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The Factors That Affects the Profitability in Real Estate Investment Trust Companies: Comparison of Turkey and Malaysia

Gayrimenkul Yatırım Ortaklıkları Firmalarının Kârlılıklarını Etkileyen Faktörler: Türkiye ve Malezya Firmalarının Karşılaştırılması

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ABSTRACT

It is defined as an investment that individuals use a source or value they own to provide income. Real estate investment trust companies are providing alternative tools to invest in bonds, stocks, etc. by converting real estate holdings from their portfolios into securities. Among the key benefits of real estate investment trust companies are that they have a certain economic cycle, as opposed to bonds, a protective against inflation, and reliable returns. Real estate investment trust companies operate in 41 countries as of 2021, with a market volume of $42 trillion. In Turkey, which is part of the real estate investment trust sector's category of developing countries, there are 37 real estate investment trust companies and the total market value is 6860 million euros. The other country included in the study is Malaysia, which also falls under the category of developing countries in the industry. In Malaysia, there are 18 real estate investment trust companies with a total market value of 8519 million euros. The aim of the study is to identify the importance of factors affecting the profitability of the companies of the two countries through the Random Forest Regression method. For this purpose, data from 2013.Q1 to 2022.Q1 were used from the companies of the two countries. As a result of the study, it has been determined that the variables with the most significant impact on the assets and equity profitability of the two countries are total debt total assets rate and logarithm of total assets ratios.

JEL Codes: M20, M21, M48

Keywords: Profitability, random forest regression, real estate investment trust

ÖZ

Bireylerin, sahip oldukları bir kaynağı veya değeri gelir sağlamak amacı ile kullanmaları yatırım olarak tanımlanmaktadır. Gayrimenkul Yatırım Ortaklık (GYO) firmaları, portföylerinde bulunan gayrimenkulleri menkul kıymetlere dönüştürerek tahvil, bono, hisse senedi vb. yatırım araçlarına alternatif araç olanağı sağlamaktadırlar. GYO'ların en önemli avantajları arasında hisse senetleri, tahvillere göre belirli bir ekonomik döngülerinin olması, enflasyona karşı koruyucu olması ve güvenilir getirilerinin olması ön plana çıkmaktadır. GYO'lar, 2021 yılı itibari ile 41 ülkede faaliyet göstermektedirler ve piyasa hacimleri 42 Trilyon Dolardır. GYO sektörünün gelişmekte olan ülkeler kategorisinde yer alan Türkiye'de, 37 GYO firması bulunmakta ve toplam piyasa değerleri 6.860 milyon eurodur. Çalışmada yer alan diğer ülke, yine sektörün gelişmekte olan ülkeleri kategorisinde yer alan Malezya'dır. Malezya'da, 18 GYO firması bulunmakta ve toplam piyasa değerleri 8.519 milyon eurodur. Çalışmanın amacı, iki ülke firmalarının kârlılıklarını etkileyen faktörlerin önem derecelerinin Rassal Orman Regresyon yöntemi ile tespit edilmesidir. Bu amaçla, iki ülke firmalarına ait 2013.Q1 – 2022.Q1 dönemleri arası veriler kullanılmıştır. Çalışmanın bağımlı değişkenleri, Aktif kârlılık (ROA) ve Özsermaye kârlılık (ROE) oranlarıdır. Bağımsız değişkenler; enflasyon oranı (INF), toplam borç toplam aktif oranı (TDTA), likidite oranı (QK), toplam aktiflerin logaritması (AS), faiz vergi ve amortisman öncesi kârlarda meydana gelen yıllık değişimler (EB) ve firma gelirlerinde meydana gelen yıllık değişimlerden (RG) oluşmaktadır. Çalışma sonucunda,

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iki ülke firmalarının aktif ve özsermaye kârlılıkları üzerinde en önemli etkiye sahip değişkenlerin TDTA ve AS oranları olduğu tespit edilmiştir.

JEL Kodları: M20, M21, M48

Anahtar Kelimeler: Kârlılık, rassal orman regresyon, gayrimenkul yatırım ortaklığı

Introduction

Real estate can be expressed as a whole in land and all kinds of structures that exist on it. In this context, real estate may include residences, commercial buildings, industrial facilities, agricultural land, and many other structures (Hepşen, 2009. p. 1). Real estate investment trust (REIT) firms offer partnership to investors through the development of real estate projects (Capellán et al., 2021. p. 2) and contribute three different ways to the country's economy, directly, indirectly, and otherwise. The direct contribution refers to the employment opportunities provided by REIT companies and the direct impact of the revenues generated by those employees in those firms to the economy. In this way, REIT firms contribute to increasing employment levels in the economy and increasing employee revenue. The indirect contribution is that REIT firms contribute to the growth of employment and revenue in supplier companies by purchasing goods and services from other companies. Other economic contributions include expenditures financed by dividend revenues from REIT shareholders and interest income from REIT bondholders (EY, 2021, p. 4).

In Turkey, housing sales increased by 21.7% in the first quarter of 2022 compared to the same period of the previous year. Such an increase occurs mainly because of low credit costs compared to inflation. Increased demand has caused an increase in housing prices. According to TCMB 2022 February, prices increased by 26.9% in real terms from the same month a year earlier. Interest in real estate is expected to continue due to construction costs, exchange rate hikes, low supply, and high inflation. Increased interest in real estate and real estate prices also increased interest in REITs (GYODER, 2022. p. 6). Real estate investment trusts were first established in the United States in 1960 and now operate in 40 countries (NAREIT, 2021, p. 16). The increasing value of the REITs every year is important to them, their investors, and the country's economy.

When the studies on the REIT sector are examined, the work on the market performance of companies is highlighted, and the work on profitability is very few. Although many studies on profitability in various sectors, especially the banking sector (Aka, 2019. p. 21; Alp et al., 2010. p. 1; Kırcı Çevik & Boran, 2020. p. 1735; Naceur, 2003. p. 1; Owoputi, 2014. p. 408; Sayılgan & Yıldırım. 2009, p. 207; Uzunlar & Gülhan, 2011. p. 341) in the REIT sector, it is seen that there are a limited number of studies related to profitability (Çelik & Arslanlı, 2020. p. 255; Jakpar et al., 2018. p. 72). While there are studies on profitability in various sectors, the fact that there are very few studies in the REIT sector constitutes a gap in the literature. This gap in the literature constitutes the need for the work to be carried out on the profitability of the REIT. Because it is thought that companies must first make profit in order to continue their activities. Another unique part of the study is the method used. There are studies in literature where econometric models are widely used in profitability (Almaqtari et al., 2019. p. 173; Asimakopoulos et al., 2009. p. 934; Benitez et al., 2018. p. 123; Lee, 2014. p. 4; Nunes et al., 2009. p. 697; Pratheepan, 2014. p. 4; Trabelsi & Trad, 2017. p. 454). This study uses the Random Forest Regression method, which estimates results from many models. The aim of the study is to identify the importance of factors affecting the profitability of REIT companies. The study used data from companies operating in Turkey and Malaysia from 2013.Q1 to 2022.Q1. Turkey and Malaysia are among the countries where the REIT sector is developing (EY, 2018, p. 4). Turkey and Malaysia have shown similar growth moves in the last decade, while recent years have shown rapid economic growth. In the last 4 years, the Turkish economy has averaged 4.2 and Malaysia's economy has grown by 2.26 (WORLDBANK, 2023). Real estate investment trust companies have emerged as organizations that aim to profit by investing in real estate projects in both countries (EPRA, 2018, p. 507). For this reason, comparisons of Turkish and Malaysian REIT firms are considered important to understand the similarities and differences of the sector in both countries. This study aims to analyze the profitability of REIT firms in both countries, offering important findings for the development of the sector and its management strategies. The study aims to select a long-term time interval (2013. Q1–2022.Q1) to more fully analyze the impact of factors on the performance and profitability of REIT firms and to avoid the problem of over-learning involved in data mining. Over-learning refers to the fact that a model is overly adapted to the training data set and that its ability to generalize is reduced (Hawkins, 2004. p. 1).

The study's dependent variables are return on assets (ROA) and return on equity (ROE) ratios. Independent variables consist of inflation rate, total debt total assets rate (TDTA), liquidity rate, the logarithm of total assets (AS), annual changes in interest tax and pre-amortization profits, and annual changes in company revenues (RG). The study found that the ratio of company size and debt ratio had a significant impact on the profitability of both companies in both countries.

In the study, the Random Forest Regression method was used. Random Forest is an important method in the field of data mining. It has advantages such as high performance, flexibility, and scalability (Cutler et al., 2007. p. 2783). The algorithm works by bringing together many decision trees, resulting in better predictions (Kingsford & Salzberg, 2008. p. 1012). It also provides valuable information by determining the importance of variables (Biau & Scornet, 2016. p. 219).

The REIT sector is a sector that promotes economic growth and provides jobs (EY, 2021, p. 4). For this reason, policies and regulations need to be properly constituted in order to enable sustainable growth of the sector. The study's results may guide legislators in developing appropriate policies to understand the needs of the sector and promote growth in the sector. By doing so, the sustainability and profitability of the sector can be boosted, investor confidence can be built, and economic growth can be stimulated.

According to the study's findings, the assets of firms in both countries have a significant impact on their profitability. The company's assets are also considered an indicator of the size of a company. B. Ambrose and Linneman (2001. p. 149), in their work, found that larger REIT firms have higher profit margins. These findings include important information for corporate executives and legislators. Firm managers are advised to consider the assets they have on the profitability of their companies as a significant influence and to create a wider portfolio of assets by focusing on increasing the size of the firm. Legislators are advised to develop policies to facilitate the acquisition and use of assets of firms. Researchers are encouraged to use data mining techniques to further analyze the profitability of REIT firms operating in different countries and to conduct comparative studies.

In the first part of the study, a review of the literature was conducted. The second part provides detailed information on REITs, emphasizing the operation and importance of the sector. A comprehensive account of the Random Forest Regression method was subsequently made. In the practice section, analysis was carried out with real-world data based on theoretical information. The results were evaluated statistically. The final chapter summarizes the results of the study and provides recommendations.

Literature Review

This chapter provides a comprehensive review of literature related to REIT firms. The research examined the impact of REIT firms on profitability, the general trends in research focusing on REIT firms, and the impact of legal regulations on REIT firms. In this context, the important findings in the current literature are summarized in this chapter. The key findings in this chapter are presented to expand the current knowledge of REIT companies and to establish the basic foundations of research.

The literature contains a limited number of studies on the profitability of REIT companies. Jakpar et al. (2018. p. 83), Malaysia, investigated factors that affected the profitability of REIT companies. In the study, they used a panel data analysis method and found a positive relationship between dividend returns and company profitability (Çelik & Arslanlı, 2020. p. 88). They have investigated the factors affecting the market values and assets profitability of REIT companies. In the study, they used the panel data analysis method and found a positive relationship between the ROA ratio and the ROE ratio.

Apart from profitability, studies on corporate governance, capital structure, and performance of the REIT are drawing attention. These studies provide findings on the size of a company, the debt ratio, and the role of real estate in relation to inflation (Ambrose & Linneman, 2001. p. 156; Ambrse et al., 2005. p. 347, 2019, p. 15) that found that REITs had a relationship between their business size and their profitability. Another remarkable reading in the literature is the study (Doğan et al., 2019. p. 326; Feng et al., 2007. p. 82; Khairulanuwar & Chuweni, 2020. p. 427; Özcan & Gürol, 2020. p. 14) that emphasizes that low rates of debt are important for the REITs. Feng et al. (2007. p. 82) state that firms with high growth potential will usually prefer lower borrowing rates because they can be more affected by the effects of financial distress costs. Furthermore, some studies (Case et al., 2011. p. 20; Chatrath & Liang, 1998. p. 93; Erol & Tirtiroğlu, 2011. p. 202) emphasize the role of REITs in providing protection to their investors in the face of inflation. These studies have found that as small REIT firms grow, they benefit from economies of scale and that for larger REIT companies, the benefits of growth are more limited.

Real estate investment trust companies are subject to various legal regulations and restrictions in the countries in which they operate. Among these restrictions, the dividend payment rate plays an important role. The main characteristic that differentiates Turkish REIT businesses from those in other countries is that they do not exist (Erol et al., 2011). Jensen (1986. p. 323) argued that the existence of a high dividend distribution rate implies that managers restrict access to free cash flow and direct firms to seek external financing. Hardin and Hill (2008. p. 367) argued that when analyzing the dividend policies of firms, the focus should be on the dividends they distribute above the rate set out in the legislation.

The literature also includes works comparing the stock market performance of REIT companies (Günay & Timur, 2019. p. 28; Kim et al., 2002. p. 85), and studies comparing different industries and REITs. Deran et al. (2013. p. 195) compared the performance of REITs with the Securities Investment Partnerships and found that the Securities Investment Partnerships' ROE and ROA profitability was higher than that of the REITs. Aktas and Darwish (2020. p. 63) compared venture capital investment partnerships with REITs' performance and found that REITs had a higher level of ROE and ROA.

In general, studies of REIT companies appear to be mainly focused on corporate performance, corporate governance, and capital structure. Furthermore, the issue of profitability has been addressed for many sectors, but there has been a gap in this regard in the REIT sector.

Real Estate Investment Trust

The real estate sector is a continuously developing sector with a large economic impact on a global scale. Real estate investment trust firms in this sector have an important role and contribute to economic activity. This chapter provides information on the real estate concept, the economic importance of REIT firms, and the current status of REIT firms worldwide.

Real estate is a general definition of land and of any construction constructed on it. According to this definition, real estate can be divided into two categories, which are inhabitable and uninhabitable. Examples include residences in residential buildings and shopping malls and offices in non-residential buildings. Residential properties are types of real estate used for a variety of purposes, from accommodation to use as a means of investment (Hepşen, 2009. p. 1). The real estate industry can be classified in a variety of ways. These classifications can be performed according to their functions, locations, property rights, and public interventions. Assorted by function, real estate types can be separated by housing, commerce, industry, and agriculture. Depending on their location, they may be separated locally, regionally, nationally, and internationally. According to property rights, rents and relics may be separated as real estate. In addition, public intervention suggests that real estate may be separated publicly or privately. In summary, the term real estate has a broad implication of the land and its structures (Kazak et al., 2017. p. 14). The real estate industry is important for emerging economies. Construction activities contribute to increased investments and economic growth while helping to develop sectors such as cement, furniture, decorating materials, and home textiles. Growth of this sector has significant

impacts on employment and national income, as well as stimulation of side industries. Thus, the real estate sector promotes economic growth, contributing to employment and national income growth (Demirdöven, 2009, p. 3).

Real estate investment trust is a type of partnership that brings together many investors in order to finance real estate and real estate projects (Sırma, 2019. p. 27). Real estate investment trust companies are low-cost, effective, and liquid tools for real estate investment. There are several advantages to REIT investments, such as having a certain economic cycle over stocks and bonds, protecting against inflation, and having a reliable return. For investors who want to be protected against inflation, REITs are performing well in terms of yields. Real estate investment trust companies outperformed the S&P 500 during periods of high and medium inflation in the United States; they performed slightly lower during periods of low inflation (NAREIT, 2021, p. 14). This is considered to be one of the main reasons why investors should invest in REIT projects.

The economic effects of REITs can be classified into three categories: Direct, indirect, and other economic effects. The direct economic contribution is associated with the creation of jobs, labor revenues, and capital expenditures of REITs. The indirect economic contribution involves REITs buying goods and services, increasing employment and revenue in supplier businesses. Other economic contributions relate to the expenditure of REITs' shareholders, bondholders, and supplier businesses. The combination of these effects contributes to the strengthening of the economic cycle and the increased interaction between businesses (EY, 2021. p. 4).

As of the end of Q1 2022, there are 37 REIT companies in Turkey, with a total market value of 6860 million euros (EPRA, 2022, p. 508). There are 18 REIT companies in Malaysia, with a total market value of 8.519 million euros (EPRA, 2022. p. 342). There are some differences between the two countries in the regulatory arrangements for REIT companies. The first is the obligation to pay the dividend, which is a requirement to benefit from corporate tax exemption. In Turkey, there is no obligation for REIT companies; the lack of a specific amount of dividend payment is seen as the most significant difference separating it from the companies of other countries. In many countries, including Malaysia, the rate is 90% (EPRA, 2022. p. 346). Real estate is a hard asset to earn value from. This requires the investment in real estate to be funded by last year's profits or liabilities (Feng et al., 2007. p. 85). However, the lack of such an obligation for Turkish companies constitutes an internal source for new investments, limiting outsourcing (Erol et al., 2011. p. 179). For Malaysian companies, this causes low free cash flows. Furthermore, it is expected that REITs will not be able to take advantage of the tax benefits of foreign debt interest charges, which increases borrowing costs and results in lower debt ratios for REIT companies (Feng et al., 2007. p. 82). The second difference is the regulation regarding debt rates. Short-term credits in Turkish companies are limited to five times the amount of equity (EPRA, 2022. p. 513). For Malaysian companies, borrowing should not exceed 50% of its assets value (EPRA, 2022, p. 346). As a result of the impact of all this, the companies' debt ratios have been estimated at 22% in Turkey and 33% in Malaysia. A low debt ratio is important for REIT companies to demonstrate their ability to pay debt and own real estate (Khairaulanuwar & Chuweni, 2020. p. 427).

Table 1.
Countries' Maturity Stages in the Industry

Nascent	Emerging	Established	Mature
Bahrain	Finland	Australia	USA
Brazil	Ireland	Belgium	
Costa Rica	Italy	Canada	
Bulgaria	Malaysia	France	
Greece	Mexico	Germany	
Hungary	South Africa	Hong Kong	
India	South Korea	Japan	
Israel	Spain	Netherlands	
Kenya	Turkey	New Zealand	
Pakistan	United Arab Emirates	Singapore	
Philippines		England	
Saudi Arabia			
Taiwan			
Thailand			
Vietnam			

The EY Global (2018, p. 4) report outlines the maturity stages in countries' industry. According to this report, Turkey and Malaysia are listed in the category of developing countries of the industry. Data that belong to different countries which are listed in the same category have been used to identify common and different aspects of the profitability of developing countries and to identify the impact of differences in legal regulations on profitability. Table 1 shows countries based on their maturity stage in the industry.

According to Table 1, Turkey and Malaysia are in the category of developing countries of the industry. The aim of this study is to identify common and different aspects of the profitability of developing countries, such as Turkey and Malaysia. As Turkey and Malaysia's GDP growth trends in recent years have been moving in the same direction, similarities and differences in the sector have been studied in both countries. Furthermore, each country has different legal frameworks and can have direct or indirect effects on profitability; data have been used from different country firms in the same category to identify the effect of discrepancies in legal regulations on profitability.

Methods

In the study, the method of Random Forest Regression, which is a method of community learning, was used. Random Forest Regression is a method commonly used in data analysis, and this has been the preferred method in the study. A variety of performance criteria metrics have been used to evaluate the success of the method. Furthermore, the variation in mean absolute error) is considered to determine the severity of variables. This section contains information on Random Forest Regression and the detection of variable severity rates.

The method of study is Random Forest Regression. Random Forest is a method that combines the performance of many decision tree algorithms to classify or predict the value of a variable (Breiman, 2001. p. 5). Traditional data mining methods often exhibit poor classifier accuracy and tend to over-learn. In contrast, the Random Forest method was designed to combine a number of

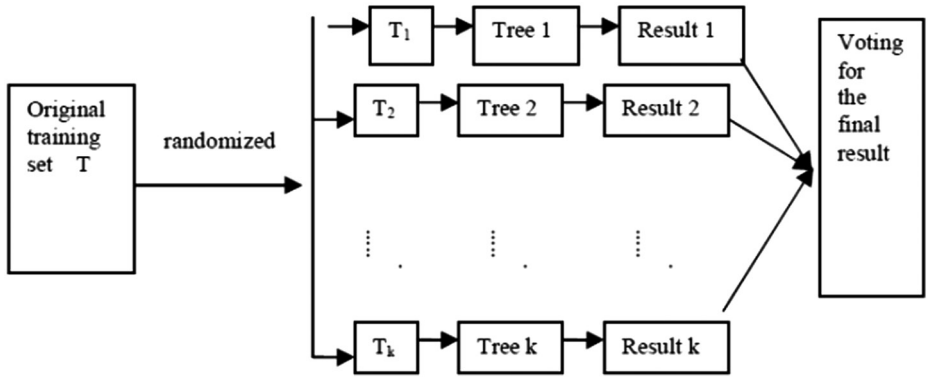

Figure 1.
Random Forest Method Work Shape. Source: (Liu et al., 2012. p. 247).

tree structure classifiers to improve accuracy and reduce over-learning (Kingsford & Salzberg, 2008. p. 1012). Thus, the Random Forest generally performs better than traditional algorithms in terms of accuracy and generalization (Liu et al., 2012. p. 246). The Random Forest works with the bagging method to prevent correlations of different trees (Rodriguez-Galiano et al., 2015. p. 3). In regression tree modeling, a stream-like series of questions is asked, which divides a sample into homogeneous groups, minimizing an in-group variance to determine a numeric answer variable (Vittinghoff et al., 2012. p. 287). As the number of trees grows, the variance of the forest decreases. Thus, it is thought that selecting a large number of trees will improve the predictive accuracy of the model (Breiman, 2001, p. 29). Figure 1 shows how the Random Forest method works.

The Random Forest Regression method has many advantages (Hutengs & Vohland, 2016. p. 129):

- Inclusion or exclusion of Proventors in non-complex ways,
- Possible inclusion of continuous and also categorical variables into the model,
- Have a few model parameters that must be specified by the user,
- Minimized the risk of overcompliance,
- Automatic calculation of variable importance scores, which evaluates the contribution of individual commentators to the final model.

In the Random Forest method, forecast variables can be numeric or categorical. No assumptions are made about the distribution of data. The data are usually divided into a training and test set, and the model's success measurement is based on the average square error (MSE) (Smith et al., 2013. p. 86). The MSE is calculated by averaging the values that are generated by squares of the differences between actual values and predicted values. A higher MSE value indicates that the forecast model makes more errors in actual values, while a lower MSE value shows better forecast performance (Baasith, 2021. p. 1). The formula for the MSE value is as follows (Chicco et al., 2021. p. 4):

$$\frac{1}{m}\sum_{i=1}^{m}\left(X_i - Y_i\right) \quad (1)$$

Variable importance measurements are a natural product of the Random Forest. The values of variables are allowed one by one and evaluate the decrease of the forecast accuracy of the new model. The greater the prediction accuracy decrease, the stronger the relationship between the allowed variable and the responsive variable (Han et al., 2019. p. 736).

Implementation

The aim of the study is to identify factors that affect the profitability of REIT companies in the two countries through the Random Forest Regression method. To this end, data were used from 28 companies operating in Turkey and 17 companies operating in Malaysia. The data cover the periods 2013.Q1–2022.Q1. The dependent and independent variables in the study are contained in Table 2.

The ROA and ROE are key ratios that measure a company's ability to generate profits based on equity and assets. Delen et al. (2013. p. 3982) found that the rates with the most significant influence on the ROA were the pre-tax earnings/equity rate, net profit margin, debt rate, and assets transfer rate. The ROE ratio is a significant ratio used to compare financial strategy, management performance, and profit payments to shareholders in the same sector (Phan et al., 2003. p. 344) in developed and emerging markets. Because of their importance in profitability, these rates are included in the study.

The study first identified the number of trees that made the mean error frame (MSE) the smallest. The purpose of this detection was to build the model that makes the most accurate predictions. Figure 2 shows the minimum MSE value for Turkish companies; Figure 3 shows the number of trees for Malaysian companies.

The number of trees that make the MSE value the smallest has been identified as 330 for Turkish companies and 209 for Malaysian

Table 2.
Dependent and Independent Variables

Variables	Abbreviation	Variable type
Return on assets ratio	ROA	Dependent
Return on equity ratio	ROE	Dependent
Inflation rate	INF	Independent
Total debt total assets rate	TDTA	Independent
Liquidity rate	QK	Independent
Logarithm of total assets	AS	Independent
Annual changes in interest tax and pre-exception proof profit	EB	Independent
Annual changes in company revenues	RG	Independent

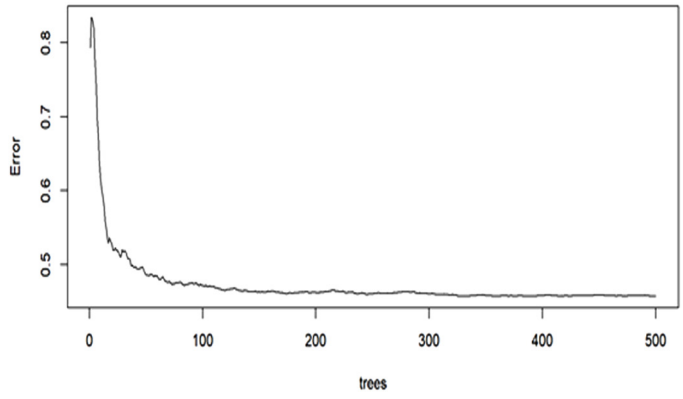

Figure 2.
Turkey ROA Model Number of Trees. ROA = Return on assets ratio.

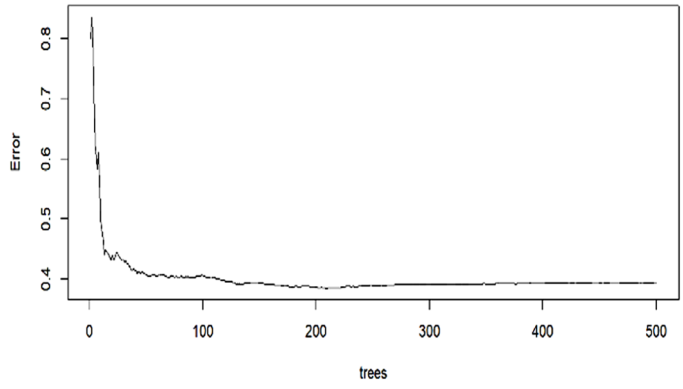

Figure 3.
Malaysian ROA Model Number of Trees. ROA = Return on assets ratio.

companies, and final models are built according to these values. The performance measurements for models were Root Mean Square Error (RMSE), R^2, and Mean Absolute Error (MAE).

Table 3 shows the performance criteria of the models formed by the ROA-dependent variable. The R^2 value was 0.60 for the model, which was created with the data of Turkish companies, and R^2 for the model was 0.63 for the data of Malaysian companies. These values indicate that the arguments contained in the models are sufficient to explain the ROA-dependent variable. The graph for the model is shown in Figures 4 and 5.

The importance of the variables has been determined following the model installation. The importance of the variables is determined by the rate of change to the MSE value if they are excluded from the model. The large variation indicates the importance of the variable. Table 4 contains the detection of the severity of the arguments.

Table 3.
Model Performances by ROA-Dependent Variable

Performance Measures	Turkey	Malaysia
RMSE	0.6627875	0.6143956
R^2	0.5980120	0.6311312
MAE	0.4556523	0.4145418

Note: ROA = Return on assets ratio; RMSE = Root Mean Square Error; MAE = Mean Absolute Error.

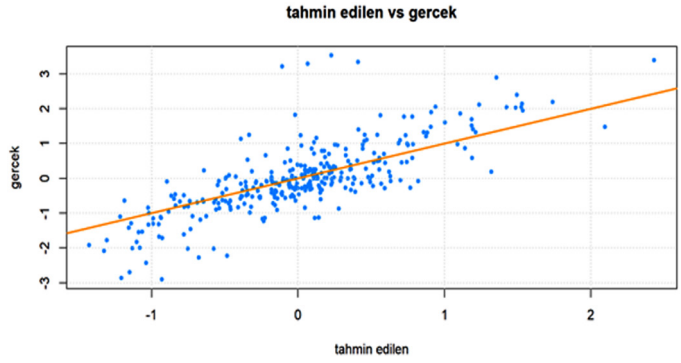

Figure 4.
Turkey ROA Model Chart. ROA = Return on assets ratio.

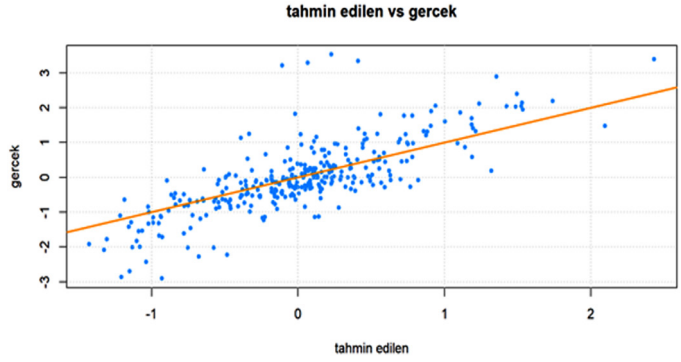

Figure 5.
Malaysia ROA Model Chart. ROA = Return on assets ratio.

The most significant effect on companies' ROA is the AS for Turkish companies and the TDTA for Malaysian companies. For both countries, TDTA and AS variables are among the top three. This indicates that the company size and total assets have a significant impact on its ROA.

The study continues with the identification of the importance of variables on their equity profitability after determining the importance of variables on their assets profitability. Figure 6 shows the number of trees for Turkish companies; Figure 7 shows the lowest MSE value for Malaysian companies.

The number of trees that make the MSE value the smallest has been identified as 493 for Turkish companies and 500 for Malaysian

Table 4.
Variable Importance Degrees (ROA)

Variables	Turkey *%IncMSE*	Malaysia *%IncMSE*
INF	22.47480	16.60392
TDTA	22.95745	32.61987
QK	18.57505	17.34664
AS	33.75637	20.47396
EB	27.55182	16.21514
RG	21.53521	21.19831

Note: AS = Logarithm of total assets; EB = Annual changes in interest tax and pre-exception proof profit; INF = Inflation rate; RG = Annual changes in company revenues; ROA = Return on assets rate; TDTA = Total debt total assets rate; QK = Liquidity rate.

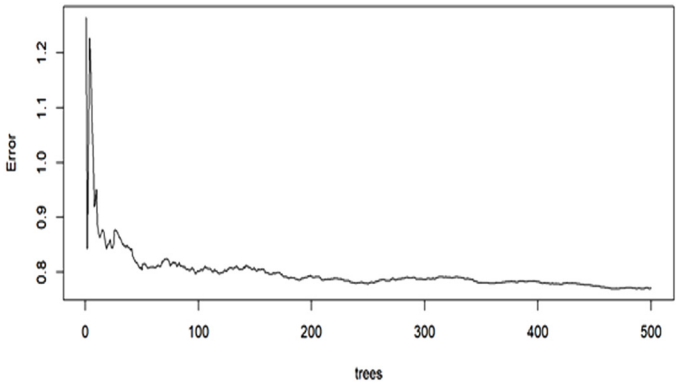

Figure 6.
Turkey ROE Model Number of Trees. ROE = Return on equity ratio.

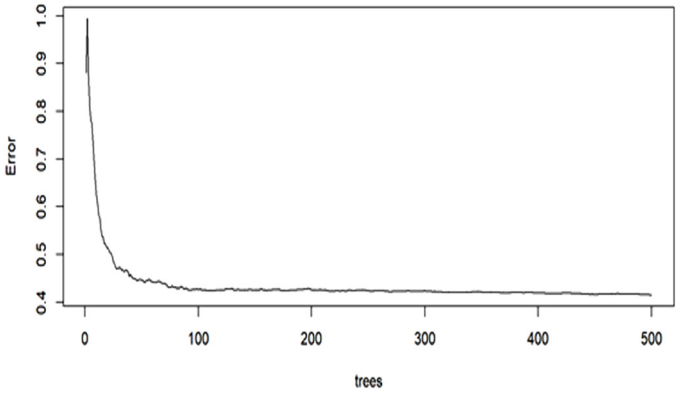

Figure 7.
Malaysian ROE Model Number of Trees. ROE = Return on equity ratio.

companies, and final models are built according to these values. The performance measurements for models were RMSE, R^2, and MAE.

Table 5 contains the performance criteria of models formed by the ROE-dependent variable. The R^2 value of the model is 0.54, which is generated by data from Turkish companies, and the R^2 value is 0.58, which is generated by data from Malaysian companies. These values indicate that the arguments contained in the models are sufficient to describe the ROE argument. The graph for the model is shown in Figures 8 and 9.

The importance of the variables has been determined following the model installation. The importance of the variables is determined by the rate of change to the MSE value if they are excluded from the model. Table 6 contains the detection of the severity of the arguments.

The most significant effect of companies on their equity profitability is that of TDTA, both of the countries' companies. For both

Table 5.
Model Performances by ROE-Dependent Variable

Performance Measures	Turkey	Malaysia
RMSE	0.4660927	0.6421244
R^2	0.5401197	0.5792385
MAE	0.2383799	0.4655510

Note: ROE = Return on equity ratio; RMSE = Root Mean Square Error; MAE = Mean Absolute Error.

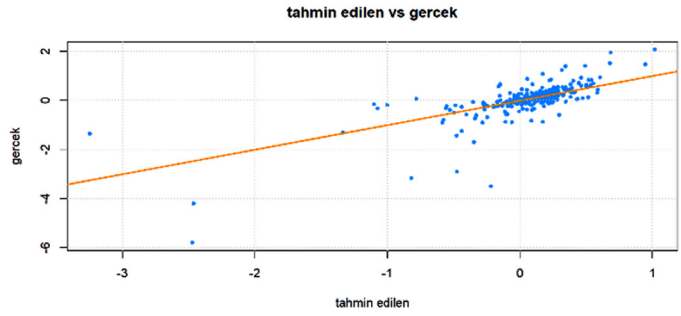

Figure 8.
Turkey ROE Model Chart. ROE = Return on equity ratio.

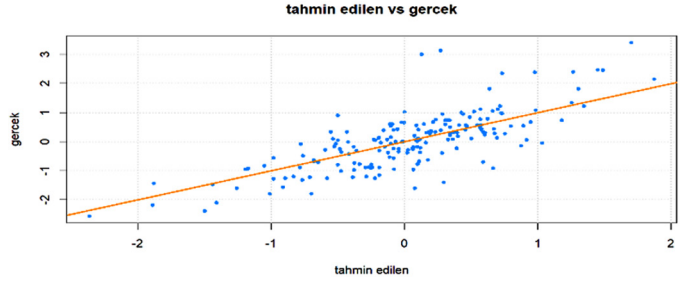

Figure 9.
Malaysia ROE Model Chart. ROE = Return on equity ratio.

countries, TDTA and AS variables are among the top three. In addition, the second- and third-rank variables are the same, with the order RG and AS. This indicates that the change in company size, total assets, and revenues has a significant impact on equity profitability.

Analyses with data from Turkish and Malaysian companies have been carried out in the industry's developing countries category. Analyses have shown that the models built up perform closely together. This detection will likely help provide a healthier assessment of detection and comparison. The findings of models built on ROA and ROE variables indicate that the assets size and debt ratio have a significant impact on business profitability.

