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A Research on the Impact of Carbon Emissions on Financial Performance of Companies in the Borsa Istanbul Sustainability Index

(Research Article)

Borsa İstanbul Sürdürülebilirlik Endeksi'nde Listelenen Firmaların Karbon Emisyonlarının Finansal Performanslarına Etkisi Üzerine Araştırma

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ABSTRACT

The goal of this study is to reveal the relationship between the amount of carbon emissions that firms emit into the atmosphere and financial performance of the firms. In this context, the data of 41 firms listed in the "Borsa Istanbul Sustainability Index" between 2017-2021 are examined. "Panel data analysis" methods were administered in the research. As consequences of the research, it is inferred that carbon emission intensity, size, leverage and growth variables have a significant impact on "Tobin's Q Ratio and ROA". Only the "growth" variable has a significant impact on "ROE". However, the study shows that total carbon emission has no significant impact on "ROA, Tobin's Q Ratio and ROE". Limited research with in this content has been found in the national literature. Within this scope, the study is a pioneering research on determining the relationship between carbon emissions and financial performance of companies traded in the "BIST Sustainability Index" and is assessed to contribute to practitioners and the literature regarding the findings obtained.

Anahtar Kelimeler:
Finansal Performans, Karbon Emisyonları, Sürdürülebilirlik, Finansal Performans Göstergesi, Panel Veri Analizi

ÖZET

Bu çalışmanın amacı, firmaların atmosfere saldıkları karbon emisyon miktarı ile finansal performans arasındaki ilişkiyi belirlemektir. Bu bağlamda, "Borsa İstanbul Sürdürülebilirlik Endeksinde" listelenen 41 firmanın 2017-2021 yılları verisi incelemeye tabi tutulmuştur. Araştırmada "panel veri analizi" yöntemi uygulanılmıştır. Çalışma neticesinde karbon emisyon yoğunluğu, büyüklük, kaldıraç ve büyüme değişkenlerinin "Tobin'nin Q Oranı ve ROA" üzerinde anlamlı bir etkisi bulunduğu belirlenmiştir. "ROE" üzerinde yalnızca "büyüme" değişkeninin anlamlı bir etkisinin bulunduğu belirlenmiştir. Bununla birlikte toplam karbon emisyonunun "ROA, Tobin'nin Q Oranı ve ROE" üzerinde anlamlı bir etkisinin olmadığı saptanmıştır.Ulusal literatürde bu kapsamda sınırlı araştırmaya rastlanılmıştır. Bu kapsamda çalışma, "BİST Sürdürülebilirlik Endeksinde" işlem gören firmaların karbon emisyonu ile finansal performansı arasındaki ilişkiyi belirlemeye ilişkin öncü bir araştırma olup elde edilen bulguların uygulayıcılara ve literatüre katkı sunacağı değerlendirilmektedir.

1. INTRODUCTION

It is possible to talk about many negative effects of climate change and global warming, in addition to threatening sustainable development. The concept of sustainable development, which was initially put forward for continuous economic growth and the protection and improvement of the environment, was later expanded to include social and economic perspectives as well as environmental concerns (Gedik, 2020: 1). There is no generally accepted definition of sustainable development in the literature. However, the definition made by "the Brundtland Commission[1]" as "Humanity's ability to make development sustainable, in other words, to ensure that today's needs are met without compromising the ability of future generations to meet their own needs" can be accepted as the most standard and accepted definition (Kates et al., 2005: 10).

The most important factor causing global warming and consequently climate change is greenhouse gas (GHG) emissions. GHGs consist of methane, carbon dioxide, water vapor, nitrogen oxide, ozone gases in various amounts in the atmosphere and gaseous compounds such as Perfluorocarbon (PFC), Hydrofluorocarbon (HFC), Sulfurhexafluoride (SF_6) formed in the industrial production process. Carbon emissions (CE) amount has a significant share in the amount of GHG emissions. Approximately 80% of the total amount of GHG emissions is CO_2 (Oral and Uğuz, 2020: 465). Within the scope of combating the GHG effect and climate change, country administrations and regulatory organizations make certain regulations and take preventive measures. In this context, UNFCCC[2], which aims to reduce carbon emissions, was signed with the participation of many countries at the "Rio Conference on Environment and Development" in 1992 (Sultanoğlu and Özerhan, 2020: 177-178). Within the scope of this Framework Convention, the "Kyoto Protocol" was signed in 1997 and entered into force in 2005 (Güneysu and Atasel, 2022: 1184; Gallego Alvarez, 2012: 436; UNFCCC, 2008). Parties to UNFCCC adopted the Paris Climate Agreement in 2015. According to the said agreement, CE expressed as Scope 1-2-3 should be reduced to very low levels (Sultanoğlu and Özerhan, 2020: 178). Turkey officially became a party to "UNFCCC on May 24, 2004" and to the "Kyoto Protocol on August 26, 2009". On April 22, 2016, it signed the "Paris Agreement" and the law on the adoption of the agreement entered into force on October 7, 2021 (Güneysu and Atasel, 2022: 1184; Ministry of Environment, Urbanization and Climate Change, 2022). Within the scope of all these regulations, companies should disclose to internal and external information users what measures they have taken to reduce CE and the course of CE over the years through sustainability reports and Carbon Disclosure Project (CDP) reports. The amount of CE resulting from company activities affects the financial performance (FP) of companies and is directly related to their sustainability.

There are studies[3] in the literature that argue that there is a relationship between environmental performance and economic performance (Caragnano et al., 2020, 2). Based on the view that environmental performance affect economic performance, this study researches the impact of CE on FP in Turkey. The literature review reveals that there is a limited number of studies "Güneysu and Atasel, 2022" examining the impact of CE on FP in Turkey. This research is a pioneering research in terms of investigating the impact of the amount of CE emitted by firms on FP in the "BIST Sustainability Index (BIST SI)"[4]. This study is differ from the study conducted by Güneysu and Atasel (2022) in terms of the sample examined. In their study, Güneysu and Atasel (2022) examined the 2014-2021 data of 19 non-financial companies traded in the "BIST 100 Index". In this research, the 2017-2021 data of 41 companies included in the "BIST SI" were examined. There are also differences in the scope of the variables used. Güneysu and Atasel (2022) used "ROE, ROA, Tobin's Q Ratio", as well as net profit margin and return per share as financial performance indicators (FPI) in their study. In this study, "Tobin's Q Ratio, ROA and ROE" were used as FPI. There are also differences in terms of the control variable. In this scope, the purpose of this research is to get the answer if a significant relationship exists between the amount of CE of firms and FPI. For this aim, the ımpacts of the independent variables of total CE and CE intensity and control variables such as "leverage, size and growth (Market Capitalization / Book Value)" on FPI such as "Tobin's Q ratio, ROA and ROE" are analyzed with panel regression models.

The research is important as "it is one of the pioneering research" carried out in Türkiye in this field and provides findings on the relationship between CE and FP. Additionally, the consequences of the research are expected to encourage firms to decrease their CE amounts. This makes the study important in terms of serving

[1] "The World Commission on Environment and Development (WCDE), which was established in 1983 as a sub-organization of the United Nations with the aim of "proposing long-term environmental strategies to ensure sustainable development until the year 2000 and beyond" by UN General Assembly Resolution, is also known as Gro Harlem Brundtland, Prime Minister of Norway, who was the former chairman of the commission (https://clu-in.org/greenremediation/docs/Sustainability_and_the_USEPA.pdf, Access Date: 01.01.2023)"

[2] "the United Nations Framework Convention on Climate Change"

[3] "Spicer (1978); Mahapatra (1984); Klassen and McLaughlin (1996); Russo and Fouts (1997); Montabon et al., (2007); Russo and Pogutz (2009)".

