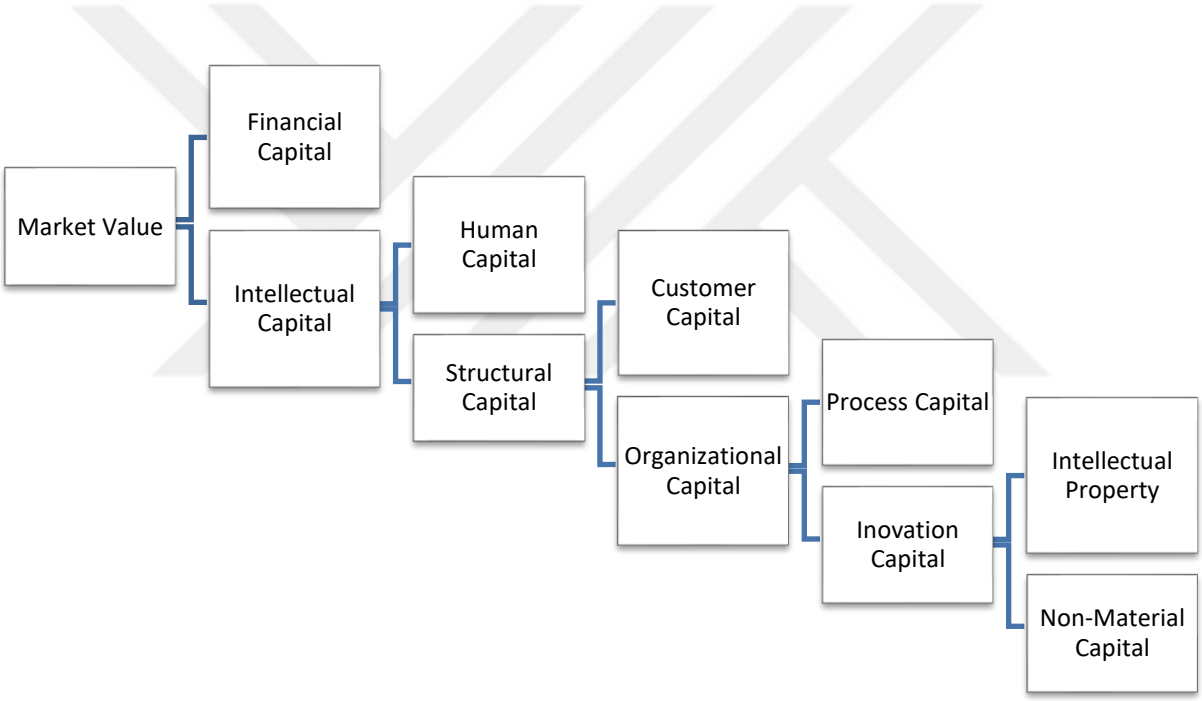
This thesis is structured as follows. In the second part of the thesis, the definition of intellectual capital is made and the measurement methods of intellectual capital are studied and all methods are explained. In the third part, studies on intellectual capital of information technology enterprises are examined and a literature review is made. In the fourth part, the data of 19 information technology companies were analyzed and intellectual capital was measured. In the empirical part, intellectual capital is measured for the 19 listed information technology companies in Turkey between 2002 and 2021 and how these 19 companies changed during the Covid-19 period is examined. In the fifth and final chapter of the thesis, general conclusions are drawn and the limitations and policy and managerial implications of the thesis are presented.

2.THE CONCEPT OF INTELLECTUAL CAPITAL

2.1. Definition of the Concept of Intellectual Capital

Intellectual capital consists of the sum of human capital, cultural capital, and social capital that a company possesses. It refers to the assets of the company that are not included in the financial indicators. It refers to the unmeasured values in the part of intellectual capital that is above the book value of the companies. Intellectual capital is defined as intangible assets that generate income and add value to the companies' financial reports (Lu et al., 2010: 547).

Figure 1: Administrative Chart of Intellectual Capital



Source: Bischoff et al., 2011: 18

Intellectual capital has a crucial importance in the immeasurable assets of companies, especially in sectors identified with knowledge capital and advanced technology (Diaz-Fernandez et al., 2015: 2). When analyzing knowledge-based business, it is evident that knowledge-based assets are critical for sustainable competitive advantage. In this regard, intellectual capital is in an important position for companies to value knowledge-based assets and achieve competitive advantage (Curado, et al., 2011; Itami and Roehl, 1991; Nahapiet and Ghoshal, 1998; Subramaniam and Youndt, 2005; Teece, 2002 cited in: Sydler et al., 2014).

Intellectual capital consists of human capital, structural capital, and customer capital. These elements are explained by Ertaş and Coşkun (2005: 124) as follows:

Human capital: it is defined as the capital created by the experience, skills and knowledge of the company's employees.

Structural capital: it is defined as the capital consisting of the immovable assets of the company, such as hardware, software, patents, brands, databases that support the productivity of the personnel.

Customer capital: It includes the company's customer loyalty, the company's brand recognition, relationships and connections with suppliers. Licensing agreements that add value to the company include collaborations.

According to Kerimov (2011), the most difficult area for companies in terms of intellectual capital is the phase of transformation of human capital and customer capital into structural capital. Customer capital develops along with structural capital and human capital and is created by moving from simple business transactions to collaborations.

Table 1 shows different approaches to intellectual capital. According to Table 1, intellectual capital is generally defined in the literature as business knowledge based on intangible assets that provide companies with profits, gains or competitive advantages.

Table 1: Definitions of Intellectual Capital

Author	**Definition of Intellectual Capital**
Bontis (1999)	Compilation of abstract entities and loop of abstract entities
Brooking (1997)	The difference between the book value and the amount that other individuals are prepared to pay
Edvinsson (1994)	Source of intangible (hidden) assets not included in the balance sheet
Harrison ve Sullivan (2000)	Information that can be turned into profit
Roos vd. (1997)	The sum of the information of the members of the firm and the conversion of this information into trademarks, patents and brands
Stewart (1999)	Intellectual material (knowledge, information, intellectual property, experience) used to generate wealth for the firm

Source: Sitar, A. and Vasic, V. 2004: 339

Lin et al. (2015) that intellectual capital has essential characteristics for firm competitiveness and continued growth. Lin et al. (2015) stated that intellectual capital has reached an important point in terms of enterprise growth and competitiveness, especially after the rapid development of technology. Zéghal and Maaloul (2010) state that the intellectual capital of enterprises will have a positive impact on the economic and financial performance of enterprises.

2.2. Measuring Methods of Intellectual Capital

This section presents the methods of measuring intellectual capital in the context of the study. At the same time, the different methods of measuring intellectual capital are mentioned.

2.2.1. Tobin q Ratio

When calculating intellectual capital, the methods for intellectual capital are not specifically specified, but the Tobin q method is used, which is most often used for economic analysis.
When calculating the Tobin q ratio;
the equation q= market value/replacement cost
is considered.
Tobin's q method was used by Stewart (1997) to measure intellectual capital. Technology and human capital oriented investments have high q coefficient values (Starovic & Marr, 2014). In general, a q coefficient greater than 1 leads to intellectual capital being valued as high.

2.2.2. Ratio of Book Value to Market Value

The ratio of the assets of the firm/business to the market value is another method of calculating the intellectual capital ratio. One of the methods used in the literature to measure intellectual capital is to relate the book value, which is based on the assets of the company, to the market value.

2.2.3. Subtracting Book Value from Market Value

One of the methods of calculating the intellectual capital ratio is subtracting the book value from the market value of the company (multiplying the share price and the number of shares). Determining the non-measurable assets of the company as a result of subtracting the book value of the company from the market value of the company is the point to be reached in this approach.

2.2.4. Value Added Approach

The value-added approach is a method for calculating intellectual capital introduced into the intellectual capital literature by Robinson & Kleiner (1996). It is based on Michael Porter's approach and Economic Value Added (EVA) based on the value added approach. To measure intellectual capital, it is important to measure which activities add value and what clear contribution they make to the organization, as well as to identify and eliminate activities that do not add value to the organization (Starovic and Marr, 2014).

2.2.5. Balanced Scorecard Approach

The balanced scorecard approach, which is one of the methods of measuring intellectual capital, is due to Kaplan and Norton (1992), who have an important place in the literature. Kaplan and Norton's (1992) method is used by Starovic&Marr (2014) based on four main criteria in measuring intellectual capital;

- **Financial metrics:** General view of the company for shareholders (metrics such as financial position, cash flow, etc.)
- **Customer metrics:** Metrics on how customers view the company. For example, criteria such as the status of the price compared to competitors are important.
- **Internal process metrics**: Metrics such as cycle times of internal processes and time to resource.
- **Learning and growth metrics:** Metrics such as the share of new products in sales and the company's level of innovation.

2.2.6. Calculated Intangible Value Method

The method for determining abstract value was developed by Stewart (1995) as a 7-stage calculation method. In the first stage, the pre-tax profit was calculated and in the second stage, the average three-year year-end values of assets were determined. In the third stage, the division of profit by assets by return on assets (RoA-return on assets) was performed. In the fourth stage, the average RoA of the industry/sector was calculated. If the RoA of the firm is lower than the average RoA of the industry, this method is considered unsuccessful (Starovic and Marr, 2014: 16). In the fifth step, the excess return is calculated by multiplying the average RoA of the industry by the average assets of the firm. In the sixth step, the average income tax for three years is calculated and this average income tax is multiplied by the excess income calculated in

the fifth step. In the seventh step, the net present value (NPV) is calculated. In calculating NPV, the discount rate and the total cost of capital are discounted (Starovic & Marr, 2014:16).

2.2.7. Intellectual Capital Coefficient Approach

The intellectual capital coefficient approach (VAIC) is the intellectual capital coefficient obtained by dividing the difference between total sales and all inputs, excluding expenditure on workers, by the total worker expenditure (Starovic and Marr, 2014: 18).

While VAIC is calculated by Pulic (2004), it is seen that it is based on general concepts. The coefficients on which VAIC is based are composed of the human capital efficiency coefficient (HCE), the structural capital efficiency coefficient (SCE) and the capital employed efficiency-(CEE) coefficients. Pulic (2004) puts added value on the basis of these coefficients.

The added value that we can abbreviate with VA is by Pulic (2004: 65);

VA= Defined as Input-Output values. More broadly, VA;

VA= Total sales - Defined as total input and material costs. Calculation of VA in practice;

It is based on the equation VA= OP+EC+D+A.

OP: Operating expenses;

EC: Personnel expenses

D: Depreciation of intangible assets

A: Depreciation on tangible assets.

According to the analysis of Pulic (2004), HCE is calculated as HCE= VA /HC (human capital).

When calculating structural capital (SC); It is calculated as SC = VA-HC.

In Pulic's (2004) analysis, it is calculated as SCE=SC/ VA.

CEE= VA/CE (net book value of assets owned by the firm/business) equation is used to calculate the CEE coefficient (Pulic, 2004: 65).

In Pulic's (2004) analysis, the coefficient of intellectual capital (ICE -intellectual capital efficiency) is:

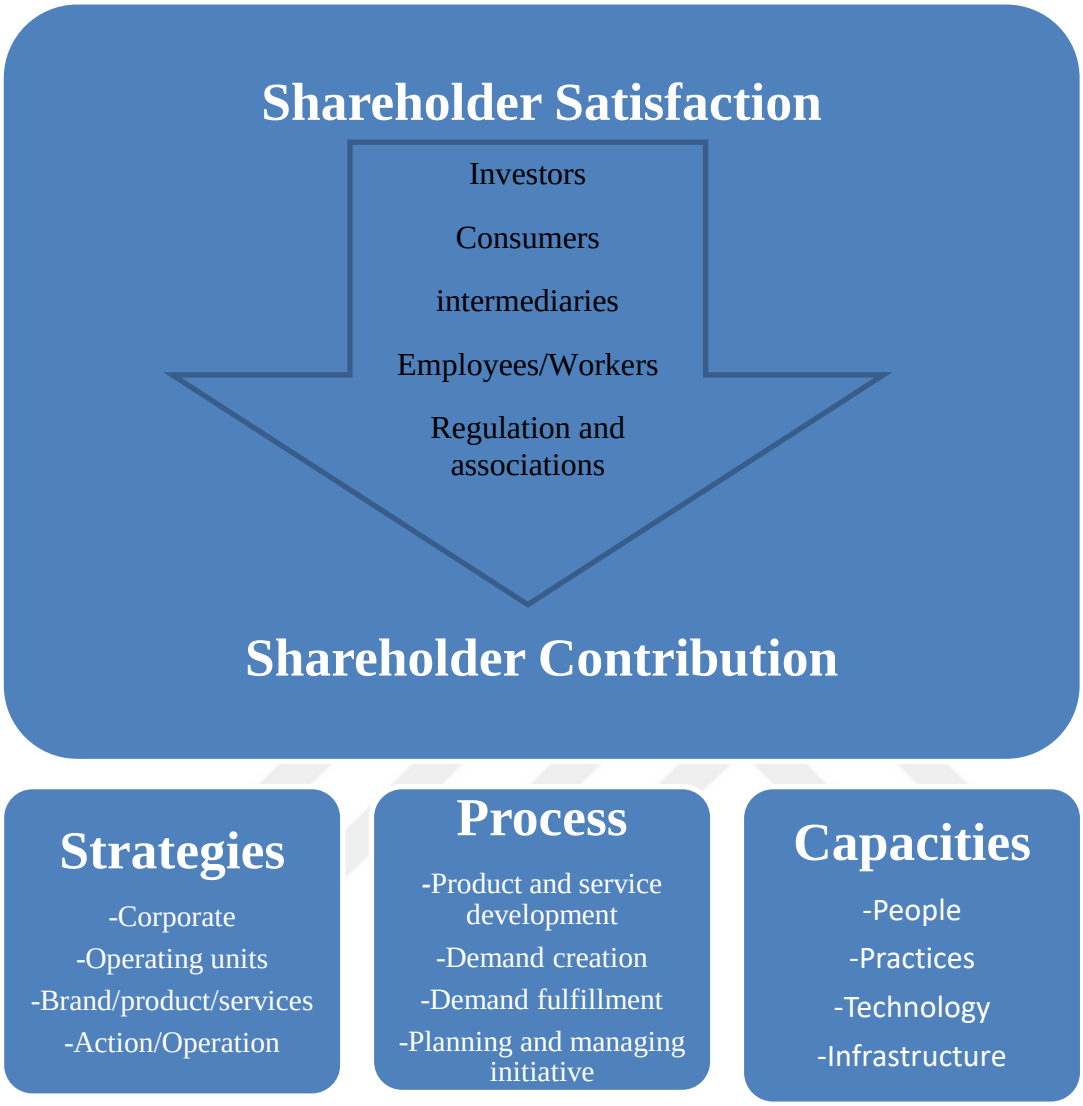
ICE=HCE+SCE. It is measured using the Intellectual Capital Coefficient (ICE) equation in the final step of calculating the intellectual capital coefficient

VAIC= ICE is calculated using the equation (HCE+CEE+SCE) (Pulic, 2004: 65).

2.2.8. Performance Prism Approach

Another approach to measuring intellectual capital is the performance prism approach. The performance prism approach is the result of collaboration between the Cranfield School of Management and Accenture (Abran & Buglione, 2003). According to the performance prism approach in Figure 2: By applying a holistic approach, planning is done in accordance with the interests of the shareholder and strategies, processes, and capacities are selected. According to Starovic & Marr (2014), the performance prism is applicable to any company or organization due to its flexibility and has a structure that can overcome the criticism of the narrow concept of the balanced scorecard. The performance prism approach measures intellectual capital in relation to the business by measuring the impact of intangible assets on key performance drivers in line with customer needs. At the heart of the performance prism are the interests of shareholders. However, as can be seen in Figure 2, this approach includes not only customers but also employees, investors, intermediaries and suppliers as shareholders.

Figure 2: Performance Prism Approach



Source: Starovic & Marr,2014:8

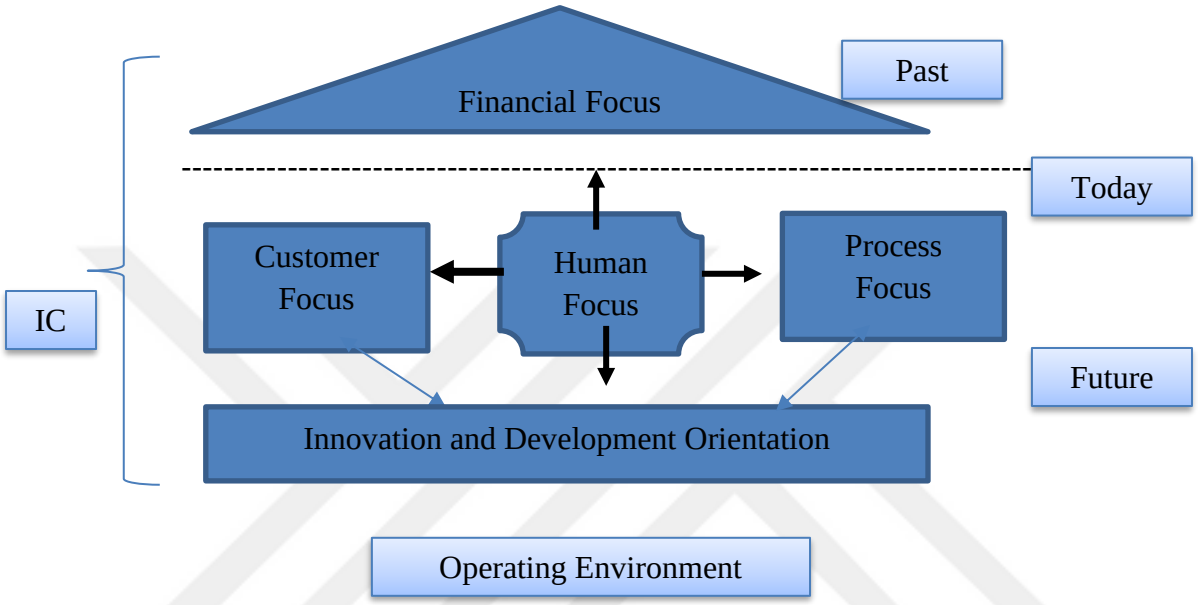
2.2.9. Skandia Guide Approach

One of the methods used to measure intellectual capital is the Skandia Guide approach. The Skandia Guide Approach interprets intellectual capital in terms of the compatibility between the company's past performance, current performance, and future performance. The Skandia Guide Approach is an approach to intellectual capital developed in Sweden based on four main pillars.

As can be seen in Figure 3, these four main pillars are financial orientation, customer orientation, process orientation, and innovation and development orientation. According to Barutçugil (2002), the Skandia guide shows a balanced picture of the company through the

financial dimension, which represents past performance, the customer, human resources and process dimension of the present, and the renewal and development dimension of the future (Barutçugil, 2002:93 cited in Kerimov, 2011 :71).

Figure 3: Skandia Guide Approach



Source: Edvinson and Malone, 1997 cited: Starovic and Marr, 2014: 11

2.2.10. Perception Measurement Method Scale

As can be seen in Figure 3, these four main pillars are financial orientation, customer orientation, process orientation, and innovation and development orientation. According to Barutçugil (2002), the Skandia Guide shows a balanced picture of the company through the financial dimension, which represents the past performance, the customer, human resources and process dimension of the present, and the renewal and development dimension of the future (Barutçugil, 2002:93 cited in Kerimov, 2011 :71).

3. LITERATURE REVIEW

When examining the literature on intellectual capital in developing countries and in Turkey, one finds that intellectual capital is studied in different dimensions. The first of these studies is Yıldız (2011b). In Yıldız's (2011b) study, the intellectual capital of 8 private listed deposit banks was investigated through a survey. In this study, intellectual capital was measured based on the responses of 421 managers at the executive level of 8 banks. The findings obtained at the end of the study show that the elements of intellectual capital influence perceived performance more than quantitative performance. Customer and structural capital were found to have a more positive influence on banks' subjective performance, while structural capital mainly influenced objective performance.

