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Relationship Between Firm Sustainability Performance and Its Labor Productivity: An Empirical Study on Turkish Firms

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Abstract

This study aims to empirically investigate the relationships of economic, social, and environmental sustainability, calculated based on the scoring system in the United Nations Environment Program Sustainability Criteria report, on labor productivity. For this purpose, the relationships of the economic, social, and environmental sustainability scores of 32 firms in Türkiye in the 2015-2019 period on labor productivity are analyzed econometrically with the Multilevel Mixed Regression Model (MMR). The findings obtained in all models estimated in the study show that the economic, social, and environmental sustainability scores of 32 firms operating in Türkiye have a positive and statistically significant relation with labor productivity during the study period. In this context, the widespread use of sustainability reporting, the economic, social, and environmental reflection of the concept of sustainable development at the firm level, would enable firms to operate as sensitive and solution-producing entities to the problems of society and increase their competitiveness and profitability with the increase in labor productivity.

Keywords: ***Labor Productivity, Sustainability, Multilevel Mixed Regression.***

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1. INTRODUCTION

The concept of sustainable development reflects the increasing environmental problems today that threaten human existence in the development literature. In general terms, the concept of sustainable development, introduced at the United Nations Conference on Human Development and Environment held in Stockholm in 1972, can be defined as meeting the needs of today in a way that does not take away the possibilities of meeting the needs of future generations. The introduction of sustainable development, which has economic, social, and environmental dimensions to the business world, became a reality at the end of the 1980s. Within this scope, firms are expected not only to be institutions that make a profit by producing and selling goods and services but also to operate as entities that are sensitive to society's problems and produce solutions. Corporate sustainability is defined as a new approach that reveals the role of firms in sustainable development. The concept above reveals the necessity for firms to undertake social, economic, environmental, and financial responsibilities (Engin and Akgöz, 2013).

This process, which started with Corporate Sustainability Reporting (CSR), continues with the concept of Triple Bottom-Line Reporting (TBL) developed by Elkington (1997). TBL (same as sustainability reporting) has three dimensions: economic, social, and environmental, which are calculated based on the scoring system in the "United Nations Environment Program Sustainability Criteria" (UNEP/SustainAbility, 1996) report. Today, the importance of TBL emerges considering that not only economic but also social and environmental information is requested from firms, and when stakeholders make their decisions on issues such as investment, partnership, and purchasing within the framework of economic data as well as social and environmental information (Şendurur and Karacaer, 2017).

This study attempts to empirically investigate the relationships of economic, social, and environmental sustainability, calculated based on the scoring system in the United Nations Environment Program Sustainability Criteria report, on labor productivity. For this purpose, the relationships of the economic, social, and environmental sustainability scores of 32[1] firms operating in 6 different sectors in Türkiye in the 2015-2019 period[2] on labor productivity are analyzed econometrically with the Multilevel Mixed Regression Model (MMR). The study contributes to the literature on the relationship between sustainability performance and firms' labor productivity in two ways. First, it applies the Multilevel Mixed Regression Model (MMR). Second, this study uses the TBL scoring system to calculate firms' sustainability performance with their economic, social, environmental and total dimensions by allowing firms to reveal their economic, environmental, social, and overall sustainability performances.

In line with the above objective, the following sections of the first part of the study introduce sustainability reporting in Türkiye, provide a review of the empirical literature, introduce the data set

[1] There are only 32 firms in Türkiye that consistently report on sustainability at the time of the research.
[2] After 2019, Türkiye entered a period dominated by high inflation. These periods were chosen so that the effects of high inflation would not affect the results of the study.

and methodology to be used in the study, and present the empirical findings. The study concludes with a final section where empirical findings are discussed and policy recommendations are presented.

2. SUSTAINABILITY REPORTING IN TÜRKİYE

The concept of "Sustainability Reporting" has been placed on the agenda of firms in the international context in recent years. As in many countries, the importance of sustainability reporting has increased in Türkiye and started to be implemented over the past decade. Especially to comply with the European Union standards since 2005, firms have begun to prepare a CSR and to voluntarily provide information about the social and environmental activities of the firm in their annual reports.

With the increasing importance of sustainability reporting, sustainability indices have been developed in the world stock markets. In Türkiye, the BIST Sustainability Index has been calculated since 2014. If they meet the criteria, they can be included in the sustainability index from the beginning of the next quarter. 329 of the 395 sustainability reports from 119 organizations in Türkiye until 2022 were prepared following the Global Reporting Initiative (GRI) sustainability standards (Eski, 2023).

Although no direct indicator demonstrates Türkiye's place in the world in terms of sustainability reporting, we might have an idea about the subject by examining the sustainable development report (SDR), which includes sustainability reporting indicators. According to the data of the SDR, which includes all the sustainability reporting criteria, Türkiye ranks 71st among 163 countries in terms of sustainability. While Türkiye has achieved its goal in 4 of the 17 sustainable development instruments, it has made progress in 7 of them and has remained stagnant in 6 (SDR, 2022).

