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INTELLECTUAL CAPITAL, EXPORT PERFORMANCE, SUSTAINABLE PRODUCTION: ANALYSIS ON LEADING TURKISH EXPORTERS

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Abstract

Sustainable production reguires both domestic and foreign production along with technology and intellectual capital. Sustainable production and improving export performance have bidirectional relationship. Factors that improves the export performance may enable sustainable production. Achieving a sustainable production reguires high export volumes. Intellectual capital may one of the factors that may create value-added products and affect export performance. Intellectual capital or "brain-power" shows how important knowledge creation throughout the intengible assets, and creating value in order to reach firms strategic objectives.

This study aims to analyze the impact of intellectual capital on export performance, thus sustainable production, for leading exporters in a developing country, Turkiye. There are various methods along with a few studies evaluating the relationship between intellectual capital and export performance. It is observed that higher levels of intellectual capital are associated with superior export performance. Thus, it emphasizes the critical role of intellectual capital in enhancing value added creation, export performance and sustainable production. Based on the findings, the existence of a positive relationship between intellectual capital and export performance, thus sustainable production can provide guidance to exporters and policymakers.

Keywords: İntellectual Capital, export performance, sustainable production

Introduction

Intellectual capital encompasses the company's all intangible assets which can be utilized to provide competitive advantage. There are three classifications of intangible assets: internal structure, external structure, and human competence. Intelectual capital is the origin of future value or benefits, which arise from innovation, distinctive organizational designs, or effective human resource practices.

Intellectual capital has three elements which are: Human capital, structural capital and customer capital. Human capital is the experience, skills and knowhow of employees and managers to create tangible value or surve customers (Edvinsson, 1997). Structural capital consist intellectual property assets (patents, property rights, design rights, trade secrets, logos) and tangible/infrastructre assets such as management philosophy, organization culture, management processes, information systems, network systems and financial relationships(Sullivan, 1999; Aslanoğlu and Zor, 2006). Customer capital is the external enviroment of a firm which can generate value including brands, customer loyalty, distribution channels, business collaborations, licensing agreements (Gutheri, 2001, 35).

Sustainable production requires both domestic and foreign production along with intellectual capital and technology. Understanding the influence of intellectual capital on export performance can help business to obtain a competitive advantage in international markets. This paper aims to investigate the impact of intellectual capital on the export performance of Turkey's leading exporters. The primary goal is to explore how Turkish firms can enhance their export performance and contribute to foreign trade surplus and thus economic stability. The study focuses on four major Turkish exporters: Ford, Vestel, Arçelik, and Tofaş, which are among Turkey's top 10 exporters. The analysis covers data from 2011 to 2022, derived from annual reports and financial statements of these firms.

In the related literatüre, there are many studies analyzed the impact of intellectual capital/intangible asssets/value added on firms performance/valuation/financial performance (Firer and Willams, 2003; Wang and Chang, 2005; Kayalı et al., 2007; Karacaer and Aygün, 2009; Phusavat et al., 2011; Clarke et al., 2011; Kendirli and Diker, 2015; Gürkan et al., 2015; Xu and Wang, 2019; Genç, 2020; Yiğit,2021). However, a few studies have investigated the relationship between intellectual capital and export performance (Zerenler et al., 2008; Pucar, 2012; Janosevic and Dženopoljac, 2012; Shaban and Kavida, 2019).

Literature review

The impact of intellectual capital or intangible asssets on firms performance or valuation is studied vastly. *Firer and Willams(2003)* have conducted a study to determine how efficiency of value added effected by firm's base resources such as; physical capital, human capital and structural capital. Their database includes 75 publicly traded South African firms from the business sector that rely intensly on intellectual capital. The results show that restricted and inconsistent relationships exist between firms performence indicators and the effectiveness of value added by a firm's key resource bases. Physical capital is still the most significant primary resource of business success in South Africa. In a study conducted by *Wang and Chang (2005),* the relationship between intellectual capital and firm performance of listed companies on the Taiwan Stock Exchange was analyzed using panel data analysis for the period from 2001-2007. The results revealed that there is no significant relationship between structural capital and firm performance. It was observed that the customer capital variable had a positive effect on return on assets, a negative effect on market value and efficiency. The inclusion of human capital as the final component of intellectual capital in the study showed a positive impact on all performance indicators.

