Marketing and Management of Innovations, 2, 2023
ISSN 2218-4511 (print) ISSN 2227-6718 (online)

NEXUS BETWEEN INTELLECTUAL CAPITAL, FINANCIAL PERFORMANCE AND SUSTAINABLE GROWTH: EVIDENCE FROM THE TURKISH ICT INDUSTRY

Serhii Lehenchuk, **ORCID:** https://orcid.org/0000-0002-3975-1210
Professor, Zhytomyr Polytechnic State University, Ukraine
Emin Zeytinoglu, **ORCID:** https://orcid.org/0000-0002-4211-8985
Ph.D., Associate Professor, Kutahya Dumlupinar University, Turkey
Iryna Hrabchuk, **ORCID:** https://orcid.org/0000-0003-3664-7765
Ph.D., Associate Professor, Zhytomyr Polytechnic State University, Ukraine
Iryna Zhalinska, **ORCID:** https://orcid.org/0000-0003-1054-7803
Ph.D., Associate Professor, Zhytomyr Polytechnic State University, Ukraine
Zhanna Oleksich, **ORCID:** https://orcid.org/0000-0002-4486-974X
Ph.D., Sumy State University, Sumy, Ukraine
Corresponding author: Serhii Lehenchuk, legenchyk2014@gmail.com
Type of manuscript: research paper

Abstract: *The paper aims to measure, using the VAIC model, the impact of intellectual capital and its elements on the financial performance and sustainable growth of Turkish ICT companies listed on the Istanbul Stock Exchange (ISE). Panel data regression was used to analyse 31 Turkish ICT companies' activity for 2019-2022. To measure the relationships between financial performance, sustainable growth and its determinants, sixteen functional models were developed, the formation of which was based on the following types of used dependent variables – Return on Assets, Return on Equity, Return on Sales, Sustainable Growth Rate. Ten independent variables were used, such as VAIC, Modified VAIC, Capital Employed Efficiency, Human Capital Efficiency, Structural Capital Efficiency, Research and Development Capital Efficiency, Relational Capital Efficiency, Leverage, Size, and Dummy Variable for Subbranch. The findings expand the understanding of the importance of intellectual capital management in generating enterprise value and providing sustainable advantages by high-tech companies in the context of forming a knowledge-based economy. The regression analysis of the impact of VAIC and its structural components on Turkish ICT companies' financial performance and sustainable growth showed rather contradictory results. The most significant effects on the financial performance of Turkish ICT companies and sustainable development are Return on Assets – VAIC, Modified VAIC, Human Capital Efficiency, Research and Development Capital Efficiency, Leverage, Dummy Variable for Subbranch; Return on Equity – Human Capital Efficiency, Leverage; Return on Sales – Human Capital Efficiency, Leverage, Structural Capital Efficiency, Size; and Sustainable Growth Rate – Research and Development Capital Efficiency, Capital Employed Efficiency, Leverage. The expediency of increasing investments in the development of experience and professional skills of employees of Turkish ICT companies, as well as strengthening their innovative activities, which will ensure the growth of their profitability in the short term, have been substantiated.*
Keywords: intellectual capital, financial performance, VAIC, sustainable growth, ICT industry.
JEL Classification: G17, O34, O40.

Received: 14 December 2022 **Accepted:** 10 June 2023 **Published:** 30 June 2023

Funding: There is no funding for this research.
Publisher: Academic Research and Publishing UG, Germany.
Founder: Sumy State University and Academic Research and Publishing UG (i.G.), Germany.

Cite as: Lehenchuk, S., Zeytinoglu, E., Hrabchuk, I., Zhalinska, I., & Oleksich, Z. (2023). Nexus Between Intellectual Capital, Financial Performance and Sustainable Growth: Evidence from the Turkish ICT Industry. *Marketing and Management of Innovations*, 2, 152–162. https://doi.org/10.21272/mmi.2023.2-14

Introduction. The Turkish information and communication technology (ICT) industry is an example of one of the fastest-growing sectors, which plays an increasingly significant role in developing the country's economy. Therefore, ICT is supported by the state through the development and implementation of preferential lending systems, tax and investment incentives, increased public funding for high-tech projects and strategic innovation initiatives in terms of breakthrough technologies (System Integration, Internet of Things, Augmented Reality, Big Data, Autonomous Robots, Cyber Security, Cloud Computing, Blockchain, Artificial Intelligence, 5G etc.). In particular, Turkey is one of the European countries that has introduced a digital services tax of 7.5%, which requires some of the largest multinational companies in the world (sales of content and paid services in social networks, 750 million euros) to pay part of the income tax in the country where their customers are located.

According to research by representatives of the Informatics Industry Association (TÜBİSAD) (Turkey's ICT sector, 2022), the Turkish ICT industry grew by an average of 23% per year from 2017 to 2021, but in 2021 this figure was already 36%, indicating an increase in growth rates in this area. First, this was due to the depreciation of the Turkish lira, the strengthening of protectionist policies regarding IT enterprises' activities, and the active development of e-commerce services in the conditions of the aggravation of the effects of the COVID-19 pandemic.

According to analyst calculations (Mordor Intelligence, 2023), the Turkish ICT industry is expected to grow by 9.3% between 2023 and 2028 as software spending remains flat and cloud computing investment continues to grow in most regions of Turkey. In addition, the growth of the ICT industry is also driven by external factors, such as the growing demand for Internet and communication services and increased sales of computers and mobile digital platforms.

To form the necessary prerequisites for the further progressive development of Turkey's ICT industry, in addition to creating a favourable investment and tax climate by the state, the leaders of such companies need to pay attention to financial performance (FP) and sustainable growth (SG) management, directly to the analysis of factors affecting achieving their proper level.