[4] "BIST Sustainability Index (BIST SI) is an index that lists the corporate companies whose shares are traded in Borsa Istanbul with high sustainability performance. In this way, companies that are successful in the field of sustainability are brought together and compared."

the goal of climate action, which is among the "Sustainable Development Goals of the United Nations". Finally, considering the impact of environmental performance on economic performance, the study is also considered to be important in terms of determining FP criteria related to these environmental impacts.

2. LITERATURE REVIEW

As a consequences of the literature review, it is seen that many studies[5] such as CE accounting, GHG emission accounting and reporting, reporting of carbon footprints, GHG disclosures and assurance auditing, carbon transparency project disclosures and CE disclosures have been conducted. When the international literature is analyzed, there are researches investigating the impact of CE on FP. In the national literature, otherwise a limited number of researches investigating the impact of CE on FP were found. Some of the researches in the national and international literature and the outcomes acquired are reported in table.

[5] "Kardeş Selimoğlu et al., (2022); Kızıltan and Doğan (2021); Demircioğlu and Ever (2020); Aliusta and Yılmaz (2020); Öktem (2020); Sultanoğlu and Özerhan (2020); Çokmutlu and Ok (2019); Güleç and Bektaş (2019); Qian et al., (2018); Altınbay and Golagan (2016); Gonzalez and Ramirez (2016); Chithambo and Tauringana (2014); Choi et al. (2013); Tsai et al, (2012); Hrasky (2012); Luo et al., (2012); Solomon et al. (2011); Burritt et al., (2011); Ratnatunga and Balachandran (2009); Stanny and Ely (2008); Simnett and Nugent (2007)."

Table 1. Some Studies in National and International Literature

"Author(s) /Year"	**"Purpose of the Study"**	**"Sample"**	**"Methodology of the Study"**	**"Results"**
"Gallego Alvarez (2012)"	"To examine the effect of the change in CE of firms between 2006-2008 on their FP between 2007-2010."	"89 companies operating in different countries and in different sectors (2006-2008) - (2007-2010) data"	"Panel Regression Analysis"	"It was concluded that the change in CE had a negative impact on return on assets in 2007."
"Wang et al., (2014)"	"To investigate the impact of GHG emissions on the FP of 69 firms operating in Australia."	"2010 data from 69 Australian companies"	"Multiple Regression Analysis"	"There was a positive relationship between GHG emissions and FP."
"Gallego Alvarez et al., (2015)"	"To investigate the impact of the change in CE of international firms between 2006-2009 on their financial and operational performance between 2008-2010."	"(2006-2009) - (2008-2010) data of 89 international companies operating in 21 countries"	"Panel Regression Analysis"	"It was determined that the change in CE affected the return on equity, but not the return on assets."
"Lewandowski (2017)"	"Determining the impact of corporate carbon performance on FP."	"Data on 1,640 international companies between 2003 and 2015"	"OLS Regression Analysis"	"It was concluded that there was a positive relationship between CE and return on sales among FPI. On the other hand, there was a negative relationship between CE and Tobin's Q ratio."
"Ganda and Milondzo (2018)"	"To investigate the impact of CE on the FPI of return on equity (ROE), return on investment (ROI) and return on sales (ROS) of firms in South Africa."	"Data from 63 South African companies"	"Multiple Regression Analysis"	"It was concluded that there was a negative relationship between CE and corporate FP."
"Busch and Lewandowski (2018)"	"To investigate the relationship between corporate carbon (a firm's CO_2 emission equivalents) as a dimension of operational performance and FP using meta-analytic techniques."	"68 estimates from 32 empirical studies covering a total of 101,775 observations and applying meta-analytic techniques"	"Meta Analytical Techniques"	"Meta-analytic findings indicated that CE varied inversely with FP."
"Butselaar (2020)"	"To investigate how investment in innovation affects the relationship between CE and firm performance."	"Data of 635 international companies between 2012-2018"	"Panel Regression Analysis"	"As a result of the study, it was determined that CE had a negative impact on firm performance, but investment in innovation reduced that negative impact."
"Miah et al., (2021)"	"To investigate the impact of CE on FP of financial and non-financial firms in emerging economies."	"2011-2020 data for 104 financial and 328 non-financial firms in emerging economies"	"OLS and 2SLS Regression Analysis"	"Financial firms were found to have lower CE than non-financial firms. In addition, CE were found to reduce return on equity (ROE), Tobin's Q ratio, Z score and credit rating."
"Busch et al., (2022)"	"To revisit the relationship between corporate carbon emission and FP and, in this context, to conduct a replication and extension study to assess the sensitivity of the findings of the study by Delmas, Nairn-Brich and Lim."	"2005-2014 data on 5,663 publicly traded US and European firms"	"OLS Regression Analysis"	"Strong evidence suggested that firms with higher CE also had higher short-term FP (ROA)."

"Güneysu and Atasel (2022)"	"To examine the effect of CE on the FP of non-financial firms traded in the BIST 100 index."	"2014-2021 data for 19 non-financial companies traded in the BIST 100 index"	"Panel Regression Analysis"	"It was concluded that there was a significant and negative relationship between CE and return on assets (ROA) and return per share; however, there was no significant relationship between return on equity (ROE), Tobin's Q and net profit margin."
"Houqe et al., (2022)"	"To investigate the impact of CE and agency costs on FP separately and in aggregate."	"Data of 2,323 US companies for 2007-2016"	"Panel Regression Analysis"	"The study concluded that firms with higher CE and higher agency costs had lower FP."
"Laskar et al., (2022)"	"To investigate the impact of CE intensity on firm performance in the context of the top 100 firms listed on the Bombay Stock Exchange in India."	"Data for 2016-2021 for the top 100 companies listed on the Bombay Stock Exchange"	"System GMM Method"	"As a result of the study, it was found that the effect of CE on firm performance was negative and statistically significant."
"Loohuis (2022)"	"To investigate whether there is a relationship between firms' FP and carbon performance."	"2017-2021 data of 830 international companies"	"Fixed Effects Regression Analysis"	"The findings of the study indicated that as CE increased, the FP of firms would have decreased in the short and long run."

As a consequence of examining the impact of CE on FP and evaluating the above-mentioned literature as a whole, it is seen that there is a positive relationship between CE and FP in some studies "Busch et al., (2022); Lewandowski (2017); Wang et al., (2014)". According to the findings of these studies, it is concluded that the FP of firms with high CE intensity is also high. However, some studies "Güneysu and Atasel (2022); Houqe et al., (2022); Laskar et al., (2022); Loohuis (2022); Butselaar (2020); Busch and Lewandowski (2018); Ganda and Milondzo (2018); Gallego Alvarez (2012)" **otherwise** found a negative relationship between CE and FP.

3. DATA AND METHODOLOGY

The data of the study involves the 2017-2021 data of 41 companies in the "BIST SI". The data of the firms were derived from the "Public Disclosure Platform (PDP)" in January 2023, financial statement footnotes and disclosures, integrated reports, annual reports, sustainability reports, and Datastream database.

