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ARE INTELLECTUAL CAPITAL AND ITS COMPONENTS AFFECTIVE ON FINANCIAL PERFORMANCE?

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Abstract

The factors that affect intellectual capital creation at firms and how these factors influence the financial performance of firms have been core questions of extant work in the channels of finance for many years. In this period, therefore, the efforts that firms make to increase their intellectual capital to create value and studies that examine the impact of the increased intellectual capital on the firm's financial performance are notable. Thus, this study aims to explore the influence of intellectual capital and its components on the financial performance of the BIST Sustainability Index companies for the period between 2018:Q4-2024:Q1. A set of Intellectual Value Added Coefficient (VAIC) and its components Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE) are employed as indicators of intellectual capital. The financial performance is measured through Return on Assets (ROA) and Return on Capital Employed (ROCE). Control variables included in each model are Market to Book Value (MV/BV), Logarithm of Total Assets (SIZE), and Asset Turnover (ATR). The fixed effects regression results show that an increase in the intellectual capital of the companies listed in the BIST Sustainability Index has a positive effect on their financial performance.

Keywords: *Intellectual capital, Value added intellectual coefficient, Financial performance, BIST sustainability index.*

ENTELEKTÜEL SERMAYE VE BİLEŞENLERİ FİNANSAL PERFORMANS ÜZERİNDE ETKİLİ MİDİR?

Öz

Firmaların finansal performansını etkileyen faktörler ve bu faktörlerin firmaların finansal performansını nasıl etkilediği, uzun yıllardır finans alanında devam eden araştırmaların odak noktalarından biridir. Bu bağlamda, firmaların değer yaratmak için entelektüel sermayelerini artırma çabaları ve artan entelektüel sermayelerinin finansal performanslarına etkisini inceleyen çalışmalar dikkat çekmektedir. Buradan hareketle çalışmada 2018:Q4-2024:Q1 dönemi arasında BIST Sürdürülebilirlik Endeksi firmalarının entelektüel sermayesi ve bileşenlerinin finansal performanslarına etkisini araştırmak amaçlanmıştır. Çalışmada entelektüel sermaye göstergeleri olarak Entelektüel Katma Değer Katsayısı (VAIC) ve bileşenleri olan Beşeri Sermaye Etkinliği (HCE), Yapısal Sermaye Etkinliği (SCE) ve Kullanılan Sermaye Etkinliği (CEE) kullanılmıştır. Finansal performans göstergesi olarak ise Aktif Karlılığı (ROA) ve Kullanılan Sermayenin Getirisi (ROCE) kullanılmıştır. Her bir modele kontrol değişkeni olarak Piyasa/Defter Değeri (MV/BV), toplam varlıkların logaritması (SIZE) ve Varlık Devir Hızı (ATR) dahil edilmiştir. Sabit etkiler regresyon sonuçlarına göre BIST Sürdürülebilirlik Endeksi'ndeki firmaların entelektüel sermayesini artırmasının finansal performanslarını olumlu yönde etkilediği bulgusuna ulaşılmıştır.

Anahtar kelimeler: *Entelektüel sermaye, Entelektüel katma değer katsayısı, Finansal performans, BİST sürdürülebilirlik endeksi.*

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1. INTRODUCTION

The concept of intellectual capital has gained much attention as a significant driver of corporate performance in dynamic and competitive business environments. Intellectual capital, often referred to as the lifeblood of an organization, is a collection of intangible assets that contribute to the value and performance of an organization. J. K. Galbraith first used the concept of intellectual capital in 1969, stating that it represented more than an act of pure reason but of reasoned action (Bontis, 1998: 67). Later explanations of intellectual capital include those of Stewart (1991) as information, skills, and expertise of employees that provide competitive advantage to the firm; Edvinsson (1997) as information that can be transformed into value; Roos et al. (1997) as processes and assets not recorded in the balance sheet in addition to tangible assets such as brand patents; Sullivan (1999) as knowledge that can be turned into cash. It is recognized that intellectual capital is the determinant of firms' profitability and competitiveness (Wu et al., 2006: 532). Although the concept of intellectual capital has found its place in many disciplines today, it has been a subject of research in finance since the 1980s. The increasing importance of intellectual capital in the field of finance, the fact that the value of firms is not equal to their physical assets, and this difference being more attractive for knowledge-intensive companies has influenced (Zor & Cengiz, 2013: 42). In particular, the fact that the market value of firms is higher than their book value has led to the realization that the investment in information for market value is more important than the investment in production, which has contributed to the development of the concept of intellectual capital (Çalışkan, 2015: 122). In this context, it has become important to investigate, measure, develop, and analyse intellectual capital and its components.