The fact that the pressure of non-governmental organizations in Türkiye is relatively low, the amount of foreign direct investment is low, the majority of firms belong to families and large groups and the lack of transparency and accountability as a result of the low share of the public in firms cause the concept of sustainability reporting to be adopted by firms late. The main reasons why firms in Türkiye give more importance to sustainability reporting activities are their desire obligation to engage in activities outside of their traditional commercial activities to gain an edge in the face of increasing competition and their obligation to comply with European Union criteria as a result of firms' desire to be included in the European market and Corporate Governance Principles, which Capital Markets Board updated in 2005 after it was published in 2003 (Van Het Hof, 2009). Although importance has been given to sustainability in Türkiye in recent years, the number of firms that regularly report on sustainability is low.

3. LITERATURE REVIEW

The empirical literature examining the effects of corporate sustainability reporting on firms generally focuses on firm performance and firm value. (Reddy and Gordon, 2010; Bachoo et al., 2012; Loh et al., 2017; Bartlett, 2012; Kasbun et al., 2016; Nnamani et al., 2017; Ching et al., 2017; Horwath, 2017; Laskar, 2018; Swarnapali and Le, 2018; Önder, 2018; Ece and Sarı, 2020). The empirical findings

obtained in these studies generally reveal that corporate sustainability reporting has positive and significant effects on firms' performance and values.

Some of the studies within the scope of this study examine the effects of corporate sustainability reporting on labor productivity. Labor productivity is defined as an important organizational outcome that shows how efficiently a firm's labor force creates output (Delmas and Pekovic, 2013). In this context, while some studies focus on the relationship between labor productivity as a dimension of competitiveness (Wu, 2006; Stuebs and Sun, 2009; Vilanova et al., 2009; Wood, 2010), some other studies have investigated the relationship between corporate social responsibility and labor productivity (Podolny, 1993; Barney and Hansen, 1994; Fombrun, 1996; Greening and Turban, 2000; Heal, 2005; Porter and Kramer, 2002 ; Roberts and Dowling, 2002 ; Schreck, 2011; Stuebs and Sun, 2010). These studies generally reveal that there is a positive relationship between firms' corporate social responsibility performance and labor productivity.

The related literature shows that this result is due to the positive effect of corporate social responsibility performance on the relationship between the firm and its employees. It is stated that firms with better corporate social responsibility performance are more successful in recruiting, maintaining and motivating their employees compared to firms with poor performance, and therefore, the productivity of employees is also high in these firms where employee satisfaction is higher (Heal, 2005; Schreck, 2011). In another group of studies within the scope of the study, the relationship between the firm’s environmental, social and governance performance and labor productivity is investigated. In these studies, it is concluded that firms that adopt environmental standards have higher labor productivity. This higher labor productivity is thought to be due to the increased training resulting from the adoption of environmental standards as well as the increased commitment of employees to the firm (Lichtenberg, 1981; Bartel, 1994; Delmas and Pekovic, 2012; Lannelongue et al., 2017).

4. DATA

Labor productivity, the dependent variable, is frequently used in the literature to measure firm performance (Woo et al., 2014). With the increase of globalization and competition between firms today, the effect of labor productivity on the profitability of firms in domestic and foreign markets is becoming increasingly important. The reason of the low unit costs and the increase of competitiveness of firms is high labor productivity. Hence, there is quite an extensive applied literature investigating the determinants of labor productivity (Papadodonas and Voulgaris, 2005).

Within this scope, in the study in which the relationship between sustainability performance and labor productivity at the firm level in Türkiye was investigated; labor productivity (Padagonas and Volugaris, 2005; Falahi et al., 2010; Sánchez and Benito-Hernández, 2015; Kouamé and Tapsoba, 2019; Lannelonguel et al., 2017; Ma et al., 2020), capital intensity (Fallahi et al., 2010; Barrymore and Sampson, 2021), firm size (Delmas and Pekovic, 2013; Kouamé and Tapsoba, 2019), firm age

(Padagonas and Volugaris, 2005; Ma et al., 2020; Kouamé and Tapsoba, 2019), vocational education (Medoff, 1982; Lynch and Black, 1998; Sala and Silva, 2013), wage (Fallahi et al., 2010; Delmas and Pekovic, 2013), R&D expenditures (Sánchez and Benito-Hernández, 2015; Barrymore and Sampson, 2021; Ma et al., 2020), business profile (Hackston and Milne, 1996; Choi, 1999; Patten, 1992), export (Fallahi et al., 2010; Kouamé and Tapsoba, 2019), holding (Delmas and Pekovic, 2013) variables and the economic, social, environmental and total sustainability scores of firms, which are frequently used in the literature, are used as dependent and independent variables, respectively.

Among the control variables used in this study, which investigates the relationship between sustainability performance and labor productivity at the firm level in Türkiye, it is seen in the literature that capital intensity, firm size, firm age, vocational training, wages and R&D expenditures are among the important factors affecting labor productivity. In this context, capital intensity (Barrymore and Sampson, 2021), firm size (Pfeffer and Langton, 1993; Zwick, 2004; Ma et al. 2020), firm age (Dunne and Hughes, 1994; Jensen et al, 2001; Ma et al. 2020), the level of vocational training (Medoff, 1982; Lynch and Black, 1998; Sala and Silva, 2013), above-market wage rates (Fallahi et al., 2010), and the level of R&D expenditures that determine the firm's capacity to innovate (Kurt and Kurt , 2015) are expected to have a positive relationship with labor productivity. Other control variables affecting labor productivity are used as dummy variables in the analysis. Among these variables, the business profile variable is used as control variables in the analysis because higher labor productivity is found in firms that are assumed to have more intensive relations with the environment due to their core business (Stray and Ballantine, 2000; Ho and Taylor, 2007), the holding variable due to the positive effect of being part of a holding firm on labor productivity through economies of scale (Zwick, 2004), and the export variable due to the fact that export-oriented firms tend to have higher labor productivity in order to compete internationally (Eriksson and Jacoby, 2003). The definitions of the dependent and independent variables in question are shown in Table 1.