According to a significant number of researchers (Chen et al., 2005; Berzkalne and Zelgalve, 2014; Ozkan et al., 2017), a decisive role in the activities of ICT enterprises related to knowledge-intensive industries is played by intellectual capital (IC), which ensures the creation of their value and acts as the main source of competitive advantages in the knowledge-based and creative economy. Therefore, studying the impact of IC on FP and SG will allow you to identify those areas of the company's activities that management should, first of all, pay attention to ensure sustainable and strategic value creation. In particular, an improved management system will help maintain and utilize IC to generate sustainable earnings.

Scientists have developed various methods, methodologies and tools for assessing IC. However, most of them are criticized because of the difficulty of collecting data for their application and complex calculation methodology, because of their uselessness for researchers who do not have access to an enterprise's internal data, and also because of the difficulty of interpreting and comparing the information obtained as a result of their application (Fijalkowska, 2014). Therefore, since almost no objects represent IC in the financial statements of firms today, it is necessary to use new methods for measuring it and analyzing its impact on FP and sustainable growth. This article proposes to use the Value Added Intellectual Coefficient (VAIC) and its extended modification – MVAIC, which allows analyzing the impact of IC in general and the influence of its elements (employed, human, structural, innovation, relational, technological capital) on FP and SG.

The article aims to measure the impact of IC and its elements on the FP and SG of Turkish ICT companies listed on the Istanbul Stock Exchange (ISE) using the VAIC model.

Literature Review. A significant number of scientific works are dedicated to the analysis of the influence of IC on the FP and SG of companies. It has become especially relevant with the transition of the economy to the post-industrial phase of its development and with the gradual establishment of intangibles as the main production factor and value-generation driver for enterprises, which is of paramount importance to enhancing firm performance (Berzkalne and Zelgalve, 2014; Dzenopoljac et al., 2016; Serpeninova et al. 2022, Xu and Li, 2022).

Many scholars have tried to develop methodologies for direct and indirect valuation of IC to determine its place and role in the assets of enterprises and in the value creation process, which has been analyzed in detail by Andriessen (2004), Zambon and Marzo (2007), and Hubbard (2014). One of the universal methods, now widely used by researchers for estimating the value of IC, is VAIC, developed by A. Pulic (Pulic, 2000; Pulic, 2004). The main advantages of using VAIC are the sufficient simplicity of calculation, the possibility of

information content using the data of an enterprise's financial statements and notes to it, and the possibility of its extension or modification based on adding new constituent elements.

Analysis of the Scopus database for the keywords «VAIC» and «financial performance» revealed 347 publications on this issue by scientists worldwide. Turkish researchers have used VAIC to analyze the relationship between IC and the FP measures of Turkish banks (Ozkan et al., 2017), real estate companies (Nassar, 2018b), production companies (Yilmaz and Acar, 2018), manufacturing firms (Bayraktaroglu et al., 2019), Turkish banks listed on ISE Index (BIST XBANK) (Arslan and Kizil, 2019), wholesale and retail trade companies (Nassar, 2019), companies included in the BIST index and listed on the ISE (Aybars and Oner, 2022). The results obtained by researchers on the example of various types of enterprises can be used to analyse the effect of IC utilisation on numerous sectors of the Turkish economy. In particular, they will help prioritize the impact of IC on the FP of various types of organizations.

Scientists from around the world explore the direct influence of the utilisation of IC, assessed using VAIC, on the FP of technology-intensive companies. For example, Shiu (2006) examined the impact of VAIC on the corporate FP of 80 Taiwanese technology companies on the 2003 annual report and found a significant positive effect on ROA (Return on Assets) and a negative impact on ATO (Asset Turnover Ratio). The results confirmed the ability of Taiwanese listed technology firms to transform IC into innovative products with high value-added.

Gan and Saleh (2008), based on a study of 89 Malaysian technology companies listed on Bursa Malaysia, found no clear impact of all VAIC elements on FP. VAIC has a significant positive effect on ROA and ATO but does not have such an impact on M/B (Market-to-Book Value).

Calisir et al. (2010) studied the annual reports of 14 Turkish ITC companies listed on the ISE for 2005–2007 and found that VAIC and HCE, compared to Size and Leverage, have the most significant impact on profitability (ROA). 41.4% of the productivity is due to Leverage, 31.2% ROE is due to Leverage and Size, and CEE and firm Leverage also predict productivity. The impact of IC on FP of Turkish IT companies was studied by Nassar (2018a), who analysed 14 ISE-listed companies. He found that HCE has the strongest positive relationship with ROE and EPS in the post-crisis period, while SCE positively affects ROA and ROE in the pre-crisis period. Since CEE does not affect FP in pre- and post-crisis periods, this indicates their dependence on IC. However, the author believes that Turkish IT companies are still poorly using their intellectual potential to create long-term value.