The theoretical framework is what grounds the perception of how important intellectual capital is in improving financial performance. Human capital, structural capital, and employed capital, as well as customer capital, social capital, technological capital, and spiritual capital. (Khalique et al., 2011: 344). Spiritual capital is one of the important intellectual capitals that stimulate people as well as organizations to go about conducting a business in a manner that respects the law and standards. Merging insights from human capital theory with resource-based theory, such that a model is put forward to analyse the relation between human capital and organizational performance (Mubarik et al., 2018: 607). The global drive toward a knowledge-based economy has drastically increased the importance of firms' human capital and related intellectual resources as sources of competitive advantage (Komnenić & Njegić, 2019: 139).

Measuring intellectual capital constitutes a critical aspect of assessing its impact on financial performance. There are various methods to evaluate intangible assets by focusing on specific tangible ones and market-based methods of determining market value like direct methods and those based on market value (Babai et al., 2016: 1063). The fact that the measurement of intellectual capital also includes non-material aspects has led to difficulties in its implementation. The most commonly used in the literature seems to be the VAIC (Value Added Intellectual Coefficient) method developed by Ante Pulic in 1998 and 2004 (Joshi et al., 2013; Özer & Özer, 2014; Dženopoljac et al., 2016; Zhang et al., 2021; Sarışın & Özkan, 2022; Puspitasari et al., 2023; Sakur & Güngör, 2023). By this method, the VAIC has three components. The first component, HCE (Human Capital Efficiency), reflects all costs related to employees as an investment made by the firm (Pulic, 2004: 64). This is because human capital is a measure of the total knowledge, skills, and competencies of the employees working for the firm (Vergauwen et al., 2007: 1167). The second component, SCE (Structural Capital Efficiency), represents knowledge resources within a firm, such as structure, system, management, and organizational processes (Sarışın & Özkan, 2022: 211). The structural capital, which results from subtracting human capital from value added, does not include resources that employees take away when they leave; hence it is seen as very important. The third component, CEE (Capital Employed Efficiency), refers to physical and financial capital within the firm. According to Pulic (2004: 64-65), a firm cannot create value with its intellectual capital alone, without the use of tangible capital, and therefore it is considered as a component of intellectual capital. This study analysed the impact of firms' intellectual capital, listed in the BIST Sustainability Index, on financial performance with consideration to all three components.

The Sustainability Index is calculated by Borsa Istanbul as of November 4, 2014. Firms traded on the Stars, Main, and the SubMarket are included in the sustainability assessment by BIST and those that are deemed

suitable are included in the relevant index (Borsa İstanbul, n.d.). Sustainability reports for corporate firms involve long-term value-creating purposes. The reports concerned include firms' economic responsibilities, environmental responsibility, social responsibility, and the interaction between them and one another. There is a debate among studies regarding the impact of publishing sustainability reports on the financial performance of firms. While some argue that it has a positive effect and provide evidence to support this claim (Yıldırım et al., 2018; Crespi & Migliavacca, 2020; Zhao & Murrell, 2022; Naeem et al., 2022), others state that research on the performance of firms included in the sustainability index is still ongoing (Aytekin & Erol, 2018; Atan et al., 2018; Lopez-de-Silanes et al., 2020; Parikh et al., 2023). However, there is a noticeable lack of studies examining the financial performance of firms included in the BIST Sustainability Index in terms of intellectual capital. These limited studies approach the topic from different methods and dimensions. The relation between environmental, social and governance competencies and intellectual capital needs to be established. Therefore, this study aims to investigate the relation between intellectual capital and the financial performance of 34 firms listed on the BIST Sustainability Index. The firms selected continuously disclose their balance sheets and represent various industrial sectors. The research period spans from 2018:Q4 to 2024:Q1. ROA and ROCE are used as dependent variables in this study. VAIC, HCE, SCE and CEE are used as independent variables in different models. SIZE, MV/BV and ATR are used as control variables.