Kayalı et al. (2007) researched the impact of intellectual capital on firm valuation. 9 technology firms traded in the Istanbul Stock Exchange (in 2005) were selected. Only human capital is found to be positively effect the technology firms in Turkiye. As the cost of capital increases, the effect of human capital decreases. *Karacaer and Aygün (2009)* have investigated the relationship between intellectual capital and firm performence for 50 firms traded in Istanbul Stock Exchange in 2007. They found a positive relationship between VAIC components and ROA. There is no significant relationship have been found between MB and components of VAIC. *Phusavat et al.(2011)* researched the effect of intangible assets on firm performance of 100 manufacturing firms traded in Thailand stock exchange market fort he period 2006-2009. Findings show that intellectual capital improves the performence of manufacturing firms and increases their long term competitive advantage.

In their study, *Clarke et al. (2011)* examined the relationship between intellectual capital and financial performance of 2161 firms operating in 10 different sectors listed in the Australian stock market for the period 2003-2008. The findings shows that VAIC and its components, human capital efficiency and capital employed efficiency, had a positive and significant correlation with performance criteria. On the other hand, structural capital efficiency showed a negative and significant relationship. *Kendirli and Diker (2015)* researched the effect of the intellecual capital on 12 technology firms performance fort he period 2008-2012. They take return on assets(ROA), Tobins'q value, assets turnover ratio(ATO) and return on equity(ROE) as dependent variables while taking components of VAIC as independent variables. There is a positive relationship between ROE and ROA dependent variables and capital employed efficiency and human capital efficiency.

Gürkan et al. (2015) have conducted a study about the impact of the components of intellecutal value added coefficent on 24 firms performance in Borsa İstanbul for the period 2008-2013. All of the components of VAIC are being found statistically significant with market to book value. In a study conducted by *Xu and Wang (2019),* the impact of intellectual capital and its components on firm performance in textile industry in China and South Korea was investigated for the period 2012-2017. The findings revealed that intellectual capital had a positive influence on the earnings, profitability and efficiency of firms. In terms of the analysis of the sub-components of intellectual capital, it was observed that the most significant components for firms in China were, in order, employed capital, structural capital, and relational capital. On the other hand, for South Korean textile firms, the key components of intellectual capital were found to be employed capital and human capital, while the impact of relational capital was relatively lower.

Genç (2020) studied the relationship between components of intellectual capital and performance indicators of a firm in chemical industry traded in Borsa İstanbul for the period 2009-2016. He selected ROA, ATO, growth, productivity and economic value added as dependent variables while VAIC and its componenets were selected as indepenedent variables on his study. He shows that structural captail efficiency is not significant with any of the dependent variables tested. However, other three independent variables which are HCE, CEE and VAIC have found to be in significant relationship with ROE, ATO and productivity. There is also no significant relationship between growth and any independent variables.

Yiğit (2021) investigated the relationship between intellectual capital and firm performance for "fragile five" countries. Firms were selected from manufacturing sector traded in stock markets fort he period 2010-2020. He selected ROA, ROE and ATO as a financial indicator. CEE is found to be significant in all countries with all independent variables. While the dependent variable is ROA, HCE is significant with all four countries except South Africa. When ROE is dependent variable, Only India and Turkey do have a statistically significant relationship with ROE. When the dependent variable is ATO, HCE has a statistically significant effect only in Brazil and India. On the other hand, SCE is statistically significant only in India when

ATO is used as the dependent variable. When ROE and ROA are used as as dependent variable, SCE is statistically significant with all countries.