In the study by Özdemir & Balkan (2010), intellectual capital was measured through a survey of 82 companies in the information technology industry. The questionnaire was completed by 400 middle and senior managers working in these companies. A total of 81 questionnaires were completed. The survey contains 64 questions, 23 of which are related to human capital variables, another 21 to structural capital variables, and the last 20 to customer capital variables. This questionnaire was prepared using a five-point Likert scale. The data were analyzed using the SPSS program. As a result of the research, it was found that the elements of structural capital and customer capital of intellectual capital contribute to the companies to a greater extent.

Bozbura & Toraman (2010) aim to investigate the components of intellectual capital of companies in Turkey and empirically examine the relationship between intellectual capital and market capitalization of companies listed on Borsa Istanbul. For this investigation, 4 hypotheses were formulated. In order to test the hypotheses, two separate questionnaires were prepared. And a 7-point Likert scale was used for these questionnaires. Cronbach's alpha test, principal component analysis, linear regression, and partial least squares were used to ensure the reliability of the questionnaires. The result of this study is that human capital and relationship capital have a positive relationship with market/book value of companies in Turkey and structural capital has a relationship with human and relationship capital.

According to Kayalı et al. (2007), the main objective of his study is to show the importance of intellectual capital in firm valuation. In the study, the importance of intellectual capital of technology companies traded on Borsa Istanbul in Turkey was investigated using Pulic's VAIC method. The study included 9 technology companies operating in Turkey whose shares are traded on Borsa Istanbul. The result of the study: the correlation and multiple regression

analyzes conducted revealed that intellectual capital is not given the necessary importance even in the technology-intensive sector of our country.

Çalışkan's (2015) study examined the impact of intellectual capital of firms in the banking sector in Turkey on firm valuation. 14 banks traded on Borsa Istanbul were included in the study. The data of the financial statements of 31.12.2013 were analyzed with the multiple regression model. The VAIC model developed by Pulic (1998) was used in the study. As a result of the study, it was found that human capital has more impact on efficiency and market valuation of banks than structural capital and that capital employed first and then human capital are effective in their profitability. It can also be concluded that the difference between the market and book value of the companies can be reduced with the increase of investment in human capital and the measurement of intellectual capital.

In the study by Zor & Cengiz (2013), the relationship between intellectual capital and firm value was investigated. The study included companies from the energy sector that were traded on Borsa Istanbul between 2009 and 2011. In order to determine the relationship between intellectual capital and firm value, the results obtained using the “Calculated Intangible Value Management" were compared with the Market Value/Book Value method of the companies. As a result of the study, it was found that companies do not attach importance to their intellectual capital and that the most important factors influencing company performance are tangible assets.

The aim of the study by Yörük & Erdem (2008) is to measure the intellectual capital of companies in the automotive industry. Data from the financial statements of 12 automotive companies operating in Turkey were used for the analysis. The companies included in the analysis are companies that manufacture commercial vehicles and/or passenger cars and provide services to the automotive industry. The data used are from the financial statements as of Sept. 30, 2003, which can be found on the Borsa Istanbul website. The VAIC method was used to measure intellectual capital. The analysis showed that although Turkish automotive companies have made significant efforts in leveraging their intellectual capital, the most important elements of the companies' performance still depend on their tangible assets.

In the study of Şamiloğlu (2006), the relationship between the VAIC and the market-to-book value of banks whose shares are traded on Borsa Istanbul between 1998 and 2001 was investigated. In the study, the relationship between market-to-book value and the components of VAIC of 12 Turkish banks was analyzed using simple and multiple regression analysis. The

results of the study show that there is no significant relationship between the components of VAIC and market-to-book value.

The aim of Atan & Tunçer (2019)'s study is to investigate the impact of intellectual capital on business performance. The first 500 and the second 500 large companies affiliated with the Istanbul Chamber of Industry participated in the study. The questionnaires were completed by the managers working in the companies. A total of 404 questionnaires were accepted as valid. The data were analyzed by structural equation modeling using the program IBM SPSS and AMOS 21.00. The result of the research is that human capital, which is one of the elements of intellectual capital, positively influences the performance of customer stakeholders, internal processes and company performance.

In the study of Soylu (2020), the influence of intellectual capital of technology companies traded on Borsa Istanbul on the income and profit generation process was investigated. 14 technology companies were included in the study. The data of 14 technology companies from 2017 and 2018 were used for the study. The CCR (Charnes-Cooper-Rhodes) and BCC (Banker-Charnes-Cooper) models were used to calculate the relative overall efficiency, pure technical efficiency, and scale efficiency of the companies. As a result of both analyzes (CCR & BCC), it was found that companies used intellectual capital components more effectively in 2018 than in 2017.

The purpose of Töre (2019)'s study is to examine the mediation aspect of information sharing in the effect of intellectual capital on innovative business behavior. Relational screening model was used in the study. Baron and Kenny's 3-stage model was used to create and test the model. 439 people working in 5-star accommodation establishments in Antalya participated in the study. According to the results of the research, it was found that knowledge sharing plays a mediating role in the effect of intellectual capital on innovative business behavior.

Arslan (2004) applied content analysis to the 2003 annual reports of the companies that were among the top 30 in Borsa Istanbul on 04/01/2004. Within the annual reports, board reports, annual reports, investor dossiers, annual reports, general publicity reports, company profiles, and annual reports of companies were examined to obtain information about the intellectual capital of the companies. Then, company balance sheets, income statements, audit reports, holding company statements, cash flow statements, cash flow statements, income distribution statements, executive summary, valuation principles, and definitions of basic ratios were included in these reviews. Each category of intellectual capital, which is examined in three main categories as internal capital, external capital, and human capital, is also divided into

subcategories within itself. According to the results of the analysis, companies gave priority to the concept of external capital in their annual reports, and the second most common category was human capital. The last analysis showed that the lowest category of intellectual capital was internal capital.

Şahin & Alabay (2011) aim to investigate the impact of intellectual capital of SMEs registered at Borsa Istanbul on firm performance. The data of SMEs operating under EU criteria between 2008 and 2010 were used. Since these companies were subjected to independent auditing, the data were considered reliable. The intellectual capital of the companies was measured using the VAIC method. Multiple regression and correlation were used as statistical methods. As a result of this study, significant effects of SMEs on market value and profitability, which are the performance indicators of VAIC and its components, were found.

Dönmez & Erol (2016) aimed to measure intellectual capital, which accountants have difficulty measuring and reporting. Data from companies with BIST -sustainability index were used for the study. The VAIC method was used to measure intellectual capital. According to the results of the study, the return of VAIC coefficients was reported as 93%.

Paksoy & Öztürk (2006) studied the formation of intellectual capital in the hotel enterprises of the service sector in the provinces of the Southeast Anatolia Project (GAP). Fifty hotel companies operating in the provinces GAP participated in this research. The results were prepared in the form of a cross tabulation according to the measurement of intellectual capital, personal interview of hotel companies and the class (number of stars) of hotels using SPSS. These results were analyzed with the Pearson correlation test according to the dependent and independent variables. According to the results of the research, the necessity of the intellectual capital in the hotel enterprises of the service sector, which consists of a human-oriented structure, was highlighted.

The aim of İpçioğlu & Şahin's (2012) study is to show the relationship between the organizational culture of lodging companies and intellectual capital. 260 four- and five-star hotels in the Marmara region were included in the study. A questionnaire was prepared for the companies and sent to them. 118 of these questionnaires were found to be suitable for analysis. As a result of these studies, it was found that there is a strong relationship between organizational culture and intellectual capital.

The objective of the study by Taşgit et al. (2015) is to investigate how hotel managers perceive the concept of intellectual capital and to determine the key determinants of intellectual capital in hotel operations. For this study, data from five-star hotels in Turkey were used. These data

were collected through a survey. SPSS 18.0 and LİSREL 8.7 programs were used to analyze the survey data. The results of the survey show that intellectual capital is perceived as a four-dimensional concept in the hotel industry. Among these dimensions, the most important determinant of the structure of hotel intellectual capital is the "employee characteristics" that constitute human capital. This is followed by the dimensions of "organizational structure", which represents structural capital, "relationships with customers" and "relationships with stakeholders", which represent relational capital.

The aim of the study of Özer & Özer (2014) is to investigate the relationship between the stakeholder approach of net added value- based total asset returns and strategic intangible asset intellectual capital in multinational companies listed on Borsa Istanbul during the 2002-2011 period. In this study, intellectual capital was measured with the VAIC method. As a result of this study, it has been revealed that both the resource-based approach and the stakeholder approach are valid for multinational companies in Borsa Istanbul.

The objective of the study by Keskin et al. (2018) is to empirically test the web of relationships, starting from the contributions of explicit and implicit information sharing mechanisms to the intellectual capital of the firm to the impact on operational and financial performance in Turkey. The study used quantitative data from 161 company employees and the AMOS program. First, a structural equation analysis and then a moderator analysis were conducted.

According to the data obtained as a result of the study:

1) The explicit and implicit information sharing within the firm intellectual capital,

2) The dimensions of intellectual capital strengthen the operational performance, and

3) Operational performance was found to have a significant and positive impact on the financial performance of the firm.

The aim of Türkoğlu & Çizel's (2016) study is to investigate the effects of intellectual capital on the competitiveness of lodging establishments. For this study, 4 and 5 star accommodation establishments in Antalya were included in their sample.

Their sample includes general managers, deputy general managers, general coordinators, and department heads of lodging establishments. 505 hotels and vacation villages were found suitable for the study. As a result of the interviews with the lodging establishments, 132 establishments were not included in the study because they were closed. A total of 373 lodging establishments were included in the study. The research was conducted through face-to-face interviews and surveys. Two separate samples were used for the study. The results of the study

show that intellectual capital has a significant and positive impact on competitiveness according to the managers of lodging establishments.

The aim of Yıldız's (2010) study is to examine on the non-reporting of intellectual capital in Turkey, to fill this gap, and to provide a bank-specific intellectual capital report with the aim of "recommendation". Eight private deposit banks listed on Borsa Istanbul were included in the study. The intellectual capital is measured “on the basis of its elements” with the method of perception measurement of the elements by the managers and reported with the Skandia Guide method. According to the results of this study conducted in private deposit banks in Turkey, "customer capital in the first place, structural capital in the second place and human capital in the third place" are the elements of intellectual capital that managers have given importance to or considered important.

Akpınar (2003) aims to investigate the relationship between intellectual capital and firm performance. The study examines how the intellectual capital elements of "human capital, structural capital, and customer capital" affect firm performance. The study refers to companies included in the Industrial Index of Borsa Istanbul. The data was collected with the help of a questionnaire. The collected data were analyzed using SPSS 10.0 program. From the analyzes of the study, it is found that the elements of intellectual capital and its sub-elements have significant effects on company performance and that these sub-elements also interact with each other.

The aim of Tunçer & Tarlacı's (2020) study is to investigate the relationship between intellectual capital and organizational performance in the context of organizational climate. 405 managers from 1000 companies registered in Istanbul Chamber of Industry participated in the research. The research data were obtained by using the survey method. SPSS and AMOS were used to analyze the research data. All elements of intellectual capital have a positive impact on organizational climate that provides resources for innovation.

In this study, Karacan & Ergin (2011) calculated intellectual capital values using data from the financial statements of 17 banks traded on Borsa Istanbul. The relationship between the intellectual capital amounts of the companies and their market values was statistically tested. The data of the last three years (2010, 2009 and 2008) of the companies were used. In this study, intellectual capital was calculated using the "Calculated Intangible Value Method" developed by Stewart. The results show that the market value creation power of banks can be directly related to the intellectual capital of banks.

The study by Özer et al. (2020) analyzed the relationship between intellectual capital, knowledge management, innovation, and firm performance of companies included in the Technology Fast 50 2018 list published by Deloitte. 158 participants who were managers in 27 companies on the Technology Fast 50 2018 list were included in the study. The data was collected with the help of a questionnaire. The results of the research show that intellectual capital has an impact on knowledge management strategies, that knowledge management strategies positively firm performance, and that global innovation plays an important mediating role in this relationship. Although the companies studied are making efforts to leverage intellectual capital, it was found that these efforts do not have an impact on business performance.

The aim of Erdoğan & Dönmez (2014) study is to investigate the impact of intellectual capital elements in firms on firm value and productivity. In this framework, the intellectual value added coefficient of companies was first determined and the relationship between the criteria of company performance was evaluated. For the period 2008-2011, 7 enterprises in the metal products, machinery and equipment industries were included in the study. The relationship between intellectual capital and enterprise performance was evaluated using panel data analysis. The results of the study show that human capital and structural capital, which were determined to be elements of intellectual capital, have positive effects on enterprise efficiency.

The aim of Topaloğlu & Bayrakdaroğlu's (2012) study is to investigate the impact of intellectual capital elements on banks' operations in the banking sector. In the research, it was found that there are a total of 1507 branches and 28,105 employees in 11 cities in the Central Anatolia region. In the research, 475 bank employees working in banks were to answer questions consisting of 35 items. A total of 1,100 questionnaires were distributed to all bank employees, regardless of their position, and 481 questionnaires were returned. The results of the analysis show that there are elements of intellectual capital in the banking sector of the Central Anatolia region. It was found that structural capital is weak compared to the other elements of intellectual capital. The reason given for this was that the banks' information infrastructure, internal training, technological developments and technical infrastructure should be given the necessary importance and investments should be made. In addition, it was stated that banks should provide their employees with a positive working environment and a fair salary system in order to increase their structural capital.

The aim of Oernek & Siyret's (2015) study is to investigate how the relationship between intellectual capital and innovative business behavior affects business performance. ninety-six individuals working in the IT sector participated in the study. The survey method was applied to the participants. The data of the participants were analyzed using LISREL 8.54 and SPSS 19. According to the results of the research, it was found that there are positive relationships between intellectual capital, innovative business behavior and business performance.

The aim of Ertaş & Çoşkun's (2005) study is to investigate the intellectual capital measurements of tourism companies traded on Borsa Istanbul. The data used for the study were obtained from the financial statements of 8 tourism companies. Within the framework of the study, the VAIC method was used to measure intellectual capital. From the data of the study, it appears that tourism companies operating in our country attach importance to the elements of intellectual capital and that structural capital is the most important factor influencing their performance.

The aim of Altan & Özpehlivan (2019) study is to determine the impact of intellectual capital and innovation orientation on job satisfaction in the sector IT. The research data was collected from 700 employees working in the sector IT and the research group was interviewed by 248 employees in 16 different companies. The data were collected using the "Intellectual Capital Scale" (Erkuş, 2006), the "Job Satisfaction Scale" (Özpehlivan, 2015) and the "Innovation Versatility Scale" (Küçük & Kocaman, 2014) and SPSS 21.0 was used for the statistical analysis of the data. From the results of the study, it is found that there is a low and moderate relationship between intellectual capital, innovation orientation and job satisfaction. It was found that there is an interaction between the three variables present in the interaction design. Intellectual capital and innovation-oriented behavior, which are important resource items in a company's competitive environment, are considered to be a situation that increases employee satisfaction, as expected. Companies that support these variables with positive practices will be able to gain a competitive advantage.

İşseveroğlu & Ercan (2019) investigate the impact of intellectual capital elements on profitability and productivity using the financial statements of 15 technology companies operating in Istanbul Borsa (BIST TUM -100) for ten years between 2008-2017. For this purpose, the measurement of intellectual capital of 15 technology companies was carried out using the VAIC method. According to the results of the measurement, it was found that human capital, one of the elements of intellectual capital, makes a significant contribution to profitability, but its contribution to productivity is low.

Abeysekera and Guthrie (2005) studied the intellectual capital of the 30 largest companies listed on the Colombo Stock Exchange from 1998 to 2000. Unlike other studies in the field of intellectual capital, Abeysekera and Guthrie (2005) used content analysis in their study. For this content analysis, they used the financial reports of 30 companies in the sample. Their results emphasize that the human capital of the firm is important for intellectual capital. Moreover, their results emphasize that the relationship between intellectual capital and financial markets does not exist to the extent discussed in this thesis. In other words, they show that market capitalization does not affect intellectual capital.

Abeysekera (2007) uses content analysis to compare intellectual capital reporting among listed companies in Australia and Sri Lanka. The results of the study show that intellectual capital reporting is based on economic, social, and political factors.

Chen et al. (2017) calculate the coefficient of intellectual capital for listed companies in Taiwan using the VAIC method. The effect of this coefficient on the financial performance and market capitalization of companies was studied between 1992 and 2002. The results show that the effect of intellectual capital on market value and financial performance for public companies in Taiwan is positive in the years considered.

Kamath (2008) examines the determinants of voluntary intellectual capital reporting in India's emerging information, communications, and technology sector using a content analysis for 30 publicly traded companies listed on the Bombay Stock Exchange for 2005-2006. His results show that there is no relationship between the occurrence of the term intellectual capital and firm size as measured by market capitalization.

Kamath (2019) examines the corporate governance characteristics and their impact on intellectual capital performance of 95 Indian companies listed on the Indian National Stock Exchange. Using a panel regression analysis, the results of this study show the effect of corporate governance on intellectual capital performance for the period 2010-2017. This effect varies by firm size.

de Castro and Saez (2008) test the joint categorization of human capital, structural capital, and relational capital using a questionnaire prepared for high-technology firms in Spain. The questionnaires prepared for their analysis were conducted in 49 companies for the year 2005. The sample companies have more than 50 employees. According to the results of the factor analysis based on the questionnaires, intellectual capital has an influence on these three main elements.

Mouritsen (2003) descriptively analyzed the relationship between intellectual capital and capital markets. His theoretical results show that intellectual capital is reflected only to a small extent in capital markets.

Sardo and Serrasqueiro (2017) examined the relationship between intellectual capital, market value, and firm-level financial performance for 14 countries in Western Europe between 2004 and 2015 using dynamic panel data analysis. Their results show that the effects of the components of intellectual capital on market value and financial performance differ in the short and long term. At the same time, corporate governance has different effects on this relationship.

Smriti and Das (2018) examined the intellectual capital and firm performance of companies listed on the Centre for Monitoring Indian Economy Overall Share Price Index in India between 2001 and 2016 using a dynamic panel data method. They used the VAIC method to measure intellectual capital. Their results show that the components of intellectual capital have a predominantly positive impact on firm financial performance.

Soewarno and Tjahjadi (2020) investigated the relationship between intellectual capital and financial performance of 114 banks listed on the Indonesian Stock Exchange between 2012 and 2017 using multiple regression analysis. In this study, the authors used the VAIC and A-VAIC models with different components (such as innovation capital efficiency) to measure intellectual capital. Their results generally suggest that intellectual capital has a positive impact on banks' financial performance.

Bozbura (2004) studied the relationship between intellectual capital and market value using a survey that included 21 questions for companies listed on the Istanbul Stock Exchange. His results show that this relationship is positive.

Vergauwen et al. (2007) investigated intellectual capital disclosure and the relative importance of intangible assets for Swedish, British, and Danish companies using a survey. Their results show that structural capital, which is a component of intellectual capital, is important for a firm's intellectual capital disclosure.

Weqar and Haque (2022) studied the impact of intellectual capital on the financial performance of 88 Indian companies engaged in tea packaging, sales, and distribution between 2013 and 2018. This study, which calculates intellectual capital using the VAIC method, found that intellectual capital has a positive effect on the profitability and productivity of these companies in the tea sector using a panel fixed effects regression.

Joshi et al. (2013) studied the relationship between intellectual capital and financial performance for the Australian financial sector between 2006 and 2008. Their sample includes

40 listed financial institutions. They used the VAIC method for intellectual capital. According to their results, they show that the effects of intellectual capital components on financial performance are different.

Mondal and Ghosh (2012) studied the relationship between intellectual capital and financial performance of 65 Indian banks between 1999 and 2008 using VAIC method. They concluded that intellectual capital of banks is very important for competition. They also found that the relationship between VAIC and financial performance is different.

Ozkan et al (2017) calculated the coefficient of intellectual capital for 44 Turkish banks using the VAIC method between 2005 and 2014. In this framework, they investigated the relationship between intellectual capital and financial performance. They found no direct relationship between VAIC and financial performance. However, the contributions of intellectual capital coefficients to financial performance were found at different levels.

Janošević et al. (2013) examined the relationship between intellectual capital and financial performance using the VAIC method for 100 non-financial companies listed on the Serbian Stock Exchange using data from 2010. According to the results, the components of intellectual capital have varying degrees of impact on financial performance.