2. LITERATURE REVIEW

Numerous studies in the finance literature have explored the term of intellectual capital. Specifically relevant to our study are the papers that examine intellectual capital for the BIST Sustainability Index, as well as those that investigate relation between intellectual capital and financial performance within the Turkish capital markets. Additionally, there is a body of research from international studies that explores the relation between intellectual capital and financial performance.

In one of the studies on intellectual capital for the Sustainability Index of the BIST, Dönmez and Erol (2016) examine the relation between intellectual capital and its components of the firms in the BIST Sustainability Index for 2014-2015 period and their business with firm performance. The non-availability of any quantitative research studying intellectual capital has been ascertained in this regard. Intellectual Capital and its components are analysed by the VAIC approach in a study calculated for ROA (Return on Assets), ROE (Return on Equity), ATR (Assets Turnover Ratio), MV/BV (Market to Book Value) and leverage ratio financial performance indicators. As a result, it is stated that there is a positive and strong correlation between VAIC and ROA and between HCE and ROE. In addition, evidence is presented that the intellectual capital components can explain ROA in 2014. Another study is carried out by Öztürk and Cihangir (2021) to include private banks that are constituents of BIST Sustainability Index between 2016-2019 in terms of disclosures on intellectual capital elements in their sustainability reports. The relation between the components of capital mentioned in International Integrated Reporting and firm value is examined by Kaya and Atasel (2022) for the firms listed on the Borsa Istanbul Sustainability Index (except the financial sector) for the period 2010-2019. Consequently, intellectual capital, human capital, social (relational) capital, and dividends (financial capital) positively affect firm value; while there is a negative relation with natural capital, produced capital, and financing costs (financial capital). From another perspective, Aktaş and Atalay (2020) search whether the variety in the board of directors of firms included in the BIST Sustainability Index affects intellectual capital. The other findings of this study are that the variable under control, selected ROA, ROE, and firm size are not explanatory of intellectual capital. This means that independent member and female member ratio factors have a significantly negative effect on intellectual capital. The other factors determining board diversity have no significant effect, it has been stated. The other findings of this study are that the variable under control, selected ROA, ROE, and firm size are not explanatory of intellectual capital.

Özer and Özer (2014) conduct a study that explores how intellectual capital impacts the financial performance of Turkish capital markets, focusing on 57 multinational firms listed on BIST from Q1 2002 to Q4 2011. They employ the VAIC methodology as proxies for intellectual capital and its components, utilizing static panel data analysis with Value Added/Total Assets as the financial performance indicator. The findings from both static and dynamic panel data analyses suggest a positive relation between financial performance and intellectual capital. While the components of intellectual capital are positively related with financial performance, only HCE