However, a few studies have investigated the relationship between intellectual capital and export performance. *Zerenler et al.(2008)* examined how the intellectual capital of the Turkish automotive supplier industry affects its innovation performance. They conducted a correlation analysis between innovation performance and three types of intelectual employee capital, structural capital and customer capital. The findings indicated that there was a strong and positive correlation between three forms of intellectual capital namely and innovation performance. One of the most important study is by *Pucar(2012)* who analyzed the impact of intellectual capital on export performance of 34 firms located in Bosnia and Herzegovina between 2004-2007. The growth of exports per worker was chosen as the dependent variable to evaluate export performance. There is a favorable impact of the value added intellectual coefficient and its elements on the growth of exports within the food and beverages sector, furniture manufacturing sector and wood products sector.

Janosevic and Dženopoljac (2012) researched the effect of intellectual capital on firms overall and export performance of Serbia's top 300 exporters. The study shows that there is no significant impact of intellectual capital on top serbian exporters firms overall performance. However, they showed that there is a significance of human capital efficiency on export volume per employee. *Shaban and Kavida(2019)* have researched the impact of intellectual capital on export performance for 96 companies from 8 industries selected from the BSE-500 (Indian Market) between 2006-2017. There is a significant correlation between intellectual capital and the export performance of Indian exporting companies. VAIC components, capital employed efficiency, human capital efficiency and structural capital efficiency, show a statistically significant association with export performance.

Research methodology

This paper aims to examine the impact of intellectual capital on export performance for some leading exporters in Türkiye, namely Ford, Vestel, Arçelik, and Tofaş. The analysis covers data the period 2011-2022 and data derived from annual reports and financial statements of these firms.

The key variables used in the analysis are:

VAIC (Value Added Intellectual Coefficient): VAIC is the independent variable representing intellectual capital, which measures the efficiency of a firm's human, structural, and financial capital.

VAIC is a combined total of three distinct indicators:

Capital Employed Efficiency (CEE) acts as an indicator of the efficiency of value-added (VA) in relation to the employed capital.

Human Capital Efficiency (HCE) acts as an indicator of the efficiency of value-added (VA) with respect to human capital.

Structural Capital Efficiency (SCE) acts as an indicator of the efficiency of value-added (VA) in relation to structural capital.

The subsequent equation provides a formal algebraic representation of the relationship.

VAIC = CEE + HCE + SCE

Where

VAIC = VA intellectual coefficient of a firm

CEE = VA /CE; VA capital employed coefficient of a firm

HCE = VA /HC; Human capital coefficient of a firm

SCE = SC/VA; Structural capital coefficient of a firm

VA = I + DP + D + T + M + R + WS

VA = Value Added

I = Interest Expenses of a firm

DP = depreciation expenses of a firm

D = dividends of a firm

T = corporate taxes

M = equity of minority shareholders in net income of subsidiaries

WS = Wages and Salaries

CE= The net assets book value of a firm.

HC= The aggregate expenditure on salaries and wages incurred by a company.

SC= VA-HC , Strucutal capital of a firm

Export Performance Variables

Real Export per Worker (EPW): The export output per employee.

Export Intensity (Expint): The share of exports in a firm's total sales.

Real Export Sales (Realexp): The total real export volume of the company.

Growth in Real Export per Worker (EPWG): The annual growth rate of export output per employee.

The study develops several econometric models to test the effects of intellectual capital on labor productivity and export performance, using panel data regression analysis. The necessary data for the research includes financial statements and activity reports of the companies. These data were accessed through the website www.kap.gov.tr. Data span includes the period 2011-2022.