Conclusion and Recommendations

Investors invest a variety of funds in revenue, preserving the savings they have in the face of inflation, etc. Real estate investment trust companies provide alternative investments for investors

Table 6.
Variable Severity Rating (ROE)

	Turkey	Malaysia
Variables	***%IncMSE***	***%IncMSE***
INF	7.880565	24.87884
TDTA	22.987490	42.83435
QK	5.313051	26.31940
AS	9.223342	34.04040
EB	6.936583	25.72499
RG	16.496036	31.54435

Note: AS = Logarithm of total assets; EB = Annual changes in interest tax and pre-exception proof profit; INF = Inflation rate; RG = Annual changes in company revenues; ROE = Return on equity rate; TDTA = Total debt total assets rate; QK = Liquidity rate.

through the process of securing their real estate. The fact that REITs have a protective role in the face of high inflation numbers is one of its major advantages. In many countries, there are a number of conditions for REITs to be tax-free. However, no such requirement exists in Turkey, and the exemption begins with the achievement of REIT status. Malaysia is required to pay a dividend of 90%.

The aim of the study is to identify the importance of factors affecting the profitability of REIT companies. To this end, data have been used from REIT companies operating in Turkey and Malaysia. The aim of selecting these two countries is to ensure that the sector falls under the category of developing countries and is subject to different legal obligations. It is therefore expected that the findings will be more healthily identified and interpreted. In the study, the Random Forest Regression method was used. The advantage of the method is that it makes its predictions based on the results it receives from many models. Analyses have found that both Turkey and Malaysia have similar characteristics. Such similarities are that the assets and equity profitability of the two countries are more important than that of the TDTA and the logarithm (AS) ratio of the assets. The total loan/total assets ratio includes information about the accounts payable rate; the logarithm of the assets contains information about the company size. There are studies in the literature that show a relationship between profitability and company size Ambrose & Linneman (2001, p. 156) found that REIT companies correlate with their size and profitability, while larger companies have higher profit margins. In addition, Ambrose et al. (2019b, p. 15) found that a 1% increase in total assets resulted in an 11.1 basis point increase in equity profitability. This detection shows the importance of the ratio. Our findings confirm this discovery and show that corporate size is one of the most important rates on profitability.

Dogan et al. (2019, p. 12) state that REITs use lower leverage ratios than REITs in countries with less strict leverage restrictions. This indicates that REITs in countries where regulations determine maximum leverage ratios take a more flexible approach. This shows that REITs in these countries tend to keep their borrowing levels lower. In this study, similarly, the borrowing rate is a significant ratio that has a significant impact on corporate profitability. Furthermore, although there are differences in regulatory regulations between the two countries regarding REIT firms, significant similarities have been found in the rates affecting their profitability.

According to the study's findings, it is possible to list a number of recommendations for business executives, legislators, and researchers. Detection shows that company size has a significant impact on profitability. Firm size is expected to have a reductive effect on information collection and interpretation costs due to the benefits of scale economy (Boyd & Runkle, 1993. p. 52). In this context, business executives should focus on increasing size and creating effective growth policies when developing growth strategies. Large-scale companies can usually achieve higher levels of profitability by providing access to larger markets and capitalizing on the economy of scale. Thus, when properly managed and backed by appropriate strategies, the company size is an important factor that can increase profitability (Ambrose & Linneman, 2001, p. 156). Another detection shows that the borrowing rate has an effect on business profitability. It is stated that the borrowing rate is a factor in the performance of REIT companies and that the optimal borrowing rate should be low (Dogan et al., 2019, p. 12). Companies with high growth potential often need more external resources. These companies may have high leverage ratios (Feng et al., 2007, p. 82) to assess investment opportunities and finance their expenditures for growth. However, in countries where dividend payment is mandatory (for example, 90% in Malaysia), firms must distribute most of their profits in dividends. This may limit the ability of these companies to regain profits and accumulate less funds for growth. On the other hand, in countries where there is no obligation to pay dividends (for example, Turkey) firms can move with more freedom and redirect their profits toward investment. This suggests that companies with high growth potential may tend to have lower leverage rates. Managers are therefore expected to focus on financial analysis and planning processes to determine optimal borrowing rates and manage their debts carefully. In addition, companies operating in countries where dividend payment is not required can redirect their profits to investment, supporting growth. Firm managers must define dividend policies in accordance with growth objectives and create strategies for accumulating capital. Legislators can take a significant step forward by creating more flexible and harmonious regulations in the REIT sector. They must take into account the fact that strict constraints on leverage ratios can limit the growth and investment potential of REITs. Creating a regulatory framework with a more balanced approach can increase REIT funding options and growth opportunities. In this way, regulation of the capital structure of REITs can help the sector develop more dynamically and sustainably. Researchers are expected to further examine the profitability of REIT firms operating in different countries and to conduct a comparative analysis. Furthermore, it is recommended that researchers use data mining methods to identify factors that affect profitability and create predictive models.

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Genişletilmiş Özet

Çalışmanın amacı, Türkiye ve Malezya'da faaliyet gösteren Gayrimenkul Yatırım Ortaklığı firmalarının kârlılıklarını etkileyen faktörleri tespit etmek ve bu faktörlerin önem sıralarını tespit etmektir.

Çalışmanın yöntemi, veri madenciliği yöntemlerinden Rassal Orman Regresyon'dur. Yöntem, yüksek tahmin gücüne sahip olma, aşırı öğrenme durumlarına karşı dirençli olma ve bağımsız değişkenleri önem derecesine göre sıralama özelliklerinden dolayı tercih edilmiştir.

Çalışma sonucunda, tüm modellerde yer alan bağımsız değişkenlerin bağımlı değişkenleri açıklamada yeterli düzeyde oldukları tespit edilmiştir. Türkiye firmalarının aktif kârlılıklarını etkileyen faktörler önem sıralarına göre; toplam varlıklar, faiz vergi ve amortisman öncesi kârlarda meydana gelen yıllık değişimler, toplam borç toplam aktif oranı, enflasyon oranı, firma gelirlerinde meydana gelen yıllık değişimler ve likidite oranıdır. Türkiye firmalarının özsermaye kârlılıklarını etkileyen faktörler önem sıralarına göre; toplam borç toplam aktif oranı, firma gelirlerinde meydana gelen yıllık değişimler, toplam varlıklar, enflasyon oranı, faiz vergi ve amortisman öncesi kârlarda meydana gelen yıllık değişimler ve likidite oranıdır. Malezya firmalarının aktif kârlılıklarını etkileyen faktörler önem sıralarına göre; toplam borç toplam aktif oranı, firma gelirlerinde meydana gelen yıllık değişimler, toplam varlıklar, likidite oranı, enflasyon oranı ve faiz vergi ve amortisman öncesi kârlarda meydana gelen yıllık değişimlerdir. Malezya firmalarının özsermaye kârlılıklarını etkileyen faktörler önem sıralarına göre; toplam borç toplam aktif oranı, toplam varlıklar, firma gelirlerinde meydana gelen yıllık değişimler, likidite oranı, faiz vergi ve amortisman öncesi kârlarda meydana gelen yıllık değişimler ve enflasyon oranıdır. Çalışma sonucunda yapılan tespit, iki ülke firmalarının aktif ve özsermaye kârlılıkları üzerinde en önemli etkiye sahip değişkenlerin toplam borç toplam aktif oranı ve toplam varlıklar olduğu tespit edilmiştir.

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Endüstri 4.0 Uygulamalarının Tedarik Zinciri Performansına Etkisi

The Effect of Industry 4.0 Applications on Supply Chain Performance

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ÖZ

Günümüzde, sürekli değişen ve gelişen teknoloji, bireyler ve işletmeler için birçok uygulamayı beraberinde getirmektedir. Ancak bu uygulamaları tedarik zinciri ve üretim süreci içerisine entegre etmek, ek maliyet oluşturmanın yanı sıra ek işgücü ihtiyacı da oluşturabilmektedir. Bu gibi nedenler teknolojiyi benimseme konusunda firmaların kararlarını etkileyebilmektedir. Bu bilgilere dayalı olarak çalışmanın amacı, Endüstri 4.0 uygulamalarının tedarik zinciri performansına olan etkisini test etmektir. Bu doğrultuda toplam 103 üretici firmaya anket uygulaması yapılmıştır. Toplanan anketlerin sonuçları, SPSS İstatistik 22.0 (IBM Corp.; Armonk, NY, ABD) programı kullanılarak analiz edilmiştir. Firmalardan toplanan verilere, açımlayıcı faktör analizi uygulanarak boyutlar elde edilmiştir. Bu veriler daha sonra yüzde – frekans analizi ve regresyon analizi testlerine tabi tutularak bulgular elde edilmiştir. Yapılan Regresyon analizi sonuçlarına göre yapay zekâ ve bulut bilişim boyutlarının maliyet performansı boyutu üzerinde, bulut bilişim boyutunun müşteri performansı boyutu üzerinde anlamlı ve pozitif bir etkisi olduğu sonucuna ulaşılmıştır.

JEL Kodları: R40, L60, O14, O30

Anahtar Kelimeler: Endüstri 4.0, tedarik zinciri, akıllı fabrika

ABSTRACT

Recently, constantly changing and developing technology has brought many applications for individuals and businesses. However, integrating these applications into the supply chain and production process may create additional costs as well as create the need for additional labor. Such reasons may affect the decisions of companies in adopting technology. This study aims to test the effect of Industry 4.0 applications on supply chain performance. In accordance with this purpose, a questionnaire was applied to a total of 103 manufacturers. Data obtained from surveys collected were analyzed using the Statistical Package for the Social Sciences Statistics 22.0 (IBM Corp.; Armonk, NY, USA) program. By using factor analysis, the dimensions were obtained. Obtained data was then subjected to tests for percent-frequency analysis and regression analysis and obtained findings. As a result of the regression analyses, it is found that there are positive and significant impacts of artificial intelligence and cloud computing dimensions on the consumer performance dimension and cloud computing dimension on the cost performance dimension.

JEL Codes: R40, L60, O14, O30

Keywords: Industry 4.0, supply chain, smart factory

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Giriş

Tüm sanayi devrimleri hem sosyal hem ekonomik yapıyı değiştirerek insanlık tarihinde önemli bir rol üstlenmiş ve günümüzdeki ekonomik ve sosyal yaşamın gelişimini desteklemiştir (Alaloul ve ark., 2020; Mohajan, 2019; Taş, 2018). 1760- 1830 yılları arasında İngiltere'de başlayan Birinci Sanayi Devrimi'nde buhar gücü, üretim tezgâhlarını geliştirmek ve üretim sisteminin performansını artırmak için kullanılmaya başlanmıştır (Manavalan & Jayakrishna, 2019; Özüdoğru ve ark., 2018). 1850'li yıllarda Sanayi Devriminin ikinci aşamasında ise kömür, demir, çelik, buhar, petrol gibi kimyasal maddelerin yanı sıra elektrik teknolojisi, fabrika, atölye ve diğer üretim alanlarında kullanılmaya başlamıştır (Taş, 2018, s. 1821). Kısaca İkinci Sanayi Devrimi endüstride elektriği kullanmakta ve elektrik gücünü optimize etmek için üretim hacmi oluşturmaktadır (Manavalan & Jayakrishna, 2019, s. 934). Üçüncü Sanayi Devrimi'nin

ise 1969 yılında, bilişim ve programlama teknolojilerindeki hızlı ilerlemeyle birlikte fabrikalarda gelişmiş bir dijitalleşme temelinde ortaya çıktığı belirtilmektedir (Drath & Horch, 2014; Lasi ve ark., 2014; Özsoylu, 2017).

Akıllı Nesneler alanında internet teknolojileri ve geleceğe yönelik teknolojilerin kombinasyonu, üst düzey sanayileşmenin ve bilgi entegrasyonunun hızlanması ise Dördüncü Sanayi Devriminin itici gücü olmuştur (He ve ark., 2020; Lasi ve ark., 2014). Sanayi Devriminin itici güçlerinden olan teknolojilerin endüstriyel alanda kullanılması ise Endüstri 4.0 olarak adlandırılmaktadır (Jaskó ve ark., 2020). Bu kavram Almanya'da 2011 yılında Hannover fuarında tanıtılmıştır (Özsoylu, 2017). Sağlık ve lojistik gibi hizmet sektörleri ve Enerji Verimliliği gibi alanlar Endüstri 4.0 teknolojilerinin önemli uygulama alanlarından olduğu bilinmektedir (Dengiz, 2017). Endüstri 4.0 tedarik zinciri alanında da kullanılmakta ve tedarik zinciri yapısını yeni bir forma dönüştürmektedir (Abdel-Basset ve ark., 2018; Alicke ve ark., 2017; Bienhaus & Haddud, 2018; Frederico ve ark., 2020; Hofmann & Rüsch, 2017; İyigün & Görçün, 2019).

Tedarik zinciri terimi, hammaddeden son müşteriye kadar tedarik ve üretim sürecinin tüm unsurlarını birbirine bağlayan zinciri ifade etmek için kullanılmaktadır (Scott & Westbrook, 1991, s. 23). Bir tedarik zinciri, perakendeciler, distribütörler, üreticiler ve tedarikçiler gibi birçok ticari kuruluşun, hammadde edinme, bu hammaddeleri dönüştürme ve bu nihai ürünleri perakendecilere ulaştırmak için birlikte çalıştığı entegre bir süreçtir (Beamon, 1998, s. 281). Tedarik zincirinin kapsamı, tedarik kaynağı ile başlamakta ve tüketim noktasında sona ermektedir (Stevens, 1990, s. 25). Tedarik zinciri yönetimi, tedarik zinciri iş süreçlerinin ve tedarik zinciri üyeleri arasındaki bilgi akışının yönetimidir (Rota ve ark., 1998, s. 475). İletişim ve bilgi teknolojisindeki son gelişmelerle birlikte firmalar, Tedarik Zinciri Yönetiminin çeşitli aşamalarının planlamasını koordine ederek lojistik maliyetlerinde önemli tasarruflar yapma fırsatına sahip olabilmektedir (Thomas & Griffin, 1996, s. 13).

Bu araştırmada ilk olarak bu alanda yapılan ulusal ve uluslararası çalışmalardan bahsedilmiş daha sonra teorik çerçeve sunulmuştur. Araştırmanın diğer başlıkları içerisinde metodolojiye, analizlere ve bulgulara yer verilmiştir. Son kısımda ise sonuçlar verilerek gelecek çalışmalar için önerilerde bulunulmuştur.

Literatür Taraması

Endüstri 4.0 2011 yılında dünyaya tanıtıldığından bu yana birçok araştırmacı konu ile ilgili çeşitli araştırmalar yapmışlardır. Endüstri 4.0 bileşenleri çeşitli sektörlerde ve çeşitli alanlarda kullanılmıştır. Endüstri 4.0 bileşenlerinin Tedarik Zinciri Performansına etkilerini belirlemeye yönelik olan bu çalışma ile ilişkili bazı ulusal ve uluslararası alanlarda yapılan çalışmalar şu şekilde sıralanabilir:

Akben ve Avşar (2017), Dijital Tedarik Zinciri ve Bulut Bilişim teknolojilerini ele alarak tedarik zincirlerinde Bulut Bilişim'e geçiş sürecindeki uyumluluk ve güvenlik gibi temel kaygıları incelemişlerdir. Bunların giderilmesi için yapılması gerekenleri, geçiş sürecindeki olası sorunları ve bu sorunların ortadan kaldırılmasına yönelik iyileştirmeleri ortaya koymuşlardır. Sonuç olarak Bulut Bilişimi başarılı bir şekilde tedarik zinciri sürecine dahil etmenin işletmeler için bazı avantajları beraberinde getireceği vurgulanmış, bu geçiş sürecine olan işletmelerin kaygılarını ortadan kaldırmaya yönelik yaklaşımlarını sunmuşlardır.

Bienhaus ve Haddud (2018), dijitalleşmenin tedarik üzerindeki etkisini ve Tedarik Zinciri Yönetimi alanındaki rolünü belirlemek için satın alma ile ilgilenen farklı endüstrilerdeki 414 katılımcıya çevrimiçi bir anket uygulamışlardır. Araştırmalarında satın alma ve tedarik zincirlerini dijitalleştirmenin önündeki potansiyel engelleri ve bunların üstesinden gelmenin yollarını sunmuşlardır. Bulgular, satın alma sürecinin dijitalleştirilmesinin, günlük iş ve idari görevleri desteklediğini, karmaşık karar alma süreçlerini kolaylaştırdığını göstermektedir. Bunun yanı sıra tedarik sürecindeki dijitalleşmenin stratejik kararlara ve faaliyetlere daha fazla odaklanma sağladığını, etkinliği ve kârlılığı arttırdığı, yeni iş modellerinin gelişimini ve yeni ürün ve hizmetlerin oluşturulmasını kolaylaştırması gibi işletme faaliyetlerine olumlu katkılarda bulunduğunu göstermektedir.

Yıldız (2019), işletmelerin tedarik zincirleri faaliyetlerininin verimliliğini arttıran ve yapılan faaliyetleri kolaylaştıran Dijital Tedarik Zincirinin genel yapısının anlatılması amaçlamaktadır. Bu amaç doğrultusunda, Dijital Tedarik Zincirinin faydaları, özellikleri, genel yapısı, Endüstri 4.0 ile olan ilişkisi, geleneksel tedarik zincirlerinden Dijital Tedarik Zincirine dönüşümü ve temel karakteristikleri ile ilgili genel bir alan yazı çalışması yapmıştır. Ayrıca, Bulut Bilişim ve Nesnelerin İnternetinin Dijital Tedarik Zinciri süreçlerindeki önemini incelemiştir.

Bag ve ark. (2020b), Tedarik 4.0'ın döngüsel ekonomide süreç performansı üzerindeki etkilerini ve bilgi işleme yeteneğinin Tedarik 4.0 ve firma performansı üzerindeki moderatör etkisini araştırmak için Güney Afrikalı üreticiler arasında bir anket çalışması yapmışlardır. Tedarik 4.0 yeteneklerini daha fazla keşfedebilmek için iş süreçlerinin bir simülasyonunu oluşturarak tedarik otomasyon sürecinin yararlarını ortaya koymuşlardır. Araştırmacılar çalışmalarında dijitalleşmenin satın alma stratejisinde ve tedarik performansında iyileştirmeler sağladığını ve alıcıların niyetini olumlu yönde etkilediği sonucuna ulaşmaktadırlar.

Garay-Rondero ve ark. (2020), Endüstri 4.0' a giden mevcut Tedarik Zinciri Yönetimi modellerindeki boşluğu araştırarak önerdikleri modelde gelişmekte olan ve mevcut Dijital Tedarik Zincirlerini yönlendiren yeni konseptler ve bileşenlere özgün ve kapsamlı bir genel bakış sağlamaktadırlar.

Haddud ve Khare (2020), Endüstri 4.0 uygulamalarının her birinin altındaki kilit alanları ve faydaları belirleyerek, tedarik zincirinin dijitalleştirilmesinin seçilmiş beş yalın operasyon uygulaması üzerindeki potansiyel etkileri incelemeyi amaçlamaktadır. Yazarlar araştırma sonucunda, tedarik zincirlerinin dijitalleştirilmesinin seçilen beş yalın operasyon uygulaması üzerindeki önemli etkisini doğrulamışlardır. İncelenen potansiyel etkilerin çoğunun, genel tedarik zinciri ve iş performansının yanı sıra, bu beş yalın operasyon uygulamalarının doğrudan belirli alanları iyileştirdiğini bulmuşlardır. Ayrıca, incelenen teknolojilerin Tedarik Zinciri Performansı ve Yönetimi üzerindeki etki düzeyini de belirlemişlerdir.

Agrawal ve Narain (2021), tedarik zincirinin dijital dönüşümünde Blockchain, Büyük Veri Analitiği, 3D Baskı, Nesnelerin İnterneti, Yapay Zekâ, Artırılmış Gerçeklik gibi çeşitli teknolojik etkinleştiricilerin uygulanabilirliğini analiz etmeyi amaçlamaktadırlar. Yaptıkları bu çalışmalarında, çeşitli tedarik zinciri faaliyetlerini gerçekleştirmek için yeni teknolojileri benimsemeye yönelik sistematik bir yaklaşım sunulmuş ve tedarik zincirinin dijitalleşmesine yönelik yasal çabaların bu süreçleri daha iyi organize etmeye yardımcı olduğu sonucuna ulaşmışlardır.

Gedik (2021), Otonom Robotlar, Büyük Veri, 3 Boyutlu Yazıcı, Arttırılmış Gerçeklik, Siber Fiziksel Sistemler, Bulut Bilişim ve

Nesnelerin İnterneti gibi ana Endüstri 4.0 uygulamalarının tedarik zinciri ve üretim sürecindeki etkilerine odaklanmıştır. Bu bağlamda Endüstri 4.0'ın etkileri üzerine geniş bir teorik çerçeve oluşturmuştur.

Shao ve ark. (2021), tedarik zinciri boyunca Endüstri 4.0 bileşenlerini kullanarak birden çok katmanı birbirine bağlamak için baştan sona tedarik zinciri akışını araştırmışlardır. Tedarik zincirini dijitalleştirmek adına çok uluslu bir şirketin Pakistan merkezli fabrikasında bir örnek vaka incelemesi yapmışlardır. Yapılan gözlemlere göre bu süreç içerisinde herhangi bir sorununun çözümünün en az iki gün sürdüğü ve ürünün üretimine ayrılan iki iş gününün kaybına neden olduğu sonucuna ulaşılmıştır. Sorunların daha verimli bir şekilde çözülmesi için ilgili verilerin gerçek zamanlı olarak erişilebilir olmasının sağlanılması, süreçlerin entegre edilmesi ve aynı zamanda düzeltici önlemlerin zamanında alınması gerekmektedir. Bulgular, bunun için en uygun yöntemin tedarik zincirinin dijitalleştirilmesi olduğunu göstermektedir.

Zekhnini ve ark. (2021), Tedarik Zinciri Yönetimi 4.0 ile ilgili mevcut en son literatürün bir incelemesini sunarak dijital teknolojiler ile Tedarik Zinciri Yönetimi arasındaki ilişkiyi tanımlamış ve değerlendirmişlerdir. Bu çalışma Yeni teknolojilerin farklı tedarik zinciri süreçleri üzerindeki etkisini tanımlamaktadır. Ayrıca, makale gelecekteki araştırma ve uygulamalar için bir yol haritası çerçevesi de geliştirmektedir.

Teorik Çerçeve

Bu ana başlık içerisinde araştırmanın bağımlı ve bağımsız değişkenlerine ait teorik alt yapı sunulmaktadır. Araştırmanın bağımsız değişkeni olan Endüstri 4.0 teknolojileri kısa açıklanmış daha sonra bağımlı değişken olan tedarik zinciri kavramı ve kapsamı aktarılmıştır.

Endüstri 4.0

Endüstri 4.0 kavramı, gelişen teknoloji olanakları sayesinde, maliyet, verimlilik, hız ve inovasyon odaklı pazarlama ve üretim anlayışında gelinen yeni bir noktayı ifade etmektedir (Soylu, 2018, s. 44). Endüstri 4.0, teorik olarak üretim süreçlerinde daha fazla operasyonel verimlilik, daha yüksek esneklik ve daha kapsamlı otomasyon sağlayan bağlı ağlardan ve hizmetlerden oluşmaktadır (Jaskó ve ark., 2020, s. 4).

Endüstri 4.0 ile kurumsal varlıklar, cihazlar ve sensörler gibi fiziksel öğelerin hem internete hem de birbirine bağlanması kolaylaşmaktadır (Sipsas ve ark., 2016, s. 236). Etkin bir şekilde kullanıldığında Endüstri 4.0, uzun süreli ve karmaşık olan firma operasyonlarının optimizasyonunu desteklemektedir (Bag ve ark., 2020a, s. 9). Endüstri 4.0 içerisinde birçok teknolojiyi barındırmaktadır. Bu teknolojilerden bazıları şunlardır:

- Siber Fiziksel Sistemler (CPS): CPS'ler, fiziksel ortamdaki varlıkları izleme ve kontrol etme ile dağıtılmış bilgi işlem sistemlerini entegre eden ağ bağlantılı sistemlerin yeni yönlerini yakalamaktadır (Burmester ve ark., 2012, s. 118). CPS'ler genel olarak fiziksel dünya içinden gerçek zamanlı veri alımını ve siber alandan bilgi geri bildirimini sağlayarak siber alanı oluşturan ve gelişmiş bağlantı sağlayan analitik hesaplama yeteneği ve akıllı veri yönetimi olarak iki ana işlevsel bileşenden oluşmaktadır (Lee ve ark., 2015, s. 19).
- Nesnelerin İnterneti (IoT): IoT, Nesneler arasında bir bağlantı oluşmasını sağlayan bir teknolojidir. IoT, günlük hayatımızda fiziksel olarak kullandığımız cihazların gerektiğinde bulundukları durumlarını değiştirmemizi ve kontrol etmemizi sağlayan bir iletişim ağı şeklinde tanımlanmaktadır (Dilek, 2020). Etrafımızda bulunan bütün nesnelerin iletişim halinde olmasının yanı sıra makinelerin birbirleriyle etkileşim içerisinde olması IoT mimarisinin daha popüler hale gelmesini tetiklemiştir. Tüm cihazların birbirleri ile internet kullanarak haberleşmesi Nesnelerin İnterneti kavramını, Endüstri 4.0 olarak adlandırılan 4. Sanayi Devrimi içerisinde önemli bir noktaya taşımıştır (Koşunalp & Arucu, 2018, s. 4).
- Büyük Veri: Büyük Veri, yakalama, aktarım, depolama, iyileştirme, arama, analiz, görselleştirme, güvenlik ve gizlilik dahil olmak üzere büyük miktarda veriyi işlemeye yönelik herhangi bir teknik için kullanılan genel bir ter imdir (Xu & Duan, 2019, s. 150). Günümüzde, internetin hızlı gelişimi sayesinde, günlük olarak o kadar büyük miktarlarda bilgi üretilmekte ve toplanmaktadır ki, bunların işlenmesi ve analizi geleneksel araçlarla mümkün değildir. Büyük Veri teknolojisi, verileri geleneksel yöntemlerden daha ileri düzeyde analiz etmeyi mümkün kılmaktadır. Web sitelerinden, veri tabanlarından veya çeşitli sistemlerden toplanan verilerin işlenilmesi ve birleştirilmesi sağlanarak, belirli bir işletmenin veya kişinin içerisinde yer aldığı durumun net bir tablosunun gösterilmesini mümkün kılmaktadır (Witkowski, 2017, s. 767– 768).
- Bulut Bilişim: Minimum yönetim çabası veya hizmet sağlayıcı etkileşimi ile depolanabilen, paylaşılabilen, serbest bırakılabilen ve hızlı bir şekilde sağlanabilen, hizmetler, uygulamalar, sunucular ve ağlar gibi yapılandırılabilir bir bilgi işlem kaynakları havuzuna isteğe bağlı ağ erişimini her yerde sağlayan bir model olarak tanımlanmaktadır (Mell & Grace, 2011, s. 2). Bulut Bilişim, kaynakları otomatik olarak optimize ve kontrol etmeye yardım etmektedir. Hem müşteri hem de hizmet sağlayıcı için şeffaflık sağlayarak izlenebilir, raporlanabilir ve kontrol edilebilir hale getirmektedir (Akben & Avşar, 2017, s. 109).
- Üç Boyutlu Yazıcı: Üç Boyutlu Yazıcılar, üç boyutlu bir model veya çizimin katmanlar şeklinde basılmasıyla oluşturulan bir nesnenin üretim süreci olarak tanımlanmaktadır. Bu süreç oldukça karmaşık gözükse de 3 Boyutlu Yazıcılar karmaşık malzemeler olmadan nesnelerin basımını gerçekleştirebilmektedir (Soylu, 2018, s. 54).
- Robotik Uygulamalar: Robotik teknolojiler firma performansını iyileştirmek için insan niteliklerini robotun nitelikleriyle birleştirme olanağı sağlamaktadır. Robotlar basit ve tekrarlayan kullanım görevlerinde üstünlük sağlamaktadır. Bunun yanı sıra herhangi bir değişikliği anlamak ve bunlara uyum sağlamak için benzersiz bilişsel becerilere sahiptir (Ferraguti ve ark., 2019, s. 1070). Bir endüstriyel robot belirli bir yere sabitlenebilmekte ve aynı zamanda endüstriyel otomasyon görevlerini gerçekleştirmek için hareket etme yeteneğine de sahip olabilmektedir (Galin & Meshcheryakov, 2019, s. 2).
- Artırılmış Gerçeklik: Arttırılmış Gerçeklik, sanal öğelerle birleştirilen gerçek dünya içerisindeki bir fiziksel alanı dolaylı veya doğrudan olarak görüntülemek için elektronik bir cihazdan yararlanan teknolojidir (Fraga-Lamas ve ark., 2018, s. 13359–13363). Arttırılmış Gerçeklik uygulamaları, yakın çevreleriyle doğrudan veya fiziksel olarak bir ilişkisi bulunmayan kullanıcıların bu varlıklarla etkileşime girmesi için sanal bir ortam sağlamaktadır (Paelke, 2014, s. 1).

Tedarik Zinciri

Teknik olarak tedarik zinciri, malzemeleri tedarik etme işlemlerini yerine getiren, bunları mamullere ve yarı mamullere dönüştüren ve daha sonra dağıtım kanallarıyla tüketicilere ulaştıran dağıtım ve hizmet türlerinden oluşan ağ yapısıdır (Eymen, 2007, s. 7).

Tedarik zincirinin kapsamı, tedarik kaynağıyla başlamakta ve tüketim noktasında sona ermektedir. Nakliye ve fiziksel dağıtımda olduğu gibi tesis planlaması, üretim yönetimi, malzeme yönetimi, satın alma, tedarikçi yönetimi, müşteri hizmetleri ve bilgi akışı ile de ilgilidir (Stevens, 1989, s. 3).

Tedarik Zinciri Yönetimi ise "hammadde tedarikinden üretime ve dağıtım ile nihai kullanıcıya kadar bir değer zincirinde yer alan müşteriler, perakendeciler, dağıtıcılar, üreticiler ve tedarikçiler arasında bilgi, para, malzeme veya ürünün yönetimi olarak tanımlanabilmektedir." Ürün yanlışlıklarını, çevrim zamanını, stok ve faaliyet maliyetlerini azaltarak müşteri tatminini artırmak Tedarik Zinciri Yönetimi'nin temel amaçları arasındadır (Özdemir, 2004, s. 89). Tedarik Zinciri Yönetimi hem operasyonel hem de stratejik nitelikteki faydaların elde edilmesine öncülük eden çağdaş bir kavram olarak kabul edilmektedir (Al-Mudimigh ve ark., 2004, ss. 309–310).

Metodolojik Çerçeve

Metodolojik çerçeve başlığı altında araştırmanın amacı, modeli ve hipotezleri, evreni ve örneklemi ile birlikte araştırmanın yöntemi verilmektedir.

Araştırmanın Amacı

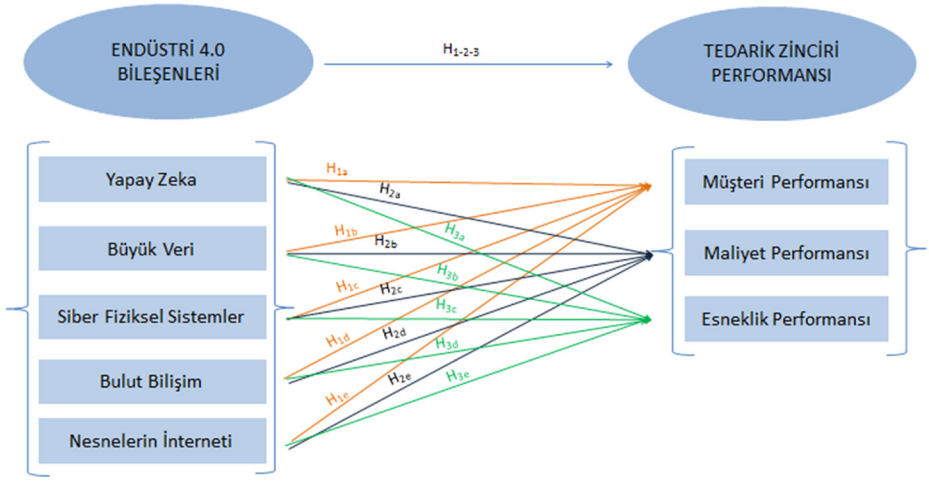
Endüstri 4.0 kavramı, geçtiğimiz 10 yıl boyunca popüler olan bir kavram olarak karşımıza çıkmaktadır. Almanya'nın öncülüğünde başlayan ve ardından tüm dünyaya yayılan Endüstri 4.0 uygulamalarının, teknoloji yoğun üretime destek olduğu bilinmektedir. Bu durum göz önüne alındığında Endüstri 4.0 uygulamalarının tedarik zinciri performansı üzerinde etkili olup olmadığı araştırılması gereken bir konu olarak karşımıza çıkmaktadır. Bu nedenle bu araştırma, üretim yapan firmalarda kullanılan Endüstri 4.0 uygulamaların tedarik zinciri performansı üzerindeki etkisini ölçmeye odaklanmaktadır.

Araştırmanın Modeli ve Hipotezleri

Tedarik zinciri bir işletme için büyük bir değere sahiptir ve ürünün doğduğu başlangıç noktasından ürünün tüketildiği son ana kadar olan bütün süreçleri kapsamaktadır. Bu nedenle tedarik zinciri performansını arttıran firmalar bir rekabet avantajı elde ederek daha etkin bir yapıya dönüşebilmektedir. Tedarik Zinciri Performansını arttırmak için firmaların denemiş oldukları birçok yöntem bulunmaktadır. Bu yöntemler içerisinde Endüstri 4.0'a dayalı Dijital Tedarik Zinciri stratejisi de yer almaktadır. Dijital Tedarik Zinciri stratejisinin tedarik zinciri performansına etkisi ise bu çalışmanın amacını oluşturmaktadır. Bu doğrultuda bu çalışma, Endüstri 4.0 uygulamalarının Tedarik Zinciri Performansı üzerinde bir etkisinin olup olmadığını araştırmaktır. Bu amaç için aşağıda yer alan model oluşturulmuştur.

Şekil 1'e göre araştırmanın bağımsız değişkeni olan Endüstri 4.0 Bileşeninden araştırmanın bağımlı değişkeni olan Tedarik Zinciri Performansının doğru giden ok ile belirtilen H_1, H_2 ve H_3 araştırmanın ana hipotezlerini oluşturmaktadır. Araştırmadaki üç ana hipotez Endüstri 4.0 bileşenlerinin tedarik zinciri performansının alt boyutlarına (Müşteri, Maliyet ve Esneklik Performansları) etkisini göstermektedir. Endüstri 4.0. Bileşenlerinin alt boyutlarından Tedarik Zinciri Performansının alt boyutlarına giden oklar ise araştırmanın alt hipotezlerini oluşturmaktadır. Araştırmanın Hipotezleri ise şu şekildedir:

- H_1: Endüstri 4.0 Bileşenlerinin Müşteri Performansı üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{1a}: Endüstri 4.0 bileşenlerinden Yapay Zekâ boyutunun Müşteri Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{1b}: Endüstri 4.0 bileşenlerinden Büyük Veri boyutunun Müşteri Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{1c}: Endüstri 4.0 bileşenlerinden Siber Fiziksel Sistemler boyutunun Müşteri Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{1d}: Endüstri 4.0 bileşenlerinden Bulut Bilişim boyutunun Müşteri Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{1e}: Endüstri 4.0 bileşenlerinden Nesnelerin İnterneti boyutunun Müşteri Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_2: Endüstri 4.0 Bileşenlerinin Maliyet Performansı üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{2a}: Endüstri 4.0 bileşenlerinden Yapay Zekâ boyutunun Maliyet Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{2b}: Endüstri 4.0 bileşenlerinden Büyük Veri boyutunun Maliyet Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.