significantly impacts financial results. Additionally, Kandil Göker (2017) analyses whether intellectual capital is effective on the financial performance of 11 firms within the information sector over the period from 2008 to 2016. The study reveals that VAIC positively affects the selected financial performance metrics. Furthermore, while HCE and CCE have significant positive impacts on firm performance, SCE does not show any significant effect on it. In a similar vein, Buyuran and Şit (2021) assess how intellectual capital and its components impact ROA and ROE across two distinct periods, from Q1 2010 to Q4 2020, focusing on 11 firms in the transportation and communication sectors listed on BIST. While CEE positively impacts ROA, the components HCE, SCE, and CEE each have varying levels of significance regarding their positive effects on ROE. In a study conducted by İşseveroğlu and Ercan (2019), the influence of intellectual capital components HCE, SCE, and CCE on ROA and ATR is examined using data from 15 technology firms listed on BIST over the period from 2008 to 2017. The findings show that HCE has an impact on ROA. However, for ATR, while HCE shows a low level of impact, the model is deemed insignificant. Additionally, Topaloğlu and Bayrakdaroğlu (2024) explore the linking between intellectual capital and its components with financial performance across both short- and long-term periods for 7 banks listed on BIST from 2010 to 2020. This research utilizes ROA and ROE as indicators of financial performance, revealing no positive relations between financial performance and intellectual capital. The VAIC is found to negatively impacts financial performance in both short and long terms, while CCE negatively affects it in the short term and SCE in the long term. Meanwhile, Sakur and Güngör (2023) search the link between intellectual capital and financial performance for the period spanning 2008 to 2015, focusing on 177 firms within the BIST Industrial Index for their subsector-specific analysis. The research establishes an FPGE (Financial Performance Indicators Index) utilizing ROA, ROE, and ATR ratios. The VAIC method is employed to assess intellectual capital and its various components. It is discovered that, with the exception of firms in the food and textile industries, VAIC positively and significantly influences FPGE. Regarding the capital components, HCE shows positive and significant impacts on the FPGEs across all sub-sectors, while the effects of SCE and CEE differ based on the specific sub-sector, with SCE exhibiting a weak influence. In contrast, a study by Öztemiz and Karesioğlu (2023) investigates whether corporate governance is effective on intellectual capital. This research focuses on holding and investment firms listed on the BIST Corporate Governance Index from 2016 to 2021. The results suggest that corporate governance impacts intellectual capital solely for firms with a high MV/BV ratio.

Joshi et al. (2013) explore the relation between intellectual capital and ROA within a sample from the Australian finance sector and its subsectors during the years 2006-2008. Their findings show that HCE is effective on financial performance, whereas the effects of SC and CEE are minimal. Additionally, they observe that different components of intellectual capital and the overall VAIC produces varying effects on ROA across the subsectors. In another investigation, Dženopoljac and Janoševic (2016) study the impact of intellectual capital on the financial performance of Serbian IT firms, utilizing panel data from 2009 to 2013. They assess financial performance through indicators such as ROA, ROE, ROIC, ATR, and profitability. Their results reveal that CEE, calculate through VAIC, significantly affects all performance metrics except for ROIC, which is positively and significantly influenced solely by HCE. Conversely, according to Puspitasari et al. (2023) HCE has a negative impact on ROIC, while SCE demonstrates positive influence on ROIC; however, CCE shows no significant effect on ROIC in the Indonesian banking sector. This contrasts with findings from a similar investigation by Yiğit (2021), who discovers that CCE positively influences financial performance metrics across all countries during the 2010-2020 period, involving 2,619 firms from the manufacturing sectors of five vulnerable countries. Yiğit (2021) also observes that SCE has positive and significant effects on ROA and ROE in all countries, as well as positive and significant effects on ATR exclusively in India. While the results concerning HCE differ among countries and financial performance indicators, they generally suggest that firms do not exert a substantial influence on financial performance under HCE. Additionally, another study by Sardo and Serrasqueiro (2017) explore the relation between intellectual capital and financial performance (ROA) and market value (Tobin's Q), along with the impact of intellectual capital on firm specialization across 14 Western European countries from 2004 to 2015. The findings suggest that CEE positively influences short-term financial performance, whereas SCE is beneficial for long-term performance, as determined through the components of intellectual capital calculated by the VAIC method on ROA; HCE is deemed significant for firm value. Nonetheless, it has been uncovered that concentrated ownership limits the intellectual capital of firms. In a related variable-based investigation, Zhang et al. (2021) observe the comparative impact of intellectual capital on the financial performance of 140 firms in Vietnam's pharmaceutical and financial