Unit Root testing and model Selection

Fisher-PP Unit root tests were conducted to ensure the stationarity of the data, followed by model selection using the Hausman test to determine the appropriate panel data models. Hausman tests results indicates Random Effects model is appropriate for all of the models. So, All models are being tested in Random Effects in the study.Also, Results of Fisher-PP test indicates that Realexp, Epw, Expint and VAIC are stationary at Their First Difference form. Only Epwg is stationary at Level form. Depending on results of Fisher-PP Unit root tests, All variables except Epwg have been used in their first differences in the study.

Testing the Reliability of model

Testing the reliability of regression models is crucial to ensure the accuracy and validity of their results. In this context, two

significant aspects are the assessment of heteroskedasticity and autocorrelation.

The Breusch-Pagan test is being used to identify whether or not there is a heteroskedasticity in the models. The Breusch-Pagan test, involves regressing the squared residuals on the independent variable in order to find out heteroskedasticity of the model. The Breusch-Pagan test results indicate that none of the four models show evidence of heteroskedasticity, as all LM test statistics are lower than the chi-squared critical value at a 95% significance level. Therefore, the regression models appear to have constant variance in their residuals.

The Durbin-Watson autocorrelation test is employed to determine the presence of autocorrelation within the models by examining the relationship among the residuals. EPW models Durbin-Watson test statistic is around 2.189. Since this value is close to 2, it suggests that there is no evidence of autocorrelation in the residuals of the EPW Model. Similar with EPW Model, EPWG model and Expint models values are higher than 2 which indicates there is no autocorrelation in the models. However, Raelexp models Durbin-Watson statistic is less than 2 which points out a potential concern for positive autocorrelation.

Table 1. EPWG Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0.136608	0.025231	5.414381	0.0000
VAIC	0.078005	0.029565	2.638478	0.0116
Weighted Statistics				
R-squared	0.148489	Prob(F-statistic)	0.009792	

When the EPWG Models results were examined, it is determined that the probability value of the f-statistic, which expresses the overall significance of the model, is significant at a 99% confidence level. It is also found that the explanatory variable explain 14% of the variance in the dependent variable (R-squared). Also, The model has determined that the VAIC is statistically significant($p<0.05$), and has a positive effect(0.078) on EPWG (Table1).

Table 2. EPW Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0.117755	0.022489	5.235999	0.0000
VAIC	0.065306	0.026352	2.478179	0.0173
Weighted Statistics				
R-squared	0.133977	Prob (F-statistic)	0.014545	

Upon reviewing the results of the EPW Models, it was observed that the probability value associated with the f-statistic, indicating the overall significance of the model, is statistically significant at a 95% confidence level. Additionally, the explanatory variable account for 13% of the variance in the dependent variable (R-squared). Furthermore, the analysis revealed that the VAIC is both statistically significant ($p<0.05$) and exhibits a positive impact (0.065) on EPW (Table2).

Table 3. Expint Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	-0.002429	0.010241	-0.237149	0.8137
VAIC	0.007069	0.012000	0.589087	0.5590
Weighted Statistics				
R-squared	0.008521	Prob(F-statistic)	0.551212	

After examining the outcomes of the Expint Model, it was noted that the probability value linked to the f-statistic, signifying the overall significance of the model, is not statistically significant. Furthermore, the explanatory variables only explain 0.8% of the variability in the dependent variable. Additionally, the analysis indicated that there is no discernible relationship between the VAIC and Expint (Table3).

The lack of statistical significance associated with the f-statistic probability value implies that the overall model is not considered significant and irrelevant. Also, the limited explanatory power of the explanatory variables, as indicated by the mere 0.8% of variance explained in the dependent variable, suggests that the selected factors may not be strong predictors of the observed outcomes and supports the idea of the model not being significant.

Table 4. Realexp Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0.156869	0.029107	5.389359	0.0000
VAIC	0.052318	0.028903	1.810106	0.0774
Weighted Statistics				
R-squared	0.073604	Prob(F-statistic)	0.074852	

After examining the outcomes of the Realexp Model, it was noted that the f-statistic probability value, representing the overall significance of the model, is statistically significant at a 90% confidence level. Also, the explanatory variables explain 7% of the variability in the dependent variable (R-squared). Additionally, the analysis indicated that the VAIC is statistically significant at a 90% confidence level ($p < 0.1$) and exerts a positive influence (0.05) on Realexp (Table4).