Sardo et al. (2018) investigated the relationship between intellectual capital and financial performance for 935 small and medium-sized hotels (SMEs) in Portugal between 2007 and 2015. According to the estimation results, based on dynamic panel data analysis, it is found that intellectual capital components generally improve the performance of SME hotels.

Dženopoljac et al. (2016) examined the relationship between intellectual capital and financial performance using the VAIC method for 13,989 Serbian information, communication, and technology (ICT) companies between 2009 and 2013, concluding that intellectual capital does not have a significant performance differentiating effect for ICT companies. They found that only CEE has a positive influence on the relationship between intellectual capital and financial performance under certain conditions.

As can be seen from the literature review, Turkish and international literature has studied intellectual capital with different dimensions. However, to the best of the author's knowledge, there is no study that compares the intellectual capital of IT companies before and after the pandemic with the dimension discussed in this thesis. To see how companies are affected by closures and restrictions that occur unexpectedly due to the pandemic, and how intellectual capital coefficients are affected in such cases, intellectual capital before the pandemic and in the Covid-19 period should be studied. A pandemic is also a sudden external shock. This thesis

how this sudden external shock affects the coefficient of intellectual capital of the technology-intensive sector during the pandemic period. Therefore, this thesis is expected to be one of the important studies that investigates the relationship between intellectual capital and pandemic in IT companies for Turkey and international literature.

4.DATASET, THE SAMPLE AND FINDINGS

In selecting the IT companies in the study, the companies in the sample were selected based on the classifications in Borsa Istanbul and Public Disclosure Platform (KAP.org.tr).

Table 2: The firms in the sample

No:	Company Code	Company Title
1	ALCTL	Alcatel Lucent Teletaş Telekomünikasyon A.Ş.
2	ARDYZ	Ard Grup Bilişim Teknolojileri A.Ş.
3	ARENA	Arena Bilgisayar Sanayi Ve Ticaret A.Ş.
4	ARMDA	Armada Bilgisayar Sistemleri Sanayi Ve Ticaret A.Ş.
5	DGATE	Datagate Bilgisayar Malzemeleri Ticaret A.Ş.
6	DESPC	Despec Bilgisayar Pazarlama Ve Ticaret A.Ş.
7	ESCOM	Escort Teknoloji Yatirim A.Ş.
8	FONET	Fonet Bilgi Teknolojileri A.Ş.
9	INDES	İndeks Bilgisayar Sistemleri Mühendislik Sanayi Ve Ticaret A.Ş.
10	KFEIN	Kafein Yazilim Hizmetleri Ticaret A.Ş.
11	KAREL	Karel Elektronik Sanayi Ve Ticaret A.Ş.
12	KRONT	Kron Telekomünikasyon Hizmetleri A.Ş.
13	LINK	Link Bilgisayar Sistemleri Yazilimi Ve Donanimi Sanayi Ve Ticaret A.Ş.
14	LOGO	Logo Yazilim Sanayi Ve Ticaret A.Ş.
15	NETAS	Netaş Telekomünikasyon A.Ş.
16	PAPIL	Papilon Savunma-Güvenlik Sistemleri Bilişim Mühendislik Hizmetleri İthalat İhracat Sanayi Ve Ticaret A.Ş.
17	PKART	Plastikkart Akilli Kart İletişim Sistemleri Sanayi Ve Ticaret A.Ş.
18	SMART	Smartiks Yazilim A.Ş.
19	TCELL	Turkcell İletişim Hizmetleri A.Ş.

Source: Kamuyu Aydınlatma Platformu(KAP). (2021). (Accessed on 10.06.2021)

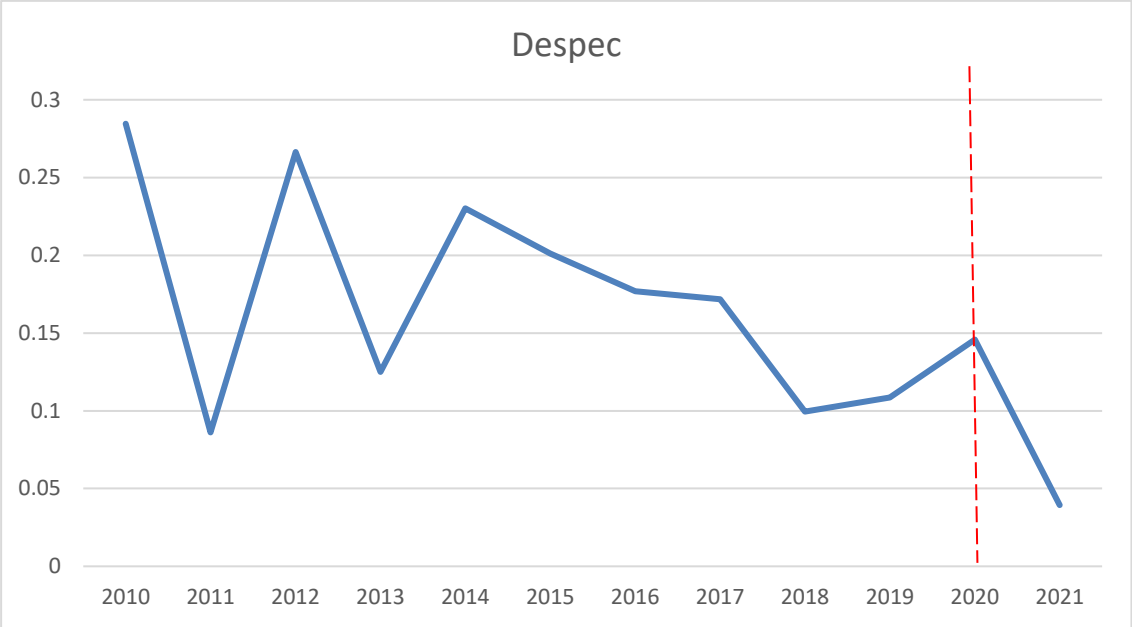
The data used in this thesis from the Thomson Reuters Refinitive database. The Refinitiv database is one of the databases that provide reliable financial information worldwide. Thus, the dataset consists of 19 companies (see Table 2) and the time period ranges from 2002 to 2021. The year 2002 was chosen as the starting year because we want to remove the effects of the 2001 financial crisis from the balance sheets.

Table 3: The descriptive statistics

Variable	Mean	Std. dev.	Min	Max	Observations
MV/BV	0.3907609	0.4366401	0.0151159	2.94553	N = 263
					n = 19
					T-bar = 13.84

Note: MV/BV denotes the market-to-book value ratio.

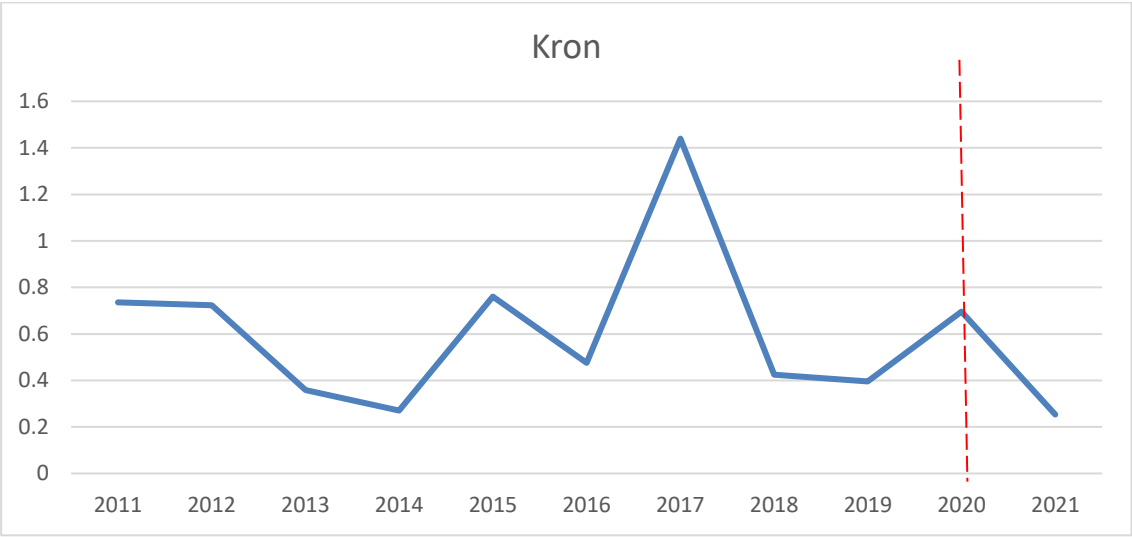
Table 3 shows the MV /BV ratio in this sample. The minimum value of MV /BV is 0.0151159, while the maximum value is 2.94553. The mean value of the MV /BV ratio is 0.3907609. The standard deviation is 0.4366401. The number of observations for the MV /BV ratio is 263. These descriptive statistics show that the intellectual capital of the sample used in this thesis has a very heterogeneous distribution.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 4: The effect of COVID-19 on the intellectual capital for the Despec Computer

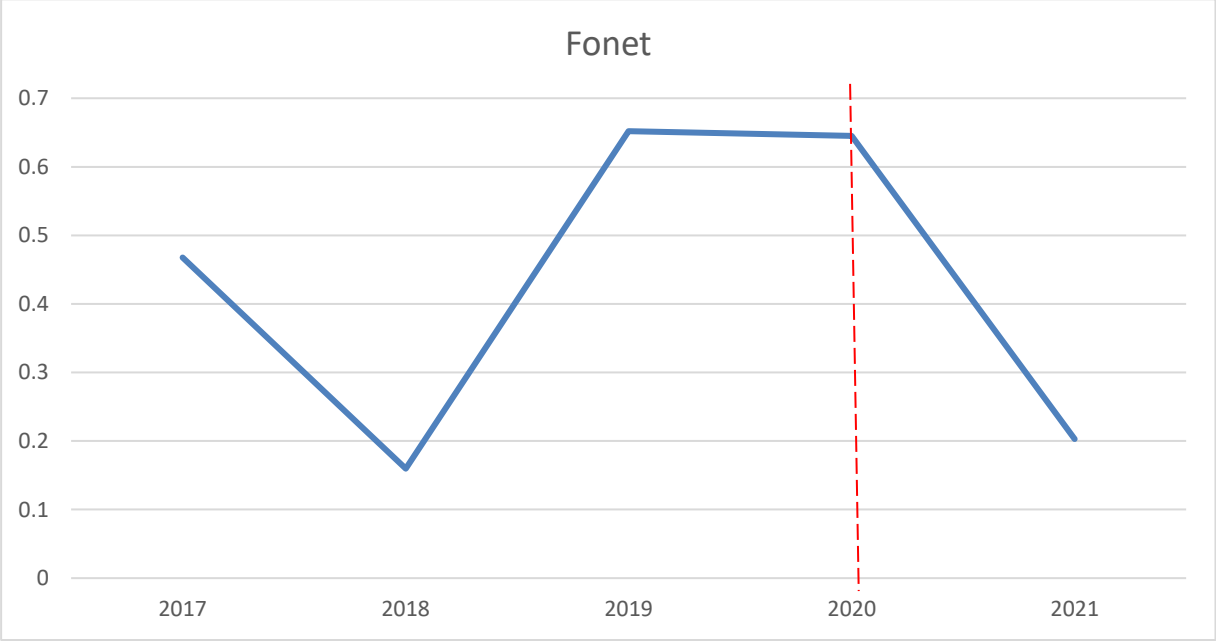
Figure 4 shows the coefficient of intellectual capital of Despec Computer, calculated from the available data, between 2010 and 2021. It can be seen that the intellectual capital coefficient of Despec Computer shows an unstable structure between 2010 and 2014. After 2014, it shows more stable until 2017. Although there is a short-term outflow from this point until the Covid-19 period, it can be observed that there is a significant structural break in the Covid-19 period.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 5: The effect of COVID-19 on the intellectual capital for the Kron Computer

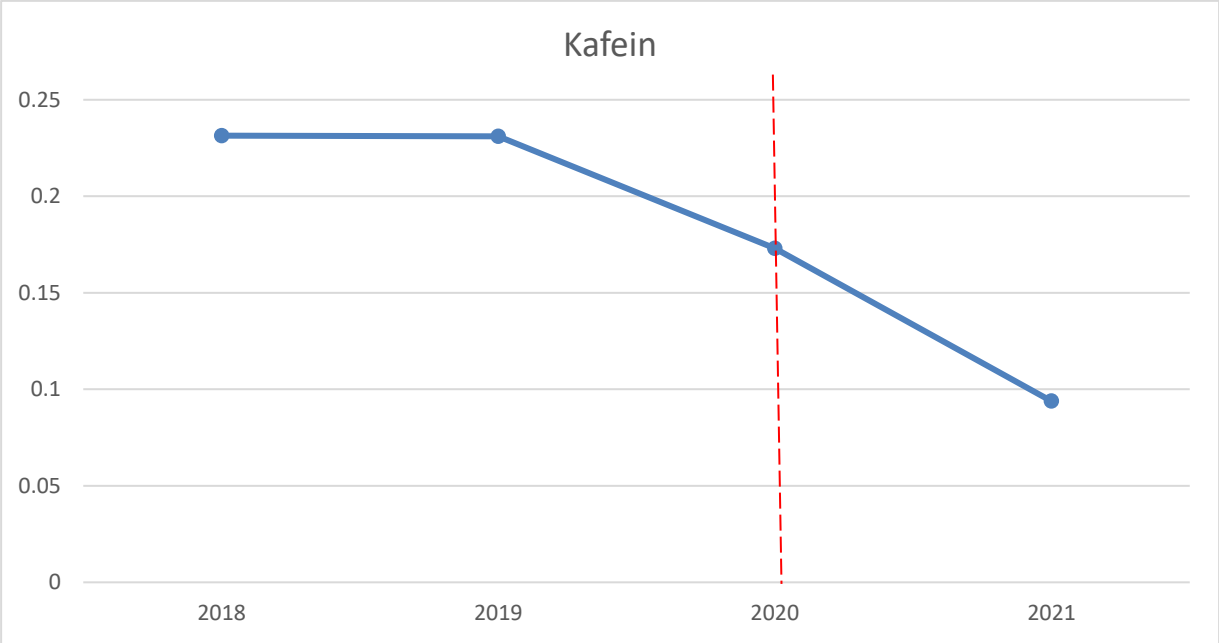
Figure 5 shows the intellectual capital coefficient data of Kron Computer calculated between 2011 and 2021. As can be seen in the figure, we cannot see a stable structure. While the intellectual capital coefficient fluctuated between 2011 and 2016, it gained a good momentum in 2017, but it was not sustainable. The decline of the intellectual capital coefficient continued until 2019. However, the intellectual capital coefficient, which increased again in 2020, i.e., during the Covid-19 period, starts to decrease again the following year. As can be seen in Figure 5, the highest coefficient for intellectual capital is observed in 2017.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 6: The effect of COVID-19 on the intellectual capital for the Fonet

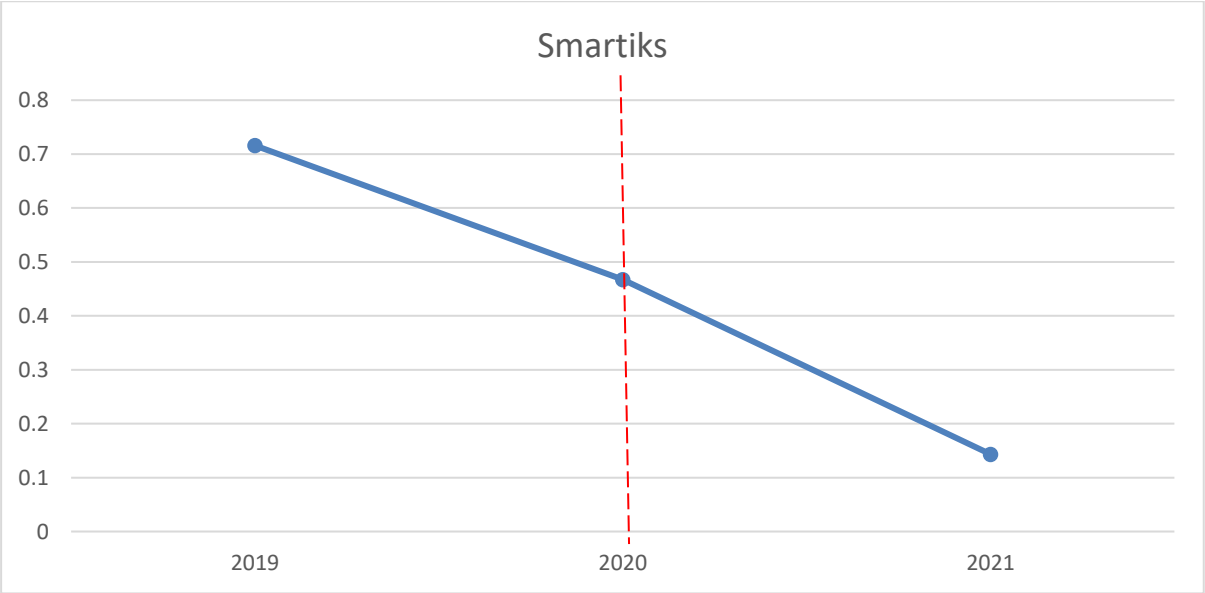
Figure 6 shows Fonet's intellectual capital coefficient data calculated between 2017 and 2021. The intellectual capital coefficient, which was high in 2017, dropped to its lowest level in 2018. However, the intellectual capital coefficient, which reached its highest level in 2019, continued in 2020, the Covid-19 period. As can be seen in Figure 6, the intellectual capital coefficient started to decrease again after 2020.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 7: The effect of COVID-19 on the intellectual capital for the Kafein

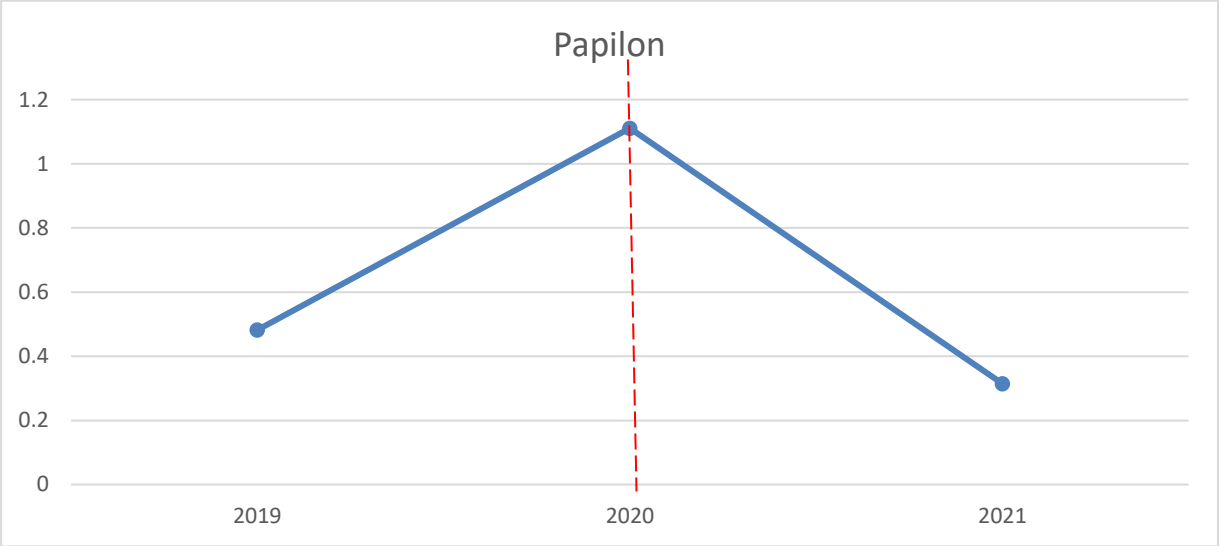
Figure 7 shows the data of intellectual capital coefficient of Kafein calculated between 2018 and 2021. The intellectual capital coefficient, which took a high and stable course between 2018 and 2019, started to decrease in 2020, during the Covid-19 period. With the decrease in 2020, the intellectual capital coefficient dropped to its lowest level in 2021.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 8: The effect of COVID-19 on the intellectual capital for the Smartiks