Şekil 1.
Araştırmanın Modeli.

- H_{2c}: Endüstri 4.0 bileşenlerinden Siber Fiziksel Sistemler boyutunun Maliyet Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{2d}: Endüstri 4.0 bileşenlerinden Bulut Bilişim boyutunun Maliyet Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{2e}: Endüstri 4.0 bileşenlerinden Nesnelerin İnterneti boyutunun Maliyet Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_3: Endüstri 4.0 Bileşenlerinin Esneklik Performansı üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{3a}: Endüstri 4.0 bileşenlerinden Yapay Zekâ boyutunun Esneklik Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{3b}: Endüstri 4.0 bileşenlerinden Büyük Veri boyutunun Esneklik Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{3c}: Endüstri 4.0 bileşenlerinden Siber Fiziksel Sistemler boyutunun Esneklik Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.

Tablo 1.
Tedarik Zinciri Performansı Faktör Analizi Sonuçları

	Müşteri Performansı	Maliyet Performansı	Esneklik Performansı
İfadeler		**Faktör Yükleri**	
TZP15	0,857		
TZP16	0,850		
TZP14	0,846		
TZP11	0,835		
TZP12	0,834		
TZP13	0,819		
TZP10	0,800		
TZP8	0,774		
TZP3		0,866	
TZP2		0,863	
TZP5		0,759	
TZP6		0,737	
TZP9		0,722	
TZP1		0,684	
TZP4		0,681	
TZP21			0,800
TZP19			0,760
TZP22			0,760
TZP18			0,672
TZP23			0,672
TZP17			0,628
Özdeğerler	1,661	1,968	12,595
Rotasyon Yöntemi	Varimax		
Açıklanan Toplam Varyans	77,255		
Bartlett's Anlamlılık	0,000		
KMO	0,920		

- H_{3d}: Endüstri 4.0 bileşenlerinden Bulut Bilişim boyutunun Esneklik Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.
- H_{3e}: Endüstri 4.0 bileşenlerinden Nesnelerin İnterneti boyutunun Esneklik Performansı boyutu üzerinde istatistiki olarak anlamlı bir etkisi vardır.

Araştırmanın Evreni ve Örneklemi

Bu çalışmanın evrenini Gaziantep ilinde faaliyet gösteren imalat firmaları oluşturmaktadır. Gaziantep ilinde sanayi odasına 2174 adet firma kayıtlıdır (Gaziantep Sanayi Odası, 2021). Dolayısıyla araştırmanın ana kütle sayısı 2174 olarak belirlenmiştir.

Tablo 2.
Endüstri 4.0 Uygulamalarının Faktör Analizi Sonuçları

	Yapay Zekâ	Büyük Veri	Siber Fiziksel Sistemler	Bulut Bilişim	Nesnelerin İnterneti
İfadeler			**Faktör Yükleri**		
Yazıcı2	0,957				
AR1	0,912				
R2	0,898				
Yazıcı1	0,897				
Yazıcı3	0,893				
Yazıcı4	0,835				
R4	0,833				
AR2	0,805				
R3	0,762				
AR3	0,654				
BD3		0,867			
BD4		0,853			
BD1		0,820			
BD2		0,803			
SFS4			0,791		
SFS1			0,774		
SFS2			0,703		
SFS3			0,631		
SFS6			0,542		
SFS5			0,450		
BB3				0,777	
BB2				0,724	
BB1				0,557	
IoT2					0,654
IoT4					0,544
IoT3					0,493
IoT1					0,450
Özdeğerler	10,267	5,864	1,843	1,411	1,129
Rotasyon Yöntemi	Varimax				
Açıklanan Toplam Varyans	70,738				
Bartlett's Anlamlılık	0,000				
KMO	0,834				

Araştırmanın örneklemini ise Gaziantep ilinde faaliyet gösteren 103 adet firmanın yöneticileri oluşturmaktadır. Her firmadan yalnızca bir adet yönetici seçilmiştir. Örneklem sayısının güven düzeyi %95, hata payı ise %9,43'tür.

Örnekleme yöntemi olarak kolayda örnekleme yöntemi seçilmiştir. Kolayda örnekleme metodunda ana kütle içerisinden seçilmesi gereken örneklem, araştırmacı tarafından tesadüfi olmadan seçilen örnekleme yöntemidir. Bu örnekleme yönteminde veriler ana kütle içerisinden en kolay şekilde hızlı ve ekonomik olarak toplanılmaktadır (Malhotra, 2004, s. 321).

Yöntemler

Bu çalışmada nicel araştırma yöntemi olan, içerisinde firma bilgilerini de içeren, 5'li likert ölçeğinden faydalanılarak hazırlanan bir anket formu kullanılmıştır. Nicel araştırma yöntemi, deneysel araştırma, karşılaştırmalı araştırma, anket araştırması gibi çeşitli şekillerde kendini göstermektedir (Yıldırım, 1999, s. 7). Gaziantep Sanayi Odasına kayıtlı firmalara 1 Mart 2021 ve 31 Aralık 2021 tarihleri arasında hem çevrimiçi hem de yüz yüze olarak anket yapılmış ve yanıtları toplanmıştır. İki farklı tür kullanılmasının sebebi araştırmanın başlangıç döneminin COVID-19 pandemi kısıtlamalarına denk gelmesidir. Kısıtlamalar nedeniyle başlangıçta çevrimiçi oluşturulan anket kısıtlamalar kaldırıldıktan sonra yüz yüze olarak gerçekleştirilmiştir.

Araştırmada ilk olarak çevrimiçi anket formu oluşturulmuş ve Gaziantep Sanayi Odasına kayıtlı firmaların e- posta adreslerine gönderilmiştir. Gönderilen e- postalardan yalnızca 9 geri dönüş alınmış ve birer hatırlatma postası daha gönderilmiştir. Hatırlatma postasından sonra iki geri dönüş daha alınabilmiştir. Böylelikle çevrimiçi olarak toplam 11 yanıt elde edilmiştir. Kalan 92 anket formu ise firmalarla yüz yüze gerçekleştirilmiştir. Sonuç olarak toplamda 103 adet kullanılabilir anket elde edilmiştir.

Anket formu temelde üç ana bölüm şeklinde gruplanmış ilk bölümde firmaların kurumsal bilgilerini tespit etmeye yarayacak ifadeler kullanılmış ikinci bölümde ise firmaların Endüstri 4.0 teknolojilerini kullanma durumunu ölçmeye yarayacak ifadeler tercih edilmiştir. Bu bölümde yer alan ifadeler Endüstri 4.0 içerisinde yer alan teknolojilerin her birinin kullanımını ölçmek için kullanılmıştır. Son kısımda ise bu bileşenlerin firmaların Tedarik Zinciri Performansı üzerindeki etkilerini ölçmeye yarayacak ifadeler kullanılmıştır. İkinci ve üçüncü bölümde kullanılan ifadeler sırasıyla Duman (2020) ve Yazgan'ın (2017) çalışmalarından alınmıştır.

Tablo 3.
Endüstri 4.0 Uygulamalarının Faktör Analizi Sonuçları

Kategoriler	Seçenekler	*F*	%
İşletmenin Hukuki Yapısı	Anonim Şirketler ve Şahıs İşletmeleri	41	39,8
	Limited Şirket	62	60,2
İşletmenin Faaliyet Alanı	Tekstil	48	46,6
	Kimya	13	12,6
	Gıda	7	6,8
	Plastik	10	9,7
	Makine- Metal	19	18,4
	Ambalaj	1	1,0
	Sağlık Ürünleri	3	2,9
	Ayakkabı	1	1,0
	Temizlik	1	1,0
Çalışanın Pozisyonu	Alt ve orta düzey yönetici	63	61,2
	Üst düzey yönetici	40	38,8
İşletmenin Çalışan Sayısı	50 kişi altı	56	54,3
	50 kişi ve üzeri	47	45,6
İşletmenin Toplam Faaliyet Yılı	10 yıl ve altı	44	42,7
	10 yıl üstü	59	57,3

Bu araştırmada kullanılan anketin ilk bölümü içerisinde katılımcı firmaların kurumsal bilgilerine yönelik sorular bulunmaktadır. Firmaların faaliyet yılı, çalışan sayısı, faaliyet gösterdiği sektör, hukuki yapıları gibi bilgiler bu bölüm içerisinde yer almaktadır. Anketin ikinci kısmında ise firmaların Endüstri 4.0 teknoloji bileşenlerinin temel uygulamalarının gerçekleştirilme düzeyleri ölçülmek istenmiştir. Duman (2020), "Endüstri 4.0 Teknoloji Bileşenlerinin Örgütsel Performansa Etkilerini Belirlemeye Yönelik Bir Araştırma" adlı çalışmada, Endüstri 4.0 teknoloji bileşenlerinin temel uygulamalarının gerçekleştirilme düzeylerini ölçmek için kullanılan ifadelerin bu çalışma için de uygun olacağı düşünülmüştür. Bu bölüm toplam 29 ifade kullanılarak uygulanmıştır. Duman'ın bu çalışmasında Cronbach Alfa değeri 0,862 olarak bulunmuştur.

Araştırma anketinin üçüncü ve son bölümünde, Endüstri 4.0 teknolojilerini kullanımının, Tedarik Zinciri Performansında yarattığı etkileri ölçmek adına; Yazgan (2017), "Tedarik Zinciri ve Bilgi Sistemleri Stratejilerinin Tedarik Zinciri Performansına Etkisi: İhracat Yapan İşletmeler Üzerine Bir Araştırma" adlı tezden derlenen 23 ifadenin bu çalışma için de uygun olabileceği öngörülerek bu çalışmanın ifadeleri derlenmiş ve anket içerisine dahil edilmiştir. Yazgan'ın bu çalışmasında Cronbach Alfa değeri 0,928 olarak bulmuştur.

Bulgular

Bu araştırmada, elde edilen bulguların değerlendirilebilmesi için, Yüzde-Frekans Dağılım Analizi, Açımlayıcı Faktör Analizi ve Regresyon Analizleri yapılmıştır. Verilerin analizine geçilmeden önce veri setinin analize uygun hale getirilmesi için normallik testi, uç değer analizi ve kayıp veri analizleri yapılmıştır. Yapılan analizlere göre herhangi bir uç değer bulunmamış ve araştırmada kullanılan ifadelerin normal bir dağılım gösterdiğine karar verilmiştir.

Açımlayıcı Faktör Analizi

Araştırmada kullanılan ölçeklere açımlayıcı faktör analizi yöntemi uygulanmıştır. Bu kapsamda ilk olarak Endüstri 4.0 bileşenleri ölçeğine, daha sonra ise Tedarik Zinciri Performansı ölçeğine faktör analizi yapılarak boyutlar belirlenmeye çalışılmıştır. Varimax rotasyon yöntemi kullanılarak yapılan analizin sonuçları aşağıdaki tablolar içerisinde yer almaktadır:

Araştırmada kullanılan ölçeklere yapılan Açımlayıcı Faktör Analizi sonuçlarına göre Endüstri 4.0 bileşenlerinin tedarik zinciri performansı üzerindeki etkiyi ölçmek için kullanılan ifadelerinin öz değeri birden büyük toplam üç faktör altında toplanmıştır (Tablo 1).

Tedarik Zinciri Performans ölçeklerine yapılan faktör analizinden TZP7 ve TZP20 ifadeleri binişik madde olduğu için analizden çıkarılmıştır. Analiz sonucunda oluşan faktörler, literatüre uygun olarak Müşteri Performansı, Maliyet Performansı ve Esneklik Performansı olarak adlandırılmıştır. Bu üç faktörün %77 oranında açıklanan toplam varyansa sahip olduğu görülmektedir. KMO (Kaiser- Meyer Olkin) ölçüm değerinin, 0,50'in altıda olması örneklem

çapının yetersiz olduğu şeklinde yorumlanırken, bu değer 0,50-0,60 aralığındaysa zayıf, 0,60–0,70 aralığındaysa orta, 0,70-0,80 aralığındaysa iyi, 0,80-0,90 aralığındaysa çok iyi, 0,90 üzerinde ise mükemmel olarak yorumlanmaktadır (Hair ve ark., 2006, s. 115). Bu çalışmada KMO ölçüm değeri 0,920 olarak bulunmuştur. Bu KMO değeri örneklem çapının yeterliliği için mükemmel olarak yorumlanmaktadır.

Endüstri 4.0 bileşenlerin temel kullanım düzeyini ölçmek için kullanılan ifadelere yapılan faktör analizi sonuçlarına göre ise öz değeri birden büyük toplam beş faktör altında toplandığı görülmüştür (Tablo 2).

Endüstri 4.0 bileşenlerine ait ifadelere yapılan faktör analizinden R1 ve BB4 ifadeleri binişik madde olduğu için analizden çıkarılmıştır. Bu faktörler, literatüre uygun olarak Büyük Veri, Yapay Zekâ, Siber Fiziksel Sistemler, Nesnelerin İnterneti ve Bulut Bilişim isimleriyle adlandırılmıştır. Bu beş faktörün %70 oranında açıklanan toplam varyansa sahip olduğu sonucuna ulaşılmıştır. Bu çalışma için yapılan faktör analizi sonucuna göre KMO ölçüm değerinin 0,834 olarak bulunmuştur. Hair ve ark. (2006)'ya göre, KMO değerinin %83 olması örneklem çapının yeterli ve geçerli olduğunu göstermektedir. Yapılan faktör analizlerine göre anket geçerliliği sağlanmıştır.

Anketin güvenirliliğini ölçmek için yapılan analiz sonuçlarına göre Endüstri 4.0 ölçeğinin cronbach alfa değeri 0,928 olarak bulunmuştur. Tedarik Zinciri Performansı ölçeğinin güvenilirliğine bakıldığında ise cronbach alfa değerinin 0,965 olduğu görülmektedir. Bu ölçekler Taber (2018)'e göre sırasıyla güçlü ve mükemmel olarak değerlendirilebilmektedir. Bu çalışma için yapılan ankette kullanılan tüm ifadelere yapılan güvenirlilik analizi sonucuna göre cronbach alfa değeri 0,951 olarak bulunmuştur. Bu sonuç yine mükemmel olarak yorumlanabilir.

Araştırmanın Frekans Dağılımı Sonuçları

Araştırmanın uygulama kısmı için ilk kısımda firmaların Tablo 3'te yer alan kurumsal bilgileri ölçülmek istenmiş ve verilen yanıtların sonuçları aşağıdaki tablo içerisinde aktarılmıştır.

Tablo 4.
Endüstri 4.0 Bileşenleri Boyutları ve Müşteri Performansı Boyutu Modeli Özeti

Model	*R*	R^2	Düzeltilmiş R^2	Tahminlenen standart Hata	Durbin-Watson
1	,475[a]	,225	,185	0,99382	1,469

Araştırmanın uygulama kısmı için ilk kısımda firmaların kurumsal bilgileri ölçülmek istenmiştir. Buna göre araştırmaya katılan firmaların çoğunluğunu limited şirketler oluşturmaktadır. Katılımcı firmaların çalışan sayılarına bakıldığında 50 kişi altında çalışana sahip firmaların; toplam faaliyet yılına bakıldığında ise 10 yıl üzerinde faaliyet gösteren firmaların çoğunluğu oluşturduğu sonucuna ulaşılmıştır.

Anket ifadelerinin frekans ve yüzdelik dağılımları incelendiğinde katılımcıların çoğunluğunun Yapay Zekâ ve Nesnelerin İnterneti boyutları altında yer alan teknolojileri henüz gerçekleştirmediği görülmüştür. Ancak Büyük Veri boyutu altında yer alan ifadelere verilen yanıtlar incelendiğinde katılımcıların çoğunluğu bu teknolojiyi kullanma noktasında hazırlık aşamasında olduklarını ve kullandıklarını belirtmişlerdir. Siber Fiziksel Sistemler ve Bulut Bilişim boyutları altındaki ifadeler incelendiğinde katılımcıların bu teknolojileri kullandıkları sonucuna ulaşılmıştır.

Araştırmanın bağımlı değişkeni olan Tedarik Zinciri Performansı alt boyutlarına verilen yanıtlar incelendiğinde Müşteri Performansı altında yer alan ifadelere katılımcıların çoğunluğu Endüstri 4.0 ile müşteri memnuniyetini sağlama, talepleri karşılama ve zamanında teslimat gibi konularında sıkıntı yaşamadıklarını belirtmişlerdir. Maliyet Performansı boyutunda yer alan ifadelere verilen yanıtlara göre katılımcıların yarısı bilgi, üretim, stok ve dağıtım gibi maliyetleri, Endüstri 4.0 ile azaltabileceklerini düşünürken katılımcıların 3'te 1'ine yakın kısmı ise bu konuda kararsız olduklarını belirtmiştir. Esneklik Performansı boyutu altında yer alan ifadelere verilen yanıtlar incelendiğinde katılımcıların yarısı Endüstri 4.0 ile tedarik zinciri faaliyetlerinde esneklik sağlayabileceklerini düşünmektedir.

Tablo 5.
Endüstri 4.0 Bileşenleri Boyutları ve Müşteri Performansı Regresyon Analizi Sonuçları

Model		Kareler Toplamı	*df*	Kareler Ortalaması	*F*	*p*
1	Regression	27,845	5	5,369	5,639	,000[b]
	Residual	95,805	97	0,988		
	Total	123,650	102			

Tablo 6.
Endüstri 4.0 Bileşenleri Boyutları ve Müşteri Performansı Boyutu Katsayılar Tablosu

		Standardize edilmemiş katsayılar		Standardize edilmiş katsayılar		
Model		B	Standart Hata	Beta	T	*p*
Bağımsız değişkenler	Sabit	2,449	0,393		6,230	
	Yapay Zekâ	0,099	0,135	0,076	0,727	,469
	Büyük Veri	0,111	0,099	0,138	1,120	,266
	Siber Fiziksel Sistemler	0,184	0,142	0,169	1,297	,198
	Bulut Bilişim	0,315	0,108	0,413	3,021	,001
	Nesnelerin interneti	-0,167	0,130	-0,174	-2,345	,167

Tablo 7.
Endüstri 4.0 Bileşenleri Boyutları ve Maliyet Performansı Boyutu Modeli Özeti

Model	*R*	R^2	Düzeltilmiş R^2	Tahminlenen standart Hata	Durbin-Watson
1	,424[a]	,18	,138	0,99630	1,571

Regresyon Analizi

Regresyon katsayısı; iki faktör arasındaki doğrusal ilişkinin derecesini belirlemek amacıyla Pearson korelasyon katsayısı kullanılmaktadır. Hesaplanan r değeri –1 ve +1 değerleri arasında bir değer alır. Kısaca r değeri, hesaplanan regresyon doğrusunun noktalara çok yakın olması halinde, –1 veya +1 değerlerini alır ve doğrunun noktalardan uzak seyretmesi oranında r değeri de sıfıra yaklaşmaktadır (Günel, 1970, s. 218). Bu çalışmada hipotezleri test etmek için Çoklu Regresyon Analizi kullanılmıştır. Bu analizler bu bölüm içerisinde verilmektedir.

Regresyon Analizine geçilmeden önce Durbin-Watson testi yapılmış ve sonuçları verilmiştir. Bu test, terimler arasında oto korelasyon olup olmadığını göstermektedir. Bu test sonucunun 3'ün altında olması regresyon analizinin yapılabileceği anlamına gelmektedir (Field, 2009).

Tablo 4, 5 ve 6 içerisinde Endüstri 4.0 Bileşenleri Boyutları ve Müşteri Performansı Boyutu arasındaki regresyon analizi sonuçları incelenmektedir.

Bağımsız değişkenlerden Endüstri 4.0 boyutları ile bağımlı değişken Tedarik Zinciri Performansı boyutlarından biri olan Müşteri Performansı arasındaki regresyonu ölçmeden önce yapılan Durbin-Watson test sonuçlarına göre bu değerin 3'ün altında olduğu görülmektedir (1,469). Düzeltilmiş R^2 değerine göre Endüstri 4.0 bileşeni boyutlarına ait bağımsız değişkenleri, bağımlı değişken durumundaki Müşteri Performansına ait varyansı %18,5 oranda açıkladığı sonucuna ulaşılmaktadır. Bu sonuca göre Müşteri Performansı boyutunun %18,5 oranında Endüstri 4.0 bileşenlerine göre şekillendiği anlaşılmaktadır.

Endüstri 4.0 bileşenleri alt boyutlarının Müşteri Performansı boyutunu anlamlı düzeyde etkileme durumunu ölçmek için yapılan çoklu doğrusal regresyon analizi sonucuna göre model anlamlı bulunmuştur ($F = 5{,}639$; $p = ,000$).

Endüstri 4.0 bileşenlerini ölçmek için kullanılan ifadelerin boyutlarının, Tedarik Zinciri Performans boyutu olan Müşteri Performansı üzerinde istatistiksel olarak anlamlı bir etkisi olup olmadığını incelemek için Tablo 6 içerisinde yer alan istatistiksel sonuçlar kullanılmıştır.

Tablo 6'ya göre regresyon katsayıları ve anlamlılık düzeylerine bakıldığında, Endüstri 4.0 bileşenin alt boyutlarından "Bulut Bilişim" boyutunun "Müşteri Performansı" boyutu üzerinde istatistiksel olarak anlamlı bir etkisi olduğu görülmektedir ($p < ,05$). Buna göre oluşturulacak regresyon denkleminde Endüstri 4.0 Bileşenlerinden Bulut Bilişim boyutu üzerindeki 1 birimlik değişim Müşteri Performansı boyutunu 0,315 birim arttıracağı sonucuna ulaşılmaktadır. H1 alt hipotezlerden yalnızca H_{1d} hipotezi desteklenmiş diğer hipotezler reddedilmiştir.

Tablo 7, 8 ve 9 içerisinde Endüstri 4.0 Bileşenleri Boyutları ve Maliyet Performansı Boyutu arasındaki regresyon analizi sonuçları incelenmektedir.

Bağımsız değişkenlerden Endüstri 4.0 boyutları ile bağımlı değişken Tedarik Zinciri Performansı boyutlarından biri olan Maliyet Performansı arasındaki regresyonu ölçmeden önce yapılan Durbin- Watson test sonuçlarına göre bu değerin 3'ün altında olduğu görülmektedir (1,571). Düzeltilmiş R^2 değerine göre Endüstri 4.0 bileşeni boyutlarına ait bağımsız değişkenleri, bağımlı değişken durumundaki Müşteri Performansına ait varyansı %13,8 oranda açıkladığı sonucuna ulaşılmaktadır. Bu sonuca göre Maliyet Performansı boyutunun %13,8 oranında Endüstri 4.0 bileşenlerine göre şekillendiği anlaşılmaktadır.

Endüstri 4.0 bileşenleri alt boyutlarının Maliyet Performansı boyutunu anlamlı düzeyde etkileme durumunu ölçmek için çoklu doğrusal regresyon analizi yapılmıştır. Regresyon analizi sonucuna göre model anlamlı bulunmuştur ($F = 3{,}760$; $p = ,002$).

Tablo 8.
Endüstri 4.0 Bileşenleri boyutları ve Maliyet Performansı Regresyon Analizi Sonuçları

Model		Kareler Toplamı	*df*	Kareler Ortalaması	*F*	*p*
1	Regression	21,112	5	4,322	3,760	,002[b]
	Residual	96,283	97	0,993		
	Total	117,396	102			

Tablo 9.
Endüstri 4.0 Bileşenleri boyutları ve Maliyet Performansı Boyutu Katsayılar Tablosu

		Standardize edilmemiş katsayılar		Standardize edilmiş katsayılar		
Model		B	Standart Hata	Beta	T	*p*
Bağımsız değişkenler	Sabit	2,206	0,401		5,496	,000
	Yapay Zeka	0,303	0,138	0,241	2,193	,031
	Büyük Veri	0,034	0,101	0,043	0,332	,741
	Siber Fiziksel Sistemler	0,013	0,145	0,012	0,088	,930
	Bulut Bilişim	0,304	0,105	0,363	2,910	,004
	Nesnelerin interneti	-0,027	0,120	-0,029	-0,276	,821

Tablo 10.
Endüstri 4.0 Bileşenleri Boyutları ve Esneklik Performansı Regresyon Analizi Sonuçları

Model	*R*	R^2	Düzeltilmiş R^2	Tahminlenen standart Hata	Durbin-Watson
1	,318[a]	,101	,083	0,98019	1,452

Endüstri 4.0 bileşenlerini ölçmek için kullanılan ifadelerin boyutlarının, Tedarik Zinciri Performans boyutu olan Maliyet Performansı ile üzerinde anlamlı bir etkisi olup olmadığını incelemek için Tablo 9 içerisinde yer alan istatistiksel sonuçlar kullanılmıştır.

Tablo 9'da yer alan regresyon katsayılarına ve anlamlılık düzeylerine bakıldığında, Endüstri 4.0 bileşenin alt boyutlarından "Bulut Bilişim" ve "Yapay Zekâ" boyutlarının "Maliyet Performansı" boyutu üzerinde istatistiksel olarak anlamlı bir etkisi olduğu görülmektedir ($p < ,05$). Buna göre oluşturulacak regresyon denkleminde Endüstri 4.0 Bileşenlerinden Bulut Bilişim boyutu üzerindeki 1 birimlik değişim Maliyet Performansı boyutunu 0,304 birim; Yapay Zekâ Boyutu üzerindeki 1 birimlik artışın Maliyet Performansı boyutunu 0,303 birim arttıracağı sonucuna ulaşılmaktadır. H_2 alt hipotezlerinden H_{2a} ve H_{2d} alt hipotezleri desteklenirken H_{2b}, H_{2c} ve H_{2e} hipotezleri reddedilmiştir.

Tablo 10, 11 ve 12 içerisinde Endüstri 4.0 Bileşenleri Boyutları ve Esneklik Performansı Boyutu arasındaki regresyon analizi sonuçları incelenmektedir.

Bağımsız değişkenlerden Endüstri 4.0 boyutları ile bağımlı değişken Tedarik Zinciri Performansı boyutlarından biri olan Esneklik Performansı arasındaki regresyonu ölçmeden önce yapılan Durbin- Watson test sonuçlarına göre bu değerin 3'ün altında olduğu görülmektedir (1,452). Düzeltilmiş R^2 değerine göre Endüstri 4.0 bileşenleri boyutlarına ait bağımsız değişkenlerin, bağımlı değişken durumundaki Müşteri Performansına ait varyansı %8,3 oranda açıkladığı sonucuna ulaşılmaktadır. Bu sonuca göre Esneklik Performansı boyutunun %8,3 oranında Endüstri 4.0 bileşenlerine göre şekillendiği anlaşılmaktadır.

Endüstri 4.0 bileşenleri alt boyutlarının Esneklik Performansı boyutunu anlamlı düzeyde etkileme durumunu ölçmek için çoklu doğrusal regresyon analizi yapılmıştır. Regresyon analizi sonucuna göre model anlamlı bulunmuştur ($F = 5,626$; $p = ,005$).

Endüstri 4.0 bileşenlerini ölçmek için kullanılan ifadelerin boyutlarının Tedarik Zinciri Performans boyutu olan Esneklik Performansı üzerinde anlamlı bir etkisi olup olmadığını incelemek için Tablo 12 içerisinde yer alan istatistiksel sonuçlar kullanılmıştır.

Tablo 12'ye göre regresyon katsayılarına ve anlamlılık düzeylerine bakıldığında, Endüstri 4.0 bileşenin alt boyutlarının Esneklik Performansı üzerinde herhangi bir etkisi bulunmadığı sonucuna ulaşılmaktadır. Buna göre H_3 hipotezi ve alt hipotezleri desteklenmemiştir.

Sonuç ve Öneriler

Endüstri 4.0 teknolojilerini yakından takip etmek birçok firma için hem zorlukları hem de kolaylıkları beraberinde getirebilmektedir. Zorlukları arasında bu teknolojinin maliyetleri ve kullanılacak olan teknoloji için yetiştirilmiş bir uzmanın olması gibi işgücüne yansıyan değişik etkiler de yer almaktadır. Bir teknolojiyi kullanmaya karar vermek için yalnızca maliyetlere odaklanmamak gerekir. Aynı zamanda yerleşik bir düzen içerisine yeni bir düzen kurma üzerindeki zorluklara da odaklanmak gerekmektedir. Birçok zorluğun yanında Endüstri 4.0 uygulamaları birçok avantaja da sahip olabilmektedir. Örneğin tedarik edilemeyen bir parça hızlı prototipleme sayesinde 3D yazıcı ile üretilebilmekte ve üretim süreci içerisinde uzun sürebilecek tedarik sürelerinden kaçınılabilmektedir. Nesnelerin İnterneti ile makineler birbirleri ile iletişim kurarak ve kendi kendine karar vererek yine üretimin aksamamasını sağlayabilmektedir. Tedarik zincirleri içerisine bu teknolojilerin entegre edilmesi ile yaşanabilecek negatif veya pozitif etkiler bu çalışma içerisinde sunulmuştur. Ayrıca bu çalışma, gelişen teknolojilerin, endüstri içerisinde kullanılması ve bu teknolojilerin tüm alanlarda yaygınlaşmaya başlaması ile birlikte bu alanlardan biri olan tedarik zinciri içerisindeki etkisine odaklanmaktadır.

Tablo 11.
Endüstri 4.0 Bileşenleri boyutları ve Esneklik Performansı Regresyon Analizi Sonuçları

Model		Kareler Toplamı	*df*	Kareler Ortalaması	*F*	*p*
1	Regression	10,810	5	5,405	5,626	,005[b]
	Residual	96,076	97	0,961		
	Total	106,887	102			

Tablo 12.
Endüstri 4.0 Bileşenleri boyutları ve Esneklik Performansı Boyutu Katsayılar Tablosu

		Standardize edilmemiş katsayılar		Standardize edilmiş katsayılar		
Model		B	Standart Hata	Beta	T	*p*
Bağımsız değişkenler	Sabit	1,994	0,383		5,203	,000
	Yapay Zeka	0,256	0,132	0,214	1,939	,055
	Büyük Veri	0,134	0,097	0,180	1,388	,168
	Siber Fiziksel Sistemler	0,204	0,138	0,201	1,471	,145
	Bulut Bilişim	0,140	0,101	0,175	1,380	,171
	Nesnelerin interneti	-0,187	0,116	-0,211	-1,616	,109

Endüstri 4.0 uygulamalarının Tedarik Zinciri Performansı üzerindeki etkisini ortaya koymak için Gaziantep ilindeki üretici firmalara anket uygulaması yapılmıştır. Anket yanıtları incelenerek yapılan analizlere göre Endüstri 4.0 bileşenlerinin tedarik zinciri alt boyutları üzerinde istatistiksel olarak anlamlı bir etkisi olup olmadığı incelenmiştir.

Bu çalışmanın evrenini Gaziantep ilinde faaliyet gösteren imalat firmaları oluşturmaktadır. Araştırmanın örneklemini ise Gaziantep ilinde faaliyet gösteren 103 adet firmanın yöneticileri oluşturmaktadır. Her firmadan yalnızca bir adet yönetici seçilmiştir. Araştırma verileri toplanırken birincil elden veri toplama yöntemlerinden olan anket yöntemi kullanılmıştır. Araştırma amacının doğrultusunda bir anket hazırlanmış ve anket formu kolayda örnekleme metodu ile uygulanmıştır. Anket formu kurumsal bilgileri ölçmeye yarayan ifadelere ek olarak iki ayrı bölümden oluşmaktadır. Bu bölümlerden ilki Endüstri 4.0 bileşenlerini kullanım düzeylerini ölçerken diğer bölüm bu bileşenlerin Tedarik Zinciri Performansı üzerindeki etkisini ölçmek adına derlenen ifadelerden oluşmaktadır. Bu çalışmanın anket uygulaması COVID-19 önlemlerinin alındığı döneme denk geldiği için ilk olarak çevrimiçi olarak gerçekleştirilmiştir. Daha sonra bu önlemlerin azaltılmasıyla birlikte yüz yüze olarak da anket yanıtları toplanmıştır. Bu kapsamda toplamda 103 yanıt elde edilmiştir.

Toplanan anketlerden elde edilen verilere yapılan analizlerin sonuçlarına göre araştırmaya katılan firmaların çoğunluğunu Limited Şirketler oluşturmaktadır. Katılımcı firmalar arasında en çok faaliyet gösterilen sektör arasında ise Tekstil sektörünün yer aldığı görülmüştür. Katılımcı firmaların çalışan sayılarına bakıldığında 50 kişiden az çalışana sahip firmaların; toplam faaliyet yılına bakıldığında ise 10 yıl üzerinde faaliyet gösteren firmaların çoğunluğu oluşturduğu sonucuna ulaşılmıştır.

Araştırma kapsamında uygulanan anket çalışmasına güvenirlilik ve normallik analizleri yapılarak parametrik testlerin yapılabileceği tespit edilmiiş ve bu doğrultuda Faktör Analizi ve Çoklu Doğrusal Regresyon Analizi yapılmıştır. Araştırma kapsamında yapılan faktör analizi sonucunda Endüstri 4.0 uygulamaları için kullanılan ifadelerin toplam beş boyuta sahip olduğu tespit edilmiştir. Endüstri 4.0 uygulamalarını ölçmek için kullanılan ifadelere ait boyutlar literatüre uygun olarak "Yapay Zeka", "Büyük Veri", "Siber Fiziksel Sistemler", "Bulut Bilişim" ve "Nesnelerin İnterneti" şeklinde adlandırılmıştır.

Tedarik Zinciri Performansına ait ifadelere yapılan faktör analizine göre ise bu bağımlı değişkene ait toplam üç alt boyut olduğu sonucu ortaya çıkmaktadır. Bu alt boyutlar literatüre uygun olarak "Müşteri Performansı", "Maliyet Performansı" ve "Esneklik performansı" şeklinde adlandırılmıştır.

Regresyon analizi ile test edilen hipotezlerin sonuçlarını incelediğimizde, Endüstri 4.0 bileşenine ait boyutlardan en az bir tanesinin, Tedarik Zinciri Performansı boyutlarından olan Maliyet ve Müşteri Performansı boyutları üzerinde istatistiksel olarak pozitif yönde anlamlı bir etkisi olduğu sonucu ortaya çıkmaktadır. Yapay Zeka ve Bulut Bilişim boyutlarının Maliyet Performansı boyutu üzerinde, Bulut Bilişim Boyutunun Müşteri Performansı üzerinde istatistiksel olarak anlamlı ve pozitif bir etkisi olduğu sonucuna ulaşılmıştır. Akben ve Avşar (2017), Bulut Bilişimi başarılı bir şekilde tedarik zinciri sürecine dahil etmenin işletmeler için bazı avantajları beraberinde getireceğini vurgulamışlardır. Bu araştırmanın bulguları da bu sonuçla benzerlik göstermektedir. Analizler sonucunda Bulut Bilişim teknolojisinin Maliyet ve Müşteri performansını arttıracağı sonucu elde edilmiştir.