The overall results of models indicate a significant and positive relationship between the Value Added Intellectual Coefficient (VAIC), which is the sum of Capital Employed Efficiency (CEE), Human Capital Efficiency, and Structural Capital Efficiency (SCE), and both Real Export Per Worker (EPW) and Real Export Per Worker Growth (EPWG). With a finding that a 1 unit increase in intellectual capital, intengible assets of a company such as knowledge, experience, expertise, brand value, and customer loyalty etc., leads to a 0.06 unit increase in Real Export Per Worker (EPW) and similar results observed for EPWG.

Results and discussion

Positive and significant relationship found in EPW and EPWG models can not be observed in Export Intensity and Real Export models. The lack of significance in the Export Intensity and Real Export Sales models may exist due companies mostly focusing on

domestic market rather than foreign market. Weak measurement of export performance by the Expint and Realexp variables could effect the inability to find a significant relationship. Essentially, Expint measures the ratio of export sales to total sales, which might result in lower values for companies oriented towards the domestic market, potentially affecting the models significance. Similarly, companies with a stronger focus on domestic sales might experience greater increases in domestic sales compared to exports, making changes in real export figures less indicative of actual export performance.

Conclusion

For a developing economy achieving a sustainable production requires high levels of export performance. Intangible assets are the actual creators of value-added products and have the potential to enhance a company's export capabilities. Intellectual capital can be identified as the sum of intangible assets, such as human capital, brand value, trademarks, and databases, as well as skills such as knowledge and expertise of employees and organizational culture.

The literature shows that the effect of intellectual capital on companies overall performance is inevitable. Most of the studies in the literature uses Ante Pulic's VAIC method while measuring the Intellectual Capital. Pucar (2012) also utilized the VAIC method in his study to measure the impact of Intellectual Capital on Export Performance while demonstrating a positive correlation between intellectual capital and export growth.

This study investigates the correlation between intellectual capital and four prominent Turkish exporting companies. The intellectual capital calculation method employed is Ante Pulic's VAIC method. Additionally, four different metrics have been chosen to measure export performance, namely: Real export per worker (EPW), Real export per worker growth (EPWG), Export intensity (Expint), and Real export sales (Realexp), based on a review of various studies. The study employed Fisher-Phillips-Perron tests to assess stationarity, revealing first-order stationarity in variables except Export per Worker Growth(EPWG). Also, Random Effects models were favored over Fixed Effects via Hausman tests for regression analysis. Furthermore, Breusch-Pagan and Durbin-Watson tests ensured model reliability, with no heteroskedasticity observed across all models, and only minimal autocorrelation detected in the Real Export model. Significant findings in EPWG and EPW models highlighted the positive influence of intellectual capital on export performance metrics, while the lack of significance in the Export Intensity and Real Export models may suggest incomplete capture of these two dependent variables as an export performance measure.

Overall results of models shows that there is a positive and significant relationship between the intellectual capital and export per worker (labor productivity). Thus, if companies invest in intangible assets such as intellectual capital, the export per worker increases, which implies an increase in labor productivity. To achieve foreign trade surplus and sustainable production in Turkey, it is essential to enhance human capital, boost labor productivity, generate value added products, and improve export performance. Besides, in a competitive world, it is crucial to increase productivity to enhance the country's competitiveness. Therefore, a developing country focusing on intellectual capital not only enhances labor productivity but also boosts export performance and achieve sustainable production.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

The authors confirm being the sole contributor of this work and have approved it for publication.

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Externally peer-reviewed.

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Conflict of interest

No potential conflict of interest was reported by the author(s).

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