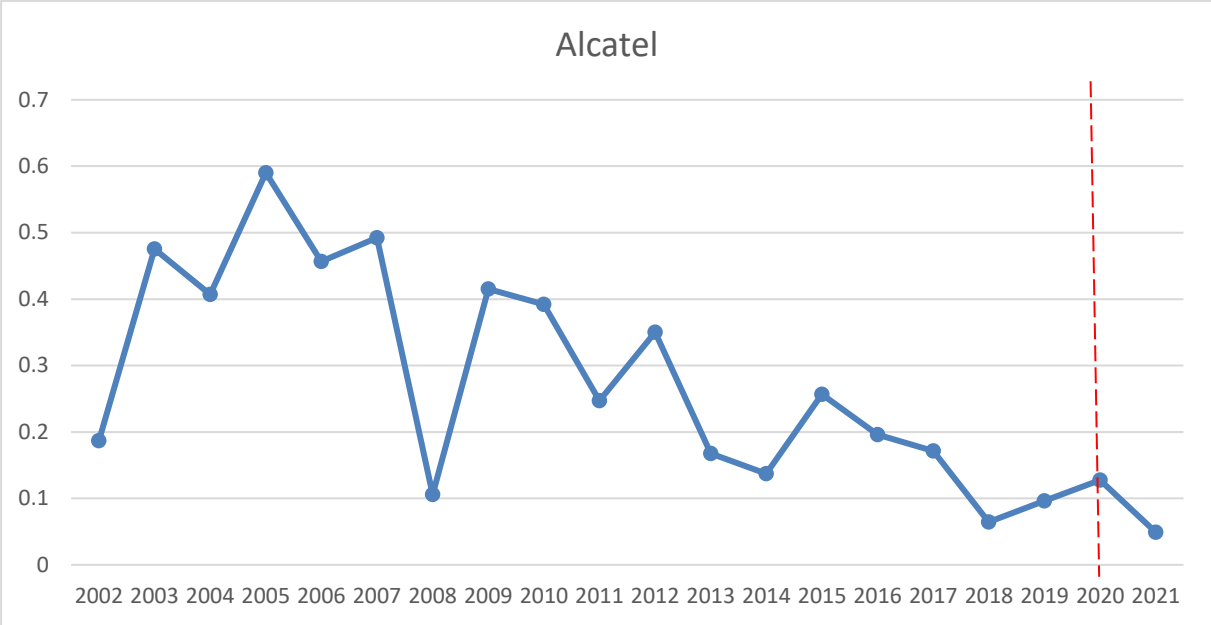
Figure 8 shows the data of the intellectual capital coefficient of Smartiks calculated between 2019 and 2021. In 2019, the intellectual capital coefficient was at its highest level and started to decrease in 2020, i.e. during the Covid 19 period. In 2020, the intellectual capital coefficient continued to decline and reached its lowest level in 2021.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 9: The effect of COVID-19 on the intellectual capital for the Papilon

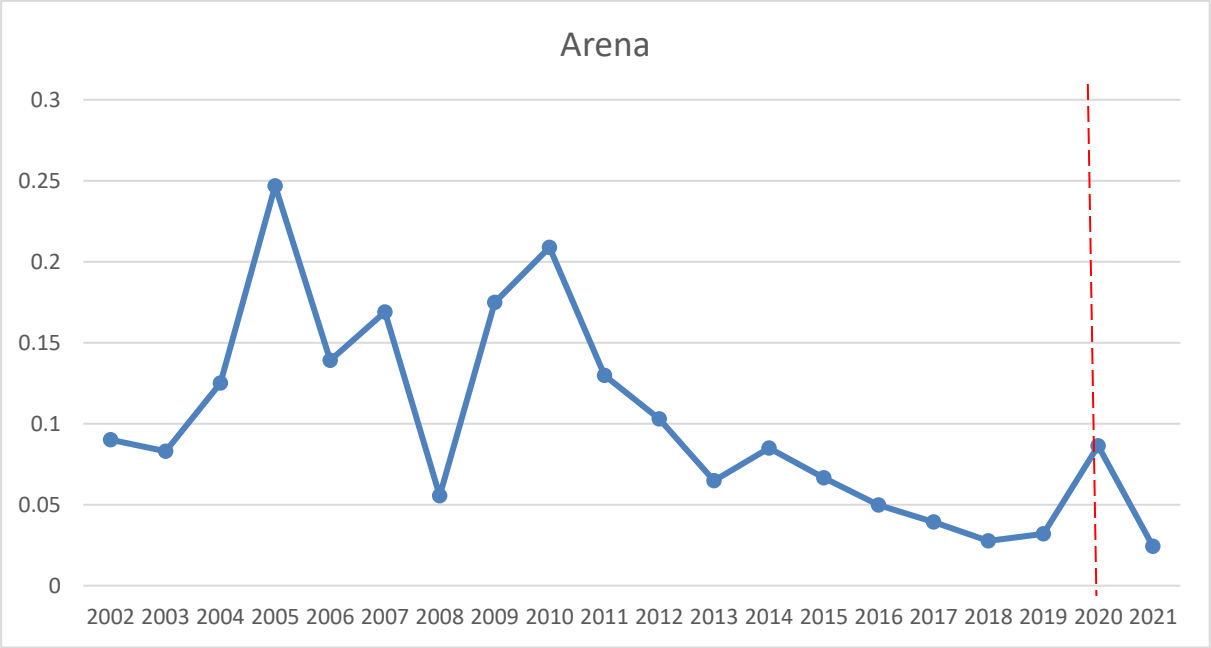
Figure 9 shows the data of the intellectual capital coefficient of Papilon calculated between 2019 and 2021. The intellectual capital coefficient, which was low in 2019, increased in 2020, i.e., during the Covid 19 period, and reached its highest level. After that, however, the intellectual capital coefficient fell to its lowest level.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 10: The effect of COVID-19 on the intellectual capital for the Alcatel

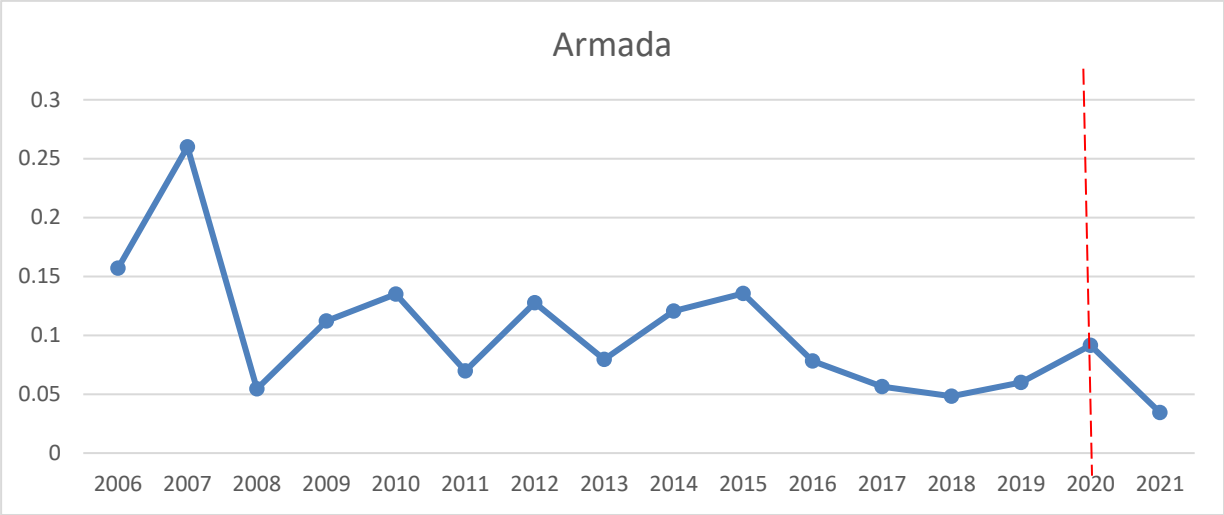
Figure 10 shows the data of Alcatel's intellectual capital coefficient calculated between 2002 and 2021. As can be seen in the graph, the intellectual capital coefficient fluctuates up and down. In 2005, it reached the highest value of intellectual capital coefficient. The intellectual capital coefficient, which returned to a low level in 2018 after a downward trend, continued to rise in 2019 and increased even more in the Covid-19 period than in the previous year. However, after the Covid 19 period, the intellectual capital coefficient began to decline again.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 11: The effect of COVID-19 on the intellectual capital for the Arena

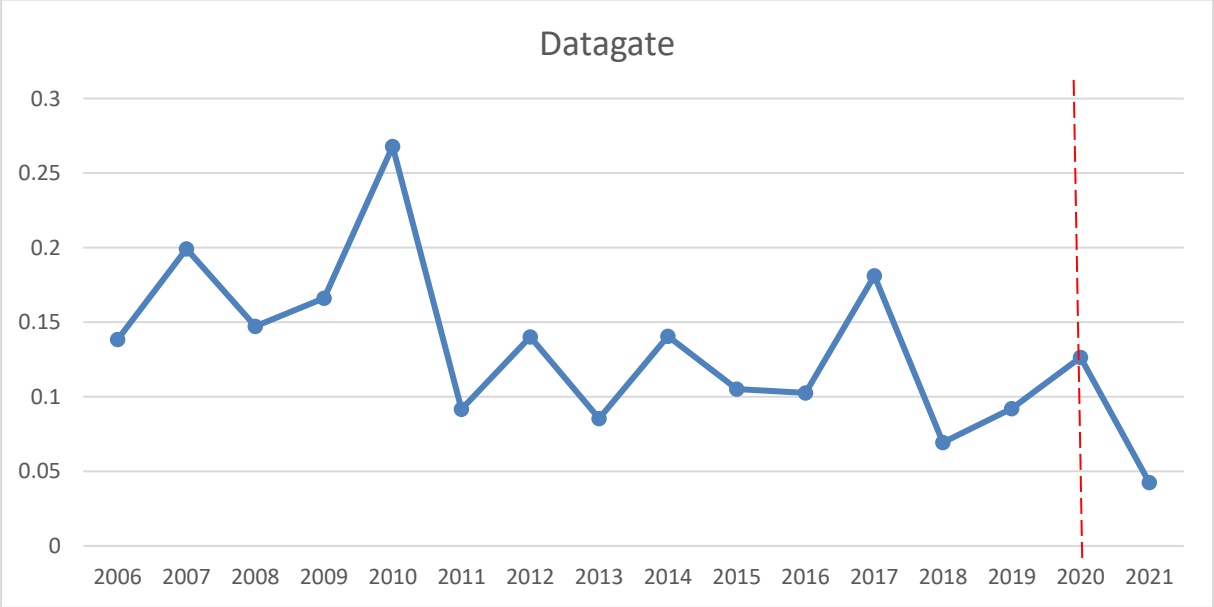
Figure 11 shows the data of Arena's intellectual capital coefficient calculated between 2002 and 2021. Although Arena's intellectual capital coefficient decreased slightly in 2003 compared to the previous year, it reached its highest level in 2005. The intellectual capital coefficient, which decreased again in the following years, increased again in 2009. From 2009 to 2019, the intellectual capital coefficient continued to decrease, but increased again in 2020, the Covid-19 period. In 2021, the coefficient of intellectual capital fell again to its lowest level.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 12: The effect of COVID-19 on the intellectual capital for the Armada

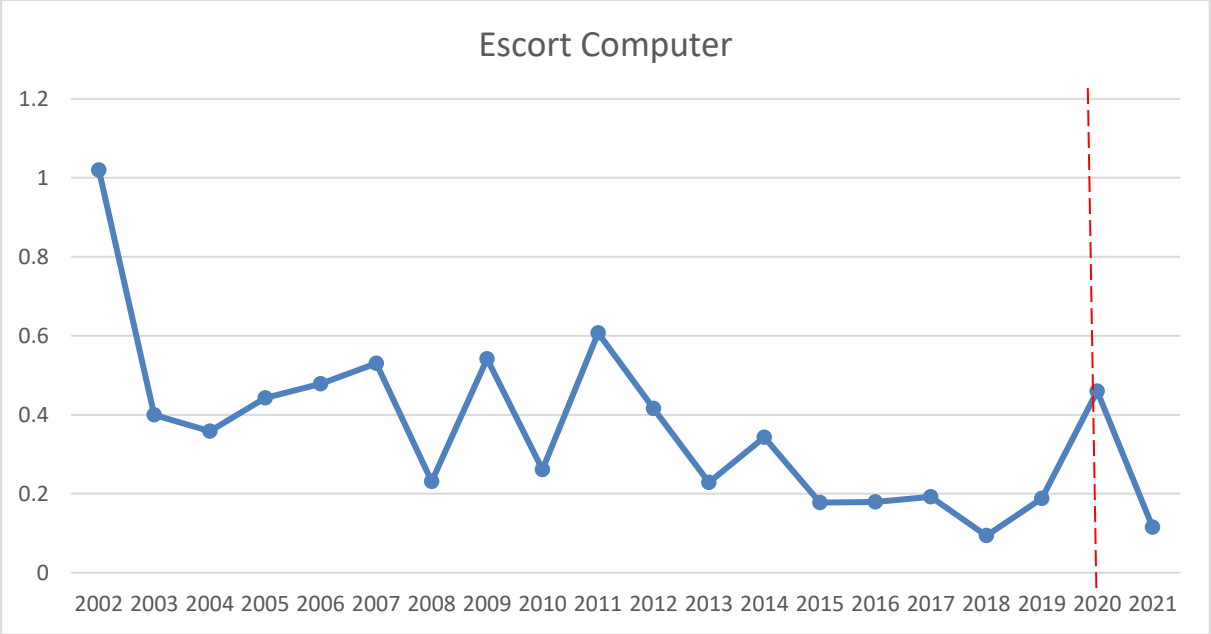
Figure 12 shows the calculation data of Armada's intellectual capital coefficient between 2006 and 2021. In 2007, the intellectual capital coefficient reached its highest level and followed a fluctuating course between 2008 and 2018. In 2019, the intellectual capital coefficient started to increase again and increased in 2020, i.e., during the Covid-19 period, compared to the previous year. In 2021, the intellectual capital coefficient decreased compared to the previous year and is at its lowest level.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 13: The effect of COVID-19 on the intellectual capital for the Datagate

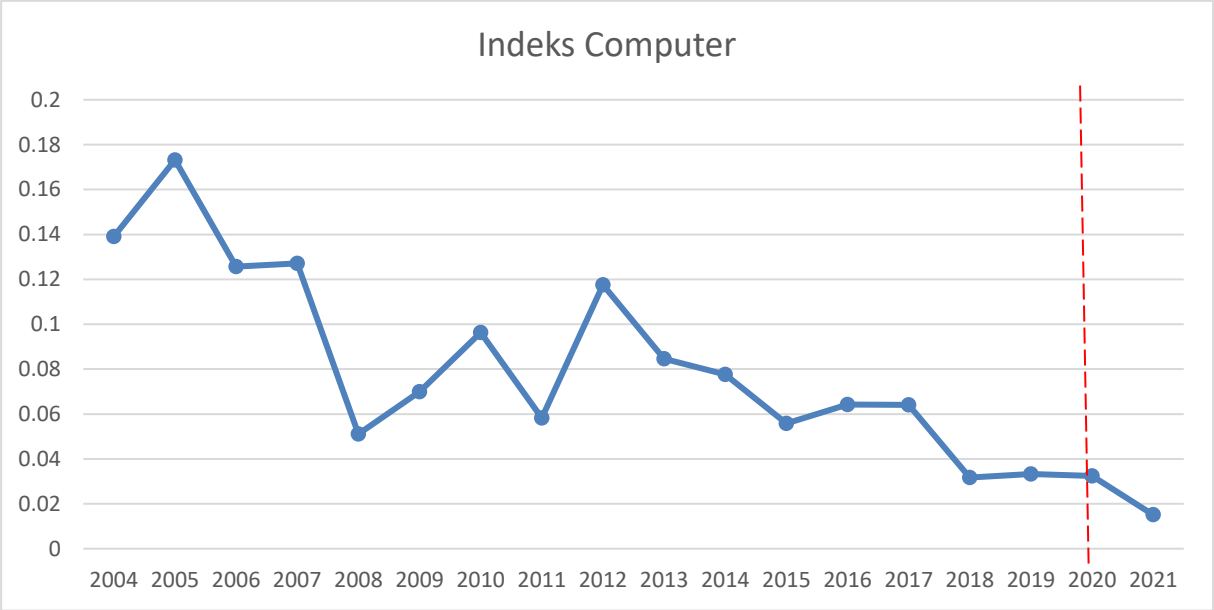
Figure 13 shows Datagate's intellectual capital coefficient data, calculated between 2006 and 2021. Between 2006 and 2021, the intellectual capital coefficient followed a fluctuating pattern, with the first increase occurring in 2007. In 2008, the intellectual capital coefficient decreased and then began to increase again in 2009. In 2010, the intellectual capital coefficient, which showed an upward trend compared to the previous year, reached its highest level. In 2011, the coefficient of intellectual capital began to decline again and followed a fluctuating course until 2016. in 2017, it rose again, but fell back to a low level in 2018. In 2019, the coefficient of intellectual capital, which showed an upward trend, also increased in 2020, i.e. during the Covid-19 period. In 2021, the coefficient of intellectual capital decreased again and reached its lowest level.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 14: The effect of COVID-19 on the intellectual capital for the Escort Computer

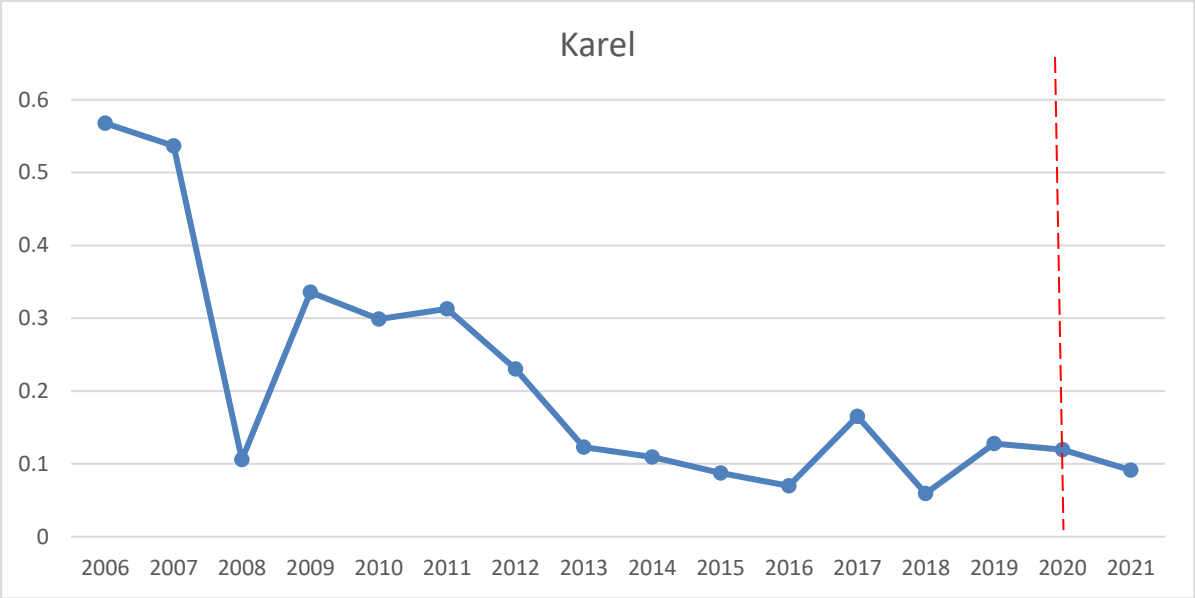
Figure 14 shows the data of intellectual capital coefficient of Escort Computer calculated between 2002 and 2021. The highest intellectual capital coefficient is observed in 2002. In 2003 and 2004, the intellectual capital coefficient started to decrease. The intellectual capital coefficient, which showed an upward trend in 2005, 2006 and 2007, started to decrease again in 2008. Between 2009 and 2018, the intellectual capital coefficient, which showed a fluctuating trend, started to increase again in 2019. In 2020, i.e., the Covid-19 period, it also increased. In 2021, it started to decrease again compared to the Covid-19 period.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 15: The effect of COVID-19 on the intellectual capital for the Indeks Computer