The criteria to be used to calculate the TBL scores in the annual reports of the firms were determined by examining the GRI 4 Sustainability Reporting Guidelines and previous studies in the literature (Suttipun, 2012; Ho and Taylor, 2007; Slaper and Hall, 2011). Looking at the world examples, it is seen that the number of firms reporting according to GRI 4 is not yet at the desired level even in developed countries. When the annual reports of BIST100 firms were examined when the study was considered to be conducted, it was observed that the criteria used in GRI 4 and previous studies in the literature were very detailed and most of the criteria were not included in the annual reports examined firms. The fact that Türkiye is a developing country and the concept of TBL is just beginning to be understood may play an important role in this phenomenon. For this reason, when selecting the criteria used in calculating the TSP scores, items that require a very detailed explanation were eliminated and items that constitute the main headings were included. There are 21 criteria in total, 7 criteria from each category to calculate the economic, social and environmental scores. The total score to be obtained from

these 21 criteria gives us the total TSP score. These 21 criteria used to calculate the TBL scores are consistent with previous studies in the literature (Ho & Taylor, 2007; Suttipun, 2012). A total of 21 economic, environmental and social criteria, 7 criteria in each category, are detailed in Appendix 1. The data collected in the study were collected twice by the same researcher at different times.

Table 1. Variables Used in Analysis and Their Definitions

Variables	**Definitions of Variables**
FLP (Labor Productivity)	Log (Net Sales / Number of Employees)
FCI (Capital Intensity)	Log (Assets / Number of Employees)
FS (Firm Size)	Log (Number of Employees)
FA (Firm Age)	LogFA (Firm Age)
FE (Vocational Education)	Log (Training Hour / Number of Employees)
FW (Wage)	Log (Total Wage / Number of Employees)
FRD (R&D Expenditures)	Log (R&D Expenditures)
FP (Business Profile)	Dummy Variable – Low (0) / High (1)
FEX (Export)	Dummy Variable – No (0) / Yes (1)
FHL (Holding)	Dummy Variable – No (0) / Yes (1)
ESP (Economic Sustainability Point)	TBL Scoring System
SSP (Social Sustainability Point)	
CSP (Environmental Sustainability Point)	
TSP (Total Sustainability Point)	

The calculation of the economic, environmental, social, and total dimensions of the firms and their sustainability scores are based on the scoring system in the "United Nations Environment Program Sustainability Criteria" report, which Jones and Alabaster (1999) stated as the most reliable scoring system. The above scoring system, a score ranging from 0 to 4, is given by analyzing firms' annual and sustainability reports. Within this scope, 0, the lowest score, is given if the firm does not explain that criterion, and 4, the highest score, is given if the firm makes a detailed explanation about that criterion referring to sustainability. Thus, if the firm makes a minimal explanation about the criterion and has little detail, it is evaluated as 1 point; if the firm makes an honest and detailed explanation, including the deficiencies and commitments of the firm, it is evaluated as 2 points, and if the firm makes an explanation covering the developments about its main field of activity and the responsibilities of the firms for its sustainability, it is evaluated as 3 points and if the firm makes an explanation covering the developments about the main field of activity for the sustainability of the firm and the responsibilities of the business within the scope of TBL and comparing with the best for the competition, it evaluated

as 4 points. The scoring criteria for the TBL scoring system, which is the basis for the calculation of the sustainability scores of the firms in the study, are shown in Table 2.

Table 2. TBL Scoring System

Score	Definitions
0 Point	No explanation was given.
1 Points	Minimal explanation and little detail.
2 Points	Making an honest, detailed explanation, including the firm's deficiencies and commitments.
3 Points	Making an explanation covering the developments about the main field of activity for the firm's sustainability and the business's responsibilities.
4 Point	Making an explanation covering the developments about the main field of activity for the sustainability of the firm and the responsibilities of the business within the scope of TBL and comparing with the best for the competition.

Source: UNEP/SustainAbility (1996), Suttipun (2012).

The dependent variable is labor productivity, and the independent variables are capital density, firm size, firm age, vocational education[3], wages, R&D expenditures, business profile, exports, holding. Data on the variables of economic, social, environmental, and total sustainability scores of firms are obtained by compiling from the annual reports, sustainability reports, websites and financial statements of the relevant firms. Data is publicly accessible and covers the period of 2015-2019.