A group of researchers drew attention to the influence of VAIC on the FP of Indian ICT firms, given the development of this industry in India. So, Shaban and Kavida (2013), after analysing 22 IT-listed firms on the Bombay Stock Exchange (BSE) for 2003-2011, found that profitability (ROA) and VAIC are positively related, and CEE positively affects productivity (ATO) and market value (M/B). Alazzawi et al. (2018) studied the influence of IC components on the FP of 241 Indian IT-listed companies from BSE between 2011 and 2015. They found that HCE's impact is indirect and insignificant, but SCE, CEE and TC have a positive and significant effect on FP (ROA, GPM, ROE). Bansal and Singh (2020) studied the impact of VAIC on the FP of Indian software companies from 2013 to 2018 and found different results. In particular, VAIC, CEE and SCE contribute positively and significantly to ROA, while HCE capital has a negative association. The authors also proved that VAIC does not significantly impact company productivity (ATO), and the control variable Size has a significant negative impact on ROA and ATO. Shaneeb and Sumathy (2021), based on an analysis of 88 IT companies over the period 2009-2018, also confirmed the conclusions of other authors regarding the presence of mixed results on the impact of VAIC and its structural elements on FP. The authors found that HCE and SCE significantly positively impact ROA, and HCE, SCE and CEE have a substantial nexus with Sales Growth. Dzenopoljac et al. (2016) analysed almost 14000 ICT companies from Serbia in 2009-2013 and found that VAIC does not play a significant role for them. Only CEE has had a significant impact on ROA and ATO. Oner et al. (2021) analysed the relationship between VAIC and the FP of enterprises from 17 developing countries over the period 2009-2019 in the context of their technological intensity. The authors found that all VAIC components significantly positively impact the growth of ROA and ROE for enterprises in more technology-intensive sectors. Size has a significant positive effect on ROA only for technology-intensive companies, while Leverage has a significant negative impact on ROA for all types of enterprises.

Several researchers and FP measures use the Sustainable Growth Rate (SGR) as an indicator that characterizes the optimal financial prospects for developing companies. This indicator was first proposed by Higgins (1977) to reflect the ability of an enterprise to achieve its growth based on the use of internal resources without external borrowing. Based on this approach, the IC of an enterprise is one of the main hidden agenda for ensuring the sustainable development of ICT companies. Based on the management of the factors influencing SGR, particularly VAIC elements, it becomes possible to increase the effect of utilising available

intellectual assets to increase the profitability of enterprises. The greater the influence of such a factor on SGR, the more important its role in achieving sustainable growth. In particular, Xu and Wang (2018) identified the most significant impact of the relational capital (RC) on SGR grounded on an analysis of 390 manufacturing firms listed on the Korean Stock Exchange from 2012 to 2016. As a result, the authors proposed strengthening the level of customer interactions in enterprises to improve reputation and customer loyalty.

The literature analysis shows that many scientists emphasise the positive and significant impact of VAIC and its elements on the FP and SG of companies. However, some studies (Gan and Saleh, 2008; Shaban and Kavida, 2013; Dzenopoljac et al., 2016; Bansal and Singh, 2020; Shaneeb and Sumathy, 2021) did not find a significant positive relationship directly for all such elements. The reason for this is the specific features of the functioning of certain sectors of the Turkish economy and the institutional framework for developing the ICT industry in different countries.

Methodology and research methods. Panel data regression analysis (PDRA) was used to determine the impact of IC on the FP and SG of ICT companies. In particular, 31 Turkish ICT companies' performance indicators for 2019–2022 were analysed. Since information on some enterprises has not been available for several years, as a result of their inclusion in the ISE listing only in recent years, 99 observations were made in the article. The Public Disclosure Platform (KAP) was used as an information base to form the data panel for four years, which discloses verified financial information of the ISE-listed companies, as well as information from the financial statements (Balance Sheet, Income Statement) of Turkish ICT companies and notes to financial statements. Turkish ICT companies include two types of entities – information technology companies and defence companies.

Three dependent variables, such as Return on Assets (ROA), Return on Equity (ROE) and Return on Sales (ROS), were used to characterize the FP of ICT companies, which are very often used by scientists in such studies (Calisir et al., 2010; Alazzawi et al., 2018; Nassar, 2018a; Xu and Wang, 2018; Oner et al., 2021). Another dependent variable characterizing the SG of companies was chosen as the Sustainable Growth Rate (SGR), calculated as the product of the Net profit ratio, Asset turnover ratio, Retention rate and Equity multiplier (Xu and Wang, 2018).

VAIC, its constituent elements (types of efficiency), and additional elements proposed by scientists based on selecting other types of IC that make up the modified VAIC model, MVAIC, were chosen as dependent variables. In the classical sense proposed by Pulic (2000), VAIC includes three main elements (types of efficiency) based on the types of capital used by an enterprise, such as capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). The general procedure for calculating VAIC is as follows:

$$VAIC = CEE + HCE + SCE \quad (1)$$
$$CEE = VA/CE \quad (2)$$
$$HCE = VA/HC \quad (3)$$
$$SCE = SC/VA \quad (4)$$

where VA – is the sum of value added for the company; CE – capital employed, measured by the sum of a company's physical and financial money; HC – human capital, measured by salaries and wages of all employees of a company; SC – structural capital, measured by the difference of VA and HC.

In addition to the classical approach to VAIC structuring, several scientists (Alazzawi et al., 2018; Yilmaz and Acar, 2018; Xu and Wang, 2018; Aybars and Oner, 2022) proposed to supplement it with other elements by adding Research and Development Capital Efficiency (RDCE) and Relational Capital Efficiency (RCE). This concept, which transforms VAIC into MVAIC, was also used in this paper. Based on this approach, MVAIC is calculated as the sum of CEE, HCE, SCE, RDCE and RCE. RDCE and RCE are calculated as the sum of the relevant capital (Research and Development Capital, Relational Capital) divided by the Value of the Company's Equity. Research and Development Capital includes the costs of R&D carried out by a company during the year, and Relational Capital is the sum of the company's marketing and advertising costs.

They also used three control variables such as company Size (l_SIZE), Leverage (LEV) and Dummy variable for subbranch (DVS). The size of a company is calculated as the natural logarithm of its total assets (Lehenchuk and Zavalii, 2021). If the first two control variables are often used by scientists when analyzing the influence of IC elements on FP (Calisir et al., 2010; Nassar, 2018b; Lehenchuk et al., 2022; Aybars and

Oner, 2022), then the use of DVS is aimed at identifying the role of a subbranch in providing financial measures and SG for Turkish IT companies. Table 1 lists the variables, equations and abbreviations used in the paper.