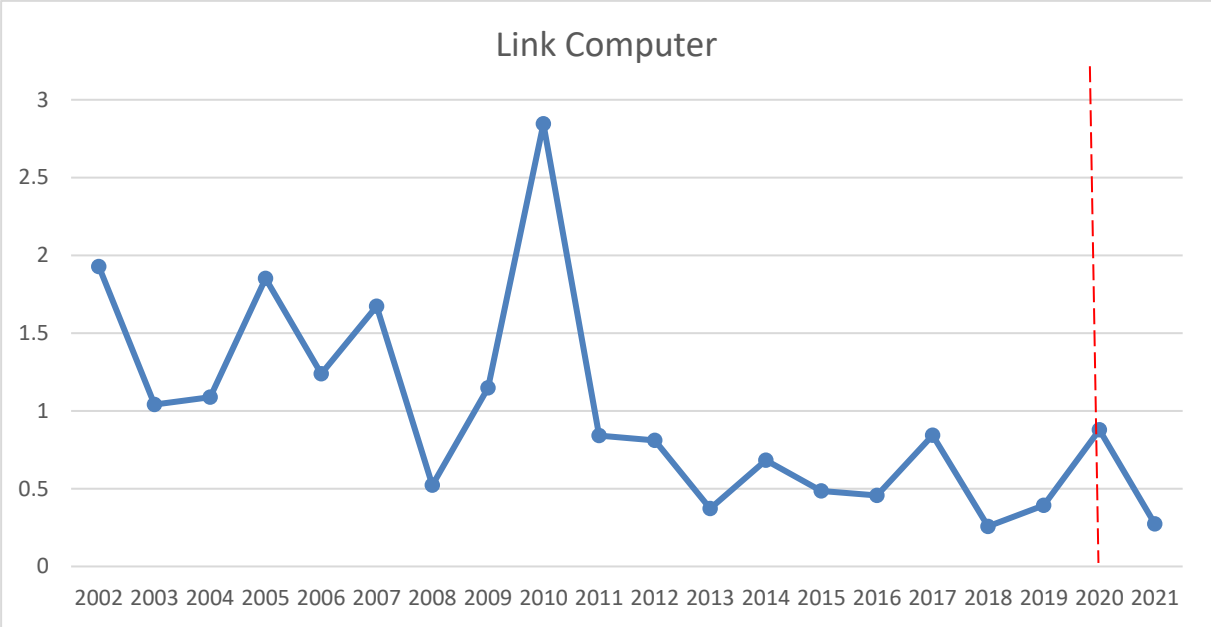
Figure 15 shows the intellectual capital coefficient data of Indeks Computer calculated between 2004 and 2021. In 2005, the intellectual capital coefficient, which showed an increasing trend compared to the previous year, reached its highest level. From 2006 to 2008, the intellectual capital coefficient decreased and then increased again in 2009 and 2010. Between 2011 and 2018, the intellectual capital coefficient followed a fluctuating trend, and although it showed a very small increase in 2019 compared to the previous year, it remained constant in 2020, during the Covid 19 period. In 2021, the coefficient of intellectual capital started to decrease again.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 16: The effect of COVID-19 on the intellectual capital for the Karel

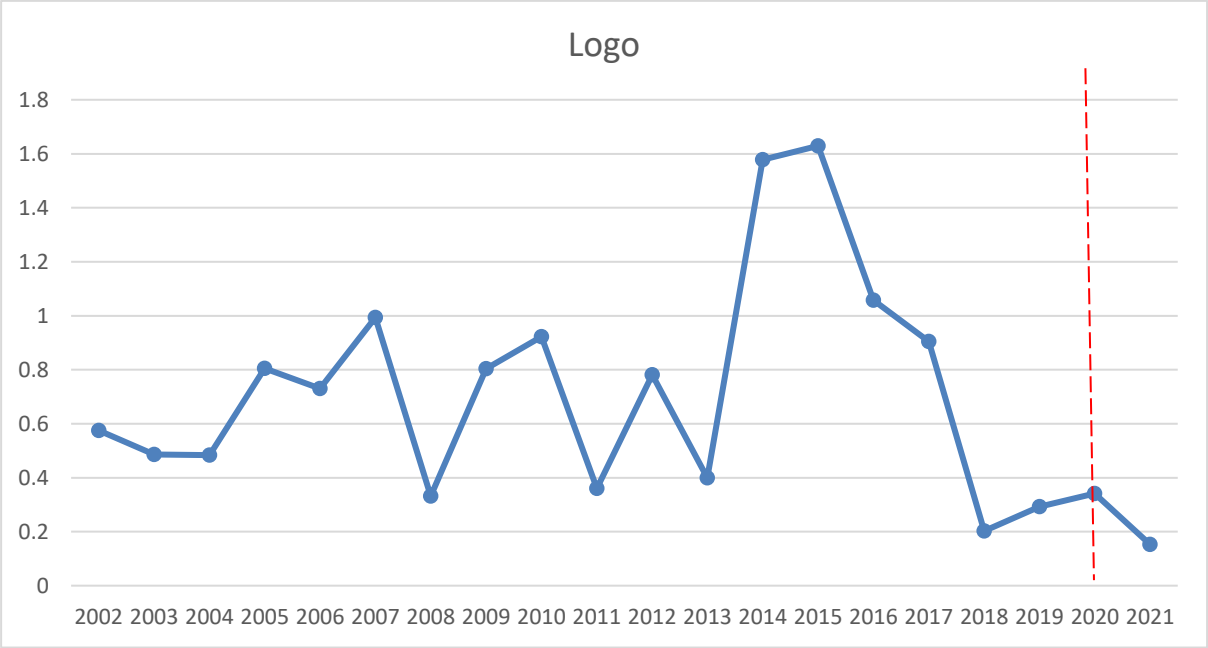
Figure 16 shows the data of intellectual capital coefficient of Karel between 2006 and 2021. In 2006, the value of intellectual capital coefficient was at the highest level and started to decrease in 2007 and 2008. In 2009, the intellectual capital coefficient showed an upward trend again and started to decrease slightly in 2010 compared to the previous year. Between 2011 and 2016, the coefficient of intellectual capital showed a gradual downward trend every year compared to the previous year. In 2017, the coefficient of intellectual capital increased again, and in 2018, it started to decrease again. In 2019, the coefficient of intellectual capital, which showed an upward trend compared to the previous year, started to decrease slightly in 2020, i.e. in the Covid-19 period. This decline will continue in 2021.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 17: The effect of COVID-19 on the intellectual capital for the Link Computer

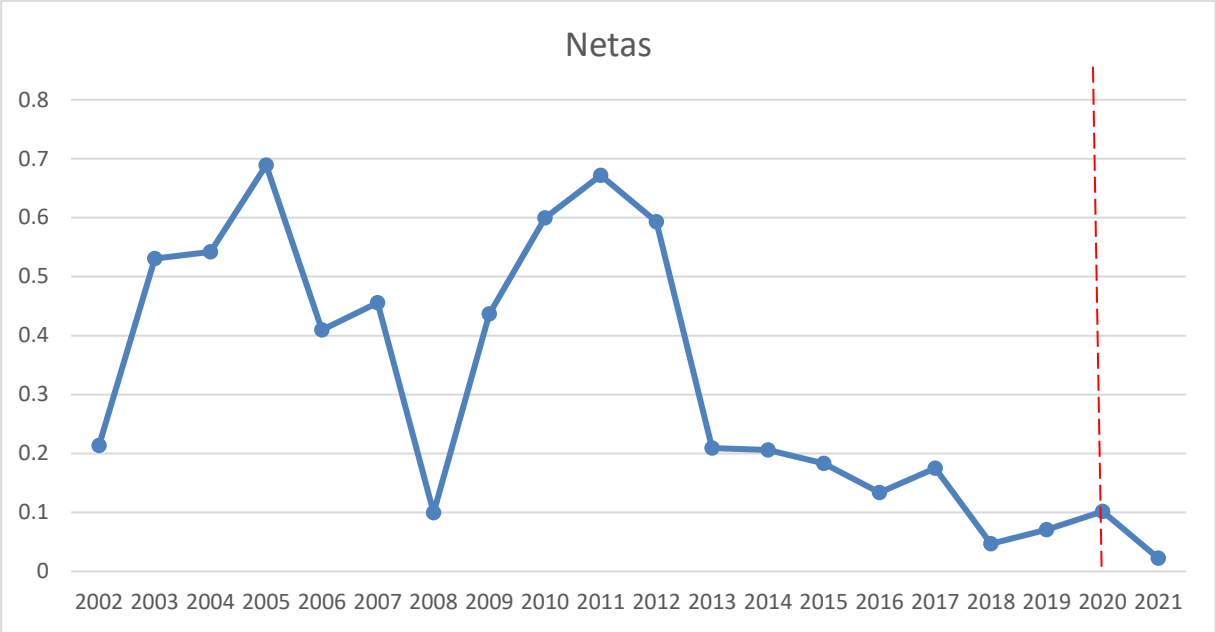
Figure 17 shows Link Computer's intellectual capital coefficient data calculated between 2002 and 2021. Between 2002 and 2008, the intellectual capital coefficient followed a fluctuating trend, increasing in 2009 and reaching its highest level in 2010. Between 2011 and 2013, the intellectual capital coefficient declined again, but rose again in 2014. In 2015 and 2016, the coefficient of intellectual capital decreased to a low level, but increased again in 2017. In 2018, the coefficient of intellectual capital, which decreased compared to the previous year, increased in 2019 and continued to increase in the Covid-19 period, i.e. in 2020. In 2021, the coefficient of intellectual capital shows a downward trend again.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 18: The effect of COVID-19 on the intellectual capital for the Logo

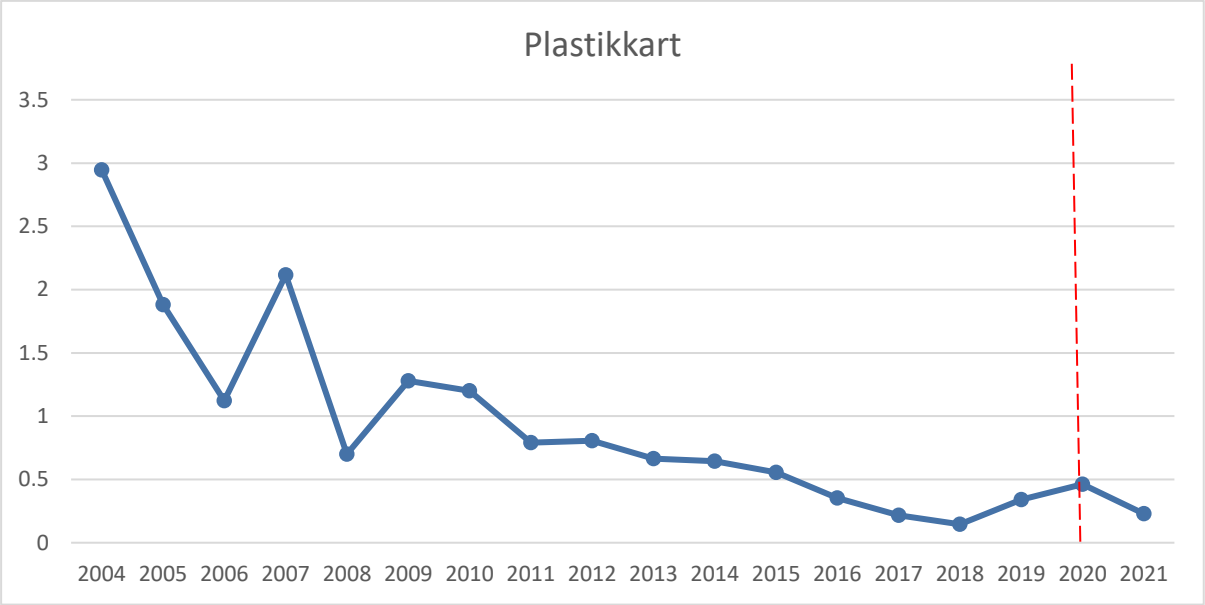
Figure 18 shows the data on the coefficient of intellectual capital of Logo, calculated between 2002 and 2021. The graph shows that the coefficient of intellectual capital decreased for the first time in 2003. This decrease continued in 2004. In 2005, the coefficient of intellectual capital showed an upward trend, which decreased again in the following year, 2006. Between 2007 and 2013, the coefficient of intellectual capital followed a fluctuating course, reaching its highest level in 2014. After 2015, the coefficient of intellectual capital continued to decline until 2018. In 2019, the coefficient of intellectual capital showed an upward trend and continued to increase during the Covid 19 period, i.e., in 2020. In 2021, the coefficient of intellectual capital decreased to its lowest level.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 19: The effect of COVID-19 on the intellectual capital for the Netas

Figure 19 shows the data of the intellectual capital coefficient of Netaş calculated between 2002 and 2021. Between 2002 and 2005, the intellectual capital coefficient showed an upward trend, but started to decrease in 2006. In 2007, the coefficient of intellectual capital showed an upward trend, but started to decrease again in 2008. Between 2009 and 2011, the coefficient of intellectual capital increased again, and then gradually decreased again between 2012 and 2016. The coefficient of intellectual capital, which started to increase in 2017, decreased again in 2018. In 2019, the coefficient of intellectual capital increased slightly in 2020, i.e. during the Covid-19 period, but then started to decrease again.

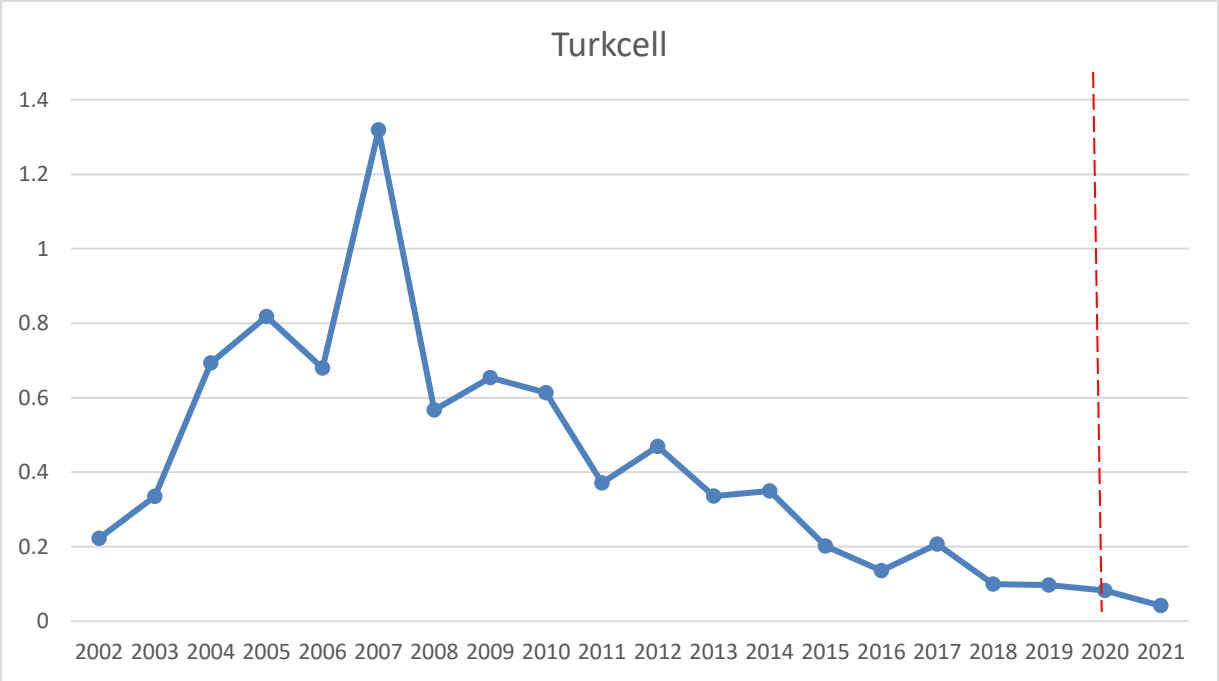


Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 20: The effect of COVID-19 on the intellectual capital for the Plastikkart

Figure 20 shows the data of the intellectual capital coefficient of Plastikkart calculated between 2004 and 2021. In 2004, the value of intellectual capital observed in 2005 and 2006 began to decrease. In 2007, the intellectual capital coefficient, which showed an upward trend, began to decrease again in 2008. In 2009, the intellectual capital coefficient, which showed an upward trend in 2009, began to show a gradual downward trend between 2009 and 2018. The coefficient of intellectual capital, which began to increase in 2019, showed a slight upward trend in 2020, the Covid-19 period. In 2021, however, it began to decline again.

Figure 21 shows the data of intellectual capital coefficient of Turkcell calculated between 2002 and 2021. Between 2002 and 2005, intellectual capital coefficient increased and decreased in 2006. In 2007, increasing intellectual capital coefficient reached its highest level. In 2008, the intellectual capital coefficient showed a downward trend again and followed a fluctuating trend between 2009 and 2016. In 2017, the intellectual capital coefficient increased again, and then gradually decreased again between 2018 and 2021. In other words, the coefficient of intellectual capital also showed a slight downward trend in the Covid-19 period.



Note: The redline represents the COVID-19 period for the Turkish economy.

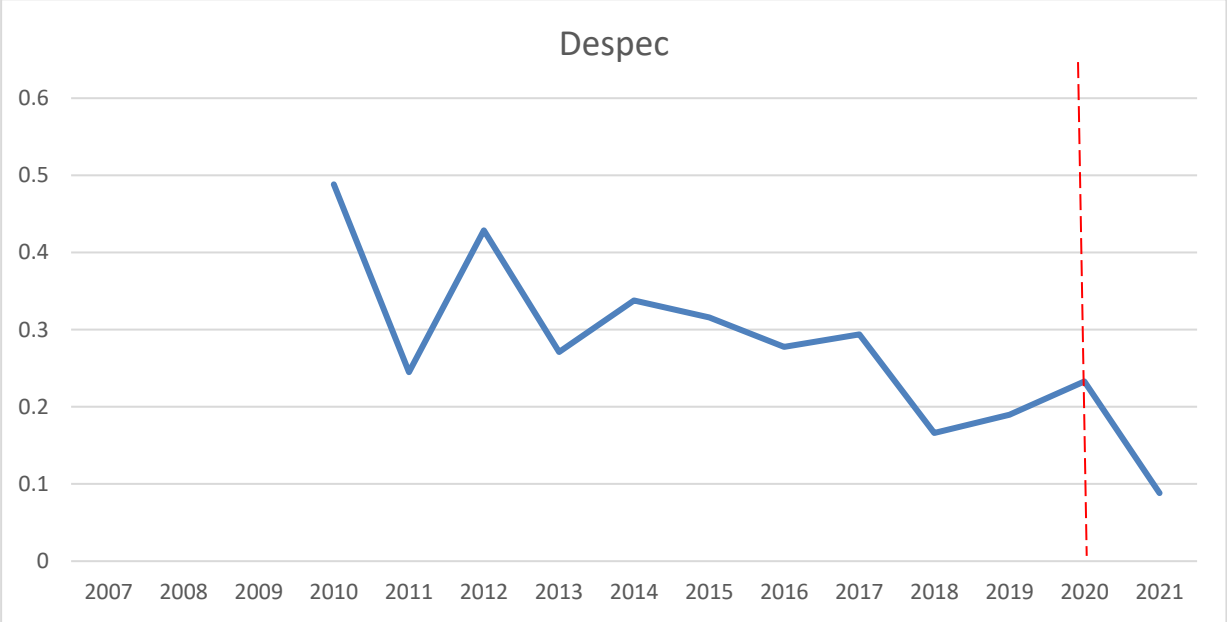
Figure 21: The effect of COVID-19 on the intellectual capital for the Turkcell

In addition to the MV /BV ratio used in this thesis, Tobin's Q ratio was also calculated for all companies in the sample where the data allowed. The calculation of Tobin's Q follows the calculation of Chung and Pruitt (1994), which is widely used in the literature. In this calculation, equity + liabilities / assets is used. All relevant results are included in the appendix of the thesis. Using these results in the appendix, it is found that the intellectual capital ratio based on Tobin's Q ratio is identical to the ratio MV /BV, which is used as the main ratio in this thesis. These results show that the main measure of intellectual capital is consistent in this study.