In the contents of the study, when the sustainability reports published by the firms in the "BIST SI" are analyzed by years, it is determined that the years between 2017-2021 are the years in which the sustainability reports are published the most. Therefore, the sustainability reports and data of the firms between 2017-2021 were subjected to analysis and this forms the limitation of the research. At the time of the research[6], there were 65 companies traded in "BIST SI". Among these 65 companies, it was determined that there were 41 companies that published their sustainability report or integrated report for 2021. In this case, it constitutes another limitation of the study in terms of determining the number of companies.

The definition of the variables used in the research, the calculation formulas of some variables and similar studies in the literature using these variables, to put it another way, the sources of the variables are as in "Table 2".

Table 2. Information on Variables

Abbreviation of Variables	*Variable Name*	*Calculation of the Variables*	*Source*
"ROA %"	"Return on Assets"	"Net Profit / Total Assets"	"Gallego Alvarez et al., (2015); Gallego Alvarez (2012); Lewandowski (2017); Butselaar (2020); Loohuis (2022); Houqe et al., (2022); Güneysu and Atasel (2022); Busch et al., (2022)"
"ROE %"	"Return on Equity"	"Net Profit / Total Equity"	"Gallego Alvarez et al., (2015); Gallego Alvarez (2012); Lewandowski (2017); Ganda and Milondzo (2018); Butselaar (2020); Loohuis (2022); Güneysu and Atasel (2022)"
"TOB Q"	"Tobin's Q Ratio"	"(Market Value + Total Debt)/Total Assets"	"Wang et al., (2014); Lewandowski (2017); Butselaar (2020); Miah et al., (2021); Loohuis (2022); Houqe et al., (2022); Busch et al., (2022)"
"Log Total GHG Emissions[7]"	"Total CE[8]"	"Logarithm of (total amount of Scope 1 and 2 or Scope 3 GHG emissions in metric tons)"	"Wang et al., (2014); Miah et al., (2021); Loohuis (2022); Houqe et al., (2022); Güneysu and Atasel (2022); Busch et al., (2022)"
"GHG Emissions Intensity (%)"	"Carbon Emission Intensity[9]"	"Total Carbon Emissions / Total Sales"	"Lewandowski (2017); Ganda and Milondzo (2018); Butselaar (2020); Loohuis (2022); Busch et al., (2022)"
"SIZE"	"Size[10]"	"log (Total Assets)"	"Gallego Alvarez et al., (2015); Gallego Alvarez (2012); Butselaar (2020); Miah et al., (2021); Loohuis (2022); Laskar et al., (2022); Houqe et al., (2022); Güneysu and Atasel (2022)"
"LEVERAGE %"	"Leverage"	"Total Debt / Total Assets"	"Gallego Alvarez (2012); Wang et al., (2014); Ganda and Milondzo (2018); Butselaar (2020); Miah et al., (2021); Loohuis (2022); Laskar et al., (2022); Houqe et al., (2022); Busch et al., (2022)"
"GROWTH (MV/BV) %"	"Growth"	"Market Value / Book Value"	"Vullings (2021); Wang et al. (2020); Maaloul (2018)"

In this context, the study, total CE and CE intensity are considered as independent variables, "size, leverage and growth" as control variables and "Tobin's Q ratio, ROA and ROE" as FPI as dependent variables. Within the scope of, since "ROA and ROE provide information about the short-term FP of firms", and "Tobin's Q ratio provides information about long-term FP", the model of the study is constructed in this framework. As presented

[6] "January, 2023"

[7] "In this study, the total amount of Scope 1 and 2 or Scope 3 GHG emissions in metric tons is taken for the Total GHG Emission variable and its logarithm is calculated to ensure linearity".

[8] "Scopes 1 and 2 are emissions that a firm owns or controls. Scope 3 emissions are the result of a firm's activities but from sources that are not owned or controlled. In other words, Scope 1 is what you burn, Scope 2 is what you buy, and Scope 3 is everything beyond that (https://www.zorlu.com.tr/akillihayat2030/yazilar/kapsam-1-2-3-ne-anlama-geliyor Access Date: 12.01.2022)"

[9] "Carbon emission intensity is an indicator of firms' carbon risk and is obtained by dividing total carbon emissions by total sales. In the literature, studies by by Zhou et al., (2017); Maaloul (2018); Jung et al., (2018); Palea and Drogo (2020); and Vullings (2021) have calculated carbon emission intensity in a similar way".

[10] "In this study, Total Assets is used as the size variable and the logarithm of Total Assets is calculated to ensure linearity."

in Table 2, "Tobin's Q ratio, ROA and ROE" have been used as variables as FPI in most studies directly related to the subject. The model of the study is as illustrated in "Figure 1"[11].

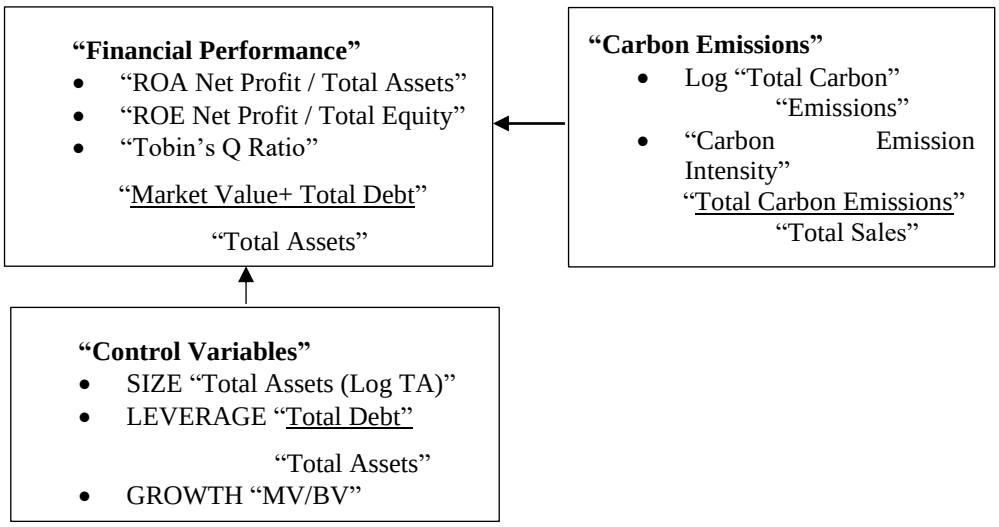

Figure 1. Research Model: The Impact of Carbon Emissions on Financial Performance

"Panel data analysis" methods were administered in this research. "The panel regression models" were conducted to specify the impact of CE on the FP of firms (FPI); three separate models for "ROA, ROE and Tobin's Q Ratio" are as follows (Özşahin Koç vd., 2023: 1291; Özşahin Koç ve Deran 2024: 86):

$$"ROA_{(i,t)} = \beta_0 + \beta_1(\text{Log}TotalGHG)_{(i,t)} + \beta_2(GHGIntensity)_{(i,t)} + \beta_3(\text{Log}SIZE)_{(i,t)} + \beta_4(LEV)_{(i,t)} + \beta_5(GROWTH)_{(i,t)} + \in_t \quad (1)"$$

$$"\text{ROE}_{(i,t)} = \beta_0 + \beta_1(\text{LogTotalGHG})_{(i,t)} + \beta_2(\text{GHGIntensity})_{(i,t)} + \beta_3(\text{LogSIZE})_{(i,t)} + \beta_4(\text{LEV})_{(i,t)} + \beta_5(\text{GROWTH})_{(i,t)} + \in_t \quad (2)"$$

$$"\text{TOBQ}_{(i,t)} = \beta_0 + \beta_1(\text{LogTotalGHG})_{(i,t)} + \beta_2(\text{GHGIntensity})_{(i,t)} + \beta_3(\text{LogSIZE})_{(i,t)} + \beta_4(\text{LEV})_{(i,t)} + \beta_5(\text{GROWTH})_{(i,t)} + \in_t \quad (3)"$$

In these three equations, "i = 1,2,.....N denotes the number of firms (41 firms)"; "t = 1, 2, 3, ...T denotes the time periods (5 years -2017 to 2021)". "NxT is the total number of observations in the dataset (41x5 = 205)" (Özşahin Koç vd., 2023: 1291; Özşahin Koç ve Deran 2024: 86).