This study uses independent control variables such as business profile, export, and holding as dummy variables. The export variable indicates whether that business exports or not, and the holding variable indicates whether that firm is a holding or not. Business profile, another dummy variable, is divided into low (0) and high (1) (Hackston and Milne, 1996; Choi, 1999; Patten, 1992). Due to the main activity of their businesses, high-profile firms are assumed to have more intense relations with the environment, while low-profile businesses are the opposite[4] (Stray and Ballantine, 2000; Ho and Taylor, 2007). Except for the said dummy variables, the natural logarithmic values of all other variables during the examination period are used in the models. Descriptive statistics, including the number of observations, mean, standard deviation, and minimum and maximum values of the mentioned variables, are shown in Table 3.

[3] According to our observations, the training of most of the firms that provide vocational training consists of compulsory training within the firm such as occupational health and safety rather than training that will improve their profession.
[4] High-profile firms are mostly from industries such as manufacturing, electricity, gas and water, and mining, while low-profile firms operate in sectors such as finance, technology, wholesale and retail trade, hotels and restaurants, construction and public works and transportation, communications and warehousing.

Table 3. Descriptive Statistics of Variables

Variables	Number of Observations	Mean	Standard Deviations	Min.	Max.
FLP (Labor Productivity)	160	0.01	1.32	-5.47	2.70
FCI (Capital Intensity)	160	1.22	1.31	-1.85	4.31
FS (Firm Size)	160	8.74	1.44	5.32	11.47
FA (Firm Age)	160	3.89	0.45	2.89	4.55
FE (Vocational Education)	160	3.49	0.61	2.23	5.38
FW (Wage)	160	3.13	1.97	-7.81	2.50
FRD (R&D Expenditures)	160	1.64	2.24	-4.61	7.69
FP (Business Profile)	160	0.37	0.48	0	1
FEX (Export)	160	0.03	0.17	0	1
FHL (Holding)	160	0.06	0.24	0	1
ESP (Economic Sustainability Point)	160	2.94	0.09	2.77	3.00
SSP (Social Sustainability Point)	160	2.79	0.07	2.48	2.83
CSP (Environmental Sustainability Point)	160	2.81	0.03	2.64	2.83
TSP (Total Sustainability Point)	160	3.95	0.05	3.76	3.99

Note: All data are obtained by compiling from the annual reports, sustainability reports, websites, and financial statements of the sample firms. Data are public. Data cover the period of 2015-2019. All data are logarithmic to ensure normality. Descriptive statistics are given as 5-year averages. The annual display of descriptive statistics is in Appendix 3.

When Table 3 is analyzed, the variables with the highest and lowest mean values among the variables without dummy variables are FS (8.74) and FLP (0.01), respectively. In this framework, when the data are analyzed in terms of standard deviation, which expresses the difference between minimum and maximum values, the variables with the highest and lowest values are FRD (2.24) and FA (0.61), respectively. In Table 3, regarding sustainability variables, TSP (3.95) and SSP (2.81) variables have the highest and lowest mean values, respectively. In terms of standard deviation within the sustainability variables, ESP (0.09) and TSP (0.05) variables have the highest and lowest values, respectively.

In the study, 32 firms whose data can be accessed during the review period covering 2015-2019 are divided into six subgroups according to the sectors they belong to. Since most of the listed firms did not publish a sustainability report before 2015, the firms in the study are limited to 32, and the starting year is 2015. Relevant firms and their sectors are shown in Table 4.

Table 4. Firms Sectors[5] and Sector Distributions

Firm Codes	Sectors	Firm Codes	Sectors
AKENR	E	THL	M
AKBNK	M	TIB	M
AKCNS	I	KCHOL	M
AKSA	I	KORDS	I
AKSEN	E	OTKAR	I
AEFES	I	SAHOL	M
ARCLK	I	SISE	M
ASELS	T	THYAO	U
AYGAZ	I	TOASO	I
BRISA	I	TSK	M
CCOLA	I	TCELL	U
CIMSA	I	TUPRS	I
DOAS	TP	ULKER	I
EREGL	I	TVB	M
FROTO	I	YKB	M
TGB	M	ZOREN	E
	Sectors	Sector Distributions (%)	
	E	9.4	
	I	46.8	
	T	3.1	
	TP	3.1	
	M	31.3	
	U	6.3	

Note: E, Electricity, Gas, and Water; I, Manufacturing; T, technology, TP, Wholesale and Retail Trade, Restaurants, and Hotels; M, Financial institutions; U, Transportation, Storage, and Communication, which are shown in the sectors columns in the table, represent the sectors.

5. METHODOLOGY

In the present study, which aims to investigate the relationship between sustainability and labor productivity at the firm level, The Multilevel Mixed Regression Model (MMR) is used as the empirical method. In this context, firms operating in the same country share similar contextual characteristics in terms of factors affecting their productivity, such as institutional framework, macroeconomic conditions, sectoral structure, etc. Standard econometric methods in the literature ignore such contextual features that have a direct impact on firm productivity, which may produce downward standard errors (Kouamé and Tapsoba, 2019, pp. 161-162). Therefore, in order to overcome the challenges of incorporating such firm-level contextual characteristics into the data structure, this study employs the Multilevel Mixed Regression Model (MMR).