Robustness Checks

Tobin's Q Estimations

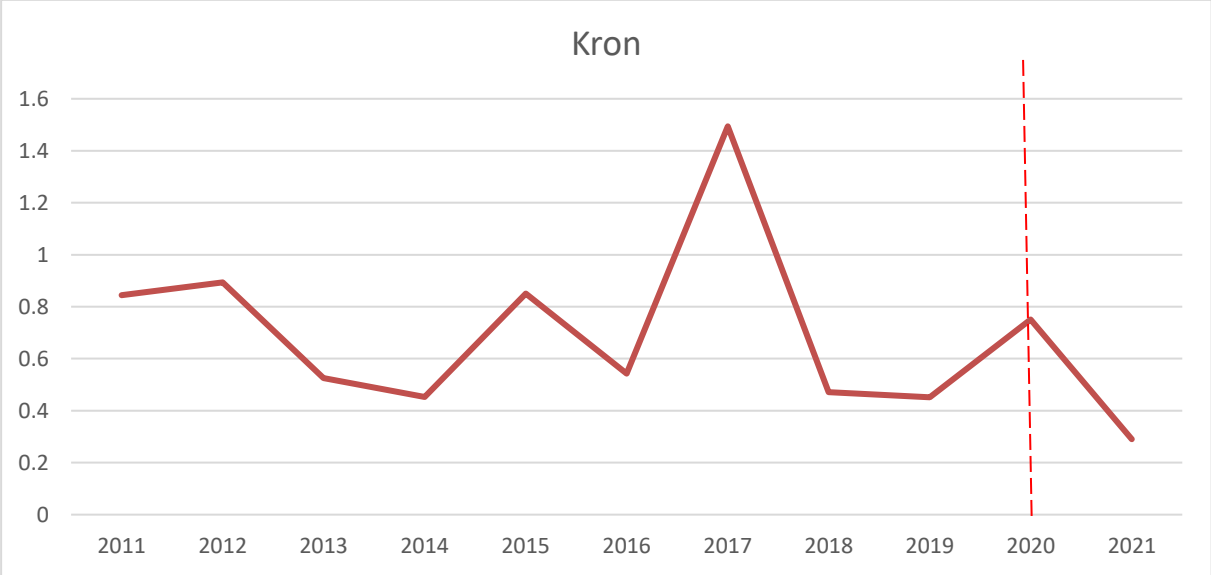
Tobin's Q is used instead of the MV /BV indicator, which is used as the main measure of intellectual capital in this thesis. Although there are differences for some companies depending on the availability of information, it generally confirms the intellectual capital results obtained with the main measure, namely the MV /BV ratio, in thesis.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 22: The effect of COVID-19 on the intellectual capital for the Despec Computer

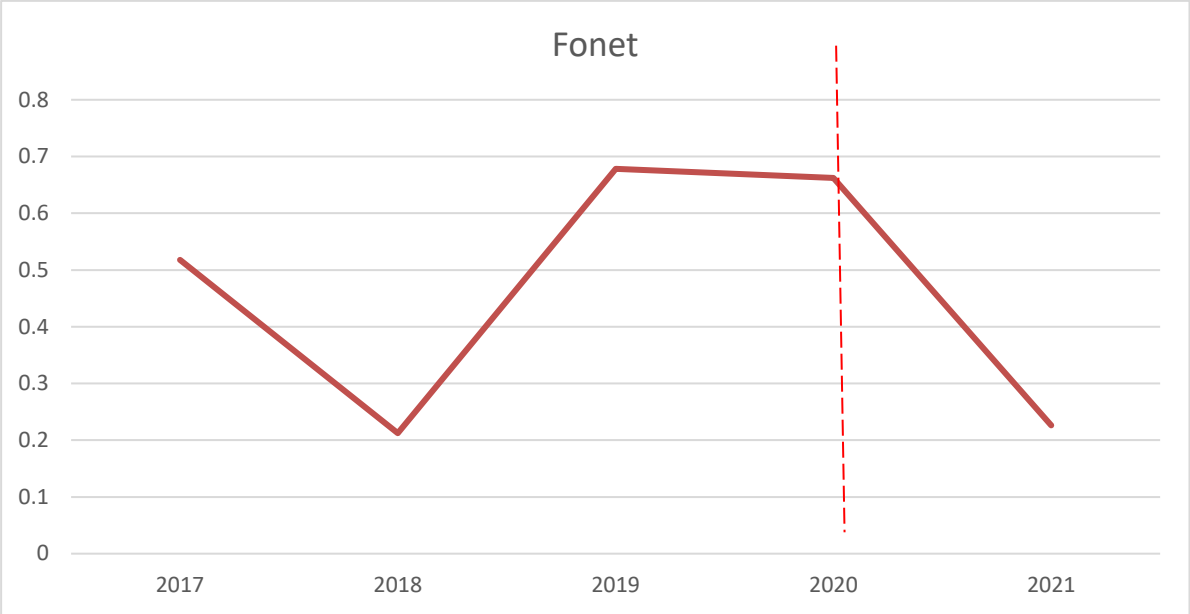
The Tobin's Q coefficient calculated by the Despec computer is shown in Figure 22. The red dashed line in Figure 22 shows the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of the Despec computer parallels the MV /BV variable, which is calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of the despec computer decreased during the pandemic period. Thus, this shows that the coefficient of intellectual capital was greatly affected by the pandemic. A look at the Tobin's Q coefficient of Despec computer shows that this coefficient is far from 1. Although there is a graph showing the coefficient of intellectual capital, the fact that this coefficient is far from 1 suggests that the intellectual capital for this firm.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 23: The effect of COVID-19 on the intellectual capital for Kron

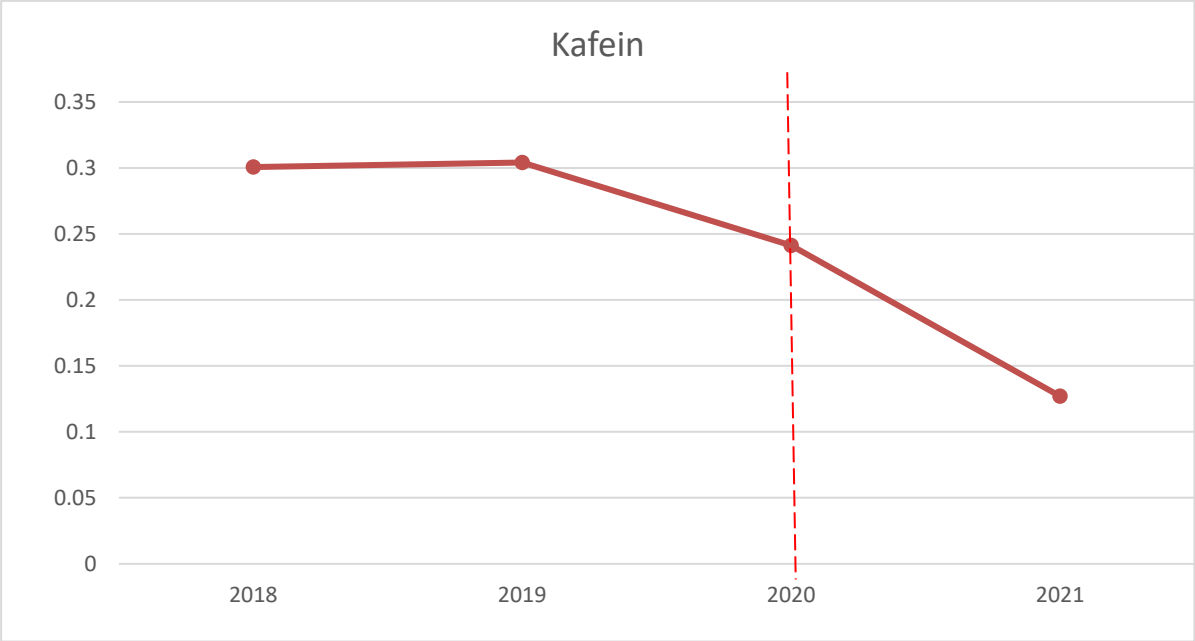
The Tobin's Q coefficient calculated by the Kron computer is shown in Figure 23. The red dashed line in Figure 23 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of the Kron Computer parallels the MV /BV variable, which is calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Kron computer decreased during the pandemic period. Thus, this shows that the coefficient of intellectual capital was greatly affected by the pandemic.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 24: The effect of COVID-19 on the intellectual capital for the Fonet

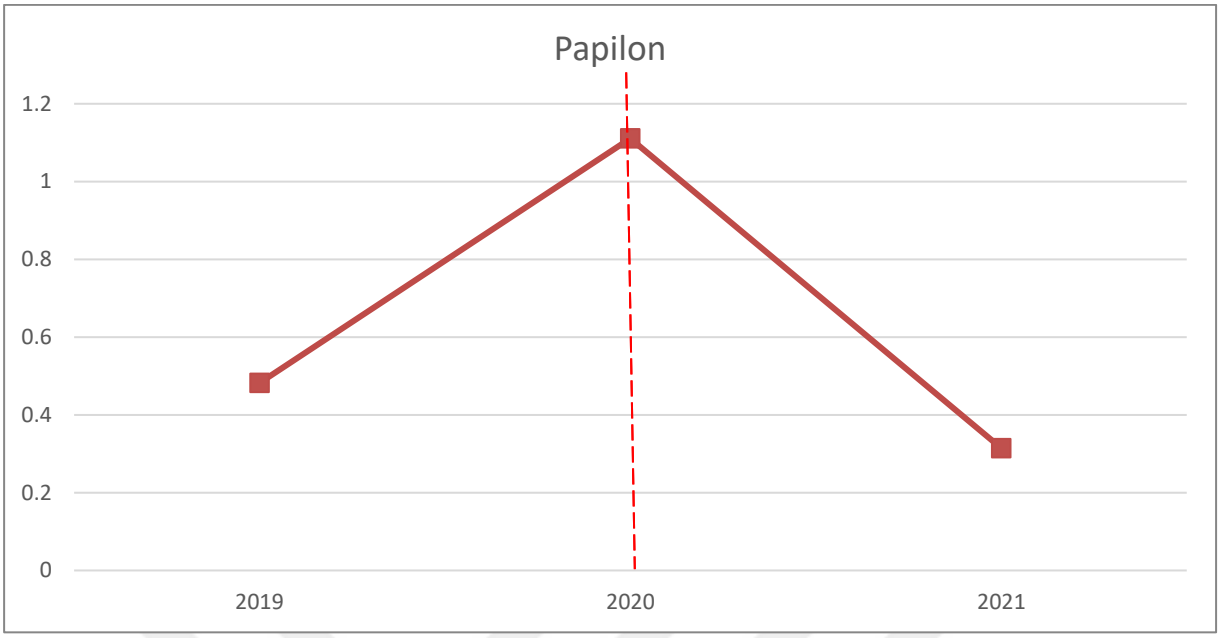
The Tobin's Q coefficient calculated for Fonet is shown in Figure 24. The red dashed line in Figure 24 indicates the pandemic period for Turkey, as in the other figures. It can be seen that Fonet's Tobin's Q coefficient parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Fonet decreased during the pandemic period. This shows that the coefficient of intellectual capital is affected by the pandemic. Looking at Tobin's Q coefficient for Fonet, we find that this coefficient is far from 1. The fact that it is far from 1 indicates that the intellectual capital of this company is low.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 25: The effect of COVID-19 on the intellectual capital for the Kafein

The Tobin's Q coefficient calculated for caffeine is shown in Figure 25. The red dashed line in Figure 25 indicates the period of the pandemic in Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient for caffeine parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient of Kafein decreased during the pandemic period. This shows that the coefficient of intellectual capital was affected by the pandemic. Looking at the Tobin's Q coefficient for Kafein, we find that this coefficient is less than 1. If it is less than 1, then it shows that the intellectual capital of this company is low.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 26: The effect of COVID-19 on the intellectual capital for the Papilon

The Tobin's Q coefficient calculated for Papilon is shown in Figure 26. The red dashed line in Figure 26 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Papilon is parallel to the MV /BV variable, which is calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Papilon decreased during the pandemic period. This shows that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for the Papilon company, we find that this coefficient is less than 1.

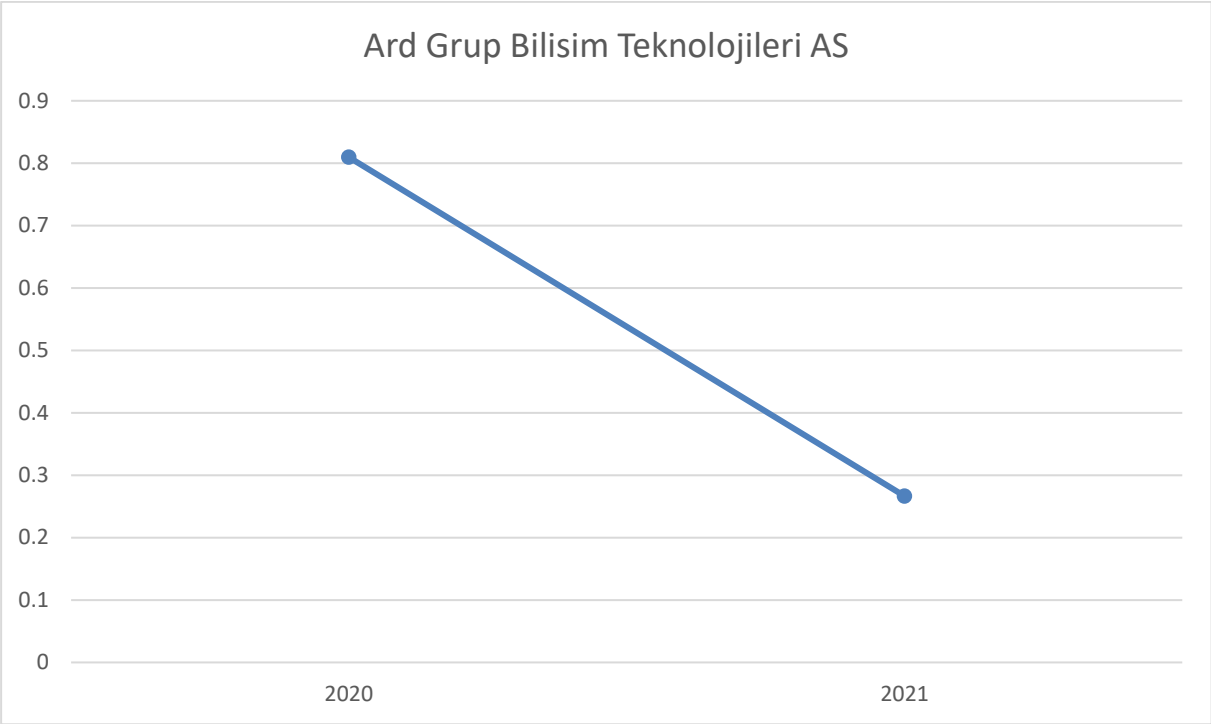
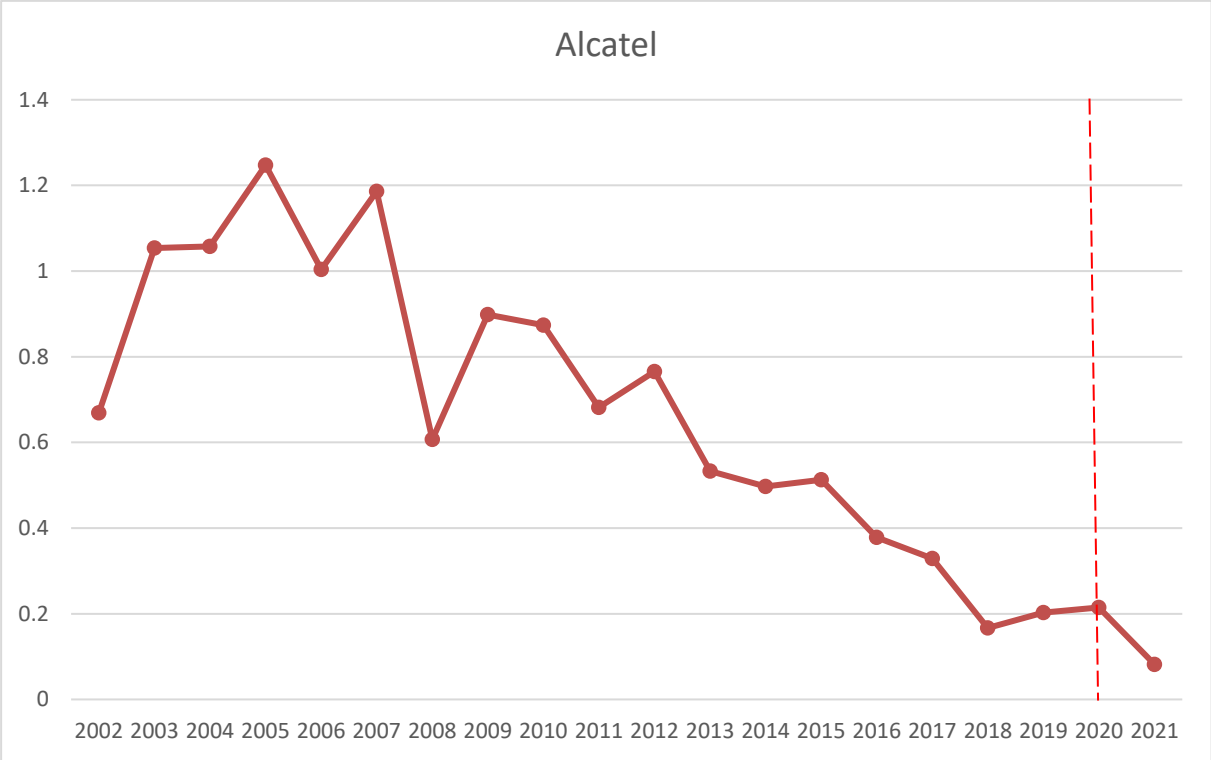


Figure 27: The effect of COVID-19 on the intellectual capital for the Ard Grup

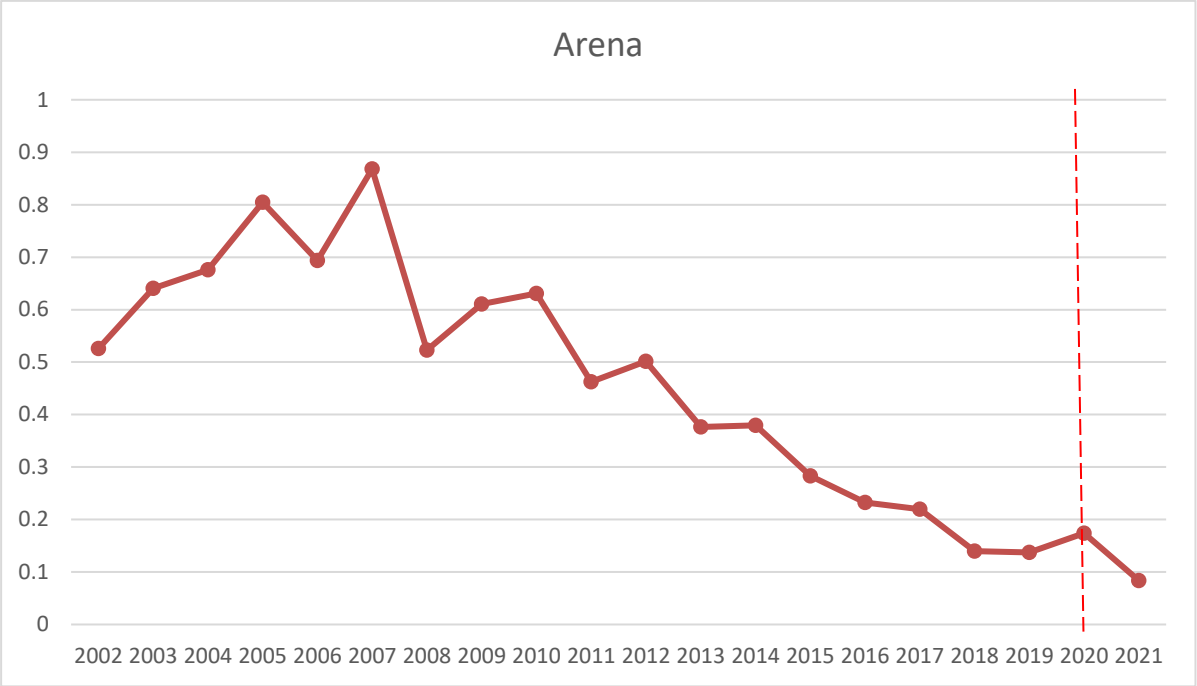
Figure 27 shows the intellectual capital trend for the ARD Group for the period COVID -19 only. Since only data for 2020 and 2021 are available from the financial reports, they are included to see the impact of COVID -19 on intellectual capital. As can be seen in Figure 27, this has a negative impact on the ARD Group.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 28: The effect of COVID-19 on the intellectual capital for the Alcatel