Endüstri 4.0 bileşenlerini kullanım düzeyinin Esneklik performansı üzerinde herhangi bir etkisinin olmadığı, yapılan regresyon analizi sonucunda ortaya çıkmıştır. Ancak As ve Ramanathan (2021), Dijital Tedarik Zinciri teknolojilerinin, firmanın Tedarik Zinciri Esnekliği uygulamalarını ve Tedarik Zinciri Performans hedeflerini desteklediğini göstermektedir. Bu noktada analiz bulguları bu çalışmadan ayrılmaktadır.

Elde edilen sonuçlara göre araştırma önerileri şu şekilde sıralanabilir:

- İşletmeler için Endüstri 4.0 uygulamalarının başlangıç maliyetleri yüksek olduğu bilinmektedir. Ancak Endüstri 4.0 uygulamalarını benimsedikten sonra maliyet performansı üzerinde etki sağlayabilecekleri öngörüldüğünden dolayı işletmelere bu teknolojileri kullanmaya başlamaları önerilebilir. Bu şekilde başlangıçta yüksek olan giriş maliyetleri daha sonra birim maliyetlerde avantaj sağlayabilir.
- Firmalara tüm tedarik zinciri boyunca dijitalleşmeyi sağlamaları önerilir. Böylelikle tedarik zincirlerinde görünürlüğü arttırarak performansı ve verimliliği arttırabilirler. Bu şekilde rekabet avantajı elde etmeleri de beklenilmektedir.
- Küresel pazarlarda rekabet gücü kazanmak için yerli firmalara bu teknolojileri benimsemeleri noktasında teşvikler sağlanması önerilir. Bu teşvikler sayesinde firmaların karşılaşacağı yüksek maliyet dezavantajı minimize edilebilir.
- Bu yeni teknolojileri uygulayabilecek yeterli sayıda kalifiye personel bulunmadığı için bu teknolojileri kullanılabilmesi ve uygulanabilmesi için eğitimlerin arttırılması önerilebilir. Böylelikle teknoloji kullanılmak istendiğinde kolaylıkla uyum sağlayabilecek uzmanların bulunması firmalara avantaj sağlayacaktır.

Bu çalışma ile benzer çalışma konusunu çalışacak olan araştırmacılara öneriler şunlardır:

- Yalnızca bir Endüstri 4.0 bileşenin Tedarik Zinciri Performansı üzerinde etkisi incelenerek daha kapsamlı bilgiler sunulabilir.
- Tedarik zinciri performansını ölçmeye yarayan ifadeler geliştirilerek alt boyutlar güncellenebilir.
- Farklı örneklemler kullanılarak daha fazla katılımcı ile detaylı bir inceleme yapılabilir. Ayrıca farklı analizler kullanılarak da analizler sunulabilir.
- Bu araştırmanın tek bir sektör üzerinde uygulanması önerilebilir. Böylelikle sektörel araştırma sayesinde hangi sektörde hangi Endüstri 4.0 bileşenin en fazla avantaj sağladığının tespit edilmesi kolaylaştırılabilir.

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Extended Abstract

Keeping up with Industry 4.0 technology may offer both challenges and benefits to many businesses. Among the challenges are the costs of these advanced technologies and the various effects on the workforce, such as the lack of a qualified specialist for the technology to be applied. When deciding whether to apply technology, it is necessary to consider not only the costs but also the difficulties of establishing a new order within an existing order. In addition to many challenges, Industry 4.0 applications can also have many advantages. For illustration, a part that cannot be supplied can be produced with a three-dimensional printer thanks to rapid prototyping, and long and complex lead times during the production process can be avoided. Production may not be interrupted thanks to the Internet of Things, which allows machines to communicate with each other and take independent decisions. The negative or positive effects that can be experienced by integrating these technologies into the supply chains are discussed in this study. In addition, this study focuses on the application of developing technologies in the industry and the effect of these technologies in the supply chain, which is one of these areas, with the spread of these technologies in all areas. In this study, a questionnaire was applied to the manufacturers in Gaziantep to reveal the effect of Industry 4.0 applications on supply chain performance. It was investigated whether the dimensions of Industry 4.0 had a statistically significant effect on the dimensions of the supply chain based on the analyses made by examining the survey responses.

This study's population consists of manufacturing companies in Gaziantep. The research sample consists of 103 managers from manufacturing companies in Gaziantep. Only one manager was selected from each company to response the survey. A questionnaire application, which is a data collection method, was used while collecting the research data. A questionnaire was created for the purpose of the study, and it was used with the convenience sampling method. In addition to the statements used to measure institutional information, the questionnaire form has two separate parts. While the first of these sections measures the level of use of Industry 4.0 components, the other section consists of statements compiled to measure the impact of these components on supply chain performance. Since the survey application of this assay coincided with the period when the coronavirus disease 2019 measures were taken, it was first carried out online. Later, with the reduction of these measures, the survey responses were collected face to face. In this context, a total of 103 responses were obtained. According to the results conveyed by analyzing the survey responses, the majority of the companies participating in the research are Limited Companies. It has been observed that the textile sector is among the sectors with the most activity among the participating companies. It has been found that the majority of the participating companies have fewer than 50 employees when we look at their employee counts. According to analyses, the majority of the participant companies have been in operation for more than 10 years.

The questionnaire used for the research was subjected to a test of normality, percent- frequency, factor analysis, and multiple linear regression analysis. As a result of the factor analysis conducted within the scope of the research, it was determined that the expressions used for Industry 4.0 applications have a total of five dimensions. Dimensions of expressions used to measure Industry 4.0 applications are named as "artificial intelligence", "big data", "cyber-physical systems", "cloud computing," and "Internet of Things" in accordance with the literature. According to the factor analysis made on the expressions of supply chain performance, it is concluded that there are three dimensions belonging to this dependent variable. These dimensions are named as “customer performance”, “cost performance” and “flexibility performance” in accordance with the literature.

When we examine the results of the hypotheses created to test with the regression analysis, it is determined that at least one of the dimensions of the Industry 4.0 component has a statistically significant positive effect on the cost and customer performance dimensions, which are among the supply chain performance dimensions. It has been determined that artificial intelligence and cloud computing dimensions have a statistically significant and positive effect on the cost performance dimension. Furthermore, It has been determined that the cloud computing dimension has a statistically significant and positive effect on the customer performance dimension. It was determined as a result of the regression analysis that the dimensions of Industry 4.0 did not have any significant effect on the flexibility performance dimension.

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Analysis of Profitability Levels of Deposit Banks in Turkey

Türkiye'deki Mevduat Bankalarının Kârlılık Düzeylerinin Analizi

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ABSTRACT

This study aims to analyze the profitability levels of deposit banks in Turkey by using the panel data analysis method. Profitability is an important indicator reflecting the financial health of banks and is of great importance in terms of determining the sustainability and competitive advantages of banks in the sector. In this study, the factors affecting the profitability levels of deposit banks in Turkey are investigated. These factors include variables such as size, asset quality, capital adequacy, and liquidity status of banks. In the study, annual data for the period 2010–2020 were used through panel data analysis method, and CIPS (Cross Sectionally Augmented IPS) unit root test and Dumitrescu–Hurlin causality analysis were performed. According to the findings, there is a reciprocal causality relationship between bank earnings and return on average assets in deposit banks. In addition, it was determined that there is a unidirectional causality relationship between liquidity ratio and return on average assets. However, there is no causality relationship between capital adequacy and return on average assets. It was found that banks with increasing size generally have higher profitability levels, whereas banks with low asset quality face difficulties in terms of profitability. These findings provide guidance on potential measures that banks can take to increase their profitability levels. The study aims to contribute to a better understanding of the performance of banks in the sector and to determine their future strategies.

Keywords: Deposit banks, panel data analysis, profitability level.

ÖZ

Bu çalışma, Türkiye'deki mevduat bankalarının kârlılık düzeylerini panel veri analizi yöntemi kullanarak analiz etmeyi amaçlamaktadır. Kârlılık, bankaların mali sağlığını yansıtan önemli bir gösterge olup, bankaların sektördeki sürdürülebilirliklerinin ve rekabet üstünlüklerinin belirlenmesi açısından büyük önem taşımaktadır. Bu çalışmada, Türkiye'deki mevduat bankalarının kârlılık düzeylerini etkileyen faktörler araştırılmaktadır. Bu faktörler bankaların büyüklüğü, aktif kalitesi, sermaye yeterliliği ve likidite durumu gibi değişkenleri içermektedir. Çalışmada panel veri analizi yöntemi ile 2010–2020 dönemine ait yıllık veriler kullanılmış ve CIPS birim kök testi ve Dumitrescu–Hurlin nedensellik analizi yapılmıştır. Elde edilen bulgulara göre, mevduat bankalarında banka kazançları ile ortalama aktif getirisi arasında karşılıklı bir nedensellik ilişkisi bulunmaktadır. Ayrıca likidite oranından ortalama aktif getirisine doğru tek yönlü bir nedensellik ilişkisi olduğu tespit edilmiştir. Ancak, sermaye yeterliliği ile ortalama aktif getirisi arasında nedensellik ilişkisi yoktur. Büyüklüğü artan bankaların genel olarak daha yüksek kârlılık seviyelerine sahip olduğu, aktif kalitesi düşük olan bankaların ise kârlılık açısından zorluklarla karşılaştıkları tespit edilmiştir. Bu bulgular, bankaların kârlılık düzeylerini artırmak için alabilecekleri olası önlemler konusunda yol gösterici niteliktedir. Çalışma, sektördeki bankaların performanslarının daha iyi anlaşılmasına ve gelecek stratejilerinin belirlenmesine katkı sağlamayı amaçlamaktadır.

Anahtar Kelimeler: Mevduat bankaları, kârlılık düzeyi, panel veri analizi

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Introduction

The banking sector plays a vital role in the financial systems of developing countries where financial markets are inadequate. In such countries, the banking sector is predominantly responsible for bridging the gap between savers and borrowers and providing financial intermediation services by converting deposits into productive investments (Sufian and Habibullah, 2009). In this framework, it can be

stated that banks are intermediary institutions that have a high degree of importance in the national economy, as well as bringing together those who supply funds and those who demand funds in financial markets.

Basically, the primary task of banks is to provide an intermediary service between savers and those in need of funds. In addition, another task of banks is to make a profit from their transactions by reducing their costs in order to continue their activities. Profit, in general terms, refers to the positive difference between the income and expenses of an institution or organization in a certain period. Like every institution or organization, banks try to increase their profits. Profitability is an important indicator that reflects the financial health of banks and is of great importance in terms of determining the sustainability and competitive advantages of banks in the sector.

In the Turkish economy, the banking sector is one of the leading sectors with 35 deposit banks and 16 development and investment banks serving with more than 9000 branches and 185,000 employees. In this sense, it is possible to say that the deposit banks group plays a dominant role in the Turkish banking sector.

In the Turkish banking sector, January 1980 and May 2001 are defined as two important breaking points (TBB, 2022). Until the 1980s, the Turkish banking sector had been organized at the regional level, heavily protected by the state with very strict regulations, closed to the outside world, and non-competitive (Işık & Hassan, 2002). With the January 24, 1980, stabilization measures and financial liberalization movements, a series of reforms such as the removal of restrictions on market entry, interest and foreign exchange transactions, reduction of reserve and liquidity requirements, and financial taxes were implemented in order to increase efficiency and competitiveness in the banking sector. As a result of these reforms, banks started to operate in a more competitive environment, increased their investments in technological infrastructure, and employed more professional staff.

In this study, the concept of banking, deposit banks, and the Turkish banking sector is introduced, the related literature is reviewed, and a panel data analysis is conducted on the factors affecting the profitability of deposit banks, which constitute an important pillar of the banking sector in Turkey.

The study aims to examine the factors affecting the profitability levels of deposit banks in Turkey using panel data analysis method. These factors include variables such as the size, asset quality, capital adequacy, and liquidity status of banks. The study aims to contribute to a better understanding of the performance of banks in the sector and to determine their future strategies.

For this purpose, the CIPS unit root test and Dumitrescu–Hurlin causality analysis were conducted using annual data for the period 2010–2020. In the study, it was found that there is a reciprocal causality relationship between earnings and the return on average assets of deposit banks. There is a unidirectional causality relationship from the liquidity ratio to return on average assets, whereas there is no causality relationship between capital adequacy and the return on average assets. It was also found that banks with increasing size generally have higher profitability levels, whereas banks with low asset quality face difficulties in terms of profitability. The findings may provide guidance on potential measures that banks can take to increase their profitability levels.

Banking System and Deposit Banking

The origins of many of the current banking services can be traced back to civilizations characterized by the vibrant development of trade and culture. Lydian, Phoenician, Greek, Chinese, and Roman civilizations can be given as examples among these civilizations. The first examples of banking activities are found in the temple of Ur belonging to the Babylonian Empire in 2000 BC. In this temple, people called monks were able to lend money thanks to their wealth. In the Babylonian Empire as well as in the Mesopotamian civilization, relics in the form of grain and other commodities were accepted in the palaces and temples of the king, which were considered the safest place. These practices were also reflected in the famous Code of Hammurabi (Aktaran Kuryłowicz, 2004, p. 2; Morawski, 2002, p. 17). Given its historical background, the concept of a bank refers to a financial institution that bridges the gap between savers and borrowers through certain types of activities such as accepting deposits, lending money, and creating money by dealing with debts and credits (Nikolaevna, 2017, p. 31).

In addition to being a financial institution with both deposit-taking and lending powers, banks can also perform other financial services. In this context, the concept of a *bank* can refer to many different types of financial institutions such as savings and loan associations and other deposit-taking institutions (Turner, 2022). Indeed, banking is only one of the types of financial intermediation. Depositors, historically the most important capital provider of banks, require banks to provide three basic services: investment, custody, and transaction execution. While the relative importance of these functions varies across depositors, the attractiveness of bank deposits is that they provide a favorable mix of safety, liquidity, and return on savings (Langevoort, 1987, p. 676).

Deposit banks are financial institutions that conduct their transactions in money and aim to make a profit while performing these transactions. In addition, it is an intrinsic characteristic of banking that banks accept deposits of money from individuals so that they can keep it in their custody for security purposes. In addition, a bank can create loans by making advances to individuals or firms in need from the funds they receive in the form of deposits. Thus, by mobilizing the savings in the economy, banks facilitate the redistribution of existing savings by providing loans with interest to other individuals or institutions that need these savings for production, investment, or personal use of the excess money of individuals or institutions (Nikolaevna, 2017, p. 31).

In this framework, the main function of deposit banks, which operate on an interest-bearing basis, is to collect time and demand deposits, extend loans to individuals and institutions, and perform other banking services (Yurttadur & Demirbaş, 2017, p. 91).

Deposit banks are financial institutions that aim to obtain the maximum possible profit by investing the deposit resources they collect from depositors in productive economic sectors and play an important role in the economic system. Their main tasks are deposit acceptance, credit and payment services, account and risk management, and financial security. The continuation of their operations depends on providing a high level of assurance to their customers and their funding capabilities.

The concept of profit refers to the income accruing to the owners of a commercial enterprise or a productive undertaking through the activities of that enterprise or undertaking (Knight, 1942, p. 126).

Maximizing profits is the primary objective of all commercial enterprises. Therefore, it is very important to predict future profitability by measuring current and past profitability (Hofstrand, 2009, p. 1).

Conceptually, profit refers to the positive difference between an organisation's revenues and expenses over a given period. Financially, profit is an important indicator and is also used as a guideline for investment and management decisions of institutions and organizations. At the same time, profit levels also form expectations about the future performance of an organization and may affect its continuity or termination of operations.

Banks, one of the most prominent structures of financial intermediation organizations, are basically commercial enterprises. From this point of view, the most fundamental objective of banks, like any other commercial enterprise, in terms of sustaining their existence, is to maximize the benefit from their current and future transactions. This benefit is mainly expressed with the term "profit."

As of 2022, there are 35 deposit banks operating in the Turkish banking sector. Of these banks, 3 are publicly owned deposit banks, 8 are privately owned deposit banks, 3 are banks transferred to the Savings Deposit Insurance Fund, 16 are foreign-owned banks established in Turkey, and 5 are foreign-owned banks that have opened branches in Turkey.

It is important to examine the financing behavior and profits of financial intermediaries, particularly banks, over business cycles to derive policy implications. Today, the banking sector has a leading role in the development of all sectors with the credit facilities it provides. Therefore, the performance of the banking system is closely monitored by all economic units. Moreover, ensuring the stable functioning of the banking system is very important as it is in everyone's favor. In this context, it can be said that the performance of the banking sector is closely affected by internal and external economic conditions.

The graph shows the return on assets of deposit banks operating in the Turkish banking sector between 2010 and 2020.

According to Figure 1, it is understood that the return on assets of publicly-owned deposit banks followed a fluctuating course from 2010 to 2017, and after 2017, the return on assets tended to decrease. The profitability of privately-owned deposit banks, on the other hand, started to decline as of 2010, fell to a minimum in 2015, and then started to recover slightly in other years. It is observed that the profitability levels of banks transferred to the Savings Deposit Insurance Fund reached the highest levels in 2011, 2012, 2013, and 2019, while they tended to decrease in 2010, 2015, 2017, and 2020. The return on assets of foreign capital deposit banks established in Turkey entered a downward trend between 2010 and 2013, reached its lowest level in 2013, followed an increasing trend from 2013 to 2018, and then declined again. The return on assets of foreign-capitalized deposit banks that opened branches in Turkey followed an increasing trend in 2014, 2018, and 2019 and entered a downward trend in 2020.

Literature Review

A closer look at the literature on the variables affecting bank profitability reveals that some studies consider the data of a single country, while others analyze the data of several countries together.

Arif and Anees (2012) used the multiple regression analysis method to evaluate the impact of liquidity risk on bank profitability in their analysis with the data of 22 Pakistani banks between 2004 and 2009. As a result of the findings, it was determined that the factors that increase liquidity risk have a significant negative impact on bank profitability.

Ayadi and Boujelbene (2012) tried to determine the variables affecting bank profitability with a panel data analysis conducted using the data of 12 Tunisian banks between 1995 and 2005. The findings indicate that bank capitalization and bank size have a positive and statistically significant effect on bank profitability. Financial structure, the bank assets to gross domestic product ratio, and stock market capitalization variables are found to have a negative and statistically significant effect on bank profitability. It is concluded that the macroeconomic indicators used in the study do not have any effect on bank profitability.

Chronopoulos et al. (2015) examined the main determinants of profitability of banks operating in the United States between 1984 and 2010, the extent to which short-term profits are sustainable, and to what extent this sustainability is affected by both changes in regulation and the financial crisis covering the years 2007–2010. As a result of the findings, it was determined that the competitive process reduces abnormal profitability levels over time. In addition to this, it is concluded that the legislative changes enacted in the 1990s affected both the level and the sustainability of bank profitability.

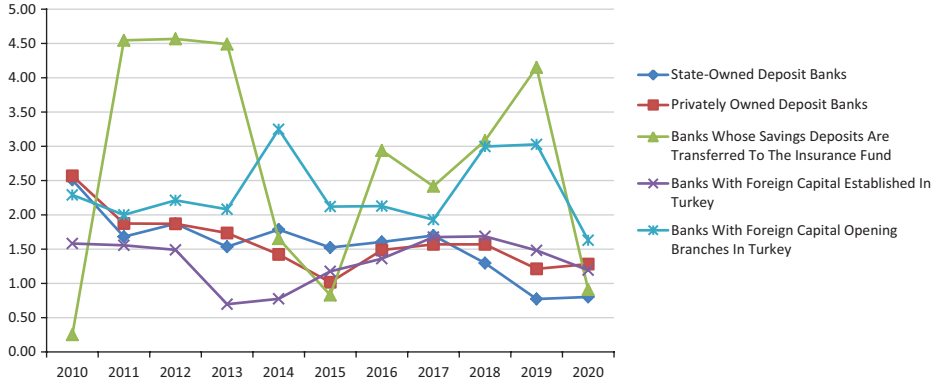

Figure 1.
Return on assets of deposit banks operating in the Turkish banking sector.

Kripa and Ajasllari (2016) conducted an analysis using data on return on average assets, growth rate, liabilities, liquidity ratio, fixed assets, capital volume, and company size for the period 2008–2013 for seven insurance companies. The findings indicate that the growth rate, liabilities, liquidity ratio, and fixed assets variables are the main factors affecting profitability. In addition, the growth rate, company size, and capital volume variables are positively related to the profitability variable, while the liabilities, liquidity ratio, and fixed assets variables are negatively related.

Saona (2016) conducted a profitability analysis with the data of seven commercial banks operating in Latin America for the period covering 1995–2012. According to the findings, there is an inverted U-shaped relationship between capital and return on assets, a positive relationship between asset diversification (such as securities and foreign exchange trading) and market concentration and profitability, and a negative relationship between income diversification (such as interest and fees) and profitability. Moreover, it is concluded that improvements in the legal and regulatory system have a negative impact on banks' profitability.

Bikker and Vervliet (2017) analyzed the effects of low interest rates on profitability with the data of commercial and savings banks operating in the United States for the period covering 2001–2015. In this framework, they used both static and dynamic modeling approaches and various forecasting methods. As a result of the findings, it is concluded that low interest rates negatively affect the performance of banks and reduce the net interest margin.

Nuhiu et al. (2017) analyzed the banking system in Kosovo with the help of panel data analysis by using the CAMEL approach with the data for the period 2010 to 2015 and constructed three different models. Through the constructed models, it is concluded that the profitability of Kosovo banks is mostly driven by bank-specific variables. They also concluded that macroeconomic factors have a positive impact on profitability but do not have a significant impact on financial performance.

Ersoy and Aydın (2018) conducted a panel data analysis with the data for the period 2007 to 2013 and found no significant relationship between board of directors size, bank size, lending level, and profitability among the variables included in the study. They also found a statistically significant but negative relationship between the number of independent directors and the proportion of foreign directors, as well as a statistically significant and positive relationship between bank capital and profitability.

Batten and Vo (2019) examined the factors affecting the profitability of various banks operating in Vietnam for the period covering the years 2006–2014 using panel data analysis method. As a result of the findings, it was determined that bank size, capital adequacy, bank risks, bank expenses, and bank efficiency variables, among the variables included in the analysis, have a strong effect on the profitability variable. In addition to the endogenous variables of the banks, the macroeconomic variables used in the analysis were also found to have a significant effect on bank profitability. However, in the analysis, it was concluded that the direction of causality is not the same among the variables affecting profitability.

Sarıkale and Kayahan (2019) conducted a correlation analysis between the ratios in their study using the percentage analysis method with data for the period 2002–2016. As a result of the analysis, a very strong relationship was found between the ratios used in the study, both in the analysis and graphically.

Akgüneş (2021) concluded that inflation and liquidity risk variables, which are among the variables used in the study, cause an increase in all profitability measures, while GDP causes a decrease in net interest margin but an increase in return on assets and return on equity with the panel regression equation he constructed with the data for the period 2008–2019. In addition, market capitalization and credit risk variables have no effect on bank profitability.

Çelik and Kaya (2021) concluded that the independent variables, such as bank age, loan/deposit ratio, financial asset ratio, in the model they constructed for domestic deposit banks have a statistically significant effect on return on assets with the panel data analysis they conducted using data for the period 2009–2017. They also found that the independent variables, such as growth in deposits, deposit/loan ratio, capital adequacy ratio, etc., in the model they constructed for foreign deposit banks have a statistically significant effect on return on assets. In addition, in the models established for both domestic and foreign deposit banks, it is found that there is a non-linear relationship between the deposit/loan ratio and return on assets.

In his study analyzing the banking systems of Balkan countries, Öncü (2021) determined that both bank-specific and non-bank variables can be effective in profitability by using the panel data analysis method. In the analysis conducted using the panel data analysis method with data for the period 2008–2017, it was found that the variables of non-performing loans, cost–income ratio, and inflation rate in the study have a negative effect on the dependent variables of return on assets and return on equity, while the GDP variable has a positive effect on the dependent variables.

According to the findings obtained with the help of panel data analysis using the data for the period 2008 to 2018, Özer et al. (2021) determined a positive relationship between return on average assets (ROAs), capital adequacy ratio, and unemployment rate, and a negative relationship between TDO (Non-Performing Loans (Gross)/Total Loans and Receivables), CR_MV (Toplam Krediler ve Alacaklar/Toplam Mevduat), and liquidity ratio. They also found a negative relationship between ROE (Return on Assets (Net Profit for the Period/Total Assets), TDO, CR_MV, and liquidity ratio, and a positive relationship between unemployment and CPI (Consumer Price Index) ratio.

In their analysis using data for the period 2014–2019, Şekeroğlu and Acar (2021) determined that the liquidity ratio in the study does not have a statistically significant effect on return on assets and return on equity with the help of structural equation modeling. They concluded that the financial leverage ratio has a negative effect on return on assets and a positive effect on return on equity.

Taysı and Özgür (2021) found that there is a deviation from the basic assumptions among the variables in the model they constructed for the panel data analysis with the data for the period 2009 to 2019. Therefore, the model was reconstructed with the help of robust estimators, and as a result of the findings, it was concluded that the dependent variable in the model was negatively affected by the financial assets (net)/total assets variable and positively affected by the non-performing receivables/total loans variable at the 5% and 1% significance levels.

Canatan and İpek (2022) based their analysis on the ARDL (Autoregressive Distributed Lag), Engle-Granger, and Johansen

cointegration approaches using data for the period 2011–2021. As a result of the findings, there is a strong relationship between mobile banking activities and bank net profits both in the short and long run.

Sihotang et al. (2022) used quantitative research and purposive sampling methods in their analysis, using the data for the period 2016–2020. As a result of the analysis, it was determined that the endogenous variables in the study have a statistically significant effect on return on assets. Additionally, among the exogenous variables used in the study, total money supply has a statistically significant effect on return on assets, but inflation does not have a statistically significant effect on return on assets.

In their multiple regression analysis using the data for the period 2012–2020, Ulusoy and Demirel (2022) concluded that the size of transactions made through internet banking has a significant effect on profitability. In addition, the digital transformation of banks has also been found to contribute significantly to bank profitability.

Methods

In this study, the profitability levelss of 27 deposit banks operating in the Turkish banking system for the period 2010–2020 are analyzed using panel data analysis. In this context, firstly, it is examined whether the variables in the model are stationary or not. For this purpose, horizontal cross-section dependence test and homogeneity tests were applied to the available data in order to determine the appropriate panel unit root test. In this framework, according to the CD (Cross-Sectional Dependence) test, which is a horizontal cross-section dependence test, it is concluded that there is horizontal cross-section dependence among the variables. According to the results of the Pesaran–Yamagata homogeneity test, heterogeneity was found in the model.

Since there is both horizontal cross-section dependence and heterogeneity in the model, the panel data analysis is continued with the "CIPS Panel Unit Root Test," one of the second generation panel unit root tests. According to the CIPS test results, both dependent and independent variables are stationary [I(0)] at the level. Subsequently, the analysis was continued with Dumitrescu–Hurlin causality analysis.

Data Set of the Study

In this study, the data of 27 deposit banks operating in Turkey in the period 2010–2020 are analyzed with the help of panel data analysis, taking into account the studies in the literature. In the model established within this framework, ROA for return on average assets is analyzed as the *dependent variable*, CAP for capital adequacy, LIQ for liquidity ratio, and ADD for bank earnings are analyzed as independent variables.

Table 1.
Variables in the Study

	Variables	Variable Codes
Dependent variable	Average return on assets	ROA
Independent variables	Capital adequacy	CAP
	Liquidity ratio	LIQ
	Bank earnings	ADD

Note: ADD = Bank earnings; CAP = Capital adequacy; LIQ = Liquidity ratio; ROA = Average return on assets.

To explain the concepts expressed in Table 1, *Return on average assets* is an indicator that shows how much profit banks can achieve in proportion to their assets. This indicator can be found by dividing banks' net profit for the period by their total assets. Capital adequacy is defined as the ability of banks to maintain sufficient equity capital against losses that may arise due to various risks they face.

The concept of *liquidity* is an indicator that expresses how much of the funds of the fund holders can be returned to the fund holders as a result of the withdrawal of the funds subject to the transaction by banks by using bank loans as a basis. The *liquidity ratio* is a ratio that shows how much of the existing assets of banks are transferred to liquid assets. In other words, the liquidity ratio expresses how much of a bank's assets can be easily converted into cash in a possible situation while trying to fulfilll its obligations. In other words, this ratio shows the extent to which a bank's current assets are sufficient to pay its debts.

Another concept closely related to the liquidity ratio is capital adequacy. *Capital adequacy* is the ability of a bank to have sufficient liquid assets to finance its financial liabilities against possible risks. From this point of view, a bank's capital adequacy ratio at a certain level (in Turkey, according to Article 45 of the Banking Law, this ratio is determined as at least 8%) indicates that the bank has sufficient capital against any risk. Because if this ratio is at a very low level, it means that the bank does not have sufficient capital, and if it is at a very high level, it means that the bank does not use its existing capital at an optimum level.

The concept of *bank earnings* is an indicator that expresses the share of total income of banks in total expenses during their operating periods. This indicator is calculated as the ratio of total revenues to total expenditures.

The deposit banks to which the data used in the study belong are listed in Table 2.

Research Method and Definition of Variables

The *panel data analysis method*, which refers to the aggregation of horizontal cross-sectional observations at a certain point in time, is a very useful method since it allows both time and cross-sectional data to be evaluated together. More broadly defined, panel data are data consisting of *N* number of units and *T* number of observations corresponding to each of these units (Tatoğlu, 2020, p. 1). Another feature of panel data is that it allows both

Table 2.
Banks in the Study

T.C. Ziraat Bank A.Ş.	Türkiye İş Bank A.Ş.	ICBC Turkey Bank A.Ş.
Türkiye Halk Bank A.Ş.	Yapı ve Kredi Bank A.Ş.	ING Bank A.Ş.
Türkiye Vakıflar Bank T.A.O.	Alternatifbank A.Ş.	QNB Finansbank A.Ş.
Akbank T.A.Ş.	Arap Türk Bank A.Ş.	Turkland Bank A.Ş.
Anadolubank A.Ş.	Burgan Bank A.Ş.	Türkiye Garanti Bank A.Ş.
Fibabanka A.Ş.	Citibank A.Ş.	Bank Mellat
Şekerbank T.A.Ş.	Denizbank A.Ş.	Habib Bank Limited
Turkish Bank A.Ş.	Deutsche Bank A.Ş.	JPMorgan Chase Bank N.A.
Türk Ekonomi Bank A.Ş.	HSBC Bank A.Ş.	Société Générale (SA)

Table 3.
Descriptive Statistics of Variables

Variables	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
ROA	297	1.565	2.281	–11.905	15.008
CAP	297	16.669	15.911	2.881	92.809
LIQ	297	34.686	21.748	8.367	99.811
ADD	297	163.910	96.444	82.702	988.215

Note: ADD = Bank earnings; CAP = Capital adequacy; LIQ = Liquidity ratio; ROA = Average return on assets.

qualitative and quantitative factors to be constructed together in a model at the same time. Finally, with the help of panel data analysis, the heterogeneity of units or time-dependent heterogeneity can be calculated by defining it in the structure of the established model. Thus, serious specification errors are prevented and the reliability of the obtained estimation results is ensured (Tüzüntürk, 2007: pp. 1-2).

In this study, the dependent variable, return on average assets, was attempted to be explained with the help of three independent variables. In this context, annual data of 27 deposit banks covering the period 2010–2020 are used. Since both horizontal and vertical cross-sectional data are available in the data set used, "panel data analysis" is preferred as the method. In this framework, the descriptive statistics of the dependent and independent variables in the analysis are presented in Table 3.

When the descriptive statistics of the variables in the model established in Table 3 are analyzed, it is seen that there are 297 observation values belonging to the variables of ROA, capital adequacy ratio (CAR), liquidity ratio (LIQ), and bank earnings (ADD). In addition, the mean, standard deviation, minimum value (which is the lowest value in the data), and maximum value (which is the highest value in the data) of these variables are given respectively.

Results and Discussion

When working with time series in econometric models, the concepts of unit root or stationarity are frequently encountered in many analyses. When a time series contains a unit root, i.e., is non-stationary, it means that the mean, variance, and covariance of the series do not approach a constant value over time. If a series is non-stationary, i.e., contains a unit root, econometric models may be spurious (Boğa, 2019, p. 366). Therefore, a model should be tested for the presence of a unit root. In this framework, in order to decide on the correct unit root test, the horizontal cross-section dependence test should be applied first.

This concept, also known as horizontal cross-sectional dependence or inter-unit correlation, basically refers to the situation where the other units are affected by a change in any of the units that make up the panel data model (Koçbulut ve Altıntaş, 2016, p. 152). In case of horizontal cross-section dependence, first generation panel unit root tests, which do not take into account the correlation between units, cannot be used. Therefore, if there is horizontal cross-section dependence in a panel data model, it is recommended to use second generation panel unit root tests. In this study, the "CD test" proposed by Pesaran (2004) was used to measure the horizontal cross-section dependence. In this test, Pesaran uses the residuals obtained from the estimation of the ADF regression and calculates the correlation of each unit with all other units except itself (Tatoğlu, 2020, p. 105). Hypotheses for the horizontal cross-section dependence test will be formulated as follows:

Table 4.
CD Test

Variables	Breusch-Pagan LM	Pesaran scaled LM	Pesaran CD	Probability
ROA	664.3895	11.828	4.456	.000
CAP	836.31	18.317	8.287	.000
LIQ	1057.464	26.663	17.414	.000
ADD	1427.14	40.616	26.881	.000

Note: ADD = Bank earnings; CAP = Capital adequacy; LIQ = Liquidity ratio; LM = Lagrange Multiplier; CD = Cross-Sectional Dependence; ROA = Average return on assets.

H_0: There is no horizontal cross-section dependence.

H_1: There is horizontal cross-section dependence.

When the probability values are analyzed according to the results in Table 4, it is seen that the probability values are below .05 for all variables at a 95% CI. Therefore, the basic hypothesis "there is no horizontal cross-sectional dependence" will be rejected; in other words, it will be accepted that there is horizontal cross-sectional dependence between the variables.

After horizontal cross-sectional dependence is determined, the homogeneity factor, which means that each unit constituting the panel data has the same quality, should also be taken into consideration. In cases where homogeneity is not ensured, the tests applied give erroneous results. In this study, "Pesaran-Yamagata Homogeneity Test" was applied to determine the homogeneity of the model. In 2008, Pesaran and Yamagata developed a test that allows the homogeneity concept to be tested for panel data models where the unit dimension and time dimension are of different sizes (Öztürk, 2018, p. 5). In this test, which is called "Delta Test," there are two test statistics characterized as Δ (Delta) and Δadi (adjusted Delta) (Koçbulut & Altıntaş, 2016, p. 159). The main advantage of this test is that it can give quite consistent results even in panel data models where both time and unit size are large. The hypotheses for this test will be formed as follows:

H_0: Slope coefficients are homogeneous.