In the panel regression models, 5-year data of 41 firms are used. Accordingly, since the unit dimension (N) is larger than the time dimension (T), in other words, since N>T, the static "panel data method" is taken into account and the classical "pooled Least Squares (POLS)", fixed impacts and random impacts estimators are determined while estimating these static panel models (Güneysu and Atasel, 2022: 1188).

Baltagi (2005) stated in his study that unit root tests are not necessary for datasets analyzed below 15 years. Baltagi stated that unit root tests were not necessary for micro panel datasets, while unit root tests were necessary for macro panel datasets. Therefore, since 5-year dataset is analyzed in this study, unit root tests are not performed (Özşahin Koç ve Deran 2024: 86).

"Descriptive statistics" are shown in "Table 3".

Table 3. Descriptive Statistics

"Variables"	*"Mean"*	*"Standard Deviation"*	*"Minimum"*	*"Maximum"*	*"Observation"*
"ROA (%)"	0.546	3.508	-0.273	28.736	
"ROE (%)"	0.157	1.336	-12.042	11.105	
"TOB Q"	13.979	84.100	0.333	729.377	
"Log Total GHG Emissions"	12.502	2.510	6.361	16.943	205
"GHG Emissions Intensity (%)"	0.082	0.214	0	1.527	

[11] "Adapted from the research of Özşahin Koç vd., (2023: 1291); Özşahin Koç ve Deran (2024: 85)."

"SIZE"	18.560	2.860	10.293	23.751
"LEV (%)"	0.704	0.217	0.075	1.837
"GROWTH (MV/BV) (%)"	2.097	18.621	-172.71	196.32

"Table 3" reports "the minimum and maximum values and standard deviations means of the independent, dependent and control variables". Within the context, "Tobin's Q ratio, ROA and ROE" FPI are considered as dependent variables and within the scope of the sample, "the minimum value of ROA is -0.273" and "the maximum value is 28.736"; "the minimum value of ROE is -12.042" and "the maximum value is 11.105"; "the minimum value of Tobin's Q ratio is 0.333" "with a maximum value of 729.377"; "the minimum value of the independent variable total CE is 6.361" "with a maximum value of 16.943"; "the minimum value of CE intensity is 0.000" "with a maximum value of 1.527". Among this variables in the scope of the analysis, "Tobin's Q ratio has the highest standard deviation" and CE intensity has the lowest standard deviation. In addition, since the mean of the Growth variable is smaller than the relevant standard deviation value, it may indicate that the variability in these series is significant.

4. FINDINGS

See the "Table 4" below the correlation matrix between control and independent variables and FPI.

Table 4. Correlation Matrix for Control and Independent Variables

	"ROA"	*"ROE"*	*"TOB Q"*	*"Log Total GHG Emission"*	*"GHG Emissions Intensity"*	*"SIZE"*	*"LEV"*	*"GROWTH"*
"Log Total GHG Emissions"	0.016	-0.022	-0.011	1				
"GHG Emissions Intensity (%)"	-0.046	-0.014	-0.048	0.507**	1			
"SIZE"	-0.391**	-0.103	-0.420**	-0.045	-0.139*	1		
"LEV (%)"	-0.146*	0.019	-0.157*	-0.215**	0.043	0.125	1	
"GROWTH (MV/BV) (%)"	-0.008	-0.849**	-0.008	-0.005	-0.010	-0.090	-0.031	1

Note 1: ** significant at p<0.01; * significant at p<0.05
Note 2: Correlation Coefficient 50 and below => weak; 50 and above => strong [Nakip (2003: 322)]

"Table 4" presents that there is a relatively strong positive relationship between CE intensity and total CE. It is seen that the size variable has a negative correlation with "Tobin's Q ratio and ROA" and the degree of relationship is weak. It is also inferred that there is a weak negative correlation between CE intensity and size variable. There is a weak negative relationship between the leverage variable and "Tobin's Q ratio, ROA and total CE". There is a negative correlation between the "ROE and growth (MV/BV)" variable and the degree of relationship is very strong. However, according to the correlation analysis results, there is no significant relationship between total CE and CE intensity and FP "ROA, ROE and Tobin's Q ratio".

Initially, in the research, unit and/or time impacts are examined by "linear regression test" to see if the "pooled OLS method", one of the conventional static panel data analyses, is suitable for each model. Considering this point, the hypotheses were tested[12].

"H_0 = There is no unit and/or time impact."

"H_1 = There is a unit and/or time impact."

Test results indicate that if there are unit and/or time impacts in the model, it is not convenient to carry out "pooled OLS".

Test results of Model 1 show that, since 0.0000<0.05, H_0 is rejected. As at least one of the unit and/or time impact is present, it is pointed out that it is not suitable to utilise "pooled OLS" for Model 1. In this context, when the unit impact and/or time impact is examined, it is seen that there is a unit impact in Model 1 (0.0000<0.05), while there is no time impact (1.0000>0.05). As a result of the analysis, it can be stated that Model 1 is a "panel data model" with one-way unit impact. "Hausman test" was carried out to examine which of the fixed or random impacts estimators is valid in the unidirectional unit effect "panel data model" and as it is 0.3863>0.05, it is inferred that the random effects estimator is viable for Model 1. Because random effects is the valid estimator for Model 1, "Levene, Brown and Forsythe (1974) tests" were applied to determine the variance

[12] "In this section, formation of hypotheses, in the presentation of tables and interpretation of model results, Özşahin Koç et al., (2023); Özşahin Koç and Deran (2024) studies were used."

and the statistics and probability values of the tests were determined as W0 = 76.9418976 (0.000); W50 = 2.7868887 (0.000); W10= 76.9418976 (0.000) and according to the results (since all of them are 0.000<0.05), it is concluded that there is variance in Model 1. "Bhargava et al. Durbin-Watson (DW) and Baltagi-Whu LBI tests" were conducted to determine autocorrelation within the scope of Model 1 (Yerdelen Tatoğlu, 2020: 241). Since the test results are less than the critical value of 2 (Durbin-Watson = 0.95304959; Baltagi-Wu LBI = 1.3092032), it is determined that autocorrelation exists in Model 1. "The Pesaran Test" was carried out specify if there is correlation between the units and in accordance with the test statistic consequences (38.958; 0.0000<0.05), it was shown that there is correlation between the units.

Because of the presence of "heteroscedasticity, autocorrelation and inter-unit correlation" in Model 1, "the Huber (1967), Eicker (1967) and White (1980) estimator" is applied. In this regard, "the panel regression" consequences acquired utilizing the robust estimator are shown in "Table 5".