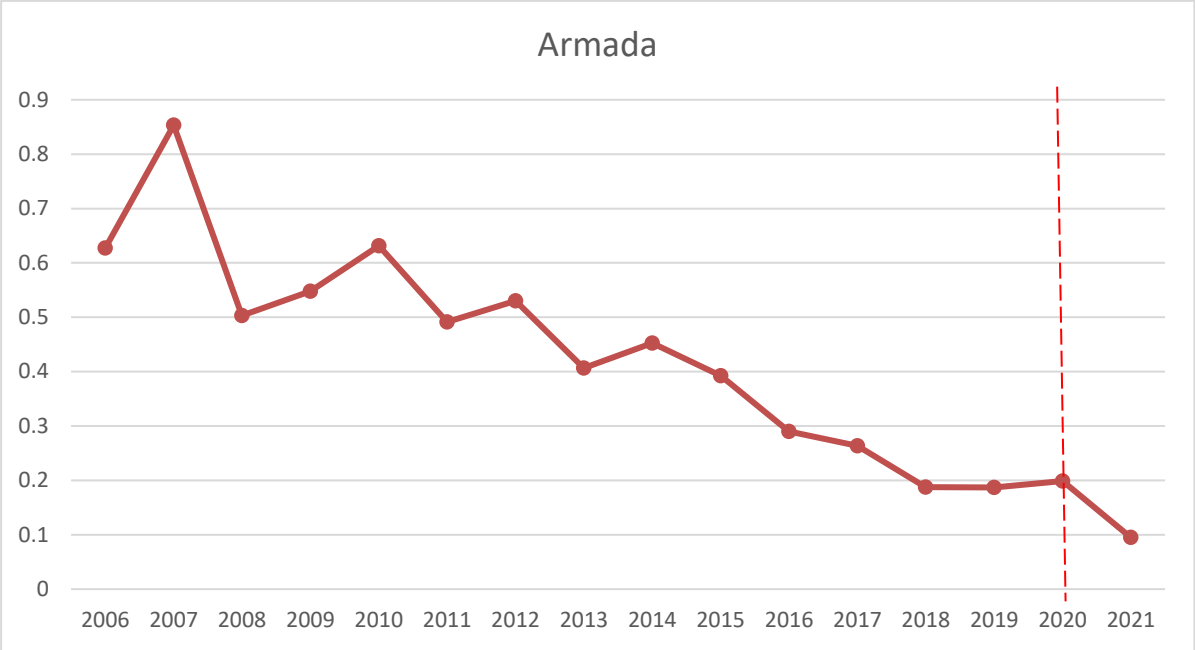
The Tobin's Q coefficient calculated for Alcatel is shown in Figure 28. The red dashed line in Figure 28 indicates the pandemic period for Turkey, as in the other figures. It can be seen that Alcatel's Tobin's Q coefficient parallels the MV /BV variable, which is calculated as the main variable in this thesis. It can be seen that Alcatel's Tobin's Q coefficient decreased during the pandemic period. Thus, it can be seen from Figure 28 that the intellectual capital coefficient is affected by the pandemic.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 29: The effect of COVID-19 on the intellectual capital for the Arena

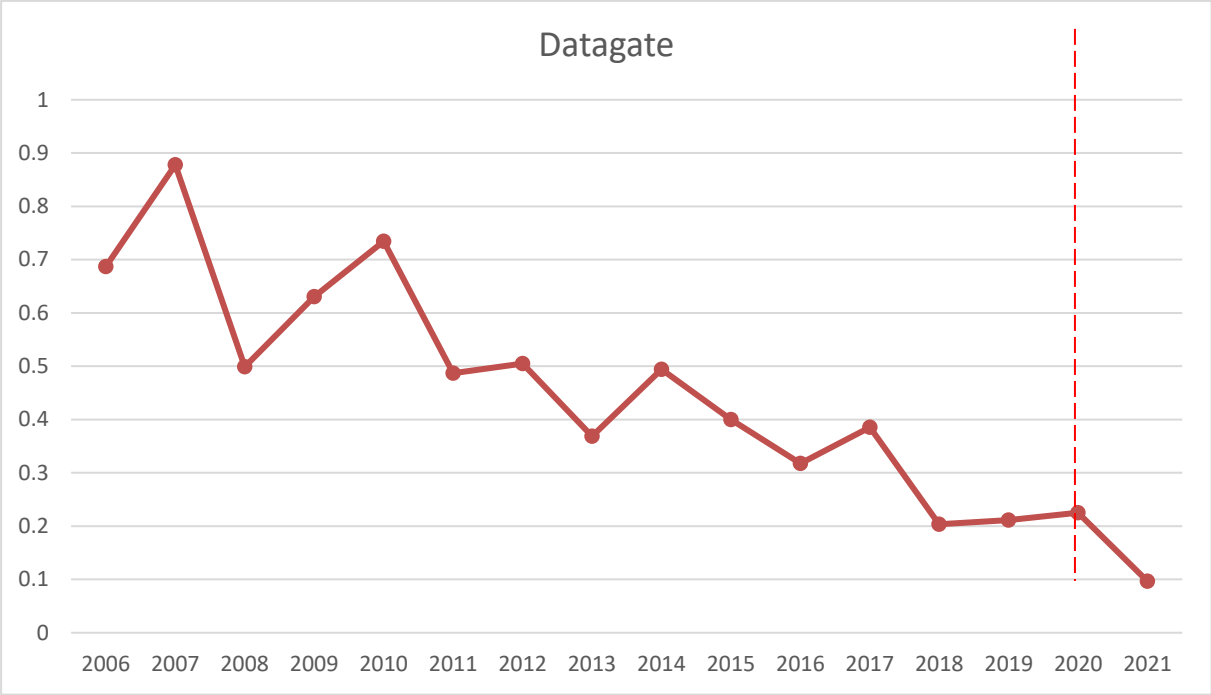
The Tobin's Q coefficient calculated for Arene is shown in Figure 29. The red dashed line in Figure 29 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Arena parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Arena decreased during the pandemic period. Thus, it can be seen from Figure 29 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Arene, we find that this coefficient is smaller than 1. And if it is smaller than 1, it shows that the intellectual capital of this company is low.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 30: The effect of COVID-19 on the intellectual capital for the Armada

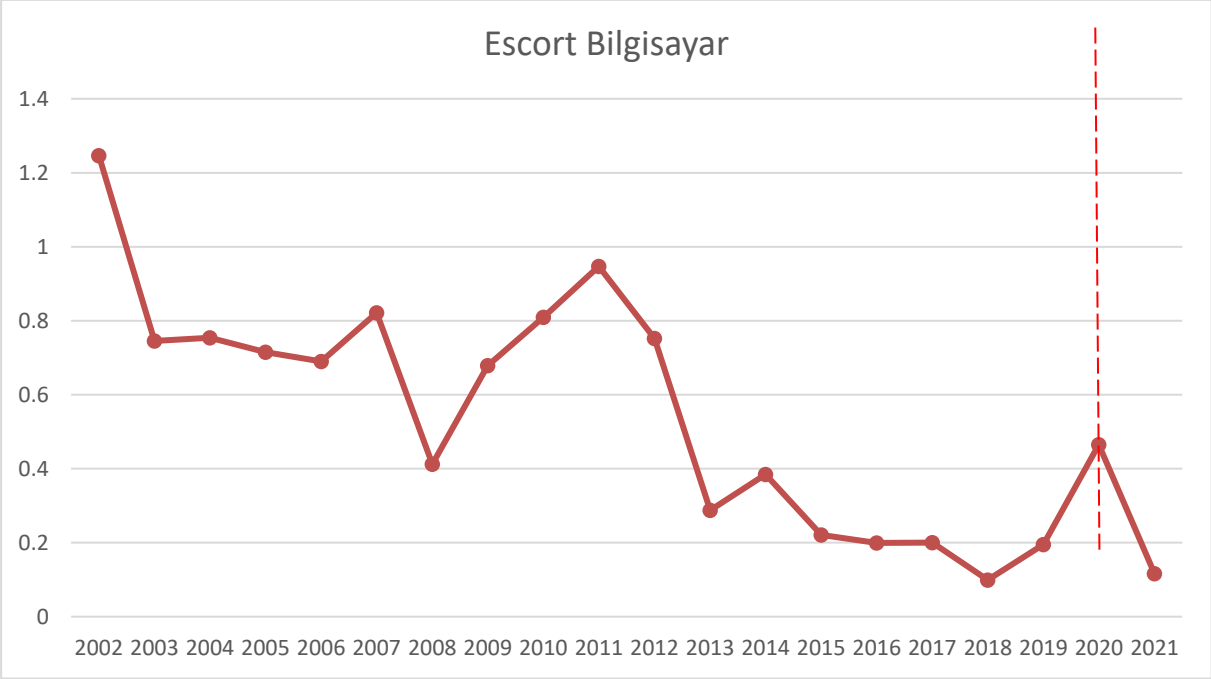
The Tobin's Q coefficient calculated for Armada is shown in Figure 30. The red dashed line in Figure 30 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Armada parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Armada decreased during the pandemic period. Thus, it can be seen from Figure 30 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Armada, it is seen that this coefficient is smaller than 1. If it is smaller than 1, it means that the intellectual capital of this company is low.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 31: The effect of COVID-19 on the intellectual capital for the Datagate

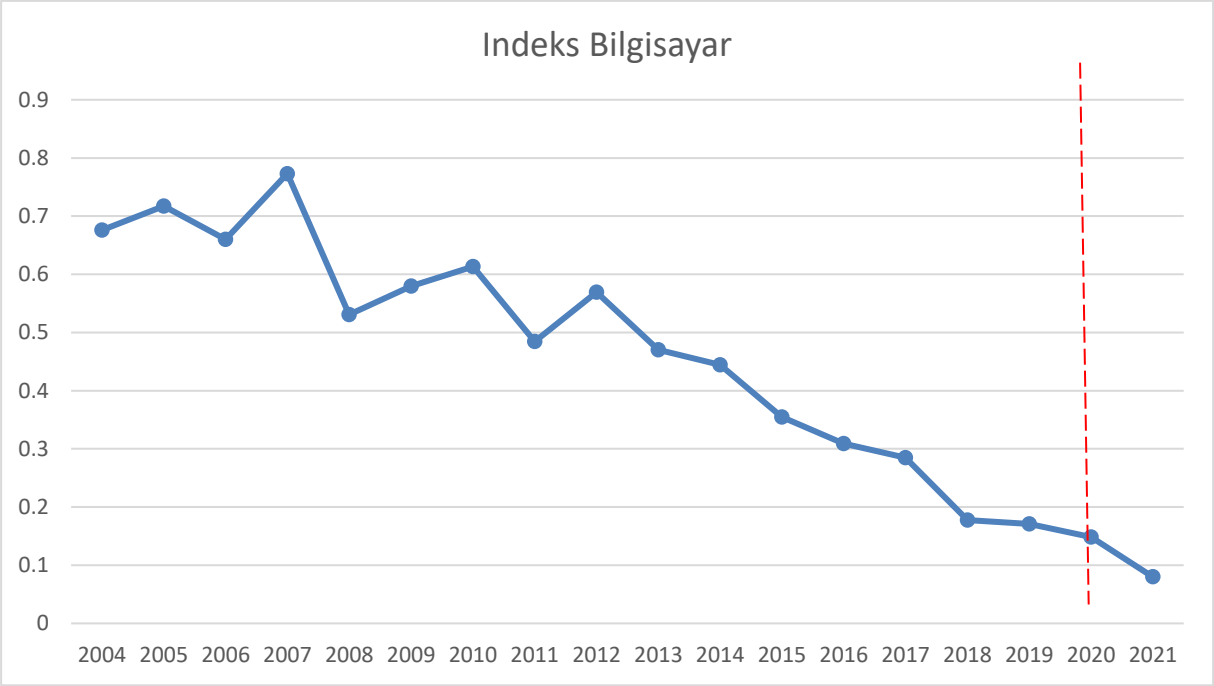
The Tobin's Q coefficient calculated for Datagate is shown in Figure 31. The red dashed line in Figure 31 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient from Datagate parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient of Datagate decreased during the pandemic period. Thus, it can be seen from Figure 31 that the intellectual capital coefficient is affected by the pandemic. Looking at the Tobin's Q coefficient for Datagate, we find that this coefficient is smaller than 1. If it is smaller than 1, it means that the intellectual capital of this company is low.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 32: The effect of COVID-19 on the intellectual capital for the Escort Computer

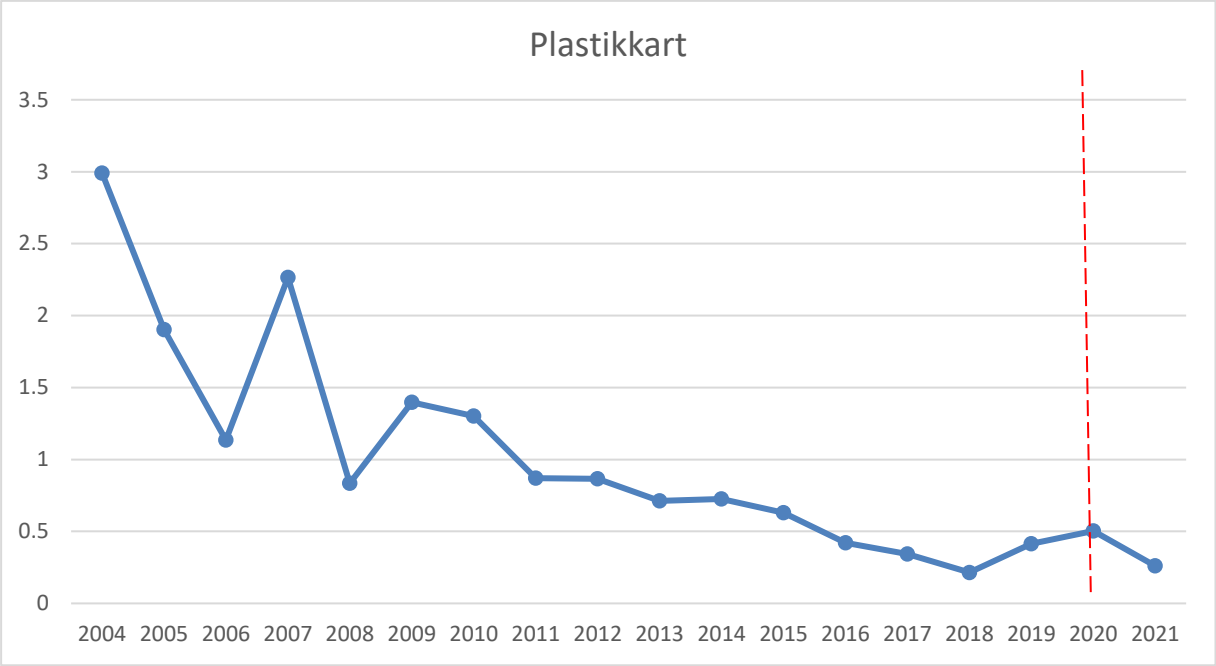
The Tobin's Q coefficient calculated for Escort Computer is shown in Figure 32. The red dashed line in Figure 32 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Escort Computer is consistent with the MV /BV variable calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient of Escort Computer decreased during the pandemic period. Thus, it can be seen from Figure 32 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Escort Computer, we find that this coefficient is greater than 1.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 33: The effect of COVID-19 on the intellectual capital for the Indeks Computer

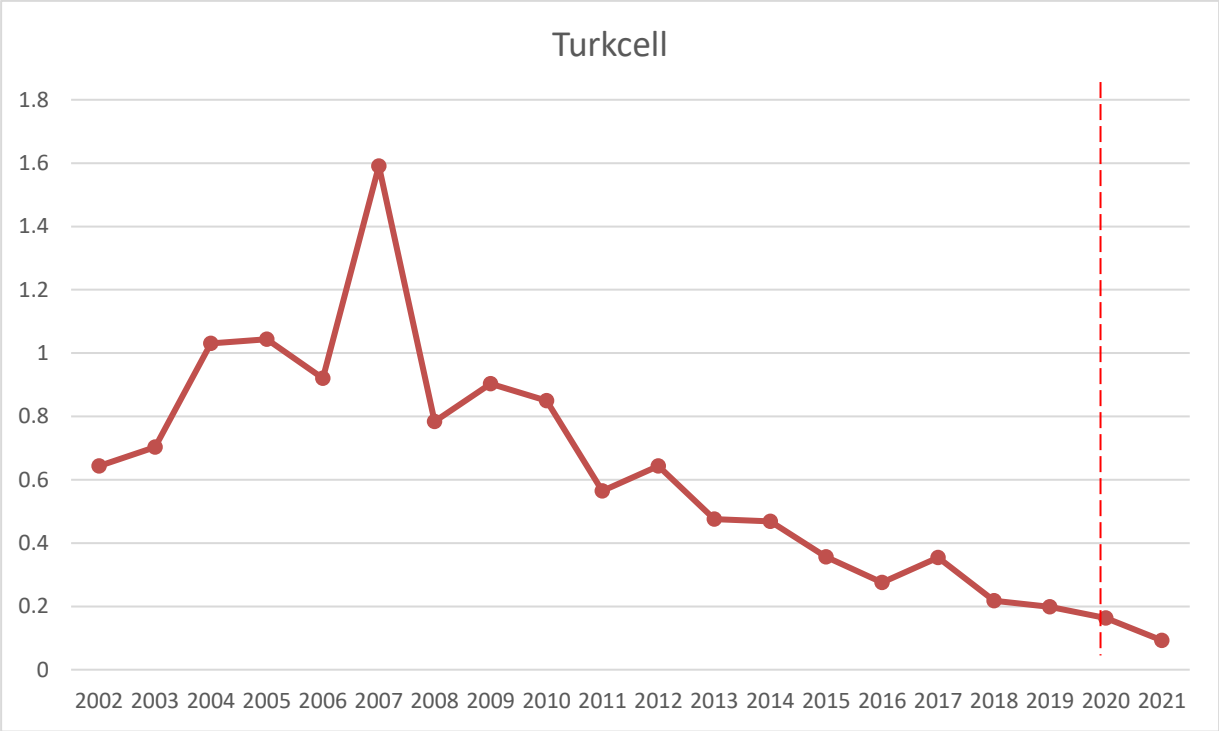
The Tobin's Q coefficient calculated for Index Computer is shown in Figure 33. The red dashed line in Figure 33 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Index Computer parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Index Computer decreased during the pandemic period. Thus, it can be seen from Figure 33 that the coefficient of intellectual capital is affected by the pandemic. If we look at the Tobin's Q coefficient for Index Computer, we see that this coefficient is less than 1. When the value of intellectual capital is less than 1, it indicates low intellectual capital for that firm.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 34: The effect of COVID-19 on the intellectual capital for the Plastikkart