Table 1. Summary of all variables, calculation methods and abbreviations used in the study

Variable	Method of Calculation	Abbreviation
Dependent Variables		
Return on Assets	Net turnover / Total Assets	ROA
Return on Equity	Net profit / Total Equity	ROE
Return on Sales	Earnings before interest and taxes / Net sales	ROS
Sustainable Growth Rate	Net profit ratio × Asset turnover ratio × Retention rate × Equity multiplier	SGR
Independent Variables (IC variables)		
Value Added Intellectual Coefficient	CEE + HCE + SCE	VAIC
Modified Value Added Intellectual Coefficient	CEE + HCE + SCE+ RDE+ RCE	MVAIC
Capital Employed Efficiency	Value added / Capital employed	CEE
Human Capital Efficiency	Value added / Human capital	HCE
Structural Capital Efficiency	Structural capital / Value added	SCE
Research and Development Capital efficiency	Research and development capital / Value of the Company's Equity	RDE
Relational Capital Efficiency	Relational capital / Value of the company's equity	RCE
Control Variables		
Leverage	(Total amount of Debts) / Total Assets	LEV
Size	Log of Total Assets	l_SIZE
Dummy Variable for Subbranch	1 for information technology, 0 for defence companies	DVS

Sources: developed by the authors.

To determine the impact of the VAIC and its elements on FP of Turkish ICT companies, two types of models were examined – PERF models (1.1-1.4) and SGR models (2.1-2.4):

Model 1.1: $PERFit = \alpha + \beta 1\, VAICit + \beta 2\, LEV + \beta 3\, l\_SIZEit + \beta 4\, DVSit + \varepsilon it$ (5)

Model 1.2: $PERFit = \alpha + \beta 1\, MVAICit + \beta 2\, LEV + \beta 3\, l\_SIZEit + \beta 4\, DVSit + \varepsilon it$ (6)

Model 1.3: $PERFit = \alpha + \beta 1\, CEE\ it + \beta 2\, HCEit + \beta 3\, SCE\ it + \beta 4\, LEV + \beta 5\, l\_SIZEit + \beta 6\, DVSit + \varepsilon i_t$ (7)

Model 1.4: $PERFit = \alpha + \beta 1\, CEE\ it + \beta 2\, HCEit + \beta 3\, SCE\ it + \beta 4\, RDE\ it + \beta 5\, RCE\ it + \beta 6\, LEV + \beta 7\, l\_SIZEit + \beta 8\, DVSit + \varepsilon it$ (8)

Model 2.1: $SGRit = \alpha + \beta 1\, VAICit + \beta 2\, LEV + \beta 3\, l\_SIZEit + \beta 4\, DVSit + \varepsilon it$ (9)

Model 2.2: $SGRit = \alpha + \beta 1\, MVAICit + \beta 2\, LEV + \beta 3\, l\_SIZEit + \beta 4\, DVSit + \varepsilon it$ (10)

Model 2.3: $SGRit = \alpha + \beta 1\, CEE\ it + \beta 2\, HCEit + \beta 3\, SCE\ it + \beta 4\, LEV + \beta 5\, l\_SIZEit + \beta 6\, DVSit + \varepsilon it$ (11)

Model 2.4: $SGRit = \alpha + \beta 1\, CEE\ it + \beta 2\, HCEit + \beta 3\, SCE\ it + \beta 4\, RDE\ it + \beta 5\, RCE\ it + \beta 6\, LEV + \beta 7\, l\_SIZEit + \beta 8\, DVSit + \varepsilon it$ (12)

where ROA, ROE, ROS and SGR are dependent variables; α – Identifier; β_n – Regression coefficients; CEE, HCE, SCE, RDE, RCE – independent variables, LEV, l_SIZE, DVS – control variables; i = entity and t = time; ε_{it} – error term.

Based on the assumption that the paper analyses the impact of VAIC and its elements on three financial measures (ROA, ROE and ROS), 12 direct models were built based on the first type of model, which will be analysed. Four more models were formed to measure the impact of VAIC and its elements on SGR.

Results. Table 2 provides descriptive statistics for all variables from 16 analysed models. Based on descriptive statistics values for 31 companies over five years (Table 2), it can be determined that unlike the independent variables ROA and SGR, which have minor deviations between the minimum and maximum values, ROE and ROS have significant variations. It is because the activities of some enterprises (Netaş Telekomünikasyon A.Ş., Escort Teknoloji Yatirim A.Ş.) have been unprofitable in recent years, which

negatively affected the values of these dependent variables. Since all the mean values of the dependent variables are positive, this indicates that most of the surveyed enterprises have positive FP measures.

Table 2. Descriptive statistics for observations: 1:1 – 31:4

Variables	Mean	Median	Minimum	Maximum	St. Dev.
ROA	0.208	0.170	-0.261	0.602	0.149
ROE	0.0172	0.219	-18.9	0.686	1.94
ROS	8.39	0.173	-14.2	532.	57.5
SGR	0.305	0.0660	-0.448	2.79	0.611
VAIC	4.69	4.31	-29.0	24.6	5.97
MVAIC	4.21	4.23	-29.0	25.4	5.81
CEE	0.553	0.373	-7.42	21.9	2.32
HCE	3.63	3.04	-29.8	18.9	5.30
SCE	0.579	0.711	-2.01	1.98	0.517
RDE	0.0571	0.0115	0.00	0.415	0.0919
RCE	0.135	0.116	-0.416	0.730	0.163
LEV	0.439	0.433	0.0149	0.996	0.248
l_SIZE	19.9	19.7	17.1	22.9	1.46

Source: developed by the authors.