The Multilevel Mixed Regression Model (MMR), developed to be used in models where units and data are in a contextual structure, as in panel data analysis, allows simultaneous relationships

[5] The firms whose ticker symbols are given in the table are displayed in the Appendix 2.

between variables by considering the hierarchical units and level of the panel. In the MMR model, the existence of an average correlation between hierarchical panel units and their data is taken into account. In Ordinary Least Squares (OLS) method, low and biased standard error, problems causing spurious regression, R^2, potential internality, etc. problems can be eliminated (Hox et al., 2018, p. 4). Unlike the standard OLS, the MMR model assumes that the hierarchical panel units and data are not independent from each other by allowing the slope parameter to vary across units, thus accounting for contextual relationships in the data structure and capturing heterogeneity across units (Stevens, 2009, pp. 505-507). Moreover, in the MMR model, the effects of negligible variables in simultaneous relationships can be controlled by fixing the hierarchical units of the panel in the form of country, region, sector, etc. and the data in the form of month, year, etc. In the MMR model, fixing the units and data in the hierarchical structure of the panel not only controls for the effects of omitted variables but also allows the model to examine the effects of changes in demand conditions and supply structure (Kouamé and Tapsoba, 2019 p. 162). In the study, the two-level and most general form of the MMR model is estimated to examine the relationships of firm sustainability on productivity at the highest level and industries at the lowest level based on regression equations 1 and 2:

Level 1: $$LP_{ist} = \alpha_0 + \beta FS_{ist} + \eta X_{ist} + \varepsilon_{ist} \quad (1)$$

Level 2: $$\alpha_{0st} = \alpha_{00t} + \vartheta_{st}, \vartheta_{st} \sim N(0, \delta^2), \vartheta_{st} \perp \varepsilon_{ist} \quad (2)$$

Of the terms in the equation, (i) and (s) indicate the hierarchical units of the panel in the form of firms, sectors and countries, respectively, while (t) denotes the values of the data of these units in a given year. The terms (LP_{ist}) and (FS_{ist}) indicate the productivity level and sustainability score, respectively, of the firm (i) in the sector (s) in the year (t), while the term (X_{ist}) indicates the set of control variables consisting of individual and structural characteristics of firms (i) in the sector (s) in the year (t) and α refers to the constant term. Finally, the term (ε_{ist}) in the equation shows the normal distribution $(\varepsilon_{ist} \sim N(0, \sigma^2))$ and the error term belongs to the firms. When equations 1 and 2 above are combined, the basic form of the two-level MMR model can be written as shown in equation 3 (Hox et al. 2018, pp. 71-80):

$$LP_{isct} = \alpha_{00t} + \beta FS_{ist} + \eta X_{ist} \quad (3)$$

Since the equation includes firm, sector, and year relationships, it allows examining the relationships of model firm sustainability on productivity, which vary according to firms and sectors.

6. RESULTS

The study aims to investigate the relation between sustainability scores of selected firms in Türkiye calculated with the TBL scoring system in terms of economic, environmental, social, and total dimensions and labor productivity with the Multilevel Mixed Regression Model (MMR) for the period 2015-2019. Within this scope, the estimation results of the model are shown in Table 5.

Table 5. Multilevel Mixed Regression Model Estimation Results

Dependent Variable: Labor Productivity (FLP)								
Variables	**Model-1**		**Model-2**		**Model-3**		**Model-4**	
	CE	**SE.**	**CE**	**SE.**	**CE**	**SE.**	**CE**	**SE.**
FCI	0.7018[a]	0.0021	0.7182[a]	0.0021	0.7152[a]	0.0021	0.7092[a]	0.0021
FS	0.3123[a]	0.0041	0.3491[a]	0.0041	0.3512[a]	0.0040	0.3459[a]	0.0040
FA	1.0124[a]	0.0152	0.8982[a]	0.0160	0.9196[a]	0.0151	0.8840[a]	0.0151
FE	-0.0456[a]	0.0012	-0.0501[a]	0.0012	-0.0527[a]	0.0012	-0.0484[a]	0.0012
FW	0.2806[a]	0.0017	0.2771[a]	0.0017	0.2789[a]	0.0017	0.2779[a]	0.0017
FRD	0.0027[a]	0.0005	0.0054[a]	0.0005	0.0056[a]	0.0005	0.0049[a]	0.0005
FP	-9.1650[a]	1.7378	-8.2367[a]	1.5013	-8.8312[a]	1.6395	-10.3939[a]	2.0172
FEX	-4.7102	5.4588	-3.8126	4.7424	-4.3846	5.1784	-6.0121	6.3722
FHL	0.5164	4.2281	0.4862	3.6732	0.4800	4.0108	0.4605	4.9354
ESP	0.3741[a]	0.0109	—	—	—	—	—	—
SSP	—	—	0.0911[a]	0.0117	—	—	—	—
CSP	—	—	—	—	0.2712[a]	0.0165	—	—
TSP	—	—	—	—	—	—	0.6403[a]	0.0193
R^2	0.436		0.436		0.437		0.439	
Observations	322,720		322,720		322,720		322,720	

Note: The terms "CE." and "SE." in the table indicate the coefficients and standard errors of the variables; the symbols "a," "b," and "c" denote that the t-statistics of the coefficients are significant at the 1%, 5%, and 10% significance level, respectively. All model estimates include firm, industry, and year-fixed relationships; weights are used and standardized to compare across firm sustainability.