H_1: Slope coefficients are not homogenous.

Table 5.
Pesaran–Yamagata Homogeneity Test

	Delta Value	*p*
Δ	2.124	.03
Δ_{adj}	2.977	.003

Table 6.
CIPS Panel Unit Root Test

	Fixed				Fixed and Trended			
Unit Root Test	**ROA**	**LIQ**	**ADD**	**CAP**	**ROA**	**LIQ**	**ADD**	**CAP**
CIPS	−2.53	−2.94	−2.28	−2.19	−2.69	−3.32	−2.72	−3.31

Note: Critical table values for CIPS are −2.69 at 5% for $N = 27$ and $T = 11$ with constant and trend. The constants are 2.36 at 1% and −2.17 at 5%, respectively.
ADD = Bank earnings; CAP = Capital adequacy; LIQ = Liquidity ratio; ROA = Average return on assets.

Table 5 shows the results of the homogeneity test. According to these results, since the probability values are less than .05, there is heterogeneity in the model.

Since the Pesaran–Yamagata homogeneity test revealed that the model is heterogeneous and the CD test revealed that there is horizontal cross-section dependence among the variables, the analysis will continue with the "CIPS Panel Unit Root Test," one of the second-generation unit root tests. In this test proposed by Pesaran (2006), simulation results under the assumption of a single common factor specification for the cross-correlation structure and a known autocorrelation order of the residuals indicate that the CIPS test performs very well (Cerasa, 2008).

H_0: Units contain a unit root.

H_1: Units are stationary.

Table 6 shows that CIPS statistical values are greater than the critical value at the 95% CI. This implies that the dependent and independent variables are stationary at level [I(0)].

The final stage of the empirical analysis is causality tests for the variables. For this purpose, the causality test developed by Dumitrescu and Hurlin (2012) and based on Wald statistics will be used. The important advantage of this test is that it takes into account the dependence and heterogeneity across countries. It can also be realized when the time dimension (*T*) is higher or lower than the section size (*N*). In this method, the analysis is performed with two stationary series, and if the series used in the analysis are not stationary, they should be stabilized by removing their inconsistencies.

Table 7.
Dumitrescu–Hurlin Causality Analysis

Dependent Variable: ROA	**Z^{HNC} Statistics**	***p***
LIQ	2.95	.03
ADD	1.88	.05
CAP	0.0611	.95
Dependent Variable: CAP	**Z^{HNC} statistics**	***p***
ROA	−0.202	.83
LIQ	2.87	.02
ADD	3.20	.00
Dependent Variable: LIQ	**Z^{HNC} statistics**	***p***
ROA	−0.42	.68
CAP	−0.44	.55
ADD	3.51	.00
Dependent Variable: ADD	**Z^{HNC} statistics**	***p***
ROA	3.234	.00
CAP	1.70	.08
LIQ	3.80	.00

Note: ADD = Bank earnings; CAP = Capital adequacy; LIQ = Liquidity ratio; ROA = Average return on assets.

According to Table 7, while there is a reciprocal causality relationship between bank earnings and the return on average assets. There is a unidirectional causality relationship from the liquidity ratio to return on average assets. There is no causality relationship between capital adequacy and the return on average assets.

Conclusion and Recommendations

The banking sector plays a leading role in the development of real sectors with the deposits it collects and the loans it extends. Therefore, it is in the interest of every economic unit in the economy that the banking system maintains its stability and performs well. It can be said that banks are one of the most prominent structures of financial intermediation organizations operating as commercial enterprises. Banks, like all other businesses, aim to make a profit in order to maximize the benefit from current and future transactions and to ensure a sustainable existence.

This study analyzes the profitability levels of deposit banks operating in the Turkish banking system for the period 2010–2020 using the panel data analysis method. In the analysis, tests were conducted to determine whether the variables were stationary or not, and the analysis was carried out on stationary variables. The results of the analysis show that there is a reciprocal causality relationship between bank earnings and the return on average assets. There is a unidirectional causality relationship from the liquidity ratio to return on average assets, whereas there is no causality relationship between capital adequacy and the return on average assets.

In addition to the factors affecting banking performance, such as liquidity ratio and capital adequacy, it is suggested to expand the scope of the study and analyze the data of other bank types in order to guide future studies on this subject. Moreover, by examining the effects of macroeconomic variables on profitability levels, it may be possible to better understand the relationships between internal and external factors of financial institutions.

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Genişletilmiş Özet

Ekonomik döngü, finansman ihtiyacı olan ve finansman fazlası olan birimlerden oluşmaktadır. Finansal aracıların varlığı, bu birimlerin eşleştirilmesi ve finansman ilişkilerindeki engellerin ortadan kaldırılması yoluyla ekonomik aktiviteyi kolaylaştırmaktadır. Finansal kuruluşlar, tasarruf sahiplerinin biriktirdiklerinin fazlasını toplayarak, bu fonları reel sektörde ihtiyacı olanlara dağıtmaktadır. Böylelikle tasarruf sahiplerinin yatırımlarından kazanç elde etmelerini sağlamakta ve verimli yatırımlarla reel sektörün büyük ölçekli üretim yapmasına olanak sağlamaktadır. Bir ekonomide bu iki sektör arasındaki ilişki ne kadar iyiyse refah seviyesi o kadar yüksek olacaktır. Tasarrufların yatırımlara kanalize edilmesi yoluyla büyüyen sermaye stoku, bilgi ve işlem maliyetlerini azaltır. Bu nedenle özellikle gelişmekte olan ülkelerde tasarruf açığı reel sektörün finansmanında ciddi sorunlara yol açmaktadır. Bu, nihayetinde, toplumun refah düzeyinin anahtarı olan büyüme potansiyelinin başarısız olmasına yol açar.

Bankacılık sektörü, finansal piyasaların yetersiz kaldığı gelişmekte olan ülkelerin finansal sistemlerinde hayati bir rol oynamaktadır. Bu tür ülkelerde tasarruf sahipleri ile borç alanlar arasındaki uçurumu kapatmak ve mevduatları verimli yatırımlara dönüştürerek finansal aracılık hizmetleri sağlamak, ağırlıklı olarak bankacılık sektörü tarafından üstlenilmektedir.Bu çerçevede bankaların, finansal piyasalar içerisinde fon arz edenlerle fon talep edenlerin bir araya gelmelerini sağlamanın yanı sıra ülke ekonomisi içinde önem derecesi oldukça yüksek olan aracı kurumlardan olduğu söylenebilir.

Mevduat bankaları, işlemlerini parayla yapan ve bu işlemleri yaparken kâr amacı güden finansal kuruluşlardır. Ek olarak, bankaların güvenlik amacıyla gözetimlerinde tutabilmeleri için bireylerden para mevduatı kabul etmeleri bankacılığın kendine özgü bir niteliğidir. Bununla birlikte bir banka mevduat şeklinde aldıkları fonlardan ihtiyaç sahibi kişi ya da firmalara avans vererek kredi yaratabilmektedir. Böylelikle bankalar ekonomide yer alan tasarrufları harekete geçirerek bu tasarrufların kişi ya da kurumların fazla paralarının üretim, yatırım veya kişisel kullanım için ihtiyaç duyan diğer kişi ya da kurumlara faizle kredi vererek mevcut tasarrufların yeniden dağıtılmasını kolaylaştırmaktadır.

Bu çerçevede faiz esasına göre çalışmakta olan mevduat bankalarının esas fonksiyonu, vadeli ve vadesiz mevduat toplayarak, kişi ve kurumlara kredi kullandırmak ve diğer bankacılık hizmetlerini yerine getirmektir.Mevduat bankaları, mudilerden topladıkları mevduat kaynaklarını verimli ekonomik sektörlere yatırarak mümkün olan maksimum karı elde etmeyi hedefleyen ve ekonomik sistemde önemli bir rol oynayan finans kuruluşlarıdır. Temel görevleri; Mevduat kabulü, kredi ve ödeme hizmetleri, hesap ve risk yönetimi ile finansal güvenliktir. Faaliyetlerinin devamı, müşterilerine yüksek düzeyde güvence sağlamasına ve fonlama kabiliyetlerine bağlıdır.

Banka kârlılığının önemi, ekonominin mikro ve makro düzeylerinde değerlendirilebilir. Mikro düzeyde kâr, rekabetçi bir bankacılık kurumunun temel ön koşulu ve en ucuz fon kaynağıdır. Bir banka yönetiminin temel amacı, herhangi bir iş yapmanın temel gereği olarak kar elde etmektir. Makro düzeyde, kârlı bir bankacılık sektörü olumsuz şoklara daha iyi dayanabilir ve finansal sistemin istikrarına katkıda bulunabilir. Banka kârlılığının hem mikro hem de makro düzeydeki önemi, araştırmacıları, akademisyenleri, banka yönetimlerini ve banka düzenleyici otoritelerini banka kârlılığını belirleyen faktörlere önemli ölçüde ilgi duymaya yöneltmiştir

Türkiye ekonomisinde, bankacılık sektörü, 9.000'den fazla şubesi ve 185.000 çalışanı ile hizmet veren 35 mevduat bankası ve 16 kalkınma ve yatırım bankası ile önde gelen sektörlerden biridir. Bu anlamda mevduat bankaları grubunun, Türk bankacılık sektöründe baskın rol oynadığını söylemek mümkündür.

Türk bankacılık sektöründe Ocak 1980 ve Mayıs 2001 tarihleri, iki önemli kırılma noktası olarak tanımlanmaktadır. 1980'li yıllara kadar Türk bankacılık sektörü, bölgesel düzeyde örgütlenmiş, devletçe çok sıkı düzenlemeler ile aşırı biçimde korunan, dışa kapalı ve rekabetçi olmayan bir sektör görüntüsündeydi. 24 Ocak 1980 istikrar tedbirleri ile birlikte uygulamaya geçilen finansal serbestleşme hareketleri ile birlikte bankacılık sektöründe etkinliği ve rekabet gücünü artırmak amacıyla piyasaya giriş, faiz ve döviz işlemleri üzerindeki kısıtlamaların kaldırılması, rezerv ve likidite gereksinimlerinin ve mali vergilerin azaltılması gibi bir dizi reform hayata geçirilmiştir. Bu reformlar sonucunda bankalar daha rekabetçi bir ortamda faaliyet göstermeye başlamış, teknolojik altyapı yatırımlarını artırmış ve daha profesyonel çalışanlar istihdam etmiştir.

Çalışmada, sırasıyla bankacılık kavramıyla birlikte mevduat bankaları ve Türk bankacılık sektörü tanıtılmış, ilgili literatür taraması yapılmış ve Türkiye'de bankacılık sektörünün önemli bir ayağını oluşturan mevduat bankalarının kârlılığını etkileyen faktörler üzerinden panel veri analizi gerçekleştirilmiştir. Bu amaç doğrultusunda, 2010-2020 dönemine ait yıllık veriler kullanılarak CIPS birim kök testi ve Dumitrescu-Hurlin nedensellik analizi yapılmıştır. Çalışmada mevduat bankalarının kazançları ile ortalama aktif kârlılığı arasında karşılıklı bir nedensellik ilişkisi olduğu, likidite oranından ortalama aktif kârlılığa doğru tek yönlü bir nedensellik ilişkisi olduğu, buna karşılık sermaye yeterliliği ile ortalama aktif kârlılığı arasında ise herhangi bir nedensellik ilişkisi bulunmadığı tespit edilmiştir. Ayrıca büyüklüğü artan bankaların genellikle daha yüksek kârlılık seviyelerine sahip olduğu, buna karşılık düşük aktif kalitesine sahip bankaların kârlılık açısından zorluklarla karşılaştığı saptanmıştır. Elde edilen bulgular, bankaların kârlılık düzeylerini artırmak için alabilecekleri potansiyel önlemler konusunda yönlendirici olabilir.

Bu konuda yapılacak gelecekteki çalışmalara yön göstermek için likidite oranı ve sermaye yeterliliği gibi bankacılık performansını etkileyen faktörlerin yanı sıra, çalışmanın kapsamının genişletilerek diğer banka türlerinin verilerinin de analiz edilmesi önerilmektedir. Ayrıca, makroekonomik değişkenlerin kârlılık düzeyleri üzerindeki etkilerinin incelenerek, finansal kuruluşların iç ve dış faktörleri arasındaki ilişkileri daha iyi anlamak da mümkün olabilir.

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Effect of the Russian–Ukrainian Crisis on Borsa Istanbul Tourism Index

Rusya-Ukrayna Krizinin Borsa İstanbul Turizm Endeksine Etkisi

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ABSTRACT

The aim of this study was to examine how the crisis between Russia and Ukraine has affected the companies included in the Borsa Istanbul tourism index. To identify abnormal returns, the event study method was applied. The event day was determined as February 24, 2022. The event and estimation periods were specified as 21 and 210 trading days, respectively. Five of the companies indicated negative abnormal returns on February 24, 2022, but among the companies, PKENT was the company that was most adversely affected by the war. According to the cumulative average abnormal returns of the overall companies, there was a significant negative return only on the event day. Therefore, the tourism companies listed in Borsa Istanbul responded immediately to the Russian–Ukrainian war, but the impact quickly diminished. Investors and financial analysts could benefit from the results by developing hedging strategies through industry diversification, and policymakers could develop effective strategies to deal with similar political uncertainties.

JEL Codes: G10, G14, G15.

Keywords: Borsa Istanbul, efficient market hypothesis, event study, stock markets, tourism

ÖZ

Bu çalışmanın amacı, Rusya ve Ukrayna arasında yaşanan krizin Borsa İstanbul turizm endeksinde yer alan şirketleri nasıl etkilediğini incelemektir. Anormal getirileri tespit etmek için olay çalışması yöntemi uygulanmıştır. Olay günü 24 Şubat 2022 olarak belirlenmiştir. Olay ve tahmin dönemleri sırasıyla 21 ve 210 işlem günü olarak belirlenmiştir. Şirketlerin beşi 24 Şubat 2022 tarihinde negatif anormal getiri göstermiştir, ancak şirketler arasında savaştan en olumsuz etkilenen şirket PKENT olmuştur. Tüm şirketlerin kümülatif ortalama anormal getirilerine göre; sadece olay gününde negatif ve anlamlı bir negatif getiri söz konusudur. Dolayısıyla, Borsa İstanbul'da işlem gören turizm şirketleri Rusya-Ukrayna savaşına hemen tepki vermiş, ancak bu etki hızla azalmıştır. Yatırımcılar ve finansal analistler sektör çeşitlendirmesi yoluyla riskten korunma stratejileri geliştirerek bu sonuçlardan faydalanabilir ve politika yapıcılar da benzer siyasi belirsizliklerle başa çıkmak için etkili stratejiler geliştirebilirler.

JEL Kodları: G10, G14, G15.

Anahtar Kelimeler: Borsa İstanbul, etkin piyasa hipotezi, olay çalışması, hisse senedi piyasaları, turizm

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Introduction

Global events including political instability, financial crises, disasters, terrorist attacks, and pandemics negatively impact the financial markets. Wars are one of them, increasing market uncertainty and vulnerability not only in the war zone but also in nations having a close economic dependence on the sides. Particularly, investors become more risk-averse and pessimistic during these tough times which cause the stock market to fluctuate (Kamal et al., 2023; Kumari et al., 2023). Consequently, the recent crisis between Russia and Ukraine needs to be carefully examined in terms of how it may affect the global economy. February 24, 2022, is the day when Russia officially started to invade Ukraine.[1] Following that day, numerous countries put sanctions against Russia, raising the possibility of political

[1] Retrieved from https://www.euronews.com/2023/01/30/ukraine-war-a-month-by-month-timeline-of-the-conflict-in-2022 (Accessed on July 20, 2023).

turmoil and worsening financial market losses worldwide (Ahmed et al., 2022; Derindere Köseoğlu et al., 2023). Therefore, many researchers examined the effect of that conflict on various stock markets and generally found a negative impact (i.e., Ahmed et al., 2022; Kamal et al., 2023; Yousaf et al., 2022). However, the geopolitical proximity of the nation to the area of conflict and the degree of economic interdependence between these nations determine how war affects the global stock markets (Güneysu, 2022; Sun & Zhang 2022; Sun et al., 2022).

Turkey is one of the countries that are neighbors to the region and has intimate economic and commercial relationships with both sides. The geopolitical position of Turkey and its status as an important emerging market make it attractive for researchers. As indicated by Doğan (2022), the BIST-100 index, Turkey's primary stock index, decreased by 8.17% at the beginning of the conflict. Although some studies investigated the effect of the Russian–Ukrainian crisis on Borsa Istanbul (i.e., Doğan, 2022; Güneysu, 2022; Keleş, 2023; Yürük, 2022), it seems that none of these studies examined its impact on the Turkish tourism sector. The tourism sector is particularly noteworthy because it reacts instantly to these types of political and geopolitical conflicts, and these events generally harm tourism expenditures (Erol, 2022). Pandey and Kumar (2023) investigated the tourism firms from 31 countries, and they found that the war affected those firms negatively on the initial day, but in the subsequent days, abnormal returns began to turn positive. On the day of the war, investors may have sold their stock holdings out of panic, but later on, they may have viewed the war as regional and bought back their shares, which produced higher profits. However, Pandey and Kumar (2023) recommended further investigation, particularly for the travel destinations that depend on Russia and Ukraine, including Turkey. Russia and Ukraine are two leading tourism markets for Turkey, but since the crisis started, their relative dominance has altered, worrying the industry (Demirkıran et al., 2022, Karabuğa et al., 2022).

Based on the abovementioned explanations, the aim of this study is to explore how the Russian–Ukrainian crisis has affected the Borsa Istanbul (BIST) tourism index. The event study approach is used to calculate any abnormal returns that may have occurred during the event period. In the following parts, first, the related literature is summarized. Second, the data and methodology are described. Third, the empirical findings are explained. The final section concludes with a discussion of the findings, their policy implications, and recommendations for future studies.

Literature Review

Every financial market in the world is susceptible to political uncertainties. There have therefore been numerous analyses on how the Russian–Ukrainian crisis has affected different financial markets. Although some of these studies used econometric models (i.e., Boungou & Yatie, 2022; Das et al., 2023; Derindere Köseoğlu et al., 2023; Gaio et al., 2022; Izzeldin et al., 2023), majority of them estimated the impact via event study methodology by calculating probable abnormal returns during the event window. Table 1 lists these studies chronologically and alphabetically along with their findings.

The majority of the studies examined the effect of the war in a multi-country context. Abbasi et al. (2022) investigated the G7 countries and found that the stock market indices of Japan, the United Kingdom, Germany, Canada, and Italy were significantly affected by the war. They also tested the relationship between abnormal returns and some firm-specific (i.e., return on assets, book-to-market) and country-level (i.e., geopolitical risk, GDP-scaled trade) variables. Consequently, they found a negative association between these variables and abnormal returns. Moreover, Yousaf et al. (2022) examined the G20 countries along with six other selected stock markets. Overall, they revealed that the conflict had a considerable and detrimental impact on the stock markets in Europe and Asia. Additionally, Ahmed et al. (2022), Mojanoski and Bucevska (2022), and Kumari et al. (2023) analyzed European stock markets. Ahmed et al. (2022) investigated the STOXX Europe 600 index as a representative of European stock markets and found a negative impact on the event and post-event days. Mojanoski and Bucevska (2022) included Southeastern European (Balkan) countries in their analyses and found that cumulative abnormal returns (CARs) of Croatia, Slovenia, North Macedonia, and Bosnia and Herzegovina stock markets are significantly affected by the war. Kumari et al. (2023) examined 25 European Union countries and concluded that most of the countries are negatively affected by the event, which also depends on the degree of proximity to the war area.

Furthermore, Sun and Zhang (2022) and Sun et al. (2022) conducted research using large data sets (86 and 95 countries' stock exchanges, respectively). Both studies indicated that the impact of war is greater in nations that are more dependent on Russian commerce and located near the area of conflict. Also, Sun et al. (2022) concluded that the war had more detrimental consequences on the manufacturing, banking, and services industries as well as Russian oil and gas enterprises. Besides, Martins et al. (2023) and Pandey and Kumar (2023) conducted sectoral analyses. Martins et al. (2023) investigated the banking industry including the 100 largest European banks and found a significantly adverse influence on the day of the event and in the days that followed the beginning of the conflict. Pandey and Kumar (2023), on the other hand, examined the tourism sector with 134 firms from 31 countries, and they found a significant negative impact for the firms located in Europe, the Middle East, and Africa.

The remaining studies in Table 1 focused on the single market. Dwijaya et al. (2023) analyzed the Indonesian Kompas100 index and found that only the mining sector was negatively affected by the conflict. Thus, the result indicates that the Indonesian market is more resilient than the European markets. Additionally, focusing on the Australian stock market, Kamal et al. (2023) discovered that while there was a noticeable negative impact on the event day, the effect disappeared in the days after the event occurred. Moreover, Pandey et al. (2023) discovered that the Indian stock market experienced negative effects before and on the day of the event, but that these effects changed to positive ones after the event.

A few studies examined the effect of invasion on Borsa Istanbul. Doğan (2022) investigated the 209 listed companies and encountered that abnormal returns are positive on the first day and the day before the conflict, and negative on the remaining days. Yürük (2023) and Keleş (2023) focused on the BIST-100 index. They both concluded that the BIST-100 index reacted negatively to the war. Additionally, Keleş (2023) conducted a cross-sectional analysis and proposed that the effect is stronger for non-financial institutions and that it is reduced for larger and more profitable companies. Lastly, Güneysu (2022) examined the impact of war sectoral, for the BIST Food Beverage Index, and although negative average abnormal returns (AARs) are observed before and after an event, it is not significant on the day of the event. On the other

Table 1.
Literature Summary

Author(s)	Country/Index	Results
Abbasi et al. (2022)	G7 Countries	Insignificant for France and the US. However, they found a significant and negative effect on Japan, the UK, and Germany, as well as a significant and positive effect on Canada during the event period. In addition, they noted a significant and positive effect on Italy on the second day after the event.
Ahmed et al. (2022)	STOXX Europe 600 index	The adverse effect on the event day and subsequent days.
Doğan (2022)	Turkey (BIST)	Significant and positive on the first day before and the first day of the event, but negative for the remaining days (before and after the event).
Güneysu (2022)	Turkey (BIST Food Beverage Index)	Insignificant on the event day, but significant and negative effects for the event windows (0,5) and (0,15).
Mojanoski and Bucevska (2022)	Balkan countries	CAR is significant for Croatia, Slovenia, North Macedonia, and Bosnia and Herzegovina
Sun and Zhang (2022)	86 countries	Lower ARs for countries with higher trade relationships with Russia.
Sun et al. (2022)	95 countries	Lower CARs for countries closer to Russia and Ukraine. The study also revealed that the negative effects of war are more prominent in the manufacturing, finance, and services sectors are more prominent.
Yousaf et al. (2022)	G20 countries, Romania, Hungary, Netherlands, Slovakia, Poland, and Ukraine	The adverse effect on the event day and subsequent days.
Yürük (2022)	Turkey (BIST100 Index)	Significant ARs and CAARs for the event period.
Dwijaya et al. (2023)	Indonesia	Insignificant for the Kompas100 index.
Kamal et al. (2023)	Australia	Adverse effect on the event day in Australia, but insignificant for the subsequent days.
Keleş (2023)	Turkey (BIST100 Index)	Significant and negative effects for the event period.
Kumari et al. (2023)	25 EU countries	Adverse effect on the event day and significant and positive CARs for Poland, Denmark, and Portugal in the post-event period.
Martins et al. (2023)	100 largest European listed banks	The adverse effect at the beginning of the event.
Pandey and Kumar (2023)	134 tourism firms from 31 countries	Significant and negative effects for the firms in Europe, the Middle East, Africa, and the Pacific. However, the impact was insignificant for the firms in the Americas and Asia on the event day.
Pandey et al. (2023)	India	Adverse effect on the pre-event period and the event day, but positive effect on the subsequent days.

Note: CAR = Cumulative Abnormal Return.

hand, they concluded that cumulative average abnormal returns (CAARs) for the (0, 5) and (0, 15) event windows are statistically significant and negative.

Methods

This study investigates the effect of the Russian–Ukrainian crisis on the BIST tourism index (XTRZM), which is comprised of 11 companies. However, for the specified period, due to the data availability, only 10 of them are included in the analyses.[2] The list of the companies in XTRZM with their codes and full names can be found at https://www.kap.org.tr/tr/Endeksler.

Additionally, the BIST-100 index is chosen as a benchmark for the market. Daily closing prices of each stock and the BIST-100 index are retrieved from www.investing.com for the period April 07, 2021–March 10 2022. The logarithmic returns of each stock and the BIST-100 index are calculated using the following formula:

$$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right). \quad (1)$$

$R_{i,t}$ is the logarithmic return of stock i on day t, $P_{i,t}$ and $P_{i,t-1}$ are the closing prices of stock *i* on day *t* and the previous day, respectively.

This study employs the event study methodology to determine how the Russian–Ukrainian challenge has affected the tourism index. The event studies are useful methods to determine the instant reaction of an unexpected event on the stock market and prices. Additionally, they are widely used in financial analyses for investigating the effectiveness of the stock market and the effect of a particular event on returns. According to Fama's (1970) efficient market hypothesis, if a market is efficient, there should be an immediate reaction on the day of the event and no reactions in the days that follow. If the abnormal returns continue after the event, it may be determined that the market is not entirely efficient (Brooks, 2014; Kothari & Warner, 2007). Hence, by the event studies it is possible to detect the market's responses to new information.

First, the day of the event is determined as February 24, 2022, when the president of Russia declared an invasion of Ukraine. Second, the event and the estimation periods have to be specified. According to Peterson (1989), the daily dataset's estimation

[2] Since BIGCH became a part of the BIST tourism index as of May 11, 2023, it is not considered in the analysis.

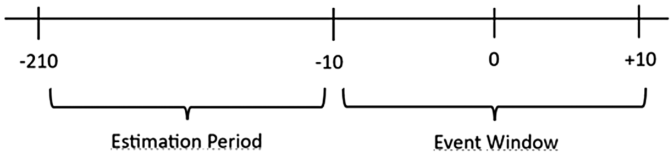

Figure 1.
Event and Estimation Periods.

period could be between 100 and 300 days, while the event window could be between 21 and 121 days. The event window—or the time frame in which an event's consequences are evaluated—is typically set as a short run, such as the 10 days before and after the trading days (Brooks, 2014). Hence, following these suggestions, the event window is specified as 10 days before (anticipation period) and after (adjustment period) the event day (total 21 trading days), and the estimation period is 210 days prior to the event period. Figure 1 shows the event and estimation periods where 0 indicates the event day.

For the next step, to compute the abnormal returns, the return subject to the event must be subtracted from the expected return that is not subject to the event (Kothari & Warner, 2007). Hence, initially, the expected returns have to be estimated. Accordingly, the OLS market model is followed to determine each stock's expected returns which is formulated as follows (Brown and Warner, 1985):

$$ER_{i,t} = \alpha_i + \beta_i R_{m,t} \quad (2)$$

$ER_{i,t}$ indicates the expected return of stock i on day t; $R_{m,t}$ denotes the BIST-100 index return on day t; α_i and β_i are the intercept and slope respectively, which are estimated by regressing the daily stock returns with the market returns covering the estimation period (−10, −210). After determining the expected returns, the abnormal returns are calculated using the following formula:

$$AR_{i,t} = R_{i,t} - ER_{i,t} \quad (3)$$

$AR_{i,t}$ denotes the abnormal return, $R_{i,t}$ is the logarithmic return, and $ER_{i,t}$ is the expected return of company i on day t.

Because abnormal returns could vary throughout the event window, it might be challenging to detect the overall patterns (Brooks, 2014). Furthermore, abnormal returns (ARs) demonstrate how investors reacted instantly to the event, and CARs can be calculated to assess the market's resilience throughout the chosen time periods (Mojanoski & Bucevska, 2022). Therefore, to observe the cumulative market reactions before and after the event day, CARs are calculated for each firm for the anticipation period (−10, 0), adjustment period (0, +10), event day (0, 0), and total event window (−10, +10). The CAR is calculated by summing up daily ARs over the period (p, q), or from time p to time q.

$$CAR_{i,p-q} = \sum_{t=p}^{q} AR_{i,t} \quad (4)$$

The statistical significance of the return averaged over all firms is usually of higher importance than whether this is present in any

Table 2.
Cumulative Abnormal Returns of Individual Companies

Codes	Statistics	Anticipation Period (−10, 0)	Event Day (0,0)	Adjustment Period (0, +10)	Total Period (−10, +10)
AVTUR	CAR	0.0182	**−0.0627**	−0.0294	−0.0739
	t-stat	0.1903	**−2.0723****	−0.03071	−0.5328
AYCES	CAR	−0.0687	−0.0382	−0.0672	−0.1741
	t-stat	−0.5238	−0.9213	−0.5126	−0.9162
DOCO	CAR	−0.0405	−0.0160	**−0.1467**	**−0.2033**
	t-stat	−0.4842	−0.6061	**−1.7529***	**−1.6759***
ETILR	CAR	0.0891	**−0.1057**	−0.0272	−0.0438
	t-stat	0.9266	**−3.4785*****	−0.2826	−0.3147
MAALT	CAR	−0.1421	−0.0394	−0.0248	−0.2063
	t-stat	−1.1944	−1.0461	−0.2087	−1.1965
MARTI	CAR	0.1403	**−0.0591**	−0.0231	0.0582
	t-stat	1.5275	**−2.0338****	−0.2511	0.4370
MERIT	CAR	0.2891	−0.0016	−0.0145	0.2731
	t-stat	0.6228	−0.0108	−0.0312	0.4058
PKENT	CAR	−0.2111	**−0.1094**	**−0.3465**	**−0.6670**
	t-stat	−1.6226	**−2.6598*****	**−2.6632*****	**−3.5379*****
TEKTU	CAR	0.0556	−0.0268	−0.1039	−0.0750
	t-stat	0.7337	−1.1168	−1.3709	−0.6834
ULAS	CAR	−0.0788	**−0.0563**	−0.0035	−0.1386
	t-stat	−0.8423	**−1.9016***	−0.0374	−1.0220

The values in bold indicate the statistically significant cumulative abnormal returns (CARs).
Note: CAR = Cumulative Abnormal Return.
*Significance level of p-value at 10%.
**Significance level of p-value at 5%.
***Significance level of p-value at 1%.

particular individual firm (Brooks, 2014). Hence, for the last step, the common reaction of firms in the XTRZM index to the Russian–Ukrainian crisis is investigated by calculating the average abnormal returns on each day with the following equation:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t} \quad (5)$$

N indicates the number of stocks (i.e., 10). The CAARs, which are calculated over the period (p, q) by adding up AARs, are used to determine whether the abnormal returns for all companies throughout the aggregated period are statistically significant. The statistical significance of the results is evaluated by using t-statistics. All calculations are performed using Microsoft Office Excel.

Results

First, the abnormal returns of each company are calculated. However, because it is hard to evaluate overall patterns with the individual abnormal returns, the CARs of each stock are evaluated for the anticipation period (–10, 0), adjustment period (0, +10), event day (0, 0), and total event window (–10, +10). The results are presented in Table 2, and the statistically significant results are shown in bold. When the anticipation periods (pre-event) are evaluated, it is observed that none of the countries have significant cumulative abnormal returns. Moreover, while the following companies experienced statistically significant and negative abnormal returns on the event day—AVTUR, ETILR, MARTI, PKENT, and ULAS—the other companies did not have any significant abnormal returns at all. These companies reacted to war immediately on the day of the event. The PKENT has the greatest negative abnormal return of the entire set with –0.109 on the event day. Additionally, DOCO shows significant CARs on the whole period and adjustment period (post-event), but there is no statistically significant result on the event day. Therefore, it could be stated that DOCO reacted to the event after it had already begun. On the other hand, PKENT shows statistically significant CARs for all periods except the anticipation period, suggesting that it may be considered the most affected company by the war.

To capture the overall index reaction to an event, the average abnormal returns (AARs) for each day are calculated, including the stocks in the XTRZM index. The results of the AARs of XTRZM are shown in Table 3. Although there is a statistically significant abnormal return seven days before the event, it is observed that the results on the remaining days are not statistically significant. Additionally, there is a statistically significant AAR of –0.0515 on the event day. However, only the second and seventh days after the event are statistically significant in the post-event period.

The CAARs are calculated for the anticipation, adjustment, total periods, and event day at the last stage since the findings of the AARs cannot depict the general pattern of the tourism industry. The results are presented in Table 4. The results show that an abnormal return is only statistically significant on the event day. For the remaining periods, the results are not statistically significant. Therefore, the companies in the tourism industry reacted to the Russian–Ukrainian war instantly; however, its effect has recovered very soon.

Discussion

Global economics and financial markets are severely impacted by war and other forms of worldwide political turmoil. The ongoing battle between Russia and Ukraine, which started on February 24, 2022, is a recent example of these uncertainties. Due to Turkey's popularity as a travel destination, Russia and Ukraine are the two largest sources of revenue for the country's tourism sector. Therefore, the present paper aims to investigate the effect of the Russian–Ukrainian conflict on the BIST tourism index in order to fill the gap in the literature. Applying the event study method enables the detection of abnormal returns.

Table 3.
Average Abnormal Returns of XTRZM

		XTRZM	
	Day	**AAR**	***t*-Test**
Anticipation period (the pre-event)	t – 10	0.0034	0.1456
	t – 09	0.0024	0.1034
	t – 08	–0.0058	–0.2491
	t – 07	**0.0498**	**2.1463****
	t – 06	0.0163	0.7043
	t – 05	0.0036	0.1552
	t – 04	–0.0027	–0.1185
	t – 03	–0.0186	–0.8032
	t – 02	–0.0297	–1.2826
	t – 01	–0.0135	–0.5808
	0	**–0.0515**	**–2.2218****
Adjustment period (the post-event)	t+01	0.0168	0.7228
	t+02	**–0.0414**	**–1.7854***
	t+03	–0.0014	–0.0623
	t+04	–0.0142	–0.6109
	t+05	0.0245	1.0570
	t+06	–0.0016	–0.0687
	t+07	**–0.0398**	**–1.7157***
	t+08	–0.0113	–0.4871
	t+09	0.0014	0.0587
	t+10	–0.0116	–0.5008

The numbers in bold indicate the statistical significant average abnormal returns (AARs).
Note: The "0" in the day column indicates the event day.
AAR = Average abnormal returns.
*Significance level of p-value at 10%.
**Significance level of p-value at 5%.
***Significance level of p-value at 1%.

The findings demonstrate that five companies—AVTUR, ETILR, MARTI, PKENT, and ULAS—responded to an event immediately and produced statistically significant CARs which were negative on the day of the event. The one with the greatest CAR among them, PKENT, continued to demonstrate statistically significant abnormal returns throughout the post-event period, indicating that it may be the company most adversely affected by the war. Petrokent Turizm (PKENT) has a hotel in Antalya which is primarily chosen by Russians and Ukrainians as their vacation destination. Furthermore, the firm disclosed in its first-period financial statements for 2022 that timeshare holiday owners continue to file lawsuits against it.[3] Therefore, the succession of these cases, the COVID-19 pandemic, and

[3] Retrieved from http://www.petrokent.com.tr/uploads/documents/230213121124_petrokent-2022-1.donem-rapor.pdf (Accessed on December 12, 2023).