Table 5. Model 1 Panel Regression Results

"Independent Variables"	*"Standardized Beta Coefficients"*	*"T value"*	*"Standard Error"*	*"p"*
"Log Total GHG Emissions"	0.053	0.97	0.055	0.530
"GHG Emissions Intensity (%)"	-2.049	-1.77	1.155	0.079*
"SIZE"	-0.491	-2.44	0.201	0.010**
"LEV (%)"	-1.802	-2.28	0.790	0.024**
"GROWTH (MV/BV) (%)"	-0.008	-2.09	0.003	0.030**
	R^2 = 0.178			
	F= 1.30			
	N= 205			
"Note 1: *** significant at p<0.01; ** significant at p<0.05; * significant at p<0.10"				

"Dependent Variable: Return on Assets (ROA)"

"Independent Variable: Log Total GHG Emissions, GHG Emissions Intensity (%), SIZE, LEV (%), GROWTH (MV/BV) (%)"

As regards the consequences of the "panel data analysis", the CE intensity variable has a statistically significant impact on "ROA" at p<0.10 significance level. In other words, when CE intensity increases by one unit, "ROA" decreases by 2.049 units. It is inferred that the control variables "leverage, size and growth" have a statistically significant impact on "ROA" at 5% significance level. However, total CE has no significant impact on "ROA". Falk and Miller (1992) stated in their study that the R^2 value should be equal to or higher than 0.10 for the variance explained to be considered sufficient. In this context, the coefficient of determination "R^2" value of the first model of this study is 0.178, which is a valid value for the variance explained to be considered sufficient and significant.

Within the scope of Model 2, unit and/or time impacts are examined by "linear regression test" in order to see if the "pooled OLS method", one of the conventional static panel data analyses, is suitable. Considering this point, the hypotheses were tested.

"H_0 = There is no unit and/or time impact."

"H_1 = There is a unit and/or time impact."

Test results indicate whether there are unit and/or time effects in the model, it is not convenient to utilize "pooled OLS".

Test results of Model 2 show that, since 0.9092>0.05, H_0 cannot be rejected. In other words, because there is no unit and/or time impact, it is suitable to utilise "pooled OLS" for Model 2. In this context, the fact that the average of "variance inflation (VIF) values" for Model 2 is less than 5 "Mean VIF = 1.19 < 5" shows that there is no multicollinearity problem in the model (Yerdelen Tatoğlu, 2020: 260). Variable variance was analyzed with the "Breush-Pagan (1979) test". When the varying variance values obtained are analyzed, it is noted that the "Breush-Pagan (1979)" probability value is less than 0.05 (0.0296<0.05) and it is determined that there is varying variance in the study. In this context, the robust estimator was carried out in the study. "Panel data analysis" consequences of the second model are reported in "Table 6".

Table 6. Model 2 Panel Data Pooled OLS Analysis Results

"Independent Variables"	*"Standardized Beta Coefficients"*	*"T value"*	*"Standard Error"*	*"p"*
"Log Total GHG Emissions"	-0.005	-0.15	0.034	0.879
"GHG Emissions Intensity (%)"	-0.083	-0.35	0.239	0.726
"SIZE"	0.009	0.47	0.020	0.641

"LEV (%)"	0.276	0.71	0.387	0.476
"GROWTH (MV/BV)"	-0.061	-32.64	0.001	0.000***
	R^2 = 0.724			
	F= 295.83			
	N= 205			
"Note 1: *** significant at p<0.01; ** significant at p<0.05; * significant at p<0.10"				

"Dependent Variable: Return on Equity (ROE)"

"Independent Variable: Log Total GHG Emissions, GHG Emissions Intensity (%), SIZE, LEV (%), GROWTH (MV/BV) (%)"

In line with the consequences of the "panel data analysis" in which "ROE" is considered as the dependent variable among the FPI, it is concluded that merely the growth variable has a statistically significant impact on "ROE" at 1% significance level. "Total CE, CE intensity, size and leverage" variables have no significant impact on "ROE". In the study conducted by Chin (1988), it is stated that R^2 = 0.67 explains significant variance, R^2 = 0.33 explains moderate variance and R^2 = 0.19 explains weak variance. In this context, the coefficient of determination "R^2" value of the second model of the current study is 0.724, which is a valid value for the variance explained to be considered sufficient and significant.

For the last model of the study (Model 3), unit and/or time impacts are examined with a "linear regression test" in order to see if the "pooled OLS method", one of the conventional static "panel data analyses", is suitable. Considering this point, the hypotheses were tested.

"H_0 = There is no unit and/or time impact."

"H_1 = There is a unit and/or time impact."

Test consequences indicate whether there are unit and/or time impacts in the model, it is not convenient to utilise "pooled OLS".

Test results of Model 3 shows that, since 0.0000<0.05, H_0 is rejected. As at least one of the unit and/or time impact, it is pointed out that it is not suitable to utilise "pooled OLS" for Model 3. In this context, when the unit effect and/or time impact is analyzed, it is indicated that there is a unit impact in Model 3 (0.0000<0.05), while there is no time impact (1.0000>0.05). Therefore, it is noted that Model 3 is a one-way "panel data model" with unit impact. "Hausman test" was carried out to examine which of the fixed or random impacts estimators is valid in the unidirectional unit effect "panel data model" and as it is 0.8474>0.05, it is inferred that the random effects estimator is viable for Model 3. Because random effects is the valid estimator for Model 3, "Levene, Brown and Forsythe (1974) tests" were performed to determine the variance and the statistics and probability values of the tests were determined as W0 = 37.841347 (0.000); W50 = 3.458833 (0.000); W10= 37.841347 (0.000) and according to the results (since all of them are 0.000<0.05), it is concluded that there is variance in Model 3. "Bhargava et al. Durbin-Watson (DW) and Baltagi-Whu LBI tests" were conducted to determine autocorrelation within the scope of Model 3 (Yerdelen Tatoğlu, 2020: 241). Since the test results are less than the critical value of 2 (Durbin-Watson = 91895711; Baltagi-Wu LBI = 1.359768), it is noted that autocorrelation exists in Model 3. The "Pesaran Test" was performed to specify if there is correlation between the units and in accordance with the test statistic consequences (43.549; 0.0000<0.05), it was shown that there is correlation between the units.

As a consequence, "the Huber (1967), Eicker (1967) and White (1980) estimator" was applied in Model 3 due to the presence of autocorrelation, variance and inter-unit correlation. In this regard, "the panel regression" consequences acquired utilizing the robust estimator are shown in "Table 7".

Table 7. Model 3 Panel Regression Analysis Results

"Independent Variables"	*"Standardized Beta Coefficients"*	*"T value"*	*"Standard Error"*	*"p"*
"Log Total GHG Emissions"	1.005	0.77	1.308	0.443
"GHG Emissions Intensity (%)"	-49.874	-1.86	26.781	0.064*
"SIZE"	-12.641	-2.62	4.825	0.009***
"LEV (%)"	-48.062	-2.14	22.496	0.034**
"GROWTH (MV/BV) (%)"	-0.199	-2.13	0.093	0.034**
	R^2 = 0.206			
	F= 1.38			
	N= 205			
"Note 1: *** significant at p<0.01; ** significant at p<0.05; * significant at p<0.10"				

"Dependent Variable: Tobin's Q Ratio (Tob Q)"

"Independent Variable: Log Total GHG Emissions, GHG Emissions Intensity (%), SIZE, LEV (%), GROWTH (MV/BV) (%)"

In accordance with the consequences of the "panel data analysis" carried out within Model 3, the independent variable of CE intensity (GHG Emissions Intensity) has a statistically significant impact on "Tobin's Q ratio", one of the FPI, at $p<0.10$ significance level. It is also inferred that the control variables "financial leverage and growth" have a significant impact on "Tobin's Q ratio" at the 5% significance level. The size variable is also found to have a significant impact on "Tobin's Q ratio" at the 1% significance level. However, the total CE variable is found to have no significant impact on the "Tobin's Q ratio", one of the FPI. As stated earlier, Falk and Miller (1992) stated that the "R^2 value" should be equal to or higher than 0.10 for the variance explained to be considered sufficient. The coefficient of determination "R^2 value" of the third model is 0.206, which is a valid value for the variance explained to be considered sufficient.