Table 5 suggests that the relation between the sustainability performances of firms, calculated with economic (ESP), environmental (CSP), social (SSP), and total (TSP) dimensions, and labor productivity (FLP) is positive and significant at the 1 percent level of significance in all models of the study. These results, in line with the literature (Sánchez and Benito-Hernández, 2015), show that sustainability performance is an important determinant of labor productivity for selected firms in Türkiye during the review period. According to these results, labor productivity increases as firms consider sustainability. However, when the findings in Table 5 are examined, it is seen that sustainability performance variables are ranked as (TSP), (ESP), (CSP) and (SSP) in terms of the magnitude of their effects on labor productivity (FLP), which are significant at 1% significance level. On the one hand, these results show that sustainability performance with its economic, environmental, social and aggregate dimensions increases the labor productivity of selected firms in Türkiye, while on the other hand, it reveals that the effects of sustainability performance on labor productivity of firms are mostly in the aggregate and least in the social dimension.

Besides, the results show that the capital intensity (FCI), firm size (FS), firm age (FA), wage (FW), R&D expenditure (FRD) independent variables, used as control variables in the model, also have a positive and 1 percent significant relation with labor productivity, in line with the literature (Papadogonas and Voulgaris, 2005, Fallahi, 2010, Kouamé and Tapsoba, 2019, Ma and Yin, 2020). Accordingly, labor productivity also increases as capital intensity, firm size, firm age, wages, and R&D investments increase.

Multilevel Mixed Regression Model Estimation results show that coefficient estimates of Vocational Education (FE) and Business Profile (FP) are significantly negative at 1%. Studies that have concluded that education harms labor productivity are found in the relevant literature (Fallahi, 2010; Sánchez and Benito-Hernández, 2015). In the mentioned studies, the relationships between the training given by the firms to their employees can only be seen in the long term, and the training of the employees should be coordinated with the business needs of the individuals. Information obtained from the annual and sustainability reports of the firms included in the study shows that the said firms mainly provided training on occupational health and safety, etc., to their employees during the review period. Within this scope, the study's results on the relationship between education and labor productivity are compatible with the literature. In the study, low-profile firms have higher TBL scores than high-profile firms. This result contradicts previous literature suggesting that high-profile businesses should have higher TBL scores. Yet, when the low-profile firms are examined in detail, they have high market values and are older businesses. Hence, the results of this study in this direction are in line with previous studies (Cowen et al., 1987; Choi, 1999; Suttipun, 2012) that argue that businesses with a higher market value and age and, therefore, a higher reputation has more social and environmental explanations.

According to the final estimation results, the relationship between the variables of export (FEX), holding (FHL) and labor productivity is negative and positive, respectively, but are insignificant. According to these results, there is no relationship between whether capital firms export or not and whether they are holdings and labor productivity.

7. CONCLUSION AND POLICY RECOMMENDATIONS

The concept of sustainable development reflects the increasing environmental problems today that threaten human existence in the development literature. The introduction of sustainable development, which has economic, social, and environmental dimensions to the business world, became a reality at the end of the 1980s. Within this scope, firms are not defined as institutions that only profit by producing and selling goods and services. Nevertheless, they are expected to operate as firms sensitive to society's problems and produce solutions. In line with society's and stakeholders' desires in the mentioned change process, the reporting system has witnessed a process of change and development. The process starts with Corporate Social Responsibility Reporting (CSR) and continues with the concept of Sustainability Reporting.

In this sense, labor productivity is defined as an important organizational result that shows how efficiently a firm’s workforce creates output; the relationship between the sustainability performance of firms and labor productivity has been investigated in the applied literature. It is stated that firms with better sustainability performances are more successful in hiring, retaining, and motivating employees compared to firms with poor performance. Therefore, the employees' productivity is higher in these firms where the employees' satisfaction is higher. In the mentioned studies, it is argued that there is a

positive relationship between the sustainability performances of firms and labor productivity. Within this scope, the study aims to investigate the relation between sustainability scores of selected firms in Türkiye calculated with the TBL scoring system in terms of economic, environmental, social, and total dimensions and labor productivity with the Multilevel Mixed Regression Model for the period 2015-2019. Multilevel Mixed Regression Model Estimation Results show that the relationship between sustainability performances calculated with economic, environmental, social, and total dimensions and labor productivity is positive and significant at the 1 percent significance level.