Table 4.
Cumulative Average Abnormal Return of XTRZM

Codes	Statistics	Anticipation Period (−10, 0)	Event Day (0,0)	Adjustment Period (0, +10)	Total Period (−10, +10)
XTRZM	CAAR	0.0051	−0.0515	−0.0787	−0.1251
	t-stat	0.0698	−.2219**	−1.0728	−1.1769

Note: CAAR = Cumulative average abnormal return.
*Significance level of *p*-value at 10%.
**Significance level of *p*-value at 5%.
***Significance level of *p*-value at 1%.

the war may have made the company more vulnerable to such conflicts.

Additionally, since DOCO only exhibited statistically significant CARs in the post-event period, it demonstrates the firm's reaction to the war after it had already begun. Overall tourism index reaction to an event was measured with the average abnormal returns (AARs) for each day. On the day of the event, a negative and significant abnormal return was observed; however, on the days before and following the event, the majority of the results were not significant. To obtain a comprehensive abnormal return pattern for the BIST tourism index, the cumulative average abnormal return (CAAR) was calculated for the last step. The results show that the event day was the only period when an abnormal return was statistically significant and negative. Therefore, to sum up, tourism companies listed in BIST responded immediately to the Russian–Ukrainian war, but the impact quickly subsided. These findings are in line with those of Pandey and Kumar (2023), who hypothesized that while stockholders may have panicked-sold their assets on the day of the conflict, they may have later seen the conflict as a regional one. The results are also consistent with the efficient market hypothesis, which proposed that if a market is efficient, there should be a quick response on the day of the event and no responses on the following days (Fama, 1970).

Turkey, according to Karabuğa et al. (2022), has a strong chance of overcoming the negative impacts of the Russian–Ukrainian war since, with the appropriate policies, it could differentiate its tourism market and offer a competitive advantage in the industry. At this point, many steps have been taken to prevent the war from causing a crisis in the Turkish tourism sector and to minimize the impact of the crisis. As indicated by Demirkıran et al. (2022), one of the political actions conducted in this direction was the interaction with Russian and Ukrainian government officials through meetings, contacts, and mediatory positions by the Turkish Presidency and later the Ministry of Foreign Affairs. Moreover, the Ministry of Culture and Tourism had promoted Turkish tourism to acquire new markets and attract tourists from other countries (Demirkıran et al., 2022). The finding that the companies in the tourism index turn negative just on the event day and thereafter recover themselves is also in line with these arguments.

Conclusion and Recommendations

This study may provide great insight for investors, financial analysts, and policymakers. Investors and financial analysts could benefit from the results by developing hedging strategies through industry diversification. Moreover, although the effect of the war was only temporary, investors may favor alternative stock markets that are less dependent on the economies of the conflicting nations, or they may prefer alternative investment tools such as cryptocurrencies to diversify their risks. Policymakers, on the other hand, could develop effective strategies to deal with similar political uncertainties. Since it seems that the negative effects of the conflict were effectively handled in this instance, policymakers may choose to adopt similar strategies in these kinds of occasions. Nevertheless, to make more accurate decisions for diversification, further studies could employ similar research for different industries. Besides, in this study, only the significance level of the abnormal returns is evaluated by the event studies, but further research could additionally examine the factors (firm size, volatility, performance, etc.) that drive the abnormal returns through the use of various econometric techniques (e.g., regressions or ARCH models).

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Genişletilmiş Özet

Siyasi istikrarsızlık, finansal krizler, felaketler, terör saldırıları ve salgın hastalıklar gibi küresel olaylar finansal piyasaları olumsuz etkilemektedir. Savaşlar da bunlardan biridir ve sadece savaş bölgesinde değil, taraflara yakın ekonomik bağımlılığı olan ülkelerde de piyasa belirsizliğini ve kırılganlığını artırmaktadır. Dolayısıyla, Rusya ile Ukrayna arasında yaşanan son krizin küresel ekonomiyi nasıl etkileyebileceğinin dikkatle incelenmesi gerekmektedir. 24 Şubatcar 2022, Rusya'nın Ukrayna'yı resmi olarak işgal ettiği tarihtir. O günü takiben, çok sayıda ülke Rusya'ya karşı yaptırımlar uygulamaya başlamış, bu da küresel finansal piyasa getirilerinin düşüş olasılığını artırmıştır (Ahmed ve ark., 2022; Derindere Köseoğlu ve ark., 2023). Türkiye, bölgeye komşu olan ve her iki tarafla da yakın ekonomik ve ticari ilişkileri olan ülkelerden biridir. Türkiye'nin jeopolitik konumu ve gelişmekte olan önemli bir pazar olması onu araştırmacılar için cazip kılmaktadır. Bazı çalışmalar Rusya-Ukrayna krizinin Borsa İstanbul üzerindeki etkisini araştırmış olsa da (örneğin, Doğan, 2022; Güneysu, 2022; Keleş, 2023; Yürük, 2022), bu çalışmaların hiçbirinin Türk turizm sektörü üzerindeki etkisini incelemediği görülmektedir. Bu çalışma, Rusya-Ukrayna krizinin 11 şirketten oluşan BIST-Turizm endeksi (XTRZM) üzerindeki etkisini araştırmaktadır. Ancak, veri mevcudiyeti nedeniyle belirtilen dönem için sadece 10 tanesi analizlere dahil edilmiştir. Ayrıca, BIST-100 endeksi piyasa için bir karşılaştırma ölçütü olarak seçilmiştir.

Şirketlerin bireysel tepkilerini ölçmek için her bir firma için anormal getiriler (AR) ve kümülatif anormal getiriler (CAR), endeksteki tüm şirketlerin genel tepkisini ölçmek için ise ortalama anormal getiriler (AAR) ve kümülatif ortalama anormal getiriler (CAAR) hesaplanmıştır. CAR'lar ve CAAR'lar beklenti dönemi (-10, 0), düzeltme dönemi (0, +10), olay günü (0, 0) ve toplam olay penceresi (-10, +10) için hesaplanmıştır. Bulgular, beş şirketin -AVTUR, ETILR, MARTI,CAR PKENT ve ULAS- olaya hemen tepki verdiğini ve olay günü negatif olan istatistiksel olarak anlamlı CAR'ler ürettiğini göstermektedir. Bunlar arasında en yüksek anormal getiriye sahip olan PKENT, olay sonrası dönem boyunca istatistiksel olarak anlamlı anormal getiriler göstermeye devam etmiş ve bu da savaştan en olumsuz etkilenen şirket olabileceğini göstermiştir. Turizm endeksinin bir olaya verdiği genel tepki, her gün için ortalama anormal getiriler (AAR) ile ölçülmüştür. Olay günü negatif ve önemli bir anormal getiri gözlemlenmiş, ancak olaydan önceki ve sonraki günlerde sonuçların çoğu anlamlı çıkmamıştır. BIST Turizm endeksi için kapsamlı bir anormal getiri modeli elde etmek amacıyla son adımda kümülatif ortalama anormal getiri (CAAR) hesaplanmıştır. Sonuçlar, anormal getirinin istatistiksel olarak anlamlı ve negatif olduğu tek dönemin olay günü olduğunu göstermektedir. Dolayısıyla, özetle, BIST'te işlem gören turizm şirketleri Rusya-Ukrayna savaşına hemen tepki vermiş, ancak bu etki hızla azalmıştır.

Bu çalışma yatırımcılar, finansal analistler ve politika yapıcılar için önemli bilgiler sağlayabilir. Yatırımcılar ve finansal analistler endüstri çeşitlendirmesi yoluyla riskten korunma stratejileri geliştirerek sonuçlardan faydalanabilir ve politika yapıcılar da benzer siyasi belirsizliklerle başa çıkmak için etkili stratejiler geliştirebilir.

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The Impact of Carbon Emissions on Firms' Financial Performance: An Application in BIST Sustainability Index

Karbon Emisyonlarının Firmaların Finansal Performansına Etkisi: BIST Sürdürülebilirlik Endeksinde Bir Uygulama

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ABSTRACT

The purpose of this study is to examine the carbon emission data of the firms listed in the Borsa Istanbul Sustainability Index in Turkey and analyze the relationship between carbon emissions and the financial performance of these firms. In this research, annual data for 31 firms listed in the Borsa Istanbul Sustainability Index for the period 2017–2020 were used. The relationship between the financial performance indicators of the firms and their carbon emissions was analyzed using a random effects panel data model. The dependent variables identified were return on assets and return on equity as measures of financial performance, while carbon emissions were considered as the independent variable, along with control variables such as firm size, leverage ratio, firm growth, and firm value. The research findings indicate that carbon emissions have a negative impact on both return on assets and return on equity.

JEL Codes: C23, M41, Q56

Keywords: BIST Sustainability Index, carbon emission, financial performance, panel data analysis, sustainability reporting

ÖZ

Bu çalışmanın amacı, Türkiye'de Borsa İstanbul Sürdürülebilirlik Endeksi'nde listelenen firmaların karbon emisyon verilerini incelemek ve bu firmaların finansal performansı ile karbon emisyonları arasındaki ilişkiyi analiz etmektir. Bu araştırmada, 2017–2020 dönemi için Borsa İstanbul Sürdürülebilirlik Endeksi'nde yer alan 31 firmanın yıllık verileri kullanılmıştır. Firmaların finansal performans göstergeleri ile karbon emisyonları arasındaki ilişki rassal etkiler panel veri modeli kullanılarak analiz edilmiştir. Finansal performansın ölçütleri olarak varlık getirisi ve özkaynak getirisi belirlenirken, bağımsız değişken olarak karbon emisyonları yanında firma büyüklüğü, kaldıraç oranı, firma büyümesi ve firma değeri gibi kontrol değişkenleri de ele alınmıştır. Araştırma bulguları, karbon emisyonlarının hem varlık getirisi hem de özkaynak getirisi üzerinde olumsuz bir etkisi olduğunu göstermektedir.

JEL Kodları: C23, M41, Q56

Anahtar Kelimeler: BIST Sürdürülebilirlik Endeksi, karbon emisyonu, finansal performans, panel veri analizi, sürdürülebilirlik raporlaması

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Introduction

Due to the excessive increase in the world population and the consequent rise in human needs, the damage to the environment is continuously increasing. Lately, challenges such as the destruction of natural habitats, overexploitation of natural resources, and the increase in pollution caused by hazardous carbon elements have led both countries and global firms to adopt new policies. Such policies have become a fundamental principle, critical for implementing specific activities at both macro and microeconomic levels, leading to the adoption of sustainable development (Ganda & Milondzo, 2018, p. 1). Global warming and climate change have emerged as significant challenges for sustainable

development. Many governments are taking steps to reduce greenhouse gas emissions through national policies that include emission trading programs, voluntary initiatives, carbon or energy taxes, and regulations and standards related to energy efficiency and emissions (The Greenhouse Gas Protocol, 2004, p. 3). If actions are not taken to mitigate and stabilize this situation, increasing carbon emissions will lead to social, economic, and environmental adverse impacts globally and in Turkey.

According to the Intergovernmental Panel on Climate Change (IPCC) report in 2021, Turkey accounted for 1% of global emissions, ranking 16th in the world, by emitting 530 million tons of carbon dioxide equivalent in 2020. When examining emission sources in Turkey, 24.1% accounts for the electricity sector, 21.2% for manufacturing, 15.8% for transportation, 13.8% for buildings, 11.1% for waste, and 9.3% for agriculture. The remaining portion is attributed to the maritime, oil, and natural gas sectors (Kaya, 2021).

Various policy methods, including emission trading systems, emission standards, carbon taxes, and energy taxes, are being implemented to reduce carbon emissions (Şencan, 2021, p. 50). To achieve comprehensive participation and feasibility of these policies, several processes have been established worldwide. One of the significant processes is the Kyoto Protocol, signed in 1997 and enforced in 2005, aiming to control greenhouse gas emissions globally (United Nations Climate Change, 2020, p. 12). The Paris Agreement, developed in 2016 to combat climate change and accepted by many countries, aims to keep global warming well below 1.5°C in the long term (United Nations Climate Change, 2020, p. 25). The implementation of the mentioned methods and compliance with these agreements play a crucial role in cost-effectiveness. Their feasibility and impact on firm performance are considered as one of the most important points (Şencan, 2021, p. 50).

Considering high carbon emission levels, studies on the relationship between emissions and corporate financial performance are of vital importance for evaluating both social and firm behavior aspects. As a result, in order to achieve long-term success in a competitive business environment and prepare for future national or regional climate policies, firms need to understand and manage emission risks.

Research shows that the use of nonrenewable energy sources contributes to increased carbon emissions and, therefore, has global-scale financial, social, and environmental impacts (Chen et al., 2019; Doğan & Öztürk, 2017; Doğan & Turkekul, 2016; Jebli & Ben Youssef, 2015; Zafar et al., 2019). There are differing views on the direction of the relationship between practices designed to reduce carbon emissions and financial performance (Ganda & Milondzo, 2018; Narayan & Sharma, 2015; Yang & Zhang, 2017). One group of researchers argues that reducing carbon emissions, or green investment activities, will cause financial losses (Ganda & Milondzo, 2018, p. 10), while some researchers claim that it enhances firm profitability (Narayan & Sharma, 2015, p. 84). Another view suggests that expenses incurred to reduce carbon emissions may initially reduce profitability but will lead to increased profitability in the later stages (Yang & Zhang, 2017, p. 1421).

The relationship between financial and environmental performance is a growing research area, and this study focuses on this topic. The lack of consensus in the literature on this issue can be attributed to several factors. Compliance with environmental regulations may impose additional costs on businesses. As a result, achieving shareholders' wealth maximization goal may not be possible due to these additional costs. However, it can be argued that a business that can effectively control pollution can also effectively control other production costs, leading to higher return rates.

In this study, the impact of carbon emissions on the financial performance of firms operating in Turkey and listed in the Borsa Istanbul Sustainability Index is examined. BIST Sustainability Index was created by Turkey's main stock exchange, Borsa Istanbul (BIST), to promote sustainable and socially responsible business practices among Turkish companies. Companies included in this index are generally evaluated according to various sustainability criteria, such as environmental performance (such as energy efficiency and emissions reduction), social responsibility (including labor practices and community participation) and governance (transparency and board structure). In this case, this index was preferred because it encourages businesses to act more environmentally friendly and socially responsible in their activities and to provide more transparent and realistic information about carbon emissions. The aim of the study is to investigate the effect of emission levels of firms emitting carbon on their financial performance. Therefore, the theoretical framework related to the topic is first presented, and the literature on carbon emissions and firm financial performance is reviewed. The study then proceeds to discuss the research methodology and the findings of the study.

Institutional Theory

Institutional theory is a way of thinking about the relationship between organizational structures and the social processes these structures develop (Dillard et al., 2004, p. 508). Institutional theory focuses on the dense and more enduring issues of a social framework. It considers the procedures in which models, regulations, values, and norms become legitimate criteria for institutional social behavior (Scott, 2004, pp. 408–414). Institutional theory examines organizational forms and explains the reasons for having homogeneous characteristics or forms in organizations within the same organizational field. DiMaggio and Powell (1983) define the organizational field as a recognized domain of institutional life consisting of organizations collectively. This field includes key suppliers, resource and product consumers, regulatory bodies, and other organizations producing similar services or products.

Institutional theory views organizations as operating within a social framework composed of norms, values, and accepted assumptions about what constitutes appropriate or acceptable economic behavior (Carpenter & Feroz, 2001, p. 565). When an organizational field is structured, various forces emerge within the society and lead the organizations in this field to become more similar to each other (DiMaggio & Powell, 1983, p. 147). The core of institutional theory, explaining the relationship between the social environment and the organization, is based on organizations' perspectives on changing norms, values, and social trends, and their processes of adapting to these changes (Rodrigues & Craig, 2007, p. 742).

Organizational forces are seen as regulatory mechanisms over an individual's interests, goals, and desires, shaping action scenarios; such forces can also lead to continuous adoption or transformation of a particular course of action. In this context, a vital component of the social environment affects how institutions are

organized, which organizations possess regulatory, normative, and cognitive structures and activities that provide stability and meaning for social behavior (Ganda & Milondzo, 2018, pp. 2–3). At the forefront of these activities are the impacts on the environment. Producing environmentally friendly products and services has become an area of increasing importance to consumers due to the growing interest in environmental issues in society (Sözüer, 2011, p. 51). Accordingly, businesses aim to minimize their environmental impact, seek solutions to mitigate damages, and disseminate green practices, thereby guiding their stakeholders towards sustainability (Emgin & Türk, 2004, p. 8). Consequently, external pressures from relevant parties prompt firms to adopt behaviors that address such demands.

Corporate pressures consist of economic, legal, and customer pressures. The impact of globalization has increased competition, leading businesses to focus on profitability and cost reduction (economic pressures), the rise of legal environmental obligations (legal pressures), and the increased expectations and desires of customers (customer pressures), all of which have driven firms to emphasize green practices (Srivastava & Srivastava, 2006, pp. 524–525). As a result, institutional theory is a theory that explains how and why organizations are influenced by their environments and examines stakeholder groups that exert various pressures on businesses. In today's rapidly changing and transforming world, organizations' ability to adapt to their environment is essential for their survival and competitiveness. To ensure their long-term existence, businesses must achieve environmental compliance and take the necessary steps (Apaydın, 2009, p. 19).

Literature Review

According to the International Local Governments Greenhouse Gas Emissions Analysis Protocol (IEAP), carbon emissions are classified into three categories: scope 1, scope 2, and scope 3. Scope 1 emissions are direct emissions resulting from sources owned and controlled by the firm. In other words, these emissions are released into the atmosphere as a direct result of a series of activities at the firm level. Scope 2 emissions are indirect emissions resulting from the production of energy purchased from a public utility provider. In other words, it includes all emissions released into the atmosphere from purchased electricity, steam, heat, and cooling consumption. Scope 3 emissions include emissions from a firm's activities, other than those specified in Scope 2, both upstream and downstream (Greenhouse Gas Protocol (GHG Protocol) Scope 2 Guidance, 2015, p. 3).

The reduction of carbon emissions is considered an activity that businesses should engage in, and such a practice not only serves profit-making purposes but also provides additional benefits. In this context, businesses are expected to participate in activities that reduce negative impacts on the natural environment, protect it, and promote recycling (Ganda & Milonfzo, 2018, p. 4). In research examining the relationship between carbon emissions and a firm's financial performance, there are different views both globally and in Turkey. When the literature in Turkey is examined, it has been determined that there are limited studies focusing on the relationship between carbon emissions and financial performance. In this context, some studies in the literature have indicated a negative relationship between carbon emissions and financial performance, while others have found evidence supporting a positive relationship. Yet, some studies emphasize that there is no significant relationship between carbon emissions and financial performance. Some argue that carbon emission reduction may not have an immediate impact on firms' profitability in the short term but will positively affect firm profitability in the long term (Bragdon & Marlin, 1972; Ghisetti & Rennings, 2014; Gore, 1992; Porter, 1991; Spicer, 1978; Yang & Zhang, 2017). In this context, a summary of research regarding the impact of carbon emissions on firms' financial performance is presented below. According to one perspective, environmental management, production efficiency, innovation, and emission reduction improvements can enhance economic performance (Gore, 1992; Porter, 1991; Spicer, 1978; Bragdon & Marlin, 1972). Carbon emissions can negatively impact a company's financial performance. Güneysu and Atasel (2022) investigated the impact of carbon emissions on the financial performance of nonfinancial firms listed on the BIST100 Index during the period 2014–2021 using panel regression models. In this context, the relationship between firms' total carbon emissions and financial performance indicators (return on assets, return on equity, Tobin's Q, net profit margin, and earnings per share) was examined. The findings indicate a significant and negative relationship between carbon emissions and return on assets and earnings per share, while no significant relationship was observed with other financial performance indicators. Ganda and Milondzo (2018) examine the impact of carbon emissions (scope 1, scope 2, and scope 1 and scope 2) on the financial performance indicators of 63 South African Carbon Disclosure Project (CDP) firms for the 2015 fiscal year, including return on equity (ROE), return on investment (ROI), and net profit margin (ROS). The research findings provide strong evidence of a negative relationship between carbon emissions and corporate financial performance. Hayami et al. (2014) demonstrate that firms producing less waste tend to have higher corporate financial performance. Cucchiella et al. (2017) argue on emission control in an Italian firm that implementing advanced emission control and environmental management systems encourages a firm's profitability to increase through a combination of increased demand and productivity. Based on the data from 941 US manufacturing firms that are publicly traded, Lucas and Noordewier (2016) show that environmental management practices and pollution control initiatives in dirty and nonproactive industries have a positive marginal effect on firm financial performance. The study suggests that this effect is even more significant in dirty sectors than in clean and proactive corporate environments. Misani and Pogutz (2015) find in their study, where they use return on equity, return on sales, and return on assets as dependent variables, that there is a moderate relationship between firms' financial performance and carbon performance, and improved environmental processes reduce carbon emissions and strengthen financial performance.

Another viewpoint is that energy conservation and emission reduction increase environmental costs and lower profit margins (Gingrich, 1995; Walley & Whitehead, 1994). This indicates a positive relationship between carbon emissions and firm profitability. Wang et al. (2016) found in their study that activities designed to reduce carbon emissions negatively impact the financial performance of firms in developing economies, posing a threat to their long-term survival. Mao et al. (2017) investigated 12 Chinese firms operating in the transportation, machinery, and electronics sectors and found that low carbon emissions improved the firm's environmental performance but had a negative effect on its financial performance. Rokhmawati et al. (2015) examined Indonesian firms and observed that carbon emissions had a positive relationship with active profitability, indicating

that reducing emissions may not always improve financial performance.

On the other hand, there is an opposing view that suggests there is no significant relationship between environmental management, energy conservation, and firm profitability (Fogler & Nutt, 1975; Salahuddin et al., 2016; Yu et al., 2016). Salahuddin et al. (2016) used data from OECD countries for the period 1991–2012 to predict the short and long-term effects of internet use and economic growth on carbon dioxide (CO2) emissions. The research results showed that economic growth had no significant short or long-term effect on carbon emissions. Yu et al. (2016) studied U.S. S&P 500 firms for the period 2012–2013 and found no significant relationship between emission reduction investments, emission savings, monetary savings, direct emissions, indirect emissions, research and development expenses, total assets, sales, net income, and the number of employees.

Another perspective suggests that improved environmental regulations may not have an immediate impact on business profitability, but they can positively affect long-term profitability (Ghisetti & Rennings, 2014; Yang & Zhang, 2017). Yang and Zhang (2017) analyzed the relationship between low carbon emissions and corporate profitability. They found that in the early stages, Research and development (R&D) costs led to decreased profitability. However, in the long run, reduced carbon emissions resulted in increased profitability. Broadstock et al. (2018) tested the relationship between firm performance and emission levels. They used return on equity and Tobin's *Q* ratio as firm performance indicators. The research results revealed a nonlinear relationship, where performance initially increased and then decreased with emission levels. Iwata and Okada (2011) examined the relationship between environmental performance and financial performance of manufacturing companies in Japan during the period of 2004–2008. The results of the research indicate that waste emissions had no impact on financial performance, but greenhouse gas reduction positively influenced long-term financial performance.

Research Methodology

In this study, panel data analysis was employed to determine the relationship between carbon emissions and financial performance of companies listed on the BIST Sustainability Index. Panel data analysis is a statistical method that allows us to both construct and test time-series and cross-sectional data. It combines the time-series and cross-sectional dimensions to provide more consistent information and controls for individual heterogeneity, recognizing that individuals, firms, or countries are heterogeneous (Baltagi, 2001, p. 1). In this context, models where both fixed and slope parameters are constant across cross-sectional and time units are referred to as pooled panel data models and are defined as follows (Yerdelen Tatoğlu, 2016, pp. 37–42).

$$Y_{it} = \alpha_0 + \sum_{k=1}^{K} \alpha_k X_{kit} + e_{it}$$

Both one-way and two-way panel data models are structured in two ways: fixed effects and random effects models. In the random effects model, error variances can vary across groups and time, while the slope coefficient remains constant (Baltagi, 2001, pp. 14–39).

Random one-way effect model is shown here.

$$Y_{it} = \alpha_i + \beta X_{it} + e_{it}$$

$$\alpha_i = \bar{\alpha} + \mu_i$$

$$u_{it} = \mu_i + e_{it}$$

Random two-way effect model is shown here.

$$Y_{it} = \alpha_0 + \beta X_{it} + e_{it}$$

One-way and two-way panel data models have been developed for panel data analysis to account for the effects of time and units. To achieve this, the likelihood ratio (LR) test is conducted to predict whether the model will be one-way or two-way based on the impact of time and cross section effects. After determining unit and time effects, the Lagrange multiplier (LM) test and LR test developed by Breusch and Pagan (1980) are performed to compare the pooled regression model with the random effects model. The Hausman Test (Hausman, 1978) is used to determine whether the fixed effects model or the random effects model is suitable for the research analysis in this study. In the Hausman test, the null hypothesis suggests that the random effects model is the appropriate model, while the alternative hypothesis proposes that the fixed effects model is the appropriate model for the analysis.

In this study, the appropriate model was determined using the *F*-test, Breusch–Pagan LM test, LR test, score test, and Hausman test.

The objective of this study is to analyze the impact of carbon emissions on financial performance. Based on the literature review, the following research hypothesis has been developed for this study:

H_0: Carbon emission intensity has no effect on the financial performance of the firm.

In the study, carbon emissions are used as independent variables. Additionally, four control variables are identified, which include the natural logarithm of total assets as a measure of firm size, the leverage ratio indicating how the firm's assets are financed, the sales growth rate indicating firm growth, and the firm's value. By considering the dependent variables, independent variables, and control variables, the main model for a firm is presented as follows:

Financial Performance $i,t = \alpha_{i,t}$ + β1Carbon Emissions i,t + β2Firm Size i,t + β3Leverage i,t + β4Growth i,t + β5Firm Value i,t + $\varepsilon_{i,t}$

α : intercept

t : time-specific effect (t=1, ... T);

i : cross section-specific effect (i=1, ... N);

$\varepsilon_{i,t}$: error term effect.

The panel regression models established to determine the relationship between financial performance indicators and carbon emissions are presented here.

Model 1: $AK_{it} = \alpha_{it} + \beta_1 l\text{LNCO2}_{it} + \beta_2 \text{LNTA}_{it} + \beta_3 \text{LEV}_{it} + \beta_4 \text{G}_{it} + \beta_5 \text{LNFV}_{it} + \varepsilon_{it}$

Model 2: 𝑂𝑆𝐾$_{it} = \alpha_{it} + \beta_1 l\text{LNCO2}_{it} + \beta_2 \text{LNTA}_{it} + \beta_3 \text{LEV}_{it} + \beta_4 \text{G}_{it} + \beta_5 \text{LNFV}_{it} + \varepsilon_{it}$

Methods

In this study, the relationship between carbon emissions and financial performance is examined. Therefore, how carbon intensity affects financial performance indicators (return on assets and return on equity) will be investigated. The research hypothesis will be analyzed using the panel data analysis method. In this context, the study will use carbon emissions data from the sustainability reports of 31 firms listed in the BIST Sustainability Index for the years 2017–2020, along with the financial performance indicators, return on assets, and return on equity, for the same firms. The data related to carbon emissions were obtained from companies' Sustainability and Integrated (Operational) Reports. Data for other variables were collected from the Public Disclosure Platform (KAP) and the Finnet Database. Therefore, this study does not require ethical approval due to its scope. The variables used in the study, their types, and abbreviations are shown in Table 1.

In this study, two financial performance indicators, namely the asset profitability ratio and the equity profitability ratio, are used as dependent variables. Profitability ratios are one of the most important financial indicators that measure a firm's financial success. The asset profitability ratio shows how efficient the firm's assets are in generating profits. It measures the efficiency of the firm's assets in generating profits during a specific period. This ratio is calculated by dividing the net profit by the net assets of the firm (Karaca & Kanışlı, 2015, pp. 35–36). A high asset profitability ratio is desirable for firms as it indicates effective utilization of all assets in generating profits (Yükçü & Atağan, 2010, p. 29).

Equity represents the monetary value of the rights of the founders, partners, and shareholders in the firm's tangible and intangible assets. The equity profitability ratio measures how much profit the firm generates with its equity and indicates its efficiency in generating profits. This ratio shows the percentage of profit earned per unit of equity contributed by the shareholders (Eren & Karasioğlu, 2012, p. 174; Konuralp, 2005, p. 129). The equity profitability ratio indicates how effectively the investment made by the shareholders in the firm is utilized and represents the profitability achieved through equity.

Table 1.
Variables Used and Type of Variables

Variables	Variable Name	Formulas
Dependent variables		
Return on assets	ROA	Net income/total assets
Return on equity	ROE	Net income/shareholders' equity
Independent variables		
Carbon emission	LNCO2	Logarithm of carbon emission (tons of CO_2)
Control variables		
Firm size	LNTA	Logarithm of total assets
Firm leverage	LEV	Total debt/total equity
Growth	G	(net sales – previous year net sales)/previous year net sales × 100
Firm value	LNFV	Logarithm of firm value

Results

In this section, the results of the research are presented. Table 2 shows the correlation coefficients between the variables.

According to Table 2, which shows the correlation between variables, it is observed that the asset profitability is negatively correlated with carbon emissions, firm size, and leverage ratio, but positively correlated with firm growth and firm value. On the other hand, equity profitability is negatively correlated with carbon emissions and leverage ratio, while it is positively correlated with firm size, firm growth, and firm value.

In panel data analysis, variables include both time and unit dimensions. It is determined that the model needs to be estimated as either one-way or two-way according to time and unit effects (Hsiao, 2005, p. 1). For this purpose, a LR test is conducted using the maximum likelihood method. According to the calculated test statistics at a 1% significance level, it has been interpreted that there is a two-way effect. The null hypothesis for the two-way effect test is that there is no unit or time effect in the model. Since the value of the test statistic for the two-way effect is 50.58529 at a 1% significance level, the null hypothesis is rejected, indicating that there is a two-way effect.

Subsequently, based on the findings of the two-way effect, the presence of unit and time effects has been tested separately. For the cross section effect analysis, the null hypothesis is that the standard error of the horizontal cross section is equal to zero (Evci & Şak, 2018, p. 212). According to the analysis results, since the value of the test statistic is 50.58529, the null hypothesis is rejected at a 1% significance level. This indicates that there is a unit effect in the panel data model.

For model 1, the presence of a time effect has also been examined, and the test statistic does not reject the null hypothesis, indicating that there is no time effect. To determine the appropriate model in the study, *F*-test, Breusch–Pagan LM test, LR test,

Table 2.
Correlation Coefficients Between Variables

	ROA	ROE	LNCO2	LNTA	LEV	G	LNFV
ROA (1)	1						
ROE (2)	0.6598	1					
LNCO2 (3)	−0.2194	−0.1198	1				
LNTA (4)	−0.0224	0.0475	0.6068	1			
LEV (5)	−0.5129	−0.4531	−0.0608	−0.1134	1		
G (6)	0.1727	0.0683	0.0504	0.0386	0.1012	1	
LNFV (7)	0.0869	0.0212	0.5010	0.8129	−0.0472	0.0697	1

Note: Numbers in parentheses, 1 = Return on assets; 2 = Return on equity; 3 = Carbon emission; 4 = Firm size; 5 = Firm leverage; 6 = Growth; 7 = Firm value.

Table 3.
Determining the Model to be used for Model 1

Test	Test Statistic	*p*	Result
F-test	7.27	.000	The classic model is not suitable.
Breusch–Pagan LM test	60.57	.000	The classic model is not suitable.
LR test	50.59	.000	The classic model is not suitable.
Score test	635.47	.000	The classic model is not suitable.
Hausman test	8.83	.115	The random effects model is suitable.
	Binary	**Unit**	**Time**
χ^2 test	50.58529	50.58529	0
p	.000	.000	1.000

score test, and Hausman test have been applied. The results are presented in Table 3.

According to the *F*-test results for model 1 in Table 3, the H_0 hypothesis, which states that all unit effects are equal to zero, was rejected because $p < .01$ in the created model. This means that the fixed effects model is preferred. According to the results of the *F*-test, the classical model is found to be inappropriate. The Breusch–Pagan LM test and LR test results used to determine whether the classical model or the random effects model is more appropriate are shown in Table 3. Lagrange multiplier test statistical values for model 1 in Table 3 are 60.57, and the probability values of the model (*p*) <.01, the H_0 hypothesis is rejected. This means that the random effects model is preferred over classical models. Likelihood ratio test statistical values for model 1 in Table 3 are 50.59, and the probability values of the model (*p*) <.01, the H_0 hypothesis is rejected. This means that the random effects model is preferred over classical models. Based on the results of the Hausman test, which is used to choose between the fixed effects and random effects models, the Hausman test statistical value was determined as 8.83 for model 1 and *p* of the model was >.05, the H_0 hypothesis was accepted. This means that the random effects model is preferred to the fixed effects model. Therefore, the random effects model is chosen as the more suitable model for the analysis.

In Table 4, the results of the analysis conducted with the random effects model are presented. The model 1 results, with return on assets as the dependent variable, show a negative relationship between carbon emissions and return on assets. According to the estimation results presented in Table 4, it was found that LNCO2, LNTA, and LEV have a negative effect on ROA. An increase of 1 unit in LNCO2, LNTA, and LEV would induce a decrease of 0.6234462, −2.651313, and 0.2477487 on ROA, respectively. On the other hand, G and LNFV have a positive effect on the ROA. An increase of 1 unit in G and LNFV would induce an increase of 0.0414499 and 3.663902, respectively.

Table 4.
Model 1 Random Effect Model Results

	Coefficient	Standard Error	*p*
LNCO2 (1)	−0.6234462	0.329481	.058*
LNTA (2)	−2.651313	1.261311	.036**
LEV (3)	−0.2477487	0.030396	.000***
G (4)	0.0414499	0.010105	.000***
LNFV (5)	3.663902	1.137132	.001***
Constant	5.982196	14.88474	.688

Note: Numbers in parentheses, 1 = Carbon emission; 2 = Firm size; 3 = Firm leverage; 4 = Growth; 5 = Firm value.
*Significant at 10% level. **Significant at 5% level. ***Significant at 1% level.

In Table 5, the results of testing assumptions are presented. The presence of heteroscedasticity (varying variance) was examined using Levene, Brown, and Forsythe's test, and it was found that there is a problem of varying variance. The values of Levene, Brown, and Forysthe test results applied in model 1 were determined as W0 1.60088441 and $p = .045$; W50 0.48310469 and $p = .987$; and W10 1.60088441 and $p = .045$, respectively. According to the findings obtained from the test statistics of Levene, Brown, and Forsythe (W0, W50, and W10), the H_0 hypothesis established that the variance of the units is equal to zero was rejected since the Leyene W0 $p < .05$, and the Brown W50 $p > .05$. The H_0 hypothesis could not be rejected and since the Forysthe W10 $p < .05$, the H_0 hypothesis, which was established as the variance of the units is equal to zero, was rejected. This means that according to the Levene W0 and Forysthe W10 test results in model 2, H_0 was rejected at the 5% significance level, indicating a heteroscedasticity problem in model 1. The presence of autocorrelation was tested using Bhargava, Franzini, and Narendranathan's Durbin–Watson test, and the result being less than 2 indicates the presence of autocorrelation. The Pesaran CD test was used to examine the correlation between units, and the results show that there is correlation between units at 5% and 10%.