5. CONCLUSION AND RECOMMENDATIONS

Within the scope of climate change, GHG emissions and CE with global warming pose a danger to nature and the life cycle. Reducing CE, which pose a danger and risk to human beings, nature and the life cycle, and managing them within the framework of necessary measures are among the sustainable development aims performed by the United Nations. Legal regulations, framework agreements and commercial agreements "such as the United Nations Framework Convention on Climate Change, Kyoto Protocol, Paris Climate Agreement" also show the importance given to GHG emissions. It is important for companies that emit large amounts of CE into the atmosphere due to their business activities to comply with environmental, social and legal regulations in order to ensure their sustainability. This is because the amount of CE, which is one of the environmental performance indicators, has an impact on the FP of firms.

In this research, which examines the impact of CE on the FP of firms, the 2017-2021 financial statement footnotes and disclosures, integrated reports, sustainability reports and annual reports, of 41 firms traded in the "BIST SI" were analyzed and the impacts of total CE, CE intensity, size, leverage and growth variables on "ROA, ROE and Tobin's Q Ratio" were examined. In this regard, it is found that "CE intensity, size, leverage and growth" variables have a significant impact on "Tobin's Q Ratio and ROA". Only the growth variable has a significant impact on "ROE". It is concluded that the total CE variable has no significant impact on "Tobin's Q Ratio, ROE and ROA".

In this study, it is concluded that CE intensity has a significant and negative impact on "ROA and Tobin's Q Ratio". This finding is supported by the findings of studies in the literature "Güneysu and Atasel (2022)[13]; Laskar et al., (2022); Loohuis (2022); Ganda and Milondzo (2018); Gallego Alvarez (2012)".

Busch et al., (2022) declared that "size and leverage" variables had a significant impact on "Tobin's Q Ratio and ROA". Houqe et al., (2022) inferred that "CE, size and leverage" variables had a significant impact on "Tobin's Q Ratio". These findings are similar to the findings of this study.

Gallego Alvarez (2012) concluded that leverage had a significant impact on "ROE". Butselaar (2020) acknowledged that "size and leverage" variables did not have a significant impact on "ROA". In addition, it was concluded that CE intensity had a significant impact on "ROE". Ganda and Milondzo (2018) found that CE intensity, size and leverage variables had a significant impact on "ROE". These findings differ from the findings acquired in this research. The reason for obtaining different results from the previous researches maybe that the asset size, debt and capital structure, "ROA and ROE" of the firms in the sample analyzed have different characteristics than the firms in the Turkish sample. This is because while the general level of debt and capital structure does not exceed 50% in developed countries, the general level of debt and capital structure may exceed 50% in developing countries such as Turkey. These and similar factors may play a role in differentiating the results.

A review of the literature shows that there is a limited number of studies examining the relationship between CE and FP in Turkey. In this study, only 41 companies traded in the "BIST SI" and disclosing their CE amount between 2017 and 2021 could be covered in the analysis. Though this gives an idea to explain the relationship between CE and FP in Turkey, future similar researches utilising various variables covering more firms and periods may ensure better outcomes.

Within the scope of the United Nations sustainable development goals, firms need to manage their existing or potential carbon risks to cope with climate change. In this context, firms may be advised to include strategies to manage carbon risks in their strategic plans and to work towards increasing carbon risk awareness at all staff

[13] "In this study, a negative relationship was found with ROA, but no relationship was found with ROE and Tobin's Q ratio".

levels. They may also be advised to develop more strategies to improve their FP, which directly contributes to environmental performance. This is because such strategies will not only add value to the firm's market capitalization, but also provide a better environment for current and future generations to lead a healthy life.

Policymakers and regulatory authorities are advised to adopt effective environmental policies that minimize CE, support environmental projects and firms that develop new technologies, renewable energy industries, invest in innovation, and create financial support and incentive packages for them.

Financial institutions should offer more favorable borrowing opportunities to environmentally friendly firms, and regulators should establish a climate fund to support green firms with environmental projects in their lending.

The general opinion is that developing countries have a lower level of environmental awareness. Therefore, it may be recommended that the governments of these countries enact binding and encouraging laws regarding carbon emissions. This is because such mandatory legal regulations will contribute to the reduction of CE and the fight against climate change.

It may be recommended to provide training to all personnel working in companies to raise awareness of the importance of reducing carbon emissions and the gains to be achieved as a result. Reward policies can be implemented in departments to encourage low carbon emissions.

It is recommended that future researches should comprise a larger data; various indices; multiple country samples; different control variables such as innovation, liquidity, volatility, firm age, Altman Z Score, beta and cash flow; additional FPI variables such as ROI, ROS, etc.; and different analysis methods such as System GMM method, machine learning and Meta Analytical Techniques.

REFERENCES

Altınbay, A., & Golagan, M. (2016). Küresel ısınma sorununa muhasebecilerin bakışı: karbon muhasebesi. *Itobiad: Journal of the Human & Social Science Researches*, *5*(7), 2106-2119.

Aliusta, H., & Yılmaz, B. (2020). Karbon maliyetlerinin muhasebeleştirilmesi: çimento sektörü uygulaması. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *15*(1), 267-294.

Baltagi, B.H. (2005). *Econometric analysis of panel data*, John Wiley&Sons Ltd. West Sussex, England.

Breusch, T.S., & Pagan, A.R. (1979). A simple test for heteroscedasticity and random coefficient variation. E*conometrica: Journal of the econometric society*, 1287-1294.

Burritt, R.L., Schaltegger, S., & Zvezdov, D. (2011). Carbon management accounting: explaining practice in leading german companies. *Australian Accounting Review*, *21*(1), 80-98.

Busch, T., Bassen, A., Lewandowski, S., & Sump, F. (2022). Corporate carbon and financial performance revisited. *Organization & Environment*, *35*(1), 154-171.

Busch, T., & Lewandowski, S. (2018). Corporate carbon and financial performance: A meta analysis. *Journal of Industrial Ecology*, *22*(4), 745-759.

Butselaar S.V. (2020). *The effect of carbon emissions on firm performance and the moderating effect of innovation*. Master's thesis, University of Radboud, Nijmegen.

Caragnano, A., Mariani, M., Pizzutilo, F., & Zito, M. (2020). Is it worth reducing GHG emissions? Exploring the effect on the cost of debt financing. *Journal of Environmental Management*, 270, 110860.

Chin, W.W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research*, *295*(2), 295-336.

Chithambo, L. & Tauringana, V. (2014). Company specific determinants of greenhouse gases disclosures. *Journal of Applied Accounting Research*, *26*(1), 323-338.

Choi, B.B., Lee, D., & Psaros, J. (2013). An analysis of australian company carbon emission disclosures. *Pacific Accounting Review*, *25*(1), 58-79.