sectors during 2016. Utilizing the VAIC method to assess the coefficient of intellectual capital, the study focuses on HCE and SCE components, selecting ROA and ROE as financial performance indicators. The results indicates that both VAIC and HCE positively affect ROA and ROE, while SCE positively impacts ROE but negatively impacts ROA. The impact of HCE on ROA is more pronounced in financial sector firms, whereas its influence on ROE is greater among pharmaceutical firms; additionally, SCE has a stronger effect on ROA for pharmaceutical firms, while its impact on ROE is more significant for those in the financial sector. In a study conducted by Barak and Sharma (2024), the relation between financial performance and intellectual capital is explored in banking sector in India, covering the years 2010 to 2022. The researchers utilize financial performance indicators such as ROA, ROE, ROCE, and ROS, while intellectual capital is assessed through the MVAIC method. Their findings reveal that within public banks, HCE shows a positive correlation with ROA, ROCE, and ROS; conversely, RCE exhibits negative correlations with both ROA and ROE. Additionally, CEE and SCE positively affect the performance indicators. For private banks, the analysis indicates that RCE has a negative correlation with ROS, whereas ROCE demonstrates a positive correlation. Similarly, Ali et al. (2022) investigate the influence of intellectual capital on financial performance in firms from Pakistan and India during the period from 2010 to 2020. Their study concludes that intellectual capital, evaluated using the MVAIC method, significantly impacts the financial performance of the firms. They also highlight that HCE, SCE, and CEE significantly influence firms in both countries, while RCE does not show any significant impact.

Although the relation between intellectual capital and the financial performance is recognized in the finance literature, findings are variable. In this context, it is still important to research the effect/relation on financial performance of the 34 companies traded in the BIST Sustainability Index without interruption and their intellectual capital and components.

3. DATA AND METHODOLOGY

This part of the study includes the BIST Sustainability Index firms used in the analyses and definitions of the variables used in the models.

3.1. Data

The aim of this research is to analyse the impact of intellectual capital on the financial performance of firms listed in the BIST Sustainability Index from 2018:Q4 to 2024:Q1. The study focused on companies that remained in the index throughout the entire period and publicly disclosed their industrial balance sheets. Out of the 82 firms included in the BIST Sustainability Index, a sample of 34 firms was selected for the study. Detailed information about these firms can be found in Table 1. All the data used in this research were extracted from the Finnet database.

Table 1: BIST sustainability index firms in the sample

No	BIST Code	No	BIST Code	No	BIST Code	No	BIST Code
1	AEFES	10	DOAS	19	OTKAR	27	TOASO
2	AKENR	11	DOHOL	20	SAHOL	28	TTKOM
3	AKSA	12	EREGL	21	SISE	29	TTRAK
4	ARCLK	13	FROTO	22	TATGD	30	TUPRS
5	ASELS	14	GLYHO	23	TAVHL	31	ULKER
6	AYGAZ	15	KCHOL	24	TCELL	32	VESBE
7	BRISA	16	KORDS	25	THYAO	33	VESTL
8	CCOLA	17	LOGO	26	TKFEN	34	ZOREN
9	CIMSA	18	MGROS				

3.2. Methodology

Table 2 includes the variables used in this study. These variables are VAIC, HCE, SCE, CEE, ROCE, ROA, ATR, MV/BV and SIZE. The calculation method developed by Ante Pulic (2004) is used to calculate the VAIC and information regarding the calculation is presented in Table 2. Furthermore, Table 2 also includes the definition of financial performance indicators used in this study.

Table 2: Variables of the study

	Code	Variable Name	Formula
Intellectual Capital and Its Components	VAIC	Value Added Intellectual Coefficient	HCE+SCE+CEE
	HCE	Human Capital Efficiency	Value Added/Personnel Expenses
	SCE	Structural Capital Efficiency	(Value Added-Personnel Expenses)/Value Added
	CEE	Capital Employed Efficiency	Value Added/(Total Assets-Current Liabilities)
Financial Performance Indicators	ROCE	Return on Capital Employed	EBIT/(Total Assets-Current Liabilities)
	ROA	Return on Assets	Net Income/Total Assets
	ATR	Asset Turnover Ratio	Net Sales/Total Assets
	MV/BV	Market to Book Ratio	Market Value/Book Value
	SIZE	Total Assets	Logarithm of Total Assets

Note: (Value Added=Operating Profit+Personnel Expenses+Amortization and Depreciation)