Due to the presence of varying variance, autocorrelation, and correlation between units, the robust random effects panel data model was used to obtain consistent estimates. The results of the robust estimation for model 1 can be seen in Table 6.

According to the robust estimation results presented in Table 6, it is found that carbon emissions, firm size, and leverage ratio are negatively related to return on assets. An increase in carbon emissions, firm size, and leverage ratio would lead to respective decreases of 0.6234462, 2.651313, and 0.2477487 in return on assets. These results indicate a connection between carbon emissions and financial performance indicators, suggesting that environmental factors have an impact on firm profitability.

Table 5.
Identifying Deviations from the Model 1 Assumption

Test	Test Statistic	*p*	Result
Levene, Brown, and Forsythe test	W0 = 1.60088441 W50 = 0.48310469 W10 = 1.60088441	.045 .987 .045	There is varying variance
Bhargava, Franzini, and Narendranathan DW test	1.74520311		There is autocorrelation
Pesaran CD test	2.169	.0301	There is correlation between units

Table 6.
Model 1 Resistive Forecast Results

	Coefficient	Standard Error	*p*
LNCO2 (1)	−0.6234462	0.204078	.055*
LNTA (2)	−2.651313	0.929909	.065*
LEV (3)	−0.2477487	0.026176	.003***
G (4)	0.0414499	0.026176	.211
LNFV (5)	3.663902	1.69184	.119
Constant	5.982196	13.73866	.693

Note: Numbers in parentheses, 1 = Carbon emission; 2 = Firm size; 3 = Firm leverage; 4 = Growth; 5 = Firm value.
*Significant at 10% level. ***Significant at 1% level.

In the panel data analysis, variables include both time and cross section size. According to time and cross section effects, it is determined that the model should be predicted to be one way or two ways. For this purpose, the LR test has performed with the maximum likelihood method for model 2 with return on equity as the dependent variable, and the findings are given in Table 7. For the two-way effects test, the null hypothesis is formed no cross section and time effects in the model. Because the value of the test statistic for the two-way effect is 4.770557 at 10% significance level, the null hypothesis is rejected. This result shows that it is a two-way effect. Then, the presence of the cross section and time effects was tested separately with the movement from the findings that it was a two-way effect. The null hypothesis for cross section effect analysis is that the standard error of cross section is equal to zero. According to the analysis results, the null hypothesis is rejected at 5% significance level since the value of the test statistic is 4.770557. In this case, there is a cross section effect in the panel data model. The existence of time effect was also examined, and the test statistic was calculated as 0 at 1% significance level. According to this result, the null hypothesis cannot be rejected at the 1% significance level with no time effects.

For model 2, various tests were conducted to determine the appropriate model, including the *F*-test, Breusch–Pagan LM test, LR test, Score test, and Hausman test. According to the *F*-test results for model 2 in Table 7, the H_0 hypothesis, which states that all unit effects are equal to zero, was rejected because $p < .01$ in the created model. This means that the fixed effects model is preferred over the classic model is not suitable. The Breusch–Pagan LM test and LR test results used to determine whether the classical model or the random effects model is more appropriate are shown in Table 7. Lagrange multiplier test statistical values for model 2 in Table 7 are 5.38, and the *p* of the model was <.05, the H_0 hypothesis is rejected. This means that the random effects model is preferred over the classical models. Likelihood ratio test statistical values for model 2 in Table 3 are 4.77, and the $p < .05$, the H_0 hypothesis is rejected. This means that the random effects model is preferred over the classical models. Based on the results of the Hausman test, which is used to choose between the fixed effects and random effects models, the Hausman test statistical value was determined as 4.97 for model 2 and *p* of the model was >.05, the H_0 hypothesis was accepted. This means that the random effects model is preferred to the fixed effects model. Therefore, the random effects model is chosen as the more suitable model for the analysis. According to the results of these tests, it was found that the random effects model is more suitable for the data. The results of the tests are presented in Table 8.

Table 7.
Determining the Model to be used for Model 2

Test	Test Statistic	*p*	Result
F-test	2.02	.006	The classic model is not suitable.
Breusch–Pagan LM test	5.38	.010	The classic model is not suitable.
LR test	4.77	.010	The classic model is not suitable.
Score test	13.19	.000	The classic model is not suitable.
Hausman test	4.97	.419	The random effects model is suitable.
	Binary	**Unit**	**Time**
χ^2 test	4.770557	4.770557	0
p	0.092	0.014	1.000

In Table 8, the results of the analysis conducted with the random effects model are presented. The model 2 results, with return on equity as the dependent variable, show a negative relationship between carbon emissions and return on equity. According to the estimation results presented in Table 8, it was found that LNCO2 and LEV have a negative effect on ROE. An increase of 1 unit in LNCO2 and LEV would induce a decrease of 5.922428, and 6.177099 on ROE, respectively. On the other hand, LNTV, LEV and G have no effect on the ROE Table 9.

In model 2, the presence of heteroscedasticity was examined using Levene, Brown, and Forsythe tests, while the presence of autocorrelation was tested using Bhargava, Franzini, and Narendranathan's Durbin–Watson test. Additionally, the presence of cross-sectional dependence was tested using the Pesaran CD test. The results of these tests indicate the existence of heteroscedasticity, autocorrelation, and cross-sectional dependence in the model. Therefore, the robust random effects panel data model, which provides consistent estimates in the presence of heteroscedasticity, autocorrelation, and cross-sectional dependence, was used to obtain the results (as shown in Table 10).

According to the robust estimation results presented in Table 10, it is observed that carbon emissions, leverage and growth have a negative effect on return on equity. Specifically, a 1-unit increase in carbon emissions, leverage ratio, and net sales growth will lead to a decrease of 5.922428, 1.552437, and 0.1920624, respectively, in the return on equity. This indicates that higher carbon emissions and leverage, as well as faster net sales growth, negatively impact the firm's equity profitability. These findings suggest that

Table 8.
Model 2 Random Effect Model Results

	Coefficient	Standard Error	*p*
LNCO2 (1)	−5.922428	3.220576	0.066*
LNTA (2)	12.95129	13.00808	0.319
LEV (3)	−1.552437	0.307635	0.000***
G (4)	0.1920624	0.140915	0.173
LNFV (5)	−6.177099	11.92232	0.604
Constant	20.8745	129.8304	0.872

Note: Numbers in parentheses, 1 = Carbon emission; 2 = Firm size; 3 = Firm leverage; 4 = Growth; 5 = Firm value.
*Significant at 10% level. ***Significant at 1% level.

Table 9.
Identifying Deviations from Model 2 Assumptions

Test	Test Statistic	*p*	Result
Levene, Brown, and Forsythe test	W0 = 1.60088441 W50 = 0.48310469 W10 = 1.60088441	.045 .987 .045	There is varying variance
Bhargava, Franzini, and Narendranathan DW test	1.5543288		There is autocorrelation
Pesaran CD test	2.136	.0327	There is correlation between units

Table 10.
Model 2 Resistive Forecast Results

	Coefficient	Standard Error	*p*
LNCO2[1]	−5.922428	0.940559	0.008**
LNTA[2]	12.95129	10.49123	0.305
LEV[3]	−1.552437	0.107939	0.001***
G[4]	0.1920624	0.050129	0.031**
LNFV[5]	−6.177099	10.30384	0.591
Constant	20.8745	29.97604	0.536

Note: Numbers in parentheses, 1 = Carbon emission; 2 = Firm size; 3 = Firm leverage; 4 = Growth; 5 = Firm value.
**Significant at 5% level. ***Significant at 1% level.

firms with lower carbon emissions and leverage, as well as steady net sales growth, tend to have higher return on equity.

Discussion and Conclusion

In developing countries like Turkey, the performance of firms plays a crucial role in the economic development of the country. To survive in competitive markets, firms should not only focus on financial profitability but also aim to create value in environmental, social, and economic aspects. In this context, this study investigates the impact of carbon emissions on firm financial performance. Content analysis method is used to collect annual carbon emission data for 31 firms listed on the Borsa İstanbul Sustainability Index from 2017 to 2020. Financial data is obtained from the Finnet Financial Analysis program. Panel data analysis method is used to analyze the data.

As dependent variables, financial performance indicators such as return on assets and return on equity ratios are used in the study. According to the results of model 1, where return on assets is used as the dependent variable, carbon emissions negatively affect return on assets. An increase in carbon emissions leads to a decrease in return on assets. Among the control variables, firm size and leverage ratio variables have significant results for model 1. Therefore, it can be said that these variables enhance the explanatory power of the model. According to the results of model 2, where return on equity is used as the dependent variable, carbon emissions negatively affect return on equity. An increase in carbon emissions leads to a decrease in equity profitability. Among the control variables, the leverage ratio and net sales growth variables have significant results for model 2. Again, these variables enhance the explanatory power of the model.

This study demonstrates that an increase in carbon emissions negatively impacts the financial performance of firms. This finding is consistent with the studies by Misani and Pogutz (2015) and Ganda and Milonzo (2018). The research results indicate that policymakers need to strengthen existing programs designed to reduce carbon emissions. Additionally, policymakers should ensure the direct and indirect implementation of stringent technical criteria and rules for reducing corporate emissions. Policymakers should also create long-term incentives to encourage firms to adopt efficient green technologies and environmentally compatible processes and systems that reduce the impact of climate change. Green technologies used to reduce carbon emissions are often excessively expensive for many firms, especially in developing economies like Turkey. Therefore, providing incentives and cost-effectiveness in their adoption is essential. If a more substantial development in low-carbon or zero-carbon environments is desired, some programs may need to be mandatorily implemented at the national level.

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Genişletilmiş Özet

Uluslararası Yerel Yönetimler Sera Gazı Salımlarının Analizi Protokolü (IEAP) karbon emisyonlarını Kapsam 1, Kapsam 2 ve Kapsam 3 olmak üzere üç kategoriye ayırmaktadır: Kapsam 1: Doğrudan emisyonları temsil eder ve firmaya ait veya kontrol edilen kaynaklardan kaynaklanır. Fabrika tesislerinden veya firmaya ait araçların egzozundan salınan emisyonlar Kapsam 1'e örnek olarak verilebilir. Kapsam 2: Dolaylı emisyonları temsil eder ve firmanın faaliyetleri için enerji sağlayan dış kaynaklardan kaynaklanır. Firmanın elektrik tüketiminin neden olduğu enerji üretimi kaynaklı emisyonlar Kapsam 2'ye örnek olarak verilebilir. Kapsam 3: Firmanın faaliyetleri ile ilişkili diğer emisyonları içerir. Bu kapsam altında, firmanın tedarik zinciri, ürünlerin ömrü boyunca kullanımı, atıkların yönetimi gibi endirekt etkilere yol açan emisyonlar yer alır.

Bu çalışmada, Türkiye'de faaliyet gösteren ve Borsa İstanbul Sürdürülebilirlik Endeksinde yer alan firmaların finansal performansları üzerindeki karbon emisyonlarının etkisi araştırılmaktadır. Çalışmada, BIST Sürdürülebilirlik Endeksinde listelenen 31 firmanın 2017–2020 yılları arasında sürdürülebilirlik raporlarında yer verdikleri karbon emisyonları ile aynı firmaların finansal performans göstergeleri olarak kabul edilen aktif kârlılık ve özsermaye kârlılığı değişkenleri kullanılmıştır. Çalışmada aşağıdaki araştırma hipotezi geliştirilmiştir:

H0: Karbon emisyon yoğunluğunun, firmanın finansal performansı üzerinde bir etkisi yoktur.

Çalışmada bağımsız değişken olarak karbon salınımı kullanılmış, dört adet kontrol değişkeni belirlenmiştir. Bu kontrol değişkenleri, toplam aktiflerin doğal logaritması ile ölçülen firma büyüklüğü, firma varlıklarının hangi kaynaklarla finanse edildiğini gösteren kaldıraç oranı, net satışlar büyüme oranı ile ölçülen firma büyümesi ve firma değeridir. Bağımlı değişkenlerin, bağımsız değişkenlerin ve kontrol değişkenlerinin tam olarak dikkate alınmasıyla, bir firma için ana model şu şekildedir:

$$\textbf{Finansal Performans}_{i,t} = \alpha_{i,t} + \beta_1 \textbf{Karbon Emisyonları}_{i,t} + \beta_2 \textbf{Firma Büyüklüğü}_{i,t} + \beta_3 \textbf{Kaldıraç}_{i,t} + \beta_4 \textbf{Büyüme}_{i,t} + \beta_5 \textbf{Firma Değeri}_{i,t} + \varepsilon_{i,t}$$

Aktif kârlılığın bağımlı değişken olarak kullanıldığı model 1 sonuçlarına göre, karbon emisyonları aktif kârlılığı negatif olarak etkilemiştir. Karbon emisyonlarındaki artış ise aktif kârlılığı azaltmaktadır. Kontrol değişkenleri olarak kullanılan değişkenlerden firma büyüklüğünde ve kaldıraç oranı değişkenleri model 1 için anlamlı sonuçlar vermiştir. Dolayısıyla bu değişkenlerin modelin açıklama gücünü artırdığı söylenebilir.

Özsermaye kârlılığının bağımlı değişken olarak kullanıldığı model 2 sonuçlarına göre, karbon emisyonları karbon emisyonlarının finansal performans göstergesi olarak kullanılan özsermaye kârlılık oranını negatif olarak etkilediği sonucuna ulaşılmıştır. Karbon emisyonlarındaki artış özsermaye kârlılığını azaltmaktadır. Kontrol değişkenleri olarak kullanılan değişkenlerden kaldıraç oranında ve net satışlar büyümesi değişkenleri model 2 için anlamlı sonuçlar vermiştir. Dolayısıyla bu değişkenlerin modelin açıklama gücünü artırdığı söylenebilir.

Analiz sonuçlarına göre, karbon emisyonlarının aktif kârlılık ve özsermaye kârlılığı üzerinde olumsuz bir etkisi olduğu tespit edilmiştir. Ayrıca, firma büyüklüğü ve kaldıraç oranının aktif kârlılık üzerinde negatif etkisi, net satış büyümesi ve firma değerinin ise pozitif etkisi olduğu belirlenmiştir. Bununla birlikte, rassal etkili panel veri analizi kullanılarak yapılan testler, modelin uygun olduğunu göstermiştir. Ancak, modelde değişen varyans, otokorelasyon ve birimler arası korelasyon gibi varsayımlardan sapmalar olduğu tespit edilmiştir. Bu sapmaların dikkate alınarak dirençli tahminlerle analiz sonuçları elde edilmiştir. Bu çalışma firmaların karbon emisyonlarındaki artışın finansal performansı negatif olarak etkilediğini göstermektedir. Bu sonuç, Misani ve Pogutz (2015) ile Ganda ve Milonzo (2018) çalışmalarıyla benzerlik göstermektedir.

Sonuç olarak, karbon emisyonlarının firmaların finansal performansı üzerinde olumsuz bir etkisi olduğu ve çevresel performansın artırılmasının finansal performansı güçlendirebileceği sonucuna ulaşılmıştır. Bu bulgular, firmaların çevresel yönetim stratejilerinin finansal performanslarını iyileştirmek için etkili olabileceğini göstermektedir. Ancak, değişen endüstri ve ekonomik koşulların da etkisi dikkate alınarak çevre dostu politikaların uygulanması değerlendirilmelidir.

Araştırma sonuçları, politika yapıcıların karbon emisyonlarını azaltmak için tasarlanmış mevcut programları güçlendirmeleri gerektiğini ortaya koymaktadır. Ek olarak, politika yapıcılar, kurumsal operasyonların karbon emisyonunun azaltılmasına yönelik katı ve sağlam teknik ölçütlerin ve kuralların doğrudan ve dolaylı düzeyde uygulanmasını sağlamalıdır. Politika yapıcılar, firmaları verimli yeşil teknolojileri benimsemeye ve iklim değişikliğinin etkilerini azaltan çevreyle uyumlu süreçler ve sistemler edinmeye teşvik edecek uzun vadeli teşvikler de oluşturmalıdır.

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Çevresel, Sosyal ve Kurumsal Yönetim Performansının Finansal Performans Üzerine Etkisi: Borsa İstanbul Örneği

The Effects of Environmental, Social, and Governance Performance on Financial Performance: The Case of Borsa Istanbul

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ÖZ

Bir yatırım konsepti ve kurumsal değerlendirme standardı olan çevresel, Sosyal ve Kurumsal Yönetim açıklamaları son yıllarda finansal kararlar üzerinde oldukça etkili olmaya başlamıştır. Çevresel, sosyal ve kurumsal yönetim puanları geleneksel finansal performans yerine çevresel, sosyal ve kurumsal yönetim performansına odaklanmaktadır. Çalışma Borsa İstanbul'da işlem gören firmaların çevresel, sosyal ve kurumsal yönetim puanlarının finansal performans üzerindeki etkisini panel veri analizi ile araştırmaktadır. Çalışma çevresel, sosyal ve kurumsal yönetim verilerinin kısıtlılığı nedeniyle seçilmiş 31 firma için yapılmış ve 2014–2022 dönemini kapsamaktadır. Çalışma kapsamında iki model kurulmuş olup, ilk model sonucuna göre çevresel, sosyal ve kurumsal yönetim puanlarının, piyasa değeri/defter değeri oranının ve aktiflerdeki büyümenin aktif kârlılığı pozitif ve anlamlı etkilediğine ulaşılmıştır. İkinci modelde evresel, sosyal ve kurumsal yönetim puanlarının ve piyasa değeri/defter değeri oranının özsermaye kârlılığı üzerindeki etkisi anlamsız tespit edilirken, aktiflerdeki büyümenin özsermaye kârlılığını anlamlı ve pozitif yönde etkilediği sonucuna ulaşılmıştır.

JEL Kodları: F65, G11, M21

Anahtar Kelimeler: Çevresel sosyal ve kurumsal yönetim, firma performansı, panel veri analizi

ABSTRACT

The statements of environmental, social, and governance values, as a concept of investments and a standard of corporate assessment, have recently started to be highly influential on financial decisions. Environmental, social, and governance scores focus on environmental, social, and governance-related performance criteria rather than conventional financial performance criteria. This study investigates the effects of the environmental, social, and governance scores of firms whose stocks are traded in Borsa Istanbul on their financial performance using the panel data analysis method. Due to the limited amount of environmental, social, and governance data, the study is conducted for 31 selected firms and covers the period of 2014–2022. In the scope of the study, two models are established, and according to the results of the first model, environmental, social, and governance scores, the market-to-book value ratio, and asset growth affect the return on assets positively and significantly. According to the results of the second model, environmental, social, and governance scores and the market-to-book value ratio do not affect the return on equity significantly, while asset growth affects the return on equity positively and significantly.

JEL Codes: F65, G11, M21

Keywords: Environmental, social and governance (ESG), firm performance, panel data analysis

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Giriş

Küresel doğal kaynak kıtlığı, iklim değişikliği, nüfus artışı, demografik değişimler ve aşırı yoksulluk, yatırımcıların geleceğe bakışını etkilemektedir. Bu sorunlara tek bir çözüm bulunmamakla birlikte,

çevresel sürdürülebilirliği sağlamak için kolektif bir küresel çaba gerekmektedir. Sürece rehberlik etmesi için Sürdürülebilir Kalkınma Hedefleri, BM İklim Değişikliği Çerçeve Sözleşmesi ve Paris Anlaşması gibi küresel çerçeveler ve anlaşmalar oluşturulmuştur. Bu değişimin en belirgin sonuçlarından biri de çevresel, sosyal ve yönetişim olarak adlandırılan (ESG) yeni bir sosyoekonomik modelin uygulamasının hızlandırılmasıdır (Shih ve ark., 2023, s. 1).

Çevresel, sosyal ve kurumsal yönetim terimi, çevresel, sosyal ve yönetişim yatırımına ilişkin 2004 BM Küresel İlkeler Sözleşmesi raporuna atfedilir. Çevresel, sosyal ve kurumsal yönetim konularına olumlu yaklaşımın şirketlerin yönetiminin genel kalitesi için önemli olduğunu kabul eden rapor, dünyanın en büyük 20'den fazla finans kuruluşu tarafından imzalanmıştır. Bu konularla ilgilenen firmalar, örneğin riski uygun şekilde yöneterek, düzenleyici eylemleri öngörerek veya yeni pazarlara ulaşarak aynı zamanda faaliyet gösterdikleri toplumların sürdürülebilir kalkınmasına da katkıda bulunarak firma değerini artırabilir (Dmuchowski ve ark., 2023).

Sürdürülebilir finans, finans ve sürdürülebilir kalkınma hedeflerinin (SKH) kesiştiği noktada önemli bir kavram olarak ortaya çıkmıştır. Avrupa Komisyonu (2021), sürdürülebilir finansı, finansal ve yatırım kararlarında ESG faktörlerini dikkate alarak gelişen bir süreç olarak tanımlamıştır. Ancak ESG faktörleriyle sınırlı olan bu tanım çok dar kapsamdadır. Sürdürülebilir finansın, finansmanını sürdürülebilir kılacak ve sürdürülebilirliğe katkıda bulunacak tüm faaliyetleri ve faktörleri kapsaması gerekmektedir. Sürdürülebilir politika hedeflerine ulaşılması, iklim finansmanı, karbon ve ESG beyanı, yeşil tahviller ve sosyal açıdan sorumlu yatırım gibi çeşitli yollarla elde edilebilir, bunların tümü sürdürülebilir finans tanımı kapsamında ele alınabilir (Kumar ve ark., 2022; Migliorelli, 2021).

Uluslararası Sermaye Piyasası Birliği, sürdürülebilir finansmanı iklim, yeşil ve sosyal finansmanı içeren, finanse edilen kuruluşların uzun vadeli ekonomik sürdürülebilirliğinin yanı sıra; faaliyet gösterdikleri genel finansal sistemin rolü ve istikrarı ile ilgili daha geniş hususları da içeren finansman olarak tanımlamaktadır (ICMA, 2020).

Çevresel, sosyal ve kurumsal yönetim sürdürülebilir ekonomik faaliyetlere ve projelere daha uzun vadeli yatırımlara yol açar. Çevresel faktörler, iklim değişikliğinin hafifletilmesi ve adaptasyonunun yanı sıra daha geniş anlamda çevreyi, örneğin biyoçeşitliliğin korunması, kirliliğin önlenmesi ve döngüsel ekonomiyi içerebilir. Sosyal faktörler, eşitsizlik, kapsayıcılık, çalışma ilişkileri, insanlara ve onların becerilerine ve topluluklarına yatırımın yanı sıra insan hakları konularına atıfta bulunabilir. Kamu ve özel kurumların yönetişimi, yönetim yapıları, çalışan ilişkileri ve yönetici ücretleri dahil sosyal ve çevresel faktörlerin karar verme sürecine dahil edilmesini sağlamada temel bir rol oynar (Nyantakyi ve ark., 2023, s. 2).

Çevresel, sosyal ve kurumsal yönetim, geleneksel finansal performanstan ziyade çevresel, sosyal ve kurumsal yönetim performansına odaklanan bir yatırım konsepti ve kurumsal değerlendirme standardıdır. Ancak finansal ve finansal olmayan unsurların bu kombinasyonunun pratikte nasıl işlediği konusunda dikkatli olmak gerekir. Yatırımcılar homojen değildir ve ESG açıklamalarına gösterilen ilgi yatırımcının amacına bağlıdır, aynı zamanda varlık sınıfına göre değişir. Bazı yatırımcıların ESG bilgilerini dahil etmekteki ana motivasyonu getirileri ve riski iyileştirmek iken diğerlerinin sürdürülebilir kalkınmaya katkıda bulunmak gibi ek bir motivasyonu vardır. Ayrıca, büyük emeklilik fonları gibi birçok yatırımcı hisse senedi yatırımları alanında ESG açıklamalarına çok daha fazla kaynak harcamaktadır (Busch ve ark., 2016, s. 305).

Naeem ve ark. (2022) çevreye duyarlı şirketlerin ESG performanslarının gelişmiş ülkelerdeki şirketlerin finansal performansı üzerinde, gelişmekte olan ülkelerdeki şirketlere kıyasla daha güçlü bir etkiye sahip olduğunu belirtmişlerdir. Gelişmiş ülkelerdeki şeffaf ve nispeten daha etik iş uygulamaları, çevreye duyarlı şirketlerin ESG performansının, gelişmekte olan ülkelere kıyasla gelişmiş ülkelerde finansal performans üzerinde daha güçlü ve olumlu etkisinin nedeni olabilir. Buna karşılık Nyantakyi ve ark. (2023) çalışmalarında ESG açıklaması, sürdürülebilirlik raporlaması ve firma performansına ilişkin araştırmalarda gelişmiş ülkelerin ön planda olduğunu ortaya koymuşlardır. Bu durum, araştırmacıların gelişmekte olan ekonomilere odaklanmaları gerektiğine dikkat çekmektedir.

Çalışmanın amacı; Borsa İstanbul'da işlem gören seçilmiş 31 firmanın ESG puanlarının firma performansları üzerindeki etkisini panel veri analizi ile 2014–2022 dönemi için araştırmaktır. Çalışmada BIST30 ve BIST Sürdürülebilirlik endeksinde yer alan ESG puanlarına ulaşılabilen 31 firma analize dahil edilmiştir. Daha önce yapılan çalışmalar incelendiğinde; Borsa İstanbul'da ESG ve firma performansı arasındaki ilişkiyi ampirik olarak inceleyen çalışmaların oldukça sınırlı olduğu görülmüştür. Bu nedenle çalışmanın alan yazınına temel katkısı Borsa İstanbul'da ESG puanlarındaki değişimlerin firma performansı üzerine etkisini ampirik bulgularla ortaya koymaktır. Elde edilen sonuçlara göre ESG puanlarının firma performans üzerindeki etkisi çevresel, sosyal ve kurumsal yönetim açıklamaları ve sürdürülebilirlik açısından yatırımcılar ve yöneticiler açısından yol gösterici olabilecektir.

Çalışmanın ikinci bölümünde ESG ve firma performansı ilişkisi incelenmiş, literatürde yer alan bu konudaki çalışmalara yer verilmiştir. Üçüncü bölümde veri seti ve yöntem, dördüncü bölümde ampirik bulgular, son bölümde değerlendirme ve sonuç yer almaktadır.

Çevresel, Sosyal ve Kurumsal Yönetim ve Firma Performansı İlişkisi

Sürdürülebilirlik raporlaması ve ESG açıklaması son zamanlarda bir firmanın finansal performansının itici gücü olarak kabul edilmektedir. Alshater ve ark. (2023) inceledikleri 263 çalışmanın yalnızca %10'unda ESG'nin finansal performans üzerinde olumsuz bir etkisi olduğunu savunurken aynı zamanda bu görüşü Giannopoulos ve ark. (2022), Nirino ve ark. (2021)'de savunmuştur. Alshater ve ark. (2023) çalışmaların çoğunda ise ESG'nin firmanın finansal performansı üzerinde olumlu bir etkisi olduğuna ulaşırken bu görüşü Friede ve ark. (2015), Cornett ve ark. (2016), Velte (2017), Brogi ve Lagasio (2018), Aybars ve ark. (2019), Shakil ve ark. (2019), Siueia ve ark. (2019), Dalal ve Thaker (2019), Naeem ve ark. (2021), Koundouri ve ark. (2022), Aksoy ve ark. (2022) ve Aydoğmuş ve ark. (2022) desteklemektedir.

Genelde çalışmalarda ESG uygulamalarının şirketler için nasıl değer yarattığı üç teorik perspektife dayalı olarak incelendiği görülebilir: Risk, bilgi ve strateji. Risk yönetimi perspektifine sahip literatüre göre, ESG uygulamalarının kurumsal değer üzerindeki risk aktarım mekanizmasının iki şekilde yansıtıldığını ortaya koymaktadır. Bir yandan, ESG uygulamaları, operasyonları ve yönetişim ile ilgili dahili riskleri azaltabilir. Örneğin borsaya kote

şirketler tarafından ESG derecelendirmelerinin yayınlanması, şirketin bilgi riskini ve operasyonel riskini azaltır, böylece sürdürülebilir kalkınma için temel oluşturur. Tersine, zayıf ESG uygulamalarına sahip firmalar, düşük kredi notları ve daha yüksek denetim ücretleri gibi sonuçlara yol açan olumsuz olaylara eğilimlidir (Xiao ve ark., 2021). Öte yandan, ESG uygulamaları muhtemelen yetersiz yönetişimle ilişkili ve olası dava maliyetlerinden, itibar hasarından ve çevre felaketlerinden kaynaklanan maliyetleri azaltabilmektedir (Broadstock ve ark., 2021; Shafer & Szado, 2020). Di Tommaso ve Thornton (2020), küçük, bağımsız ve cinsiyet çeşitliliğine sahip bir yönetim kurulu tarafından desteklenen kurumsal ESG uygulamalarının kurumsal risk almayı azaltmada ve finansal istikrarı desteklemede çok etkili olabileceğini belirtmişlerdir. Giese (2019), daha düşük sermaye maliyetleri ve daha yüksek değerlemelerin bir sonucu olarak bir şirketin risk profilinin ESG performansından etkilendiğini göstermiştir.

Bilgi açısından bakıldığında, şirketler için yüksek düzeyde ESG açıklaması, yatırımcılar arasındaki ve yatırımcılar ile yöneticiler arasındaki bilgi asimetrisini azaltır, düzenleyici maliyetleri azaltır ve artan bilgiler nedeniyle daha fazla yatırımcının dikkatini çekebilir (Dhaliwal ve ark., 2011). Dış pazarlar için, kurumsal ESG sorumluluğunun yönetim uygulamaları, daha az ek maliyetle daha fazla çalışanı çekebilen ve müşteri kanalı aracılığıyla yüksek satış ve pazar payı elde ederek tüketicilerde kademeli olarak güven inşa edebilen iyi bir itibara sahip şirket imajını şekillendirebilir (Xie ve ark., 2019). Araştırmalar, iyi ESG uygulamalarının bilgi etkisiyle borç ve sermaye maliyetini önemli ölçüde azaltabileceğini göstermiştir (Ould Daoud Ellili, 2020). Ayrıca, etkili ESG açıklaması, teminatsız borcun ve uzun vadeli borcun toplam borca oranını artırarak firmalara daha fazla finansal esneklik sağladığını öne sürmüşlerdir (Feng & Wu, 2021).

Çevresel, sosyal ve kurumsal yönetim bilgilerinin açıklanması ve yüksek ESG puanı, operasyon verimliliğini artırmaya ve işletmelerin teknolojik yenilik yeteneğini geliştirmesine yardımcı olabilir. Ayrıca, şeffaflığı artırabilir, bilgi asimetrisini azaltabilir, yatırımcı güvenini, sosyal tanınırlığı artırabilir ve sermaye maliyetini düşürebilir. Bazı çalışmalarda, ESG raporunun kurumsal performansın farklı göstergeleri üzerinde farklı eşik değerlere sahip olduğu ve şirketin iş performansının ancak rapor kalitesi belirli bir eşiği geçtiğinde olumlu etkileneceği belirtilmiştir (Bansal ve ark., 2021). Özellikle hizmetten ziyade üretici şirketlerde ESG açıklamaları sosyal inovasyonlarını yansıtır. Bu nedenle, bu tür şirketlerin ESG açıklamaları performans üzerinde daha önemli bir etkiye sahiptir (Aksoy ve ark., 2022).

Stratejik yönetim düşüncesine dayanan, ESG gibi finansal olmayan konulardaki proaktif girişimler, toplumsal kabulü artırmak için farklı paydaşların beklentilerini karşılamanın yanı sıra şirkete somut ve soyut kaynaklar getirerek rekabet avantajı geliştirmesini sağlar, diğer şirketlerin taklit etmesinin zor olduğu bu pazarda finansal performansı ve değeri artırır (Taliento ve ark., 2019). Birçok kurumsal yatırımcı sürdürülebilir firmaların daha yüksek hisse senedi getirisine sahip olacağını belirterek; sürdürülebilir yatırım alanındaki faaliyetlerini motive etmektedir. Bu beklenti, birçok sınıfının en iyisi portföyün yanı sıra kurumsal yatırımda birçok ESG tabanlı stratejiye yol açmıştır. Burada sorun, menkul kıymet fiyatlarının ESG ile ilgili önemli bilgileri yansıtıp yansıtmadığıdır. Bazı araştırmalarda, piyasaların maddi olmayan bilgileri fiyatlandırmakta zorlandığı (Edmans, 2011), bazılarında da piyasanın bu bilgilerin bir kısmını zaten aldığı belirtilmektedir (Busch ve ark., 2016; Chava, 2014).

Çevresel, sosyal ve kurumsal yönetim uygulamalarının kurumsal finansal performans üzerinde olumsuz bir etkiye sahip olduğunu öne süren çalışmalar da mevcuttur (Duque-Grisales & Aguilera-Caracuel, 2021; Ur Rehman ve ark., 2016). Bunun nedeni muhtemelen yerel firmaların ESG faaliyetlerine katılımının güçlü maliyet etkisi veya zayıf bilgi aktarımı nedeniyle finansal piyasaların ESG faktörlerinin değerini varlık fiyatlandırma mekanizmalarına yeterince dahil edememesidir (Ionescu ve ark., 2019; Ruan & Liu, 2021).

Çevresel, sosyal ve kurumsal yönetim kavramı her ne kadar yeni bir kavram olsa da dünya genelinde birçok araştırmaya konu olurken Borsa İstanbul'da az sayıda çalışmaya konu olmuştur. Şişman ve Çankaya (2021) Borsa İstanbul havayolu sektöründe yer alan firmaların toplam ESG puanının ve kriterlerin ayrı ayrı puanlarının özkaynak kârlılığı ve Tobin Q üzerindeki etkisini araştırmışlar ve çalışma sonucunda anlamlı bir etkinin olmadığına ulaşmışlardır. Saygılı ve ark. (2022) Borsa İstanbul Kurumsal Yönetim Endeksindeki şirketlerin ESG açıklamalarının finansal performans üzerindeki etkisini araştırmışlardır. Bulgularına göre, çevresel açıklamalar olumsuz bir etkiye sahiptir. Sosyal boyutunda paydaşların şirket yönetiminde yer alması operasyonel verimliliğe yol açmaktadır. Yönetişim boyutunda ise finansal performans üzerinde olumlu bir etkiye sahiptir. Kulalı (2022) Borsa İstanbul'da işlem gören ve ESG puanı bulunan 75 şirketin ESG yatırımlarının uzun vadede piyasa değerini artırabileceği, ayrıca firma büyüklüğünün kurumsal sürdürülebilirlik ve ESG uygulamaları konusundaki girişimlerinin boyutları üzerinde etkili olduğuna sonuçlarına ulaşmıştır. Korkmaz ve Nur (2023) çalışmalarında BİST Banka Endeksinde faaliyet gösteren bankaların ESG skorları ile firma performansı arasında istatistiksel olarak anlamlı ve pozitif yönlü ilişki, firma yaşı ve büyüklüğü ile firma performansı arasında istatistiksel olarak anlamlı ve negatif yönlü ilişki olduğunu belirtmişlerdir.