Analysing the multicollinearity problem between the independent variables made it possible to establish that regression models are freer from multicollinearity. At the same time, its existence was revealed for LEV and l_SIZE (0.7), VAIC and MVAIC (1.0), and VAIC and HCE (0.9). The high level of multicollinearity for the last two pairs of independent variables is explained by the direct relationship between these indicators since one of the variables is a component of the others. Such independent variables are not used simultaneously in the same models. Regarding the high level of multicollinearity between LEV and l_SIZE, the use of PDRA helps reduce the multicollinearity problem. However, when found in individual models, such variables will be excluded from their composition during calculations due to the settings implemented in the GRETL software.

The feasibility of using the Pooled ordinary least squares regression method (Pooled OLS) as a panel data estimate parameter was determined based on the application of the F-statistics test. Its use will ensure that the models correlate adequately with the data used. Three classical assumptions, such as normality, autocorrelation and heteroscedasticity, were used to test the adequacy of panel data from an investigated sample. As a result of the normality test, a normal distribution of residuals was found only for models 1.1 ROS and 1.4 ROA. As a result of the Wooldridge test application, an autocorrelation was found for the following models: 1.1 ROA, 1.2 ROA, 1.3 ROA, 1.4 ROE, 2.1 SGR, 2.2 SGR and 2.4 SGR. Based on the use of the Wald tests, heteroscedasticity was confirmed for models 1.1 ROE, 1.2 ROE, 1.3 ROA, 1.3 ROE, 1.3 ROS, 1.4 ROA and 1.4 ROE. To eliminate the identified heteroscedasticity, it is proposed to use the Pooled OLS method for PDRA, corrected for robust standard errors (RSE) (Oner et al., 2021; Serpeninova et al., 2022). Table 3 discloses the results of applying PDRA for 14 proposed functional models (p-value and significance level), combined into two groups – PERF and SGR models. These results allow you to determine which of the independent variables have the most significant effect on the dependent variable of each model (ROA, ROE, ROS and SGR), as well as the strength and direction of such influence.

The analysis of the impact of VAIC, MVAIC and its components on the FP and SG of Turkish ICT companies revealed that such an impact is heterogeneous. This requires providing different types of advice and using various tools to improve the IC management processes of ICT companies.

In general, VAIC and MVAIC have a significant positive effect (at the 1% level) (marked *** in Table 3) only on ROA, without significantly affecting ROE and ROS. In addition, l_SIZE has a significant positive impact on ROS with a probability of 10%, indicating that Turkish ICT consolidation is worthwhile to improve this FP measure. Other control variables negatively affect various FP measures. Thus, a company's affiliation with a subbranch (DVS) significantly negatively impacts ROA (at the level of 5%), which is confirmed for models 1.1 ROA and 1.2 ROA. The negative impact of LEV on ROS, with a significance of 1%, indicates the inexpediency of attracting borrowed capital by companies.

Table 3. Analysed PERF models (1.1-1.4) and SGR models (2.1-2.4). OLS, using the observations: 1-99

Variables	Models								
	1.1			1.2			1.3		
	ROA	ROE (RSE)	ROS	ROA	ROE (RSE)	ROS	ROA (RSE)	ROE (RSE)	ROS (RSE)
Const	0.0071***	0.9817	0.1531	0.0072***	0.9972	0.1529	0.0355**	0.6134	0.0814*
VAIC	1.10e-06***	0.2836	0.4300						
MVAIC				7.23e-07***	0.2852	0.4097			
CEE							0.2416	0.4412	0.1350
HCE							8.21e-07***	0.1911	0.3280
SCE							0.8954	0.2967	0.1185
RDE									
RCE									
LEV	0.2281	0.1731	0.0043***	0.2170	0.1733	0.0044***	0.3141	0.1439	0.0660*
l_SIZE	0.1028	0.6665	0.0739*	0.1030	0.5547	0.0737*	0.1660	0.3494	0.0713*
DVS	0.0411**	0.2836	0.5431	0.0410**	0.6793	0.5395	0.1486	0.3722	0.5466
R-squared	0.275232	0.141744	0.097939	0.281407	0.142816	0.09849	0.285422	0.225051	0.245307

	1.4			2.1	2.2	2.3	2.4
	ROA (RSE)	ROE(RSE)	ROS	SGR	SGR	SGR	SGR
Const	0.1722	0.3263	0.2540	0.1125	0.1106	0.0802*	0.4950
VAIC				0.4296			
MVAIC					0.3729		
CEE	0.9431	0.2585	0.5479			0.3884	0.0034***
HCE	5.15e-09***	0.0607*	0.0506*			0.3341	0.1792
SCE	0.5879	0.8555	0.0002***			0.1583	0.2410
RDE	0.0012***	0.0670*	0.4213				1.26e-010***
RCE	0.9702	0.1429	0.9899				0.1780
LEV	0.0191**	0.0705*	0.0055***	0.7866	0.7781	0.9154	0.0860*
l_SIZE	0.5100	0.5013	0.1515	0.2432	0.2406	0.1808	0.6440
DVS	0.3602	0.3053	0.8531	0.3130	0.3019	0.1851	0.6991
R-squared	0.489600	0.452820	0.250781	0.045493	0.047228	0.082120	0.435617

Source: developed by the authors.

Among the components of IC, HCE has the most significant positive impact on ROA, with a significance at the 1% level, which is confirmed for models 1.3 ROA (RSE) and 1.4 ROA (RSE). A similar positive relationship, but with a significance of 10%, was also found between HCE and ROE. At the same time, HCE has a negative and significant effect on ROS at 10%. The results prove the need for the priority implementation of a system of management policies and measures to develop and preserve human capital and increase its quality level, which will improve the FP (ROA and ROE) of Turkish ICT companies.