Committee on Incorporating Sustainability In The U.S. Environmental Protection Agency. (2011), Sustainability and the U.S. EPA, https://clu-in.org/greenremediation/docs/Sustainability_and_the_USEPA.pdf

Çevre, Şehircilik ve İklim Değişikliği Bakanlığı. (2022). İklim değişikliği, Erişim adresi https://iklim.csb.gov.tr/bmidcs-ve-turkiye-i-4376. (Erişim Tarihi: 1.01.2023)

Çokmutlu, M.E. & Ok, Ş. (2019). Borsa İstanbul sürdürülebilirlik endeksi işletmelerinin sera gazı beyanlarına yönelik güvence denetimleri: ISAE 3410 güvence denetim standardına ilişkin bir araştırma. *IBAD Sosyal Bilimler Dergisi*, (5), 164-174.

Demircioğlu, E., & Ever, D. (2020). Karbon maliyetlerinin belirlenmesine ilişkin demir çelik işletmesinde uygulama. *İşletme Araştırmaları Dergisi*, *12*(1), 649-662.

Eicker, F. (1967). *Limit theorems for regressions with unequal and dependent errors. proceedings of the fifth berkeley symposium on mathematical statistics and probability* (s. 59-82). University of California Press.

Jung, J., Herbohn, K., & Clarkson, P. (2018). Carbon risk, carbon risk awareness and the cost of debt financing. *Journal of Business Ethics*, *150*(4), 1151-1171.

Falk, R.F., & Miller, N.B. (1992). A primer for soft modeling, University of Akron Press.

Ganda, F., & Milondzo, K.S. (2018). The impact of carbon emissions on corporate financial performance: Evidence from the South African firms. *Sustainability*, *10*(7), 2398.

Gallego Alvarez, I. (2012). Impact of CO_2 emission variation on firm performance. Business Strategy and the Environment, *21*(7), 435-454.

Gallego-Álvarez, I., Segura, L., & Martínez-Ferrero, J. (2015). Carbon emission reduction: The impact on the financial and operational performance of international companies. *Journal of Cleaner Production*,103, 149-159.

Gedik, Y., (2020). Sosyal, ekonomik ve çevresel boyutlarla sürdürülebilirlik ve sürdürülebilir kalkınma. *International Journal of Economics, Politics, Humanities & Social Sciences*, *3*(3), 196-215.

Gonzales-Gonzales, J.M & Ramirez, C.Z. (2016). Voluntary carbon disclosure by Spanish companies: an empirical analysis. *International Journal of Climate Change Strategies and Management*, *8*(1), 57-79.

Güleç, Ö.F., & Bektaş, T. (2019). Karbon muhasebesi ve karbon maliyetlerinin incelenmesi. In XIII. IBANESS Congress Series on Economics, Business and Management, Tekirdağ, 5-6 Ekim 2019, 1010-1022.

Güneysu, Y., & Atasel, O.Y. (2022). Karbon emisyonları ile finansal performans arasındaki ilişkinin incelenmesi: BIST100 endeksinde bir araştırma. *Fırat Üniversitesi Sosyal Bilimler Dergisi*, *32*(3), 1183-1193.

Houqe, M.N., Opare, S., Zahir-Ul-Hassan, M.K., & Ahmed, K. (2022). The effects of carbon emissions and agency costs on firm performance. *Journal of Risk and Financial Management*, *15*(4), 152.

Huber, P.J. (1967). *The behavior of maximum likelihood estimates under nonstandard conditions. proceedings of the fifth berkeley symposium on mathematical statistics and probability* (s.221-223). University of California Press.

Hrasky, S. (2012). Carbon footprints and legitimation strategies: symbolism or action?. *Accounting, Auditing & Accountability Journal*, *25*(1), 174-198.

Kardeş Selimoğlu, S., Poroy Arsoy, A. & Bora Kılınçarslan, T. (2022). Güvence denetiminin unsurları bağlamında uluslararası güvence denetimi standardı 3410'a göre sera gazı beyanlarına ilişkin güvence oluşturulması. *Muhasebe ve Finansman Dergisi*, (95), 21-34.

Kates, R.W., Parris, T.M., & Leiserowitz, A.A. (2005). What is sustainable. *Environment: Science and Policy for Sustainable Development*, *47*(3), 8-21.

Kızıltan, B. & Umut Doğan, D. (2021). Çimento sektöründe karbon ayak izlerinin raporlanması amacıyla bir çerçeve önerisi. *Çağ Üniversitesi Sosyal Bilimler Dergisi*, *18*(1), 40-58.

Klassen, R.D., & Mclaughlin, C.P. (1996). The impact of environmental management on firm performance. *Management Science*, *42*(8), 1199-1214.

Laskar, N., Kulshrestha, N., Bahuguna, P.C., & Adichwal, N.K. (2022). Carbon emission intensity and firm performance: An empirical investigation in Indian context. *Journal of Statistics and Management Systems*, *25*(5), 1073-1081.

Lewandowski, S. (2017). Corporate carbon and financial performance: The role of emission reductions. *Business Strategy and the Environment*, *26*(8), 1196-1211.

Loohuis, D.S. (2022). *The impact of carbon emissions on corporate financial performance*. Master's thesis, University of Twente, Netherlands.

Luo, L., Lan, Y. & Tang, Q. (2012). Corporate incentives to disclose carbon information: evidence from the CDP Global 500 Report. *Journal of International Financial Management & Accounting*, *23* (2), 93-120.

Maaloul, A. (2018). The effect of greenhouse gas emissions on cost of debt: Evidence from Canadian firms. *Corporate Social Responsibility and Environmental Management*, *25*(6), 1407-1415.

Mahapatra, S. (1984). Investor reaction to a corporate social accounting. *Journal of Business Finance & Accounting*, *11*(1), 29-40.

Miah, M.D., Hasan, R., & Usman, M. (2021). Carbon emissions and firm performance: evidence from financial and non-financial firms from selected emerging economies. *Sustainability*, *13*(23), 13281.

Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of Operations Management*, *25*(5), 998-1014.

Nakip, M. (2003). *Pazarlama araştırmaları teknikler ve (SPSS destekli) uygulamalar*, 1. Baskı, Seçkin Yayıncılık, Ankara.

Oral, O., & Uğuz, S. (2020). Türkiye'deki farklı sektörlere ait sera gazı emisyon değerlerinin çok katmanlı algılayıcılar ve topluluk öğrenmesi yöntemleri ile tahmin edilmesi. *International Journal of Engineering Research & Development (IJERAD)*, *12*(2).

Öktem, B. (2020). Sera gazı emisyon muhasebesi ve raporlamasının GRI 305: emisyon standardı çerçevesinde incelenmesi. *Kırklareli Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *9*(2), 186-211.

Özşahin Koç, F., Atalay, E., & Deran, A. (2023). The impact of human resources practices on the financial performance of companies: the analysis of BIST 30 companies. *Karamanoğlu Mehmetbey Üniversitesi Sosyal ve Ekonomik Araştırmalar Dergisi*, *25*(45), 1284-1297.

Özşahin Koç, F., & Deran, A. (2024). Borsa istanbul imalat sektöründe yer alan firmaların borçlanma maliyetlerinin finansal performansa etkisi üzerine araştırma. *Journal of Accounting and Taxation Studies*, *17*(1), 73-98.

Qian, W., Hörisch, J., & Schaltegger, S. (2018). Environmental management accounting and ıts effects on carbon management and disclosure quality. *Journal Of Cleaner Production*, 174, 1608-1619.

Palea, V., & Drogo, F. (2020). Carbon emissions and the cost of debt in the eurozone: The role of public policies, climate related disclosure and corporate governance. *Business Strategy and the Environment*, *29*(8), 2953-2972.