Following models are used in the analyses:

$$ROCE_{it} = \beta_0 + \beta_1 VAIC_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (1)$$

$$ROCE_{it} = \beta_0 + \beta_1 HCE_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_i t \quad (2)$$

$$ROCE_{it} = \beta_0 + \beta_1 SCE_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (3)$$

$$ROCE_{it} = \beta_0 + \beta_1 CCE_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (4)$$

$$ROA_{it} = \beta_0 + \beta_1 VAIC_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (5)$$

$$ROA_{it} = \beta_0 + \beta_1 HCE_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (6)$$

$$ROA_{it} = \beta_0 + \beta_1 SCE_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (7)$$

$$ROA_{it} = \beta_0 + \beta_1 CCE_{it} + \beta_3 ATR_{it} + \beta_4 MV/BV_{it} + \beta_5 SIZE_{it} + \varepsilon_{it} \quad (8)$$

In the formulas, $ROCE_{it}$ represents Return on Capital Employed for the firm *i* at time *t*, ROA_{it} represents Return on Assets for the firm *i* at time *t*, ATR_{it} represents Asset Turnover Ratio for the firm *i* at time *t*, MV/BV_{it} represents Market to Book Value for the firm *i* at time *t*, $SIZE_{it}$ represents the Logarithm of Total Assets for the firm *i* at time *t*, β represents Model Coefficients, ε_{it} represents the Error Terms for the firm *i* at time *t*, HCE_{it} represents Human Capital Efficiency for the firm *i* at time *t*, CCE_{it} represents Human Capital Efficiency for the firm *i* at time *t*, and SCE_{it} represents Structural Capital Efficiency for the firm *i* at time *t*.

Fixed effects panel data analysis is used in this study. This model controls both time invariant heterogeneity and unobserved time varying and time invariant factors. Firstly, F test is applied and as a result fixed effect model is preferred to pooled OLS. Secondly, as a result of Breusch Pagan Lagrangian Multiplier test random effects model is preferred to OLS model. Finally, in order to decide between random effects and fixed effects model Hausman test is conducted. Fixed effect model is preferred to random effects model. By using Driscoll and Kraay (1998) estimator cross sectional dependency, heteroscedasticity and autocorrelation issues are mitigated.

4. EMPIRICAL RESULTS

The descriptive statistics of the variables used in this study are shown in Table 3. Average VAIC value of the selected firms is 7.87. Mean values of HCE, SCE and CEE are 6.89, 0.78 and 0.19. among the intellectual capital components highest value belongs to HCE and lowest value belongs to CEE. Average ROA value of the sustainability firms is 8.93 and average ATR value of these firms is 1.14. Mean values of MV/BV and SIZE variables are 3.72 and 24.05, respectively.

Table 3: Descriptive statistics

Variable	N	Mean	Sd	P25	P50	P75
HCE	782	6.89	5.36	3.16	5.57	9.28
SCE	782	0.78	0.43	0.7	0.82	0.9
CEE	782	0.19	0.15	0.08	0.16	0.26
VAIC	782	7.87	5.51	4.08	6.61	10.39
ROA	782	8.93	12.05	2.32	6.59	13.52
ATR	782	1.14	0.93	0.57	0.86	1.42
ROCE	782	0.24	0.22	0.1	0.18	0.3
MV/BV	782	3.72	18.76	0.97	1.56	2.6
SIZE	782	24.05	1.57	23	23.99	24.88

Table 4 reports the Pesaran's CD test for cross sectional dependence for the variables used in the analyses. According to the test results all the variables have cross sectional dependence.

Table 4: Pesaran's CD test for cross sectional dependence

Variable	CD-Test	P-Value	Average Joint T	Mean P	Mean Abs(P)
HCE	25.625	0	23	0.23	0.34
SCE	17.509	0	23	0.15	0.29
CEE	69.998	0	23	0.62	0.62
VAIC	25.705	0	23	0.23	0.34
ROA	14.763	0	23	0.13	0.46
ATR	79.162	0	23	0.7	0.71
ROCE	37.776	0	23	0.33	0.55
MV/BV	34.423	0	23	0.3	0.38
SIZE	110.276	0	23	0.97	0.97

Table 5 shows the heteroskedasticity, autocorrelation and cross-sectional dependence of the each of the model used in this paper. According to modified walt test results the null is rejected for all the models and it is concluded that there is heteroskedasticity in each model. Since the Durbin- Watson and Baltagi-Wu LBI test results are below 2, there is autocorrelation issue in all of the models. Pesaran test results gives significant results for each of the model and therefore there is cross sectional dependence issue in the models. Since there are these 3 issued in the models, Driscoll Kraay standard errors are used in the regressions.