Using the MVAIC structural concept made it possible to establish that RDE also affects ROA and ROE, but with a different level of significance – at 1% and 10%, respectively. And if this effect is positive for ROA, then it is negative for ROE. This indicates the need to expand the innovative activities of ICT companies, pay more attention to this activity on the part of management, and attract more employees to develop and implement promising creative projects. The negative impact of RDE on ROE points to the need to improve the efficiency of investment in R&D. The presence of a significant positive influence of SCE and ROS at the level of 1% was also revealed. When using MVAIC, a significant negative impact of LEV on all FP measures (ROA, ROE and ROS) was also found, which confirms the inappropriate use of borrowed funds to finance the activities of Turkish ICT companies.

The analysis of the impact of CEE on various FP measures of Turkish ICT companies allowed the establishment of its complete absence. This generally confirms the priority role of IC in improving these indicators and necessitates the development of effective mechanisms for its growth and preservation based on the identified strength and directions of influence of independent variables.

Regression analysis results show that VAIC and MVAIC do not have a significant relationship with SGR, which generally indicates a minor role of IC in ensuring the sustainability of Turkish ICT companies. Analysis of the influence of MVAIC components and control variables on SGR revealed the presence of a significant impact of CEE, RDE and LEV with different significance levels. If CEE and LEV negatively affect SGR with significance at the 1% and 10% levels, respectively, then RDE has a significant positive effect at the 1% level. These results prove the need for research and development by ICT companies to ensure sustainability in the context of knowledge economy development. The negative impact of CEE and LEV indicates ICT companies'

inefficient use of assets and the inexpediency of attracting loans for their further development, necessitating the search for internal financing tools.

Conclusions. The paper aims to use the VAIC model to measure the impact of IC and its elements on the FP and SG of Turkish ICT companies listed on the ISE. The findings expand the understanding of the importance of the management of IC and its components in generating enterprise value and providing sustainable advantages by high-tech companies in the context of forming a knowledge-based economy. As a result of the PDRA of the impact of VAIC and MVAIC models on the FP and SG of Turkish ICT companies, rather contradictory results were obtained. Unlike the conclusions of Gan and Saleh (2008) and Janosevic and Bontis (2016), who noted the existence of a significant dependence of technology-intensive firms on physical capital efficiency, VAIC, MVAIC and their elements have a significant positive impact on the ROA of Turkish ICT companies. The results obtained are in line with Shaban and Kavida (2013), Nassar (2018a), Bansal and Singh (2020), Shaneeb and Sumathy (2021). Based on the assumption that and Oner et al. (2021), who identified a positive relationship between IC and measures of profitability. Such changes in relation to IC in recent years are primarily justified by its growing role in generating value for companies. The lack of impact of VAIC and MVAIC on ROE and ROS for Turkish ICT companies found in this paper correlates with the findings of Calisir et al. (2010). Among all VAIC components, the most significant positive effect on ROA was found for HCE, confirming the findings of Calisir et al. (2010), Shaban and Kavida (2013), Nassar (2018a), and Shaneeb and Sumathy (2021). These findings show that the experience and advanced skills of employees of Turkish ICT companies play an important role in ensuring their profitability. At the same time, such results contradict the study by Bansal and Singh (2020), which found a negative association between HCE and ROA, and the work of Alazzawi et al. (2018), who found no such significant effect.

In contrast to the results of Nassar (2018a), Bansal and Singh (2020), and Alazzawi et al. (2018), who found a positive and significant impact of SCE on ROA and ROE, this paper did not find a significant relationship between such variables. A similar situation is observed concerning the effect of CCE on FP. Suppose Calisir et al. (2010), Dzenopoljac, Janosevic and Bontis (2016), Alazzawi et al. (2018), and Bansal and Singh (2020) found a positive and significant effect of CEE on ROA and ROE. In that case, such an influence is not confirmed at all in this work. The results confirm the findings of Nassar (2018a) and can be justified by the fact that most Turkish ICT companies provide services, so the performance of capital assets is not so important to them. The results regarding the significant positive effect of RDE on ROA and SGR partially contradict the findings of Alazzawi et al. (2018), who found that technological assets (capital) indirectly impact a firm's FP. Thus, the results of this study once again confirm the authors' position regarding the need to increase investment in innovations of Turkish ICT companies, particularly through state support. The existing positive influence of RDE on SGR indicates that R&D costs incurred help improve the profitability of Turkish ICT companies in the short term.

Thus, for elements of IC, the following most significant effects on FP measures were found: HCE has a positive impact on ROA and ROE and a negative effect on ROS; RDE has a positive impact on ROA and a negative effect on ROE; LEV negatively affects ROA, ROE and ROS; DVS negatively affects ROA; SCE has a positive effect on ROS. It has been established that CEE does not significantly impact any of the FP measures, which generally confirms the priority role of IC in ensuring the financial efficiency of Turkish ICT companies. VAIC and MVAIC are not significantly related to SGR, but RDE has a significant positive effect on SGR, while CEE and LEV have a negative impact. This study has some limitations. First, the study used data from Turkish ICT companies listed on the ISE from 2019 to 2022. However, some companies were included in the listing only in recent years, so the analysis did not consider part of the data on their activities. Secondly, three dependent variables (ROA, ROE and ROS) were used to analyze the impact of IC on FP, and only one SGR variable was used to characterize sustainable growth. Other studies may expand the range of such dependent variables, providing more accurate and conclusive results. Thirdly, this study did not consider the possibility of the influence of individual elements of the VAIC and MVAIC models in periods other than those in which the costs of their creation were incurred, which may become one of the directions for future research.