The findings of this study reveal a positive and significant relationship between sustainability performance and labor productivity. In particular, economic (ESP), environmental (CSP), social (SSP) and total (TSP) sustainability dimensions all have a significant impact on labor productivity (FLP) at 1% significance level (Sánchez and Benito-Hernández, 2015). These results suggest that as the importance given to sustainability increases, labor productivity will also increase. However, the higher impact of TSP than the other dimensions (ESP, CSP and SSP) emphasizes that firms' collective assessment of their sustainability performance has a stronger impact on productivity. Moreover, control variables such as capital intensity (FCI), firm size (FS), firm age (FA), wages (FW) and R&D expenditures (FRD) also have positive and significant effects on labor productivity, which is in line with the findings in the literature (Papadogonas and Voulgaris, 2005; Fallahi, 2010; Kouamé and Tapsoba, 2019; Ma and Yin, 2020). Moreover, the significant negative association of vocational training (VT) and job profile (JP) variables with labor productivity suggests that the effects of training programs should be observed in the long run and that training should be aligned with employees' business needs (Fallahi, 2010; Sánchez and Benito-Hernández, 2015). Moreover, low-profile firms have higher TBL scores, which can be explained by the fact that they are older firms with higher market capitalization, which is in line with previous studies (Cowen et al., 1987; Choi, 1999; Suttipun, 2012). The results reveal that independent variables such as exports (FEX) and holding (FHL) show negative and positive relationships with labor productivity, but these relationships are not significant. In light of these findings, it is recommended that firms consider their sustainability strategies more integrated, taking into account all sustainability dimensions rather than only environmental or social performance. Moreover, aligning employee training programs with workforce productivity and firm needs can maximize the impact of training processes on long-term productivity. In future studies, it would be useful to examine the relationship between training and sustainability performance in more depth and to increase the generalizability of these findings by researching on different sectors and firm scales. Moreover, examining the effects of sustainability performance on labor productivity over a wider time period may help us better understand the long-term effects of education and R&D investments.

The results of the study reveal important evidence that sustainability performance is an important determinant of labor productivity as an indicator of firm performance during the review period for selected firms in Türkiye. In this context, the widespread use of sustainability reporting, which is the

economic, social, and environmental reflection of the concept of sustainable development at the firm level, will enable firms to operate as sensitive and solution-producing entities to the problems of the society, as well as to increase their competitiveness and profitability with the increase in labor productivity. In this context, the positive impact of sustainability performance on labor productivity allows firms fulfill their environmental and social responsibilities and make their business processes more efficient. Therefore, making sustainability reporting more transparent and focusing more on sustainability criteria may contribute to firms' efforts to increase labor productivity. In addition, firms need to promote long-term sustainable growth rather than focusing only on short-term profitability targets. This will be a critical strategy to both meet society's expectations and gain competitive advantage (Papadogonas and Voulgaris, 2005; Sánchez and Benito-Hernández, 2015; Kouamé and Tapsoba, 2019).

While this study has made important contributions to understanding the relationship between sustainability and labor productivity, research in this area needs further sectoral deepening. Future studies should examine in more detail the impacts of sustainability strategies on labor productivity across different industries. In particular, the potential impacts of technological developments such as digitalization and artificial intelligence on the workforce should also be explored. Furthermore, future research could include variables such as organizational culture, leadership styles and internal communication in addition to the variables used in this study (Norris and O'Leary, 2020; Jordan et al., 2021). Such research will help us to understand the interaction between sustainability and labor productivity more comprehensively. Based on the study findings, these results and findings can provide guidance for policy makers and firm managers, particularly those seeking to improve and understand the relationship between sustainability performance and labor productivity.

Ethics Committee approval was not required for this study.

The authors declare that the study was conducted in accordance with research and publication ethics.

The authors confirm that no part of the study was generated, either wholly or in part, using Artificial Intelligence (AI) tools.

The authors declare that there are no financial conflicts of interest involving any institution, organization, or individual associated with this article. Additionally, there are no conflicts of interest among the authors.

The authors affirm that they contributed equally to all aspects of the research.

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Appendix 1. TBL Scoring Criteria

TBL Scoring Criteria	
Economic Statements	
• Size and profitability • Product and service analysis • Dividend distribution • Taxes	• Employee benefits • Size of major investments • R&D investments
Social Explanations	
• Corporate participation in philanthropic activities • Employee training • Anti-bribery policies • Awards related to social performance	• Employee benefits • Customer privacy policies • Human rights policies
Environmental Disclosures	
• Incorporating environmental concerns into business decisions • Supporting renewable energy consumption • Information on reused or recycled materials • Water usage information	• Waste management • Environmental rewards • Environmental impact of the lead product and service

Appendix 2. List of Firms Used in the Study

No.	**Firm Code**	**Firm Name**
1.	AKENR	Akenerji Elektrik Üretim A.Ş.
2.	AKBNK	Akbank
3.	AKCNS	Akçansa Çimento Sanayi ve Çimento A.Ş.
4.	AKSA	Aksa Akrilik Kimya Sanayi A.Ş.
5.	AKSEN	Aksa Enerji Üretim A.Ş.
6.	AEFES	Anadolu Efes Biracılık ve Malt Sanayi AŞ.
7.	ARCLK	Arçelik A.Ş.
8.	ASELS	Aselsan Elektronik Sanayi ve Ticaret A.Ş.
9.	AYGAZ	Aygaz A.Ş.
10.	BRISA	Brisa Brigdestone Sabancı Lastik ve Ticaret A.Ş.
11.	CCOLA	Coca-Cola İçecek A.Ş.
12.	CIMSA	Çimsa Çimento Sanayi ve Ticaret A.Ş.
13.	DOAS	Doğuş Otomotiv Servis ve Ticaret A.Ş.
14.	EREGL	Ereğli Demir ve Çelik Fabrikaları T.A.Ş.
15.	FROTO	Ford Otomotiv Sanayi A.Ş.
16.	TGB - GARAN	Türkiye Garanti Bankası A.Ş.
17.	THL - HALKB	Türkiye Halk Bankası A.Ş.
18.	TIB	Türkiye İş Bankası A.Ş.
19.	KCHOL	Koç Holding A.Ş.
20.	KORDS	Kordsa Teknik Tekstil A.Ş.
21.	OTKAR	Otokar Otomotiv ve Savunma Sanayi A.Ş.
22.	SAHOL	Hacı Ömer Sabancı Holding A.Ş.
23.	SISE	Türkiye Şişe Cam Fabrikaları A.Ş.
24.	THYAO	Türk Hava Yolları A.O.
25.	TOASO	Tofaş Türk Otomobil Fabrikası A.Ş.
26.	TSK-TSKB	Türkiye Sınai Kalkınma Bankası A.Ş.
27.	TCELL	Turkcell İletişim Hizmetleri A.Ş.
28.	TUPRS	Tüpraş-Türkiye Petrol Rafinerileri A.Ş.
29.	ULKER	Ülker Bisküvi Sanayi A.Ş.
30.	TVB-VAKBN	Türkiye Vakıflar Bankası T.A.O.
31.	YKB-YKBNK	Yapı ve Kredi Bankası A.Ş.
32.	ZOREN	Zorlu Enerji Üretim A.Ş.