Table 5: Heteroskedasticity, autocorrelation, cross sectional dependence

	Modified Wald Testi	Durbin-Watson Testi	Baltagi-Wu LBI	Pesaran
1. Model	(10741.93)***	0.86	0.93	(6.38)***
2. Model	(11478.17)***	0.86	0.93	(6.11)***
3. Model	(32285.06)***	0.79	0.87	(8.28)***
4. Model	(13279.35)***	0.99	1.05	(17.96)***
5. Model	(13167.75)***	0.48	0.59	(3.89)***
6. Model	(13930.68)***	0.47	0.59	(3.75)***
7. Model	(16533.97)***	0.45	0.55	(8.72)***
8. Model	(10098.52)***	0.46	0.57	(9.51)***

Note: '***', shows %1 significance value.

Table 6 shows Hausman, Breusch Pagan and F Test results for each of the model. Null is rejected in the Breusch Pagan test and therefore random effect model is preferred to OLS. Secondly, according to the F test results fixed effect is preferred to OLS. Finally, the null of the Hausman test is rejected and it is concluded that fixed effect model is preferred to random effect model.

Table 6: Hausman, Breusch Pagan, F test

	Hausman Chi2(4)	Breusch Pagan	F Test
1. Model	(27.42)***	(1689.43)***	F(4,744) = (355.74)***
2. Model	(26.23)***	(1694.50)***	F(4,744) = (350.10)***
3. Model	(27.28)***	(1660.04)***	F(4,744) = (290.52)***
4. Model	(42.70)***	(941.05)***	F(4,744 = (335.26)***
5. Model	(30.67)***	(1110.04)***	F(4,744) = (201.43)***
6. Model	(30.13)***	(1111.42)***	F(4,744) = (199.81)***
7. Model	(14.70)***	(1042.45)***	F(4,74) = (156.95)***
8. Model	(230.66)***	(680.87)***	F(4,744) = (162.88)***

Note: '***', shows %1 significance value.

Table 7 shows the fixed effect regression results by using Driscoll Kraay standard errors. Dependent variable is ROCE in the regressions. In the first column, VAIC is the main independent variable. According to the regression results, as intellectual capital increases, ROCE of the sustainability firms increases. HCE and SCE are the main independent variables in the second and third models, respectively. Although an increase in HCE results in an increase in ROCE, SCE does not affect ROCE. Furthermore, in the fourth model CEE is the main independent variable and there is a positive relation between CEE and ROCE. Among the control variables ATR and MV/BV positively affect ROCE.

Table 7: The effect of intellectual capital on ROCE

		Independent Variables				Control Variables			
		1	2	3	4				
		VAIC	HCE	SCE	CEE	ATR	MV/BV	SIZE	Constant
Dependent Variable	ROCE	0,013*** [0,001]				0,213*** [0,006]	0,0004*** [0,0001]	0,012 [32,752]	-0,407* [0,202]
			0,013*** [0,001]			0,213*** [0,006]	0,0003*** [0,0001]	0,013 [0,008]	-0,400* [0,203]
				0,024 [0,015]		0,224*** [0,006]	0,0005*** [0,0001]	0,008 [0,010]	-0,235 [0,239]
					0,299*** [0,061]	0,210*** [0,006]	0,0004** [0,0001]	0,008 [0,010]	-0,258 [0,245]

Note: '***', '**', '*' show %1, %5 and %10 significance results. The numbers in paratheses are Driskoll Kraay standard errors.