Author Contributions: conceptualization: S. L. and E. Z.; data curation: I. G., Z. O. and I. Z.; formal analysis: I. G., Z. O. and I. Z.; funding acquisition E. Z., Z. O. and I. Z.; investigation: I. G., Z. O. and I. Z.; Methodology: E. Z.; project administration: S. L.; resources: I. G., Z. O. and I. Z.; software: I. Z.; supervision: E. Z.; validation: E. Z.; visualization: I. G., Z. O. and I. Z.; writing – original draft: S. L., E. Z., I. G., Z. O., and I. Z.; writing – reviewing & editing: S. L., E. Z., I. G., Z. O. and I. Z.

Conflicts of Interest: Authors declare no conflict of interest.

Data Availability Statement: The Public Disclosure Platform (KAP) was used as an information base to form the data panel: https://www.kap.org.tr/en/.

Informed Consent Statement: Not applicable.

References

Alazzawi, A., Upadhyaya, M., El-Shishini, H., & Alkubaisi, M. (2018). Technological capital and firm financial performance: Quantitative investigation on intellectual capital efficiency coefficient. *Academy of Accounting and Financial Studies Journal*, *22*(2), 1-10. [Google Scholar]

Andriessen, D. (2004). *Making Sense of Intellectual Capital Designing a Method for the Valuation of Intangibles*. Elsevier. [Google Scholar]

Arslan, M.L., & Kizil, C. (2019). Measuring Intellectual Capital of Turkish Banks Listed on the Borsa Istanbul Banking Index (BIST XBANK) with the Market Value / Book Value Method and Value Added Intellectual Coefficient (VAIC) Model. *Emerging Markets Journal*, *9*(1), 101-116. [Google Scholar] [CrossRef]

Aybars, A., & Oner, M. (2022). The impact of intellectual capital on firm performance and value: An application of MVAIC on firms listed in Borsa Istanbul. *Gazi İktisat ve İşletme Dergisi*, *8*(1), 47-60. [Google Scholar] [CrossRef]

Bansal, D., & Singh, S. (2020). Impact of intellectual capital on the financial performance of the Indian software sector. *Asia-Pacific Management Accounting Journal*, *15*(1), 67-95. [CrossRef]

Bayraktaroglu, A.E., Calisir, F., & Baskak, M. (2019). Intellectual capital and firm performance: an extended VAIC model. *Journal of Intellectual Capital*, *20*(3), 406-425. [Google Scholar] [CrossRef]

Berzkalne, I., & Zelgalve E. (2014). Intellectual capital and company value. *Procedia – Social and Behavioral Sciences*, 110. 887-896. [Google Scholar] [CrossRef]

Calisir, F., Gumussoy, C.A., Bayraktaroğlu, A.E., & Deniz, E. (2010). Intellectual capital in the quoted Turkish ITC sector. *Journal of Intellectual Capital*, *11*(4), 538-554. [Google Scholar] [CrossRef]

Chen, M.-Ch., Cheng, Sh.-J., & Hwang, Yu. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of Intellectual Capital*, *6*(2), 159-176. [Google Scholar] [CrossRef]

Dzenopoljac, V., Janosevic, S., & Bontis, N. (2016). Intellectual capital and financial performance in the Serbian ICT industry. *Journal of Intellectual Capital*, *17*(2), 373-396. [Google Scholar] [CrossRef]

Fijalkowska, J. (2014). Value Added Intellectual Coefficient (VAIC™) as a Tool of Performance Measurement. *Przedsiębiorczość i Zarządanie, XV*(1), 129-140. [Google Scholar] [CrossRef]

Gan, K., & Saleh, Z. (2008). Intellectual Capital and Corporate Performance of Technology-Intensive Companies: Malaysia Evidence. *Asian Journal of Business and Accounting*, *1*(1), 113-130. [Google Scholar]

Higgins, R.C. (1977). How Much Growth Can a Firm Afford? *Financial Management*, *6*(3), 7-16. [Google Scholar] [CrossRef]

Hubbard, D.W. (2014). *How to Measure Anything. Finding the Value of "Intangibles in Business"* (3rd ed). Wiley. [Google Scholar]

Hurriyet Daily News. (2022). *Turkey's ICT sector grew 36 percent last year*. Retrieved from [Link]

Lehenchuk, S., & Zavalii, T. (2021). The impact of customer capital on company's market value: An empirical study from 100 U.S. stock market leaders. *International Journal of Management and Economics*, *57*(4), 299-312. [Google Scholar] [CrossRef]

Lehenchuk, S., Tumpach, M., Vyhivska, I., Makarovych, V., & Laichuk, S. (2022). The Impact of Innovationon the Profitability of Slovak Pharmaceutical Companies. *Marketing and Management of Innovations*, *2*, 284-296. [Google Scholar] [CrossRef]

Mordor Intelligence. (2023). *Turkey ICT market - growth, trends, Covid-19 impact, and forecasts (2023 - 2028)*. Retrieved from [Link]

Nassar, S. (2018a). The Impact of Intellectual Capital on Corporate Performance of IT Companies: Evidence from Bursa Istanbul. *Journal of Accounting and Applied Business Research, 1*(3). [Google Sholar] [CrossRef]

Nassar, S. (2018b). The Impact of Intellectual Capital on Firm Performance of the Turkish Real Estate Companies Before and After the Crisis. *European Scientific Journal, 14*(1), 29-45. [Google Scholar] [CrossRef]

Nassar, S. (2019). The Influence of Intellectual Capital on Corporate Performance of the Turkish Wholesale and Retail Trade Companies. *IUG Journal of Economics and Business, 27*(3), 1-14. [Google Scholar] [CrossRef]