Appendix 3. Descriptive Statistics of Variables (Annually)

Variables (2015)	Mean	Standard Deviations	Min.	Max.
FLP	-0.38	1.31	-5.45	1.97
FCI	0.91	1.36	-1.84	4.16
FS	8.70	1.49	5.57	1.14
FA	3.84	0.47	2.89	4.51
FE	3.47	0.57	2.45	5.12
FW	-3.41	2.00	-7.75	1.81
FRD	1.29	2.27	-4.60	6.81
FP	0.37	0.49	0.00	1.00
FEX	0.03	0.17	0.00	1.00
FHL	0.06	0.24	0.00	1.00
ESP	2.93	0.09	2.77	2.99
SSP	2.77	0.07	2.56	2.83
CSP	2.81	0.04	2.63	2.83
TSP	3.94	0.05	3.76	3.98
Variables (2016)	**Mean**	**Standard Deviations**	**Min.**	**Max.**
FLP	-0.21	1.32	-5.46	1.88
FCI	1.05	1.30	-1.69	3.78
FS	8.73	1.46	5.47	1.14
FA	3.86	0.46	2.94	4.52
FE	3.50	0.66	2.23	5.37
FW	-3.35	2.03	-7.80	1.89
FRD	1.63	2.16	0.00	7.44
FP	0.37	0.49	0.00	1.00
FEX	0.03	0.17	0.00	1.00
FHL	0.06	0.24	0.00	1.00
ESP	2.94	0.08	2.77	2.99
SSP	2.78	0.07	2.48	2.83
CSP	2.81	0.03	2.70	2.83
TSP	3.95	0.04	3.80	3.98
Variables (2017)	**Mean**	**Standard Deviations**	**Min.**	**Max.**
FLP	-0.01	1.29	-5.15	2.28
FCI	1.22	1.31	-1.61	3.95
FS	8.74	1.44	5.32	1.14
FA	3.48	0.69	2.35	5.06
FE	-3.11	1.97	-7.75	2.00
FW	1.63	2.20	0.00	7.46
FRD	0.37	0.49	0.00	1.00
FP	0.03	0.17	0.00	1.00
FEX	0.06	0.24	0.00	1.00
FHL	2.94	0.08	2.77	2.99
ESP	3.88	0.45	2.99	4.53
SSP	2.79	0.07	2.56	2.83
CSP	2.81	0.03	2.70	2.83
TSP	3.95	0.04	3.80	3.98
Variables (2018)	**Mean**	**Standard Deviations**	**Min.**	**Max.**
FLP	0.21	1.31	-4.99	2.69
FCI	1.38	1.26	-1.32	4.19
FS	8.75	1.45	5.31	1.14
FA	3.91	0.44	3.04	4.54
FE	3.48	0.61	2.32	4.66
FW	-2.96	1.92	-6.796	2.10

Appendix 3 (cont.)

Variables (2018)	Mean	Standard Deviations	Min.	Max.
FRD	1.76	2.28	0.00	7.59
FP	0.37	0.49	0.00	1.00
FEX	0.03	0.17	0.00	1.00
FHL	0.06	0.24	0.00	1.00
ESP	2.95	0.08	2.77	2.99
SSP	2.80	0.06	2.63	2.83
CSP	2.81	0.02	2.77	2.83
TSP	3.95	0.04	3.82	3.98
Variables (2019)	**Mean**	**Standard Deviations**	**Min.**	**Max.**
FLP	0.34	1.28	-4.87	2.68
FCI	1.50	1.27	-1.13	4.31
FS	8.75	1.45	5.45	1.14
FA	3.93	0.43	3.09	4.55
FE	3.50	0.50	2.63	4.78
FW	-2.78	1.96	-7.02	2.49
FRD	1.87	2.36	0.00	7.69
FP	0.37	0.49	0.00	1.00
FEX	0.03	0.17	0.00	1.00
FHL	0.06	0.24	0.00	1.00
ESP	2.94	0.08	2.77	2.99
SSP	2.80	0.04	2.70	2.83
CSP	2.81	0.02	2.77	2.83
TSP	3.95	0.04	3.85	3.98

Note: The number of observations in all years in the table is 32.