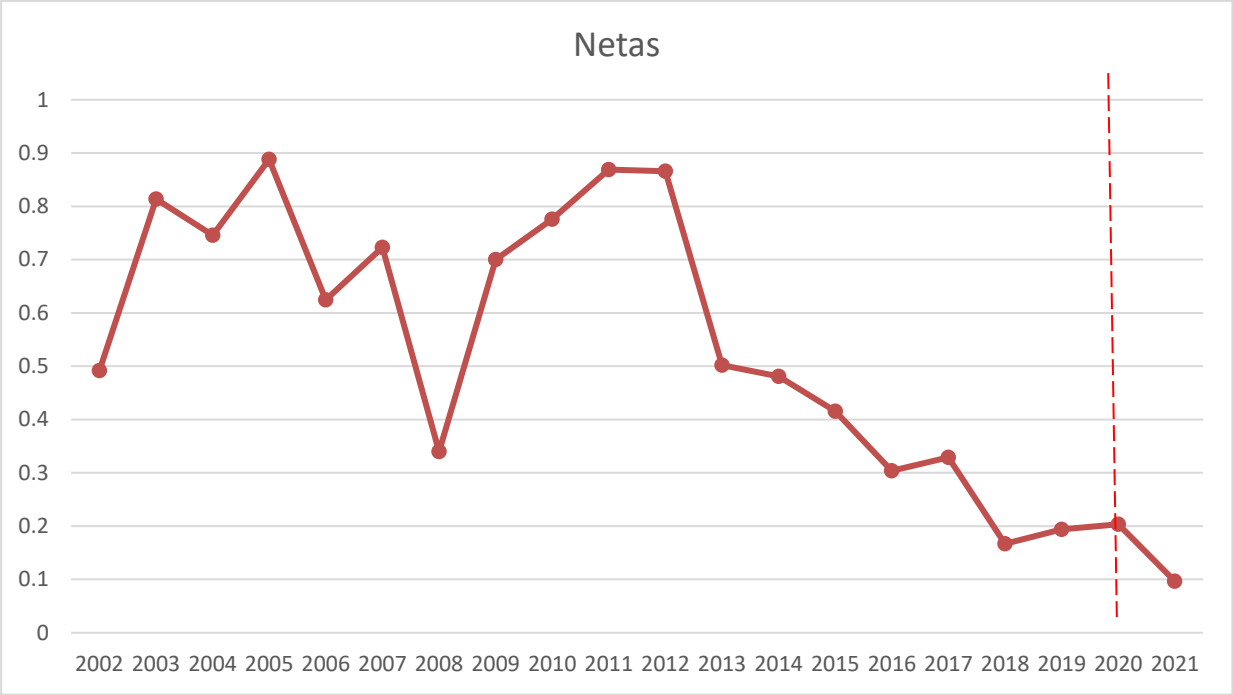
The calculated Tobin's Q coefficient for Plastikkart is shown in Figure 34. The red dashed line in Figure 34 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Plastikkart parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient of Plastikkart decreased during the pandemic period. Thus, it can be seen from Figure 34 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Plastikkart, we find that this coefficient is greater than 1.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 35: The effect of COVID-19 on the intellectual capital for the Turkcell

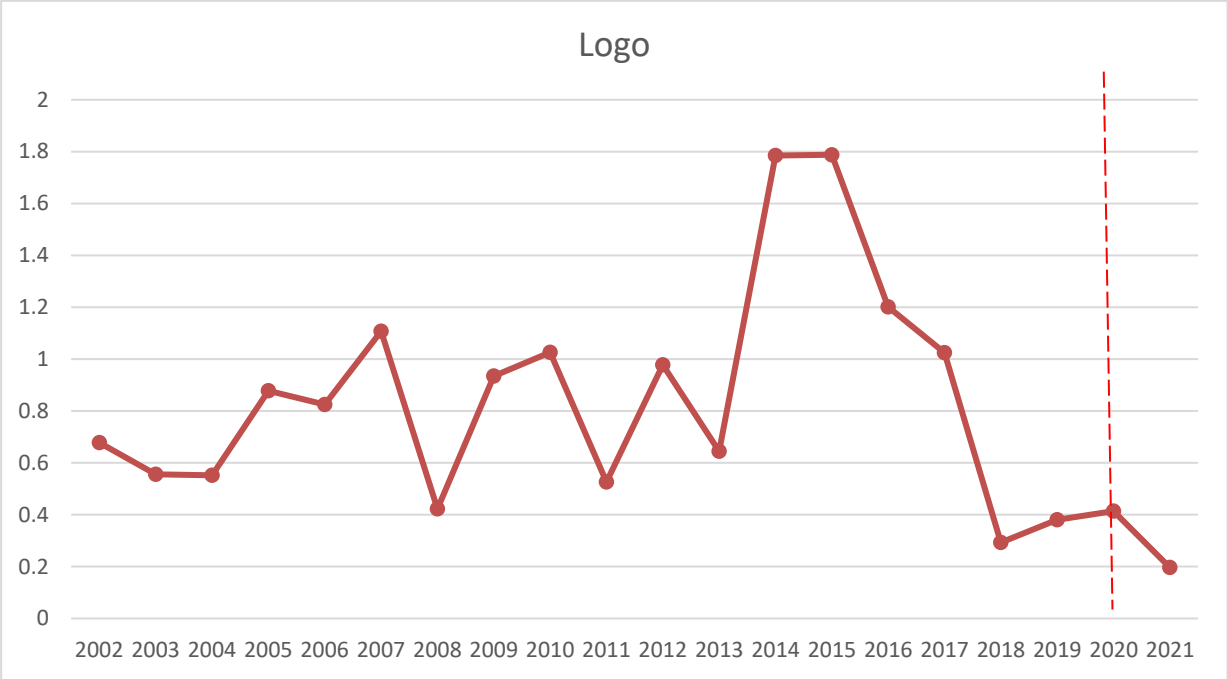
The Tobin's Q coefficient calculated for Turkcell is shown in Figure 35. The red dashed line in Figure 35 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Turkcell parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient of Turkcell decreased during the pandemic period. Thus, it can be seen from Figure 35 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Turkcell, we find that this coefficient is greater than 1.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 36: The effect of COVID-19 on the intellectual capital for the Netas

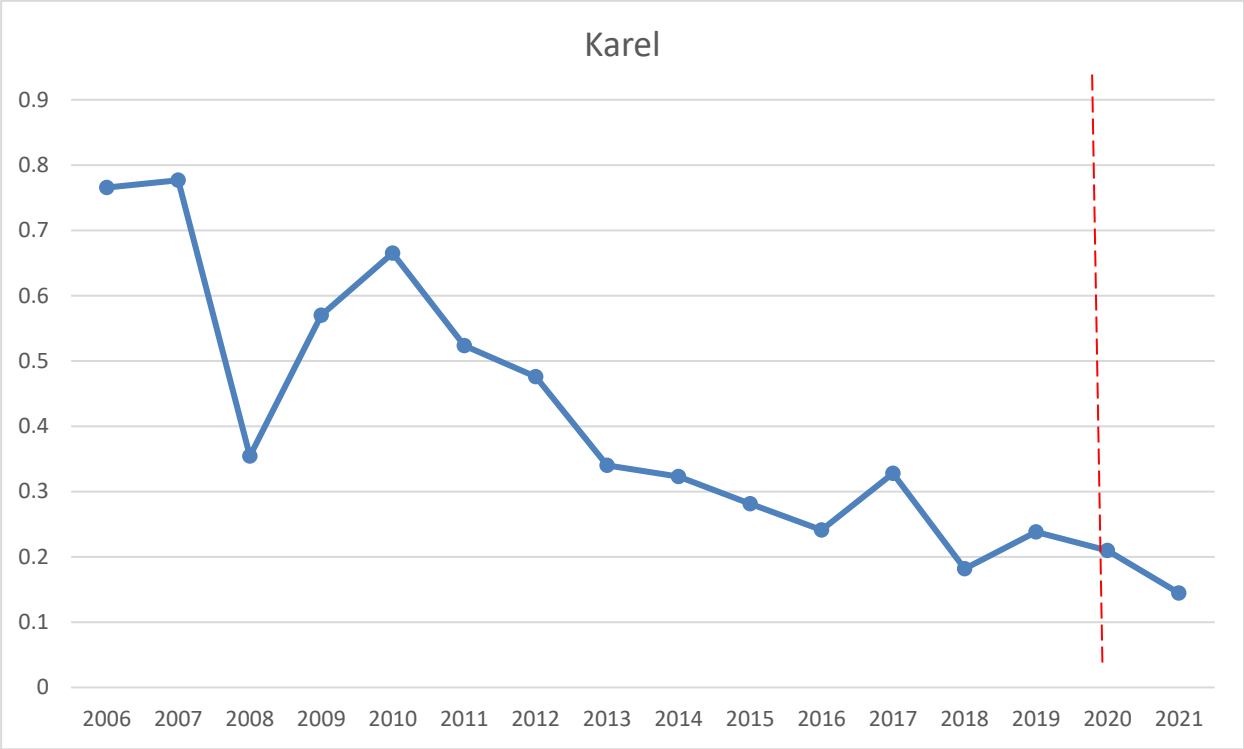
The Tobin's Q coefficient calculated for Netaş is shown in Figure 36. The red dashed line in Figure 36 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Netaş is parallel to the MV /BV variable, which was calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient of Netaş decreased during the pandemic period. Thus, it can be seen from Figure 36 that the coefficient of intellectual capital is affected by the pandemic. Analyzing Tobin's Q coefficient for Netaş, it can be seen that this coefficient is less than 1. When the value of intellectual capital is less than 1, it indicates low intellectual capital for that firm.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 37: The effect of COVID-19 on the intellectual capital for the Logo

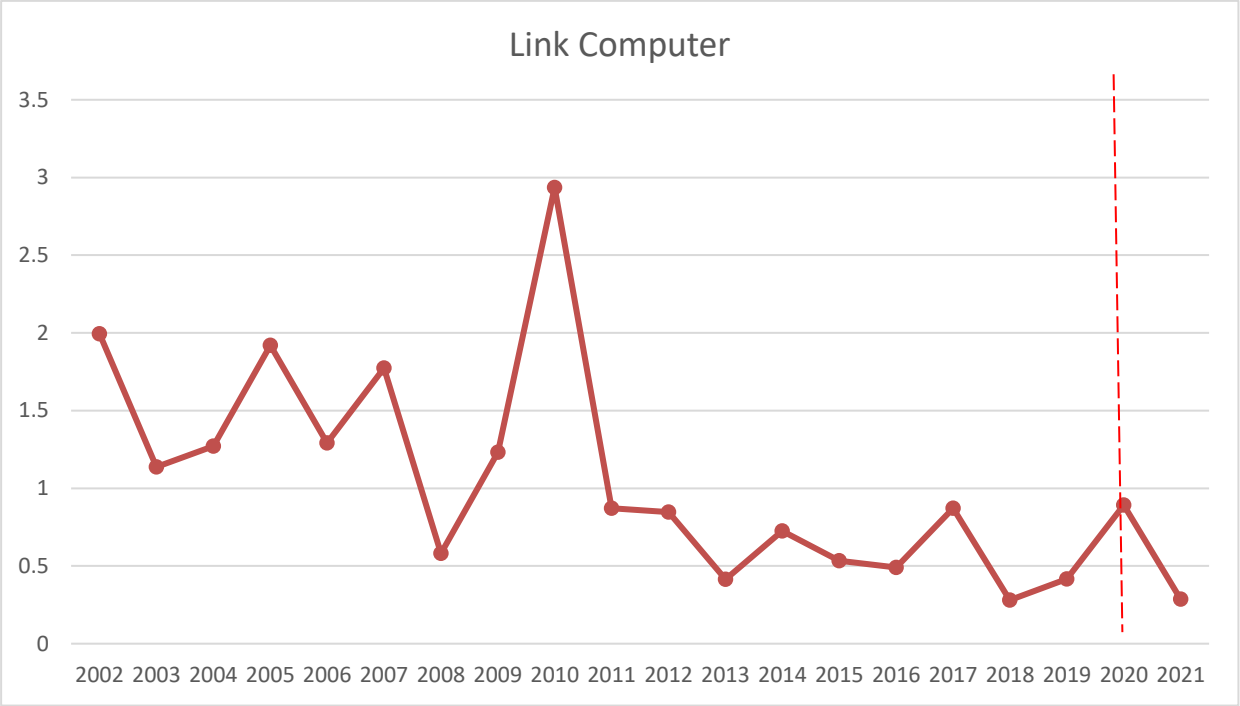
The calculated Tobin's Q coefficient for Logo is shown in Figure 37. The red dashed line in Figure 37 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient for Logo parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Logo decreased during the pandemic period. Thus, it can be seen from Figure 37 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Logo, we find that this coefficient is greater than 1.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 38: The effect of COVID-19 on the intellectual capital for the Karel

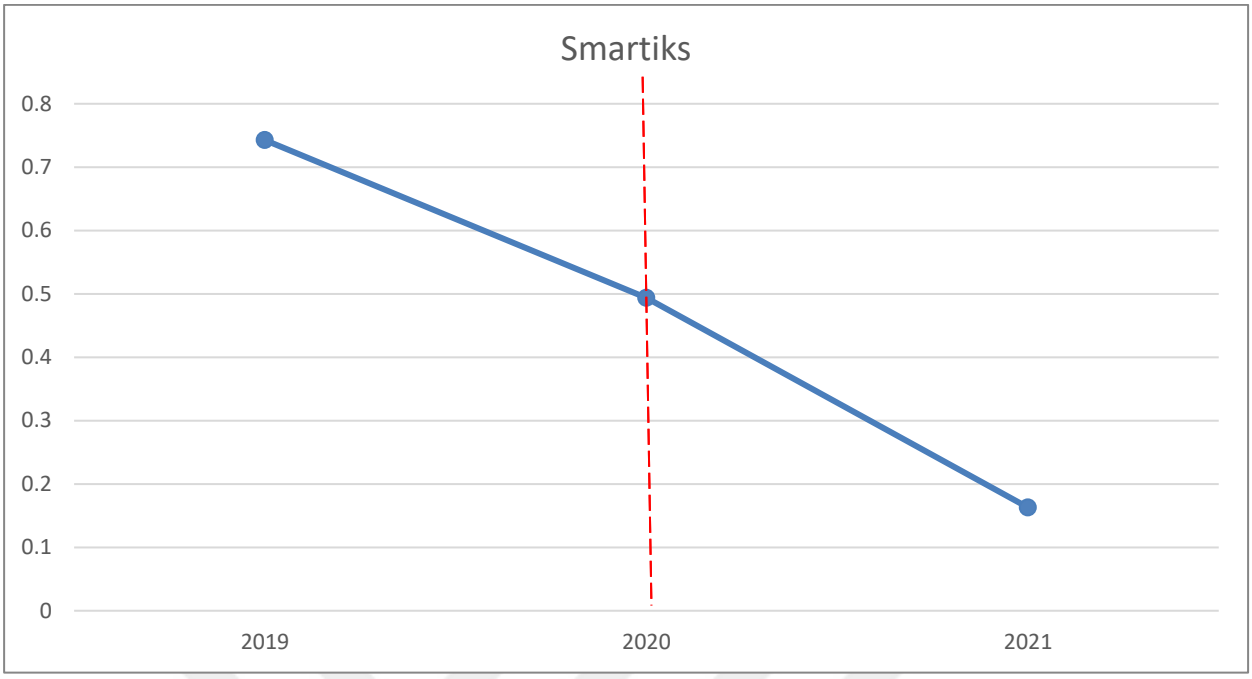
The calculated Tobin's Q coefficient for Karel is shown in Figure 38. The red dashed line in Figure 38 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient for Karel parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be seen that the Tobin's Q coefficient for Karel decreased during the pandemic period. Thus, it can be seen from Figure 38 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Karel, we find that this coefficient is smaller than 1. If it is smaller than 1, this shows that the intellectual capital of this company is low.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 39: The effect of COVID-19 on the intellectual capital for the Link Computer

The Tobin's Q coefficient calculated for Link Computer is shown in Figure 39. The red dashed line in Figure 39 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Link Computer parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Link Computer decreased during the pandemic period. Thus, it can be seen from Figure 39 that the coefficient of intellectual capital is affected by the pandemic. Looking at the Tobin's Q coefficient for Link Computer, we find that this coefficient is greater than 1.



Note: The redline represents the COVID-19 period for the Turkish economy.

Figure 40: The effect of COVID-19 on the intellectual capital for the Smartiks

The calculated Tobin's Q coefficient of Smartiks is shown in Figure 40. The red dashed line in Figure 40 indicates the pandemic period for Turkey, as in the other figures. It can be seen that the Tobin's Q coefficient of Smartiks parallels the MV /BV variable, which was calculated as the main variable in this thesis. It can be observed that the Tobin's Q coefficient of Smartiks decreases during the pandemic period. Thus, it can be seen from Figure 40 that the coefficient of intellectual capital is affected by the pandemic. If we look at the Tobin's Q coefficient for Smartiks, we find that this coefficient is less than 1. If the value of intellectual capital is less than 1, it means that the intellectual capital of this company is low.

5.CONCLUSIONS

5.1. Main Conclusion

In this thesis, intellectual capital, which is an important competitive factor for companies, is studied for , in the information technologies and telecommunications sector in Turkey. The coefficient of intellectual capital of these companies is studied between 2002 and 2021, including the Covid-19 period when there were significant restrictions and closures for these companies.

The literature review shows how various aspects of intellectual capital have been studied in both Turkish and international literature. However, to the author's knowledge, there is no study that compares intellectual capital for IT organizations before and after the pandemic with the aspect this thesis deals with. Intellectual capital before the pandemic and in the Covid-19 era should be studied to determine how organizations are affected by closures and restrictions that suddenly occur due to the epidemic and how the coefficients of intellectual capital change in such cases. Another abrupt external shock is a pandemic. This thesis how the severe external shock of the pandemic period affects the coefficient of intellectual capital of the technology-intensive sector.

Surprisingly, the results show that the coefficient of intellectual capital is quite heterogeneous for the firms considered in this thesis. In other words, it turns out that the coefficients of intellectual capital of information technology and telecommunications firms are not close to each other, but differ on a firm-by-firm basis. This is also true for the Covid-19 period, but it was expected that the Covid-19 period, when digital tools increased more than before this period and the importance of online work in our lives increased even more, would be an important advantage for these firms. However, the results show that the coefficient of intellectual capital did not increase for all these firms during the Covid-19 period. At the same time, it was found that the coefficient of intellectual capital is not stable for the firms considered in this thesis (even if we do not consider the Covid-19 period). These are the main results of this thesis.

This thesis also considers different versions of the intellectual capital coefficient. In this thesis, the coefficients MV /BV and Tobin's Q are used. All coefficients of intellectual capital are almost one-to-one compatible. Therefore, the findings obtained in this thesis are quite robust.

5.2. Limitations

When discussing the limitations of this study, the following limitations can be mentioned. thesis some limitations to this study. The first of these limitations relates to the data set. Since the dataset used in this thesis contains information about publicly traded companies, a dataset consisting only of these companies was created. Of course, since this thesis deals with the calculation of intellectual capital based on the market, this limitation is quite expected. Another limitation of this thesis is that the calculation of intellectual capital is limited to a single sector. Since the objective of this thesis is to deal with intellectual capital in a technology-intensive sector, this limitation can also be considered normal. However, the fact that the findings obtained are limited to a single sector means that these results cannot be generalized to other sectors. At the same time, an attempt was made to calculate the coefficient of intellectual capital using the VAIC method calculated by Pulic (2005), but the analysis could not be performed because data on employees were not available. Therefore, the two most appropriate methods for the coefficient of intellectual capital were used for this study. This can be considered as the third limitation of this thesis.

5.3. Managerial and Policy Implications

In light of the results of this study, some implications for C-suite executives can be derived. The calculated intellectual capital coefficients show that some companies lag behind others in the ratio of market capitalization to book value. This suggests that the intangible assets of some of the IT companies used in this thesis are not valued in the market as they should be. This can be interpreted as an indication that these companies are lagging behind their competitors. It is recommended that the managers of these companies develop policies focused on intellectual capital and focus on the missing aspects at this point.

The calculated coefficient of intellectual capital decreased for all IT firms during the pandemic period. In light of these results, it is recommended that these companies should be proactive in crisis management.

In light of the findings of this study, a number of actions can be recommended to policy makers. The thesis states that technology-intensive sectors are highly vulnerable to exogenous shocks such as pandemics. In times of crisis, it is recommended that grants, interest-free loans, or

supportive policies be provided to these firms to maintain current levels of technology. This is the first of these policy recommendations.

Since technology-intensive sectors play a major role in economic growth, protecting the intellectual capital of these companies can reduce the vulnerability of the country's economy. Another result of thesis is that the coefficient of intellectual capital of some enterprises is relatively low even if we do not consider the pandemic period. Therefore, incentives can be created for these companies to increase their intangible assets. These incentives may include technology transfer or financial support to increase the current level of technology. This is the second of these policy recommendations.

5.4. Recommendations For Further Studies

As a recommendation for future studies, it is suggested that the reasons for the high variation in the coefficient of intellectual capital in the information technology and telecommunications sectors firm survey or interview methods.

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