Oner, M., Aybars, A., Çinko, M., & Avci, E. (2021). Intellectual Capital, Technological Intensity and Firm Performance: The Case of Emerging Countries. *Scientific Annals of Economics and Business, 68*(4), 459-479. [Google Scholar] [CrossRef]

Ozkan, N., Cakan, S., & Kayacan, M. (2017). Intellectual capital and financial performance: A study of the Turkish Banking Sector. *Borsa Istanbul Review, 17*(3), 190-198. [Google Scholar] [CrossRef]

Pulic, A. (2000). VAIC™ – an accounting tool for IC management. *International Journal of Technology Management, 20*(5-8), 702-714. [Google Scholar] [CrossRef]

Pulic, A. (2004). Intellectual capital – does it create or destroy value? *Measuring Business Excellence, 8*(1), 62-68. [Google Scholar] [CrossRef]

Serpeninova, Yu., Lehenchuk, S., Mateasova M., Ostapchuk T., & Polishchuk I. (2022). Impact of intellectual capital on profitability: Evidence from software development companies in the Slovak Republic. *Problems and Perspectives in Management, 20*(2), 411-425. [Google Scholar] [CrossRef]

Shaban, M., & Kavida, V. (2013). Intellectual Capital, Financial Performance and Market Valuation: An Empirical Investigation of Information Technology Industry in India. *Asia-Pacific Journal of Management Research and Innovation, 9*(1), 55-62. [Google Scholar] [CrossRef]

Shaneeb, P., & Sumathy, M. (2021). Impact of Intellectual Capital on Firm Performance in Indian It Companies. *Journal of Contemporary Issues in Business and Government, 27*(2), 4335-4340. Retrieved from [Link]

Shiu, H.-J. (2006). The Application of the Value Added Intellectual Coefficient to Measure Corporate Performance: Evidence from Technological Firms. *International Journal of Management, 23*(2), 356-365. [Google Scholar]

Xu, J., & Li, J. (2022). The interrelationship between intellectual capital and firm performance: evidence from China's manufacturing sector. *Journal of Intellectual Capital, 23*(2), 313-341. [Google Scholar] [CrossRef]

Xu, J., & Wang, B. (2018). Intellectual Capital, Financial Performance and Companies' Sustainable Growth: Evidence from the Korean Manufacturing Industry. *Sustainability, 10*, 4651. [Google Scholar] [CrossRef]

Yilmaz, I., & Acar, G. (2018). The Effects of Intellectual Capital on Financial Performance and Market Value: Evidence from Turkey. *Eurasian Journal of Business and Economics*, *11*(21), 117-133. [Google Scholar] [CrossRef]

Zambon, S., & Marzo, G. (Ed.). (2007). *Visualising Intangibles: Measuring and Reporting in the Knowledge Economy* (*268 p.). Farnham:* Ashgate Publishing, Ltd. [Google Scholar]

Сергій Легенчук, д.е.н., Державний університет «Житомирська політехніка», Україна
Емін Зейтіноглу, Ph.D., Університет Кютахья Думлупінар, Туреччина
Ірина Грабчук, к.е.н., Державний університет «Житомирська політехніка», Україна
Ірина Жалінська, к.е.н., Державний університет «Житомирська політехніка», Україна
Жанна Олексіч, к.е.н., Сумський державний університет, Україна

Зв'язок між інтелектуальним капіталом, фінансовою результативністю та сталим розвитком: докази турецької галузі ІКТ

Мета статті полягає в тому, щоб за допомогою моделі VAIC виміряти вплив інтелектуального капіталу та його елементів на фінансові показники та стале зростання турецьких ІКТ-компаній, зареєстрованих на Стамбульській фондовій біржі (ISE). Регресія панельних даних була використана для аналізу діяльності 31 турецької ІКТ-компанії за період 2019-2022 рр. Для вимірювання взаємозв'язків між фінансовою ефективністю, стійким зростанням та його детермінантами розроблено шістнадцять функціональних моделей, формування яких базувалося на наступних типах використаних залежних змінних – рентабельність активів, рентабельність власного капіталу, рентабельність продажів, темпи сталого зростання. Було використано десять незалежних змінних, таких як VAIC, модифікований VAIC, ефективність залученого капіталу, ефективність людського капіталу, ефективність структурного капіталу, ефективність капіталу досліджень і розробок, ефективність реляційного капіталу, кредитне плече, розмір, фіктивна змінна для підгалузі. Отримані результати розширюють розуміння важливості управління інтелектуальним капіталом у створенні вартості підприємства та забезпеченні стійких переваг високотехнологічних компаній у контексті формування економіки, заснованої на знаннях.

Проведений регресійний аналіз впливу VAIC та його структурних компонентів на фінансові показники та стале зростання турецьких ІКТ-компаній показав досить суперечливі результати. Найбільш суттєвими впливами на фінансові показники турецьких ІКТ-компаній та сталий розвиток є: рентабельність активів – VAIC, модифікований VAIC, ефективність людського капіталу, ефективність капіталу досліджень і розробок, кредитне плече, фіктивна змінна для підгалузі; Рентабельність власного капіталу – ефективність людського капіталу, кредитне плече; Рентабельність продажів – ефективність людського капіталу, кредитне плече, ефективність структурного капіталу, розмір; і темпи сталого зростання – Ефективність капіталу в дослідженнях і розробках, Ефективність використання капіталу, леверидж. Обґрунтовано доцільність збільшення інвестицій в розвиток досвіду та професійних навичок працівників турецьких ІКТ-компаній, а також посилення їх інноваційної діяльності, що забезпечуватиме зростання їх прибутковості в короткостроковій перспективі.

Ключові слова: інтелектуальний капітал, інтелектуальний коефіцієнт доданої вартості, фінансові показники, сталий розвиток, галузь ІКТ.