In Table 8, ROA is used as a dependent variable. All of the intellectual capital components seem to positively influence ROA. In addition, ATR and SIZE have a positive relation with ROA. "The Resource Dependency (RD) Theory emphasizes the crucial role of human resources in enabling a firm to sustain enduring relationships with its stakeholders. Abeysekera (2010) suggests that, from this viewpoint, a firm can establish strong connections with its external environment when it possesses effective and efficient human resources, also known as human capital (Bansal and Singh, 2020: 74)." Therefore, a positive relation between human capital efficiency and financial performance is in line with this theory. According to the Organizational Learning (OL) Theory, Njuguna (2009) explained that organizational learning, as an ongoing process, enables a firm to gain new knowledge that drives innovation. This innovation can then be safeguarded by distinctive assets like patents and copyrights, collectively known as intellectual property. This intellectual property is accepted as structural capital and a positive impact of it on financial performance is expected (Bansal and Singh, 2020). Pulic (1998) argued that intellectual capital resources cannot function effectively without the support of physical and financial capital resources. For this reason, he developed the VAIC model, which integrates intellectual capital with physical resources. Physical capital is expected to be positively related with the financial performance.

Table 8: The effect of intellectual capital on ROA

		Independent Variables				Control Variables			
		5	6	7	8				
		VAIC	HCE	SCE	CEE	ATR	MV/BV	SIZE	Constant
Dependent Variable	ROA	0.816*** [0.181]				9.802*** [0.544]	-0.008 [0.009]	1.597*** [0.361]	-47.01*** [7.968]
			0.829*** [0,192]			9.801*** [0.561]	-0.008 [0,009]	1.618*** [0.348]	-46.818*** [7.740]
				1.375** [0.537]		10.514*** [0.765]	-0.0001 [0.007]	1.318*** [0.35]	-35.795*** [8.529]
					9.923*** [2.223]	10.024*** [0.646]	-0.005 [0.008]	1.33*** [0.429]	-36.35*** [10.097]

Note: '***', '**', '*' show %1, %5 and %10 significance results. The numbers in paratheses are Driskoll Kraay standard errors.

5. CONCLUSIONS

A few decades ago, companies relied more heavily on tangible assets like real estate and machinery. However, in today's economy, there's a growing emphasis on intangible assets. To stay competitive, companies need to closely monitor economic shifts and adapt their operations to meet market demands and capital maintenance needs. Establishing strong intangible assets is crucial for ensuring positive financial performance and long-term business sustainability (Bubik and Susak, 2015). Intellectual capital consists of intangible assets that enhance an organization's value and performance. Exploring the intellectual capital measurement and its influence on firm performance has been an important issue in academic committees.

This study explores the effect of intellectual capital on profitability of the BIST Sustainability Index firms. This study aimed to analyze how intellectual capital and its components affect the financial performance of companies listed on the BIST Sustainability Index from Q4 2018 to Q1 2024. To measure intellectual capital, the study uses the Value Added Intellectual Coefficient (VAIC) along with its components: Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE). Financial performance is assessed through two key indicators: Return on Assets (ROA) and Return on Capital Employed (ROCE). Additionally, the models incorporate control variables such as Market to Book Value (MV/BV), the logarithm of total assets (SIZE), and Asset Turnover (ATR). Fixed effect panel regressions are used in the analyses.

4 different intellectual capital proxies are used in different models. According to the empirical results, all of the mechanisms of intellectual capital impact profitability of the sample firms. To put it differently, the findings show that firms with high level of intangible assets ends up with higher firm performance. The findings are in line with the literature such as Kaya and Atasel (2022), Kandil Göker (2017) and Sakur and Güngör (2023). The more intangible assets a company possesses, the greater its capacity to generate profits. This leads to higher investor confidence, reflected in the company's large market capitalization, ultimately boosting the company's overall value (Qureshi and Siddiqui, 2020). These findings show that the investors consider the intellectual capital of the firms in their investment decisions. Thus, the importance of intellectual capital grows among the firms and more improvement should be done in this area by the managers. This finding also underscores the importance and durability of intellectual capital in building a competitive edge in a developing market.

Future research could aim at investigating this relation for different industries and for different countries. By doing this, comparative analyses might be done among different samples. Furthermore, additional financial performance and policy measures could be used by future research. Additionally, upcoming studies could include more control variables that influence financial performance of the sustainability firms.

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