Ratnatunga, J.T. & Balachandran, K.R. (2009). Carbon business accounting: the impact of global warming on the cost and management accounting profession. *Journal of Accounting, Auditing & Finance*, *24*(2), 333-355.

Russo, M.V., & Fouts, P.A. (1997). A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, *40*(3), 534-559.

Russo, A., & Pogutz, S. (2009, August). Eco-efficiency vs eco-effectiveness. exploring the link between ghg emissions and firm performance. *In Academy of Management Proceedings* (*Vol. 2009*, No. 1, pp. 1-6). Briarcliff Manor, NY 10510: Academy of Management.

Simnett, R., & Nugent, M. (2007). Developing an assurance standard for carbon emissions disclosures. *Australian Accounting Review*, *17*(42), 37-47.

Solomon, J.F., Solomon, A., Norton, S.D., & Joseph, N.L. (2011). Private climate change reporting: an emerging discourse of risk and opportunity?. *Accounting, Auditing & Accountability Journal*, *24*(8), 1119-1148.

Spicer, B.H. (1978). Investors, corporate social performance and information disclosure: An empirical study. *Accounting Review*, 94-111.

Sultanoğlu, B. & Özerhan, Y. (2020). İklim değişikliği raporlaması: Türkiye'deki işletmelerin gönüllü karbon saydamlık projesi (CDP) açıklamaları. *Muhasebe Bilim Dünyası Dergisi*, 22, 176-194.

Stanny, E. & Ely, K. (2008). Corporate environmental disclosures about the effects of climate change. *Corporate Social Responsibility and Environmental Management*, *15*(6), 338-348.

Tsai, W.H., Shen, Y.S., Lee, P.L., Chen, H.C., Kuo, L., & Huang, C.C. (2012). Integrating information about the cost of carbon through activity-based costing, *Journal of Cleaner Production*, 36, 102-111.

United Nations Framework Convention on Climate Change (UNFCC). 2008. *Kyoto protocol reference manual on accounting of emissions and assigned amount*. UNFCC: Germany.

Vullinghs, M. (2021). *Examining the impact of carbon intensity on cost of debt: the moderating effects of forward-looking indicators*, Master Thesis, Rotterdam School of Management (Erasmus University) Rotterdam, The Netherlands.

Wang, L., Li, S., & Gao, S. (2014). Do greenhouse gas emissions affect financial performance?–an empirical examination of Australian public firms. *Business Strategy and the Environment*, *23*(8), 505-519.

Wang, Y.C., Feng, Z.Y., & Huang, H.W. (2020). Corporate carbon dioxide emissions and the cost of debt financing: evidence from the global tourism ındustry. *International Journal of Tourism Research*, *23*(1), 56-69.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, (48), 817-838.

Yerdelen Tatoğlu, F. (2020). *Panel veri ekonometrisi*, Beta Yayınları, 5. Baskı, İstanbul.

Zhou, Z., Zhang, T., Wen, K., Zeng, H., & Chen, X. (2018). Carbon risk, cost of debt financing and the moderation effect of media attention: Evidence from Chinese companies operating in high carbon industries. *Business Strategy and the Environment*, *27*(8), 1131-1144.

APPENDIX

Appendix-1: "BIST SI" Company List

"Row"	**"Code"**	**"Company Title"**
"1"	"AKBNK"	"AKBANK T.A.Ş."
"2"	"AKCNS"	"AKÇANSA ÇİMENTO SANAYİ VE TİCARET A.Ş."
"3"	"AKENR"	"AKENERJİ ELEKTRİK ÜRETİM A.Ş."
"4"	"AKSA"	"AKSA AKRİLİK KİMYA SANAYİİ A.Ş."
"5"	"AKSEN"	"AKSA ENERJİ ÜRETİM A.Ş."
"6"	"ALBRK"	"ALBARAKA TÜRK KATILIM BANKASI A.Ş."
"7"	"AEFES"	"ANADOLU EFES BİRACILIK VE MALT SANAYİİ A.Ş."
"8"	"ARCLK"	"ARÇELİK A.Ş."
"9"	"ASELS"	"ASELSAN ELEKTRONİK SANAYİ VE TİCARET A.Ş."
"10"	"AYGAZ"	"AYGAZ A.Ş."
"11"	"BIZIM"	"BİZİM TOPTAN SATIŞ MAĞAZALARI A.Ş."
"12"	"BRISA"	"BRİSA BRIDGESTONE SABANCI LASTİK SANAYİ VE TİCARET A.Ş."
"13"	"CCOLA"	"COCA-COLA İÇECEK A.Ş."
"14"	"CIMSA"	"ÇİMSA ÇİMENTO SANAYİ VE TİCARET A.Ş."
"15"	"DOAS"	"DOĞUŞ OTOMOTİV SERVİS VE TİCARET A.Ş."
"16"	"ENKAI"	"ENKA İNŞAAT VE SANAYİ A.Ş."
"17"	"EREGL"	"EREĞLİ DEMİR VE ÇELİK FABRİKALARI T.A.Ş."
"18"	"FROTO"	"FORD OTOMOTİV SANAYİ A.Ş."
"19"	"SAHOL"	"HACI ÖMER SABANCI HOLDİNG A.Ş."
"20"	"KERVT"	"KEREVİTAŞ GIDA SANAYİ VE TİCARET A.Ş."
"21"	"KCHOL"	"KOÇ HOLDİNG A.Ş."
"22"	"KORDS"	"KORDSA TEKNİK TEKSTİL A.Ş."
"23"	"LOGO"	"LOGO YAZILIM SANAYİ VE TİCARET A.Ş."
"24"	"MGROS"	"MİGROS TİCARET A.Ş."
"25"	"OTKAR"	"OTOKAR OTOMOTİV VE SAVUNMA SANAYİ A.Ş."
"26"	"POLHO"	"POLİSAN HOLDİNG A.Ş."
"27"	"SKBNK"	"ŞEKERBANK T.A.Ş."
"28"	"SOKM"	"ŞOK MARKETLER TİCARET A.Ş."
"29"	"TOASO"	"TOFAŞ TÜRK OTOMOBİL FABRİKASI A.Ş."
"30"	"TCELL"	"TURKCELL İLETİŞİM HİZMETLERİ A.Ş."
"31"	"TUPRS"	"TÜPRAŞ-TÜRKİYE PETROL RAFİNERİLERİ A.Ş."
"32"	"THYAO"	"TÜRK HAVA YOLLARI A.O."
"33"	"GARAN"	"TÜRKİYE GARANTİ BANKASI A.Ş."

“34”	“HALKB”	“TÜRKİYE HALK BANKASI A.Ş.”
“35”	“ISCTR”	“TÜRKİYE İŞ BANKASI A.Ş.”
“36”	“TSKB”	“TÜRKİYE SINAİ KALKINMA BANKASI A.Ş.”
“37”	“SISE”	“TÜRKİYE ŞİŞE VE CAM FABRİKALARI A.Ş.”
“38”	“VAKBN”	“TÜRKİYE VAKIFLAR BANKASI T.A.O.”
“39”	“ULKER”	“ÜLKER BİSKÜVİ SANAYİ A.Ş.”
“40”	“YKBNK”	“YAPI VE KREDİ BANKASI A.Ş.”
“41”	“ZOREN”	“ZORLU ENERJİ ELEKTRİK ÜRETİM A.Ş.”

Source: “Public Disclosure Platform (2023)”