Birçok araştırmaya göre ESG açıklamasının kurumsal performans göstergeleri üzerindeki olumlu etkisi aktif kârlılık (ROA) ve özsermaye kârlılığına (ROE) dayanmaktadır. Açıklama düzeyi ne kadar yüksekse, aktif kârlılık ve özsermaye kârlılığı da o kadar yüksektir (Alareeni & Hamdan, 2020). Almeyda ve Darmansya (2019) G7 ülkelerinde yer alan 380 şirketin 2014–2018 dönemi için ESG puanlarının finansal performans üzerine etkisini panel veri yöntemi ile araştırmışlar çalışma sonucunda; ESG puanının ROA değişkenini üzerinde pozitif ve anlamlı bir etkiye sahip olduğuna ulaşmışlardır. Buallay (2019) sürdürülebilirlik ve banka performansı arasındaki ilişkiyi Avrupa bankacılık sektöründe ROA, ROE ve Tobin Q değişkenleriyle incelemiş çalışma sonucunda; ESG'nin kullanılan değişkenlerin hepsi üzerinde pozitif bir etkiye sahip olduğuna ulaşmıştır.

Buallay, Fadel, Al-Ajmi ve Saudagaran (2020) MENA bankacılık sektöründe 2008–2017 dönemi için ESG performansının ROA, ROE ve Tobin Q üzerindeki etkisini araştırmışlar çalışma sonucunda; Tobin Q değişkeninin ESG'yi negatif yönde etkilediği ROA ve ROE değişkenlerinin ise ESG değişkeni üzerinde anlamlı bir etkiye sahip olmadığına ulaşmışlardır. Azmi ve ark. (2021) yükselen 44 ekonomide bankacılık sektörü için ESG faaliyetleri ve banka değeri arasındaki ilişkiyi incelemişler ve çalışma sonucunda; doğrusal olmayan bir ilişki tespit etmişlerdir. Aynı zamanda düşük düzeyde yer alan ESG faaliyetlerinin banka değerini pozitif etkilediği sonucuna ulaşmışlardır.

Naeem ve ark. (2021) yapmış oldukları çalışmada 2010–2019 dönemi için tüm gelişmekte olan ülkelerden 1042 şirketin verilerini

kullanarak benzer sonuçlara ulaşmışlardır. Ayrı ayrı ve toplam ESG puanının firma değeri üzerinde önemli pozitif etkiye sahip olduğu sonucuna varılmıştır. Benzer şekilde, ROA sonuçları da ESG'nin bileşenlerinin ve ESG'nin birleşik puanının firma kârlılığı üzerinde anlamlı pozitif etkisi vardır. ESG toplam puanı kullandıkları modellere göre ROA üzerinde anlamlı pozitif etkiye sahiptir. Çalışma, ESG'nin firma performansını olumlu yönde etkileyen önemli bir belirleyici olduğuna dair önemli kanıtlar sunmuştur. Koundouri ve ark. (2022) çalışmalarında hissedarların riskinin güçlü ESG performansına sahip şirketlerde daha düşük olma eğiliminde olduğunu, dolayısıyla bu da nispeten daha düşük bir öz sermaye riskine işaret ettiğini belirtmişlerdir. Analiz tüm sektörlerde ESG performansı iyi olan şirketlerin kârlılığında diğerlerine kıyasla açık bir üstünlük olduğunu ortaya koymuştur. Bu durum hem ROA hem de ROE için geçerlidir.

Yöntemler

Bu çalışmanın temel amacı BIST30 ve BIST Sürdürülebilirlik endeksinde yer alan ESG puanlarına ulaşılabilen 31 firmanın ESG puanlarının firma performansları üzerindeki etkisini 2014–2022 dönemi için araştırmaktır. Analize dahil edilen firmalar Ek1.'de verilmiştir. Dönemin 2014 yılından başlamasının sebebi daha önceki yıllarda ESG açıklamalarının oldukça az olmasından kaynaklanmaktadır. ESG verilerinin yıllık frekansta açıklanmasından dolayı tüm değişkenlerin verileri yıllık olarak kullanılmıştır. Ekonometrik analiz öncesinde uygulamaya motivasyon sağlaması amacıyla çalışmada kullanılan ESG, ROA ve ROE değişkenlerinin yıl bazlı tüm firmaların ortalama seyri gösterilmiştir.

Şekil 1'de analize dahil edilen firmaların ortalama ESG, ROA ve ROE oranlarının serisinin yıllar itibariyle değişimleri gösterilmiştir. Şekil incelendiğinde ESG değişkeninin yıllar itibariyle arttığı ROA ve ROE değişkenlerinin de genel olarak artış eğiliminde olduğu görülmektedir.

Çalışmada kullanılan ESG verileri Refinitiv Eikon veri tabanından, firma performanslarına ilişkin değişkenlerin verileri FİNNET Elektronik Yayıncılık Data İletişim San. Tic. Ltd. Şirketi'nden FİNNET 2000+ programından elde edilmiştir.

Çalışmada kullanılan değişkenler ve açıklamaları Tablo 1'de sunulmuş olup, değişkenlerin seçiminde teorik ve literatürdeki çalışmalar dikkate alınmıştır. Çalışmada kullanılan değişkenlerin tanımlayıcı istatistikleri Tablo 2'de sunulmuştur.

Tablo 2'de 9 yıllık ortalama değerlere bakıldığında ROA değerinin 6,085699, ESG değerinin 53,3405, ROE değerinin 20,1733, PD/DD değerinin 1,86311 ve son olarak Q değerinin 31,2786 olduğu görülmektedir. Çalışmada kullanılan değişkenler için, model öncesinde korelasyon testi yapılmış olup, sonuçlar Tablo 3'te sunulmuştur.

$$MODEL\,1: ROA_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 PD/DD_{it} + \beta_3 Q_{it} + \varepsilon_{it} \quad (1)$$

$$MODEL\,2: ROE_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 PD/DD_{it} + \beta_3 Q_{it} + \varepsilon_{it} \quad (2)$$

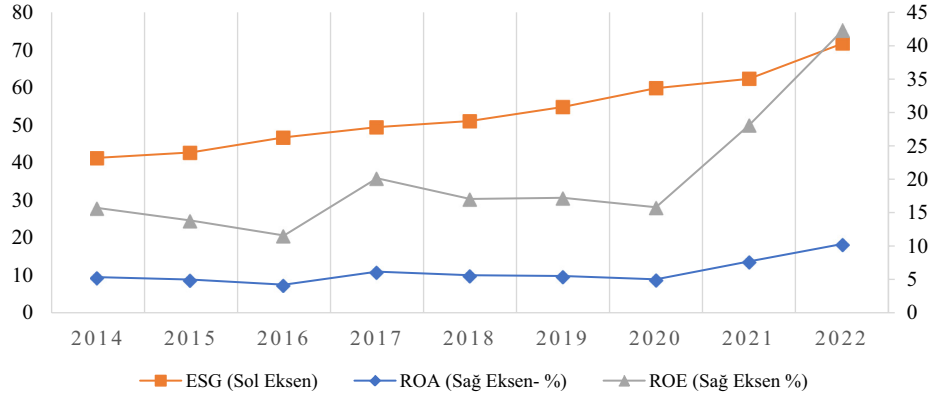
Tablo 3'te görüldüğü üzere değişkenlerin çapraz korelasyon test sonuçlarına göre aktif kârlılık ile özsermaye kârlılık değişkeni arasında yüksek pozitif korelasyon olduğu (0,7092) katsayısına ulaşılmıştır. Diğer değişkenler arasında önemli bir korelasyon tespit edilmemiştir.

Borsa İstanbul'da işlem gören firmaların çevresel, sosyal ve kurumsal yönetim (ESG) puanlarının firma performansları üzerindeki etkisini test etmek amacıyla (1) ve (2) denklemlerinde belirtilen iki farklı model kullanılmıştır. Bu denklemlerde t zamanı, i firmaları, ε ise hata terimlerini ifade etmektedir.

Çevresel, sosyal ve kurumsal yönetim puanlarının firma performansları üzerindeki etkisini test etmek amacıyla panel veri analizi kullanılmıştır. Analizine geçmeden önce yapılması gereken ön koşullardan biri olan yatay kesit bağımlılığı testidir. Bu test değişkenler arasında korelasyon ilişkisinin varlığını test etmek için yapılmaktadır. Bu test sonucuna göre kaçıncı kuşak panel birim kök testlerinin kullanılacağına karar verilir. Çalışmada N > T (N = 31, T = 9) olduğu için birimler arası korelasyonun sınanması için Pesaran CDLM testi uygulanmıştır (Pesaran, 2004, s. 3).

Pesaran CDLM testinde yatay kesit bağımlılığı olmadığını ifade eden sıfır hipotezine karşı alternatif hipotez test edilmektedir. Tablo 4'te yatay kesit bağımlılığı istatistikleri ile bu istatistiklere ait olasılık değerleri raporlanmıştır. Test sonuçlarına göre, tüm değişkenler için sıfır hipotezinin reddedildiği ve yatay kesit bağımlılığının olduğu görülmektedir.

Seride birimler arası korelasyon yani yatay kesit bağımlılığı olduğu için ikinci kuşak panel birim kök testlerinden olan Harris ve Tzavalis (HT) birim kök testi kullanılmıştır. Bu birim kök testi panel veride yer alan tüm birimlerin aynı otoregresif parametreye sahip olduğunu varsayar (Harris & Tzavalis, 1999). İkinci kuşak panel birim kök testlerinden olan Harris ve Tzavalis (HT) birim kök testi sonuçları Tablo 5'te raporlanmıştır.



Şekil 1.
Yıllar İtibariyle Çevresel, sosyal ve kurumsal yönetim, ROA ve ROE Değişkenlerinin Seyri.

Tablo 1.
Değişkenlerin Açıklanması

Değişkenler	Değişkenlerin Açıklaması
ROA	Aktif Kârlılık Oranı
ESG	Çevresel (E), sosyal (S) ve kurumsal yönetim (G)
ROE	Özsermaye Kârlılık Oranı
PD/DD	Piyasa Değeri/Defter Değeri
Q	Aktiflerdeki Büyüme

Harris ve Tzavalis (HT) Test Sonuçlarına göre çalışmada kullanılan değişkenlerden aktif kârlılık (ROA), özsermaye kârlılığı (ROE) ve büyüme (Q) değişkenlerinin durağan olduğu; çevresel, sosyal ve kurumsal yönetim (ESG) ve piyasa değeri defter değeri (PD/DD) değişkenlerinin ise birinci dereceden farklarının alınarak durağan hale geldiği görülmektedir. Hausman testi sabit etkili ve rassal etkili modeller arasında karar vermede kullanılan bir test olduğu için her iki model için yapılan test sonuçları Tablo 7'de sunulmuştur.

Hausman testinde boş hipotez, alternatif hipoteze karşı test edilmektedir. Bu test sonuçlarına göre boş hipotezin reddedilmediği durumda rassal etkili; reddedildiği durumda ise sabit etkili model sonuçları desteklenmektedir. Tablo 6'da yer alan Hausman test sonuçlarına göre model I için boş hipotez reddedildiği için sabit etkili model; model II için boş hipotez reddedilemediği için rassal etkili model desteklenmektedir. Sabit etkiler ve rassal etkiler ile tahmin edilen modellerin otokorelasyon ve değişen varyans testi sonuçları Tablo 7'de raporlanmıştır.

Modeller için kullanılan test istatistiği bilgisi ve testin geçerliliğine karar vermede kullanılan değerler tabloda sunulmuştur. Sabit etkiler modelinde, Değiştirilmiş Wald testi otokorelasyon için ise Bhargava, Franzini ve Narendranathan ve Durbin–Watson testleri kullanılmıştır. Test sonuçlarına göre, sabit etkiler için oluşturulan modelde değişen varysans ve otokorelasyon sorunu gözlemlenmiştir. Rassal etkiler için Levene, Brown ve Forsythe Testi; otokorelasyon için ise Bhargava, Franzini ve Narendranathan ve Durbin–Watson testleri kullanılmıştır. Değiştirilmiş Wald ve Levene, Brown ve Forsythe testleri için değişen varyans sınamasında kullanılan p değeri parantez içinde sunulmuştur. Bhargava, Franzini ve Narendranathan ve Durbin–Watson test sonuçlarına göre elde edilen ve parantez içinde gösterilerin istatistiki değerlerin literatürde kabul edilen 2 değerinin altında olduğu tespit edilmiştir. Test sonuçlarına göre rassal etkiler için oluşturulan modelde de değişen varyans ve otokorelasyon sorunu gözlemlenmiştir.

Hausman test sonuçlarına göre model I için sabit etkiler model II için için rassal etkiler panel veri tahmincisi desteklenmektedir. Sabit ve rassal etkiler modellerinin sınanmasında değişen varyans ve otokorelasyon sorunlarına rastlanmıştır. Bu nedenle hem sabit etkiler hemde rassal etkiller modellerin tahmini Driscoll ve Kraay Tahmincisi kullanılmış olup; elde edilen

Tablo 3.
Çapraz Korelasyon Test Sonuçları

	ROA	ESG	ROE	PD/DD	Q
ROA	1,000				
ESG	–1,1240	1,000			
ROE	0,7092	0,1842	1,000		
PD/DD	0,4935	–0,0599	0,5105	1,000	
Q	0,2077	0,2294	0,3404	0,1183	1,000

Tablo 4.
Pesaran Yatay Kesit Bağımlılığı Test Sonuçları

Değişkenler	CD-Test İstatistiği	*P* Olasılık Değer	Ortalama Korelasyon Katsayısı	Ortalama Mutlak Korelasyon Katsayısı
ROA	15,23	0,000	0,235	0,444
ESG	36,20	0,000	0,560	0,662
ROE	26,35	0,000	0,407	0,500
PD/DD	22,36	0,000	0,346	0,461
Q	35,44	0,000	0,548	0,565

Tablo 5.
Harris ve Tzavalis (HT) Test Sonuçları

	Harris ve Tzavalis (HT) Sabitli	
Değişkenler	İstatistik Değeri	Olasılık Değeri
ROA	0,3181	0,000
ESG	0,7746	0,9157
ROE	0,2176	0,000
PD/DD	0,6397	0,1331
Q	–0,2125	0,000
D.ESG	–0,1147	0,000
D.PD/DD	–0,2296	0,000

Tablo 6.
Hausman Test Sonuçları

Modeller	Ki-Kare Değeri	*p*
Model 1	11,19	0,0108
Model 2	1,96	0,5817

Tablo 2.
Değişkenlerin Tanımlayıcı İstatistikleri

Değişkenler	Gözlem Sayısı	Ortalama	Standart Sapma	Minimum Değer	Maksimum Değer
ROA	279	6,085699	6,717289	–8,87	33,08
ESG	279	53,3405	20,26467	15	94
ROE	279	20,1733	18,77447	–62,46	117,99
PD/DD	279	1,863113	1,767476	.23	13,21
Q	279	31,27864	30,32365	–10,07	316,34

Tablo 7.
Değişen Varyans ve Otokorelasyon Test Sonuçları

	Modeller	Değişen Varyans	Otokorelasyon Testi
Sabit Etkiler	Model 1	Değiştirilmiş Wald testi (0,00)	Bhargava, Franzini ve Narendranathan ve Durbin–Watson (1,31)
Rassal Etkiler	Model 2	Levene, Brown ve Forsythe Testi (0,00)	Bhargava, Franzini ve Narendranathan ve Durbin–Watson (1,50)

Tablo 8.
Panel Veri Regresyon Sonuçları

	Değişkenler	Katsayı	S.Hata	*t*-istatistiği	*p*	R^2 (Within)
Bağımlı Değişken ROA model 1	DESG	0,05751	0,02963	1,94	,093*	0,1238
	DPD/DD	0,8621	0,3666	2,35	,051*	
	Q	0,03879	0,1168	3,32	,013**	
	C	4,6406	0,3046	15,23	,000***	
Bağımlı Değişken ROE model 2	DESG	0,3184	0,1882	1,69	,135	0,1625
	DPD/DD	3,4406	3,0154	1,14	,291	
	Q	0,1979	0,0661	2,99	,020**	
	C	12,8014	3,3794	3,79	,007***	

*,**,***, sırasıyla katsayıların %10, %5 ve %1 düzeyinde anlamlılığını göstermektedir.

sonuçlar Tablo 8'de raporlanmıştır. Elden edilen ampirik bulgular incelendiğinde; model 1 için D.ESG değişkeni, ROA'yı %10 düzeyinde anlamlı ve pozitif yönde etkilemektedir. İstatistiki olarak, D.ESG değişkenindeki 1 birimlik bir artış, ROA'nın ortalama olarak 0,5 düzeyinde artmasına sebep olmaktadır. D.PD/DD değişkeni, ROA'yı %10 düzeyinde anlamlı ve pozitif yönde etkilemektedir. İstatistiki olarak, D.PD/DD değişkenindeki 1 birimlik bir artış, ROA'nın ortalama olarak 0,8 düzeyinde artmasına sebep olmaktadır. Bir diğer bağımsız değişken Q değişkeni, ROA'yı %5 düzeyinde anlamlı ve pozitif yönde etkilemektedir. İstatistiki olarak, Q değişkenindeki 1 birimlik bir artış, ROA'nın ortalama olarak 0,03 düzeyinde artmasına sebep olmaktadır. Model 2 için; D.ESG ve D.PD/DD değişkenlerin ROE değişkeni üzerindeki etkisi ise anlamsız olarak tespit edilmiştir. Q değişkeni, ROE'yı %5 düzeyinde anlamlı ve pozitif yönde etkilemektedir. İstatistiki olarak, Q değişkenindeki 1 birimlik bir artış, ROE'nın ortalama olarak 0,19 düzeyinde artmasına sebep olmaktadır. D.ESG ve D.PD/DD değişkenlerin ROE değişkeni üzerindeki etkisi ise anlamsız olarak tespit edilmiştir.

Sonuç

Geleneksel finans, çevreye zararlı veya sosyal açıdan sorumsuz faaliyetlerde bulunan şirketlere finansman sağlayarak bu sorunlara katkıda bulunduğu için sıklıkla eleştirilmektedir. Bu nedenle hem çevresel hem de sosyal açıdan sorumlu yatırım projelerini finanse etmeyi amaçlayan daha sürdürülebilir finansman biçimlerine ihtiyaç oluşmuştur. Sürdürülebilir finans, finans sektöründe yatırım kararları alınırken ESG faktörlerinin dikkate alınması sürecini ifade eder ve sürdürülebilir ekonomik faaliyetlere ve projelere daha uzun vadeli yatırımlara yol açar.

Birçok çalışma, daha yüksek ESG derecelendirmesine sahip şirketlerin daha iyi işletme performansına, finansal sonuçlara sahip olduğunu ve yatırımcılar için daha cazip olduğunu kanıtlamıştır. Bunun yanı sıra, ESG bileşenlerini geliştiren ve uygulayan şirketlerin piyasadaki konumlarını artırdığını ve bu tür şirketlerin değerinin arttığını göstermiştir. İyi ESG performansına sahip firmaların temerrüt riski daha düşüktür; bu da aynı sektördeki daha düşük ESG notuna sahip firmalarla karşılaştırıldığında finansman maliyetlerinin daha düşük olduğunu gösterebilir. ESG açıklaması ve stratejileri bir şirketin ürünlerine değer katabilir ve alıcıların ve yatırımcıların satın alma arzusunu artırarak işletme gelirinin artmasını sağlayabilir.

Bu nedenle, ESG faktörlerinin etkisini değerlendirmek için bu çalışmada Borsa İstanbul'da işlem gören seçilmiş 31 firmanın ESG puanlarının firma performansları üzerindeki etkisinin panel veri analizi ile 2014–2022 dönemi için araştırılmıştır. Çalışma sonucunda kurulan ilk modelde ESG puanlarının, PD/DD ve aktiflerdeki büyümenin aktif kârlılığı pozitif ve anlamlı etkilediğine ulaşılmıştır. Bu sonuç Almeyda ve Darmansya (2019), Buallay (2019), Azmi ve ark. (2021), Naeem ve ark. (2021), Koundouri ve ark. (2022) ve Korkmaz ve Nur (2023) çalışmalarını destekler niteliktedir. İkinci modelde ESG puanlarının ve PD/DD'nin özsermaye kârlılığı üzerindeki etkisi anlamsız tespit edilirken aktiflerdeki büyümenin özsermaye kârlılığını anlamlı ve pozitif yönde etkilediğine ulaşılmıştır.

Çalışma firmalar açısında değerlendiğinde firmaların ESG stratejilerini geliştirmeleri ve ESG performanslarına daha fazla önem vermesi gerekmektedir. Yatırımcılar açısından değerlendirildiğinde firmanın ESG skorunun yüksek olması, finansal performansını etkilemekte fakat diğer faktörlerin de göz önünde bulundurulması gerektiği söylenebilir. Bu çalışma alan yazına incelenen dönem firma ve değişkenler itibariyle katkı sağlayacaktır. Çalışmanın tarih aralığı değiştirilerek, zamanla daha fazla ESG puanı açıklanmasıyla firma sayısı artırılarak, farklı değişkenler kullanılarak ya da sektörler bazında inceleme yapılarak daha sonra yapılacak olan çalışmalara yol gösterici olacaktır.

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EK1. Analize Dahil Edilen Firmalar

AKBNK.IS	Akbank T AŞ
ARCLK.IS	Arçelik AŞ
BIMAS.IS	BİM Birleşik Mağazalar AŞ
EKGYO.IS	Emlak Konut Gayrimenkul Yatırım Ortaklığı AŞ
ENKAI.IS	ENKA İnşaat ve Sanayi AŞ
EREGL.IS	Ereğli Demir ve Çelik Fabrikalari TAŞ
FROTO.IS	Ford Otomotiv Sanayi AŞ
SAHOL.IS	Hacı Ömer Sabancı Holding AŞ
KCHOL.IS	Koç Holding AŞ
KOZAL.IS	Koza Altın İşletmeleri AŞ
PETKM.IS	Petkim Petrokimya Holding AŞ
SISE.IS	Türkiye Şişe ve Cam Fabrikaları AŞ
TAVHL.IS	TAV Havalimanları Holding AŞ
TOASO.IS	Tofaş Türk Otomobil Fabrikası AŞ
TCELL.IS	Turkcell İletişim Hizmetleri AŞ
TUPRS.IS	Türkiye Petrol Rafinerileri AŞ
THYAO.IS	Türk Hava Yolları AO
GARAN.IS	Türkiye Garanti Bankası AŞ
ISCTR.IS	Türkiye Iş Bankası AŞ
YKBNK.IS	Yapı ve Kredi Bankası AŞ
AKSA.IS	Aksa Akrilik Kimya Sanayii AŞ
AKSEN.IS	Aksa Enerji Üretim AŞ
ANSGR.IS	Anadolu Anonim Türk Sigorta Şti
AEFES.IS	Anadolu Efes Biracılık ve Malt Sanayii AŞ
ANHYT.IS	Anadolu Hayat Emeklilik AŞ
CCOLA.IS	Coca-Cola İçecek AŞ
TTKOM.IS	Türk Telekomunikasyon AŞ
HALKB.IS	Türkiye Halk Bankası AŞ
TSKB.IS	Türkiye Sınai Kalkınma Bankası AŞ
VAKBN.IS	Türkiye Vakıflar Bankası TAO
VESTL.IS	Vestel Elektronik Sanayi ve Ticaret AŞ

Extended Abstract

The statements of environmental, social, and governance values, as a concept of investments and a standard of corporate assessment, have recently started to be highly influential on financial decisions. Environmental, social, and governance scores focus on environmental, social, and governance-related performance criteria rather than conventional financial performance criteria. This study investigates the effects of the environmental, social, and governance scores of firms whose stocks are traded in Borsa Istanbul on their financial performance using the panel data analysis method. The main aim of the study was to investigate the effect of environmental, social, and governance scores on company performances of 31 companies whose environmental, social, and governance scores are available in BIST30 and BIST Sustainability Index for the period 2014–2022.

Due to the limited amount of environmental, social, and governance data, the study is conducted for 31 selected firms and covers the period of 2014–2022. Because environmental, social, and governance data are reported annually, annual data were used for all variables. Correlation analyses were conducted for the variables in the study before establishing a model, and while there was a strong positive correlation between the return on assets variable and the return on equity variable, there was no significant correlation between the other variables. To test the effects of environmental, social, and governance scores on firm performance levels, the panel data analysis method was used. As a requirement before starting panel data analysis, a cross-sectional dependence analysis was conducted, and the presence of cross-sectional dependence was confirmed. Due to the presence of correlations between units, i.e., cross-sectional dependence, the Harris–Tzavalis unit root test, which is a second-generation unit root test, was carried out. According to the results of the Harris–Tzavalis test, among the variables used in the study, the return on assets, return on equity, and growth variables were stationary, whereas the environmental, social, and governance and market-to-book value ratio variables could be made stationary after their first differences were taken. As a test that is used to decide between fixed-effects and random-effects models, the Hausman test was carried out for both models. The fixed-effects model was supported in model I, while the random-effects model was supported in model II. The modified Wald test was used in the fixed-effects model, and the Bhargave, Franzini, and Narendranathan and Durbin–Watson tests were used for testing autocorrelations. The Levene and Brown–Forsythe tests were utilized for random effects, and the Bhargava, Franzini, and Narendranathan and Durbin–Watson tests were used to test autocorrelations. According to the Hausman test results, panel data estimates with fixed effects and random effects were supported in models I and II, respectively. In the tests of the fixed and random effects, heteroskedasticity and autocorrelation problems were encountered. Thus, the Driscoll–Kraay estimator was used to estimate both the fixed-effects and random-effects models.

In the scope of the study, two models are established, and according to the results of the first model, environmental, social, and governance scores, the market-to-book value ratio, and asset growth affect the return on assets positively and significantly. According to the results of the second model, environmental, social, and governance scores and the market-to-book value ratio do not affect the return on equity significantly, while asset growth affects the return on equity positively and significantly.

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"Next in Line": A Framework for Ensuring Effective Executive Succession in Namibian Commercial Public Enterprises

"Sıradaki": Namibya Ticari Kamu İşletmelerinde Etkili Yönetici Yedeklemesi Bir Çerçeve

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ABSTRACT

This study was conducted to gain first-hand insight into the attitudes, beliefs, values, and experiences of the targeted managers regarding executive leadership succession planning and its implementation in Namibia's commercial public enterprises. The primary data collection for this study was qualitative and quantitative. The total population of the study was 63 participants, derived from 22 commercial public enterprises. The study developed a succession management framework for Namibian organizations called the Muadinohamba succession development progression framework, a tool for planning leadership succession in Namibian companies. The framework's elements include making succession planning a key performance metric, setting a mandated retirement age, educating managers on succession practices, and providing a structured succession process. This study suggests that, in addition to researching leadership, companies within a specific cultural context should research leadership succession plans and implementation processes due to existential differences.

JEL Codes: M10, M12.

Keywords: Commercial public enterprises, executive succession planning, leadership, organizational culture, succession management framework

ÖZ

Bu çalışma, Namibya'nın ticari kamu işletmelerinde üst düzey yönetici yedekleme planlaması ve bunun uygulanmasına ilişkin olarak hedeflenen yöneticilerin tutumları, inançları, değerleri ve deneyimleri hakkında ilk elden bilgi edinmek amacıyla gerçekleştirilmiştir. Bu çalışma için birincil veri toplama yöntemi nitel ve niceldir. Çalışmanın toplam evreni 22 ticari kamu kuruluşundan 63 katılımcıdır. Çalışma, Namibyalı kuruluşlar için Muadinohamba yedekleme gelişimi ilerleme çerçevesi adı verilen ve Namibyalı şirketlerde yönetici yedekleme planlanmasına yönelik bir araç olan bir yedekleme yönetimi çerçevesi geliştirmiştir. Çerçevenin unsurları arasında yedekleme planlamasının kilit bir performans ölçütü haline getirilmesi, zorunlu bir emeklilik yaşının belirlenmesi, yöneticilerin yedekleme uygulamaları konusunda eğitilmesi ve yapılandırılmış bir yedekleme sürecinin sağlanması yer almaktadır. Bu çalışma, liderlik araştırmalarına ek olarak, belirli bir kültürel bağlamdaki şirketlerin varoluşsal farklılıklar nedeniyle liderlik yedekleme planlarını ve uygulama süreçlerini araştırmaları gerektiğini öne sürmektedir.

JEL Kodları: M10, M12

Anahtar Kelimeler: Ticari kamu işletmeleri, yönetici yedekleme planlaması, liderlik, organizasyon kültürü, yedekleme yönetimi çerçevesi

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Introduction

Succession planning involves and is not limited to selecting new talent, conducting selection assessments, and identifying a new leader (Rothwell, 2011). Succession planning has evolved from being a mitigation measure against losing executive leaders in big organizations to promoting the

development of leaders, managing change, retaining talent, and building teams in a way that makes the organization reach its full potential in its operations (Rothwell, 2010). A succession event in an organization is inevitable, whether planned or unplanned, and organizations need to identify and develop talent that can replace key individuals (Griffith, 2012). Organizations must not underestimate the loss of organizational memory or tribal knowledge and must prepare young leaders who will move up (*What Is Succession Planning and Why Is It Important?*, n.d.). It is not always easy to find talent for leadership roles in organizations, and this heightens the need for executive leadership succession planning.

Human resources management plays a key role in succession planning. Luna (2012) defines succession planning as determining goals, needs, and responsibilities within an organization and preparing individuals or employee groups for their roles in the work that needs to be done within the organization. To recruit and keep talent, organizations must keep up with people becoming more strategic in their career management and job searches (Fink & Brayman, 2006).

There are three facets to the history of succession planning and management. In the first period, which lasted from 1960 to 1980, succession research was at its peak. The second period, 1980–1990, is devoted to the "emergence of succession planning trends and its development." The third period, "succession planning and beyond," covers 1990 to the present time. Research into succession planning has been contested since the mid-1950s to the mid-1960s, when chief executive officer (CEO) succession and management development emerged (Sharma & Agarwal, 2016; Zaich, 1986). Between the mid-1970s and mid-1980s, human resource planning took over attention from planning, management, and development (Bhattacharyya, 2009; Zaich, 1986). In the 1990s, succession planning was not questioned, even by businesses, although educational institutions recognized the need. Thus, research has recently expanded to include education, government, corporate, nonprofit, health-care, and small companies (Rothwell, 2003). The subjects found in the overall succession planning umbrella have become varied. Hunte-Cox (2004) studied the relationship between succession planning and organizational learning capacity and discussed the issue of management succession.

National economic development relies heavily on public enterprises, and their continuity is important. Since executive leadership is essential for an organisation's sustainability, developing a succession plan for its leadership is equally significant. Comercial public enterprises (CPEs) in Namibia can benefit from understanding what hinders succession planning for executive leadership.

The study has the potential to fill a knowledge gap by enhancing an understanding of how executive leadership succession planning can influence the transition of technical skills. Such results can be used in the development of an effective executive leadership succession planning framework in CPEs in Namibia. Extensive and tacit knowledge acquired during decades of experience can be lost by retiring employees in CPEs, creating knowledge gaps and disrupting business. Succession planning can help mitigate the impact of this disruption. Recruitment costs may be substantially reduced for organizations when employees retire or voluntarily leave, resulting in an unplanned vacuum and loss of knowledge. Mentoring and coaching can enhance succession planning and prepare individuals for the next job, strengthen the pool of talent, and give the organization a competitive edge.

Overall, the study remains useful to CPEs in Namibia in various categories. The study explores the development of an executive leadership succession planning framework which will help organizations reduce the attrition rate, mitigate risk, and enhance continuity. Background information on Commercial Public Enterprises in Namibia remains indispensable in this study. Provide a clear understanding of the problem setting of the study under the background of the study. This is important because it provides the reasoning for the study.

Literature Review

Essentials for Effective Succession Plans

To ensure a smooth and successful transition to new leadership for the organization, succession planning should be included in the operations' strategic plan. According to several studies, succession planning and management play an important role in business, with several factors to consider, including the assessment of organizational needs, individual talent, and individual growth plans (Rothwell et al., 2005).

Plan early to work through possibilities and challenges critical for an effective succession plan (Blaney, 2017). Rothwell (2005) proposes that leadership emergencies cause one to notice the requirement for an efficient method for identifying and developing leadership. Then, succession planning and the executives become appealing, despite problems; for example, delays in filling basic positions, a lack of qualified internal candidates, the departure of skilled and talented workers to further their career goals, or failed internal substitutions in new positions of authority within the organization (Neefe, 2009). Rothwell (2005) shows succession planning is usually used to build a pool of potential leaders, which ensures a coherent focus and the achievement of strategic goals.

Spending time on creating an effective succession plan is an investment in the organisation's assets. One essential for effective succession planning is to consult key advisors, including financial partners, bankers, and lawyers. According to Khumalo and Harris (2018), among other barriers such as organizational culture, lack of understanding of the purpose of succession planning, lack of framework plans to copy from other sectors and organizations, competition for talent and leadership in the industry or sectors and lack of resources, can be barriers to developing and starting an effective succession plan.

There is a need for setting realistic timeframes, discipline, and commitment in succession planning. Choosing the successor is another essential task in succession planning. There are many factors to consider when choosing successors; for example, an insider conversant with the company may have features and work ethics that inspire achievement (Ahrens et al., 2019). An insider seems ideal sometimes instead of hiring a new leader based on a set of ideal features which might not come to fruition. However, an outsider can be more knowledgeable and can bring positive contributions to the organization.

After identifying the successor, the next stage would be to consider the skills or qualifications and training they will need to equip them (Ahrens et al., 2019). Succession planning must start early because the training process can take years, especially if the selected leader is from outside. The time may be little for leaders who grow and develop within an organization as they are already aligned with the organizational culture and goals and are set up to lead when their opportunity arrives. Continuous training of employees at every level and in all departments must be

part of succession planning, unlike in the past when training was mainly focused on and benefited mostly executive-level employees (Ahrens et al., 2019). Continuous training helps to measure and track the progress of participants to ensure sustained development.

Deciding the rate of profitability of your training endeavors is not just an indication of the effectiveness of the leadership development program, but also a sign of whether the organization is holding its competitive edge and setting up new leaders for progress (Kaplan & Norton, 2018). The succession plan must be reviewed regularly to keep it up to date. Assessments done after training can help the discovery of employees that have gained a lot through learning and implementing what they learned and the identification of the common competencies that the organisation's highest performers share. Training efforts can be more focused on those competencies making sure the pipeline of top talent is ready to be channeled to needed leadership roles (Leskiw & Singh, 2007).

Despite conventional assessments and estimation strategies, such as surveys and tests, organizations can investigate how appraisals can help create the leadership pipeline which should be a significant key activity for any ground-breaking organisation preparing for new leadership. It is commonly understood that well-designed succession plans can exist on paper and fail in the implementation stages (Bashiri, 2018).

An organisation's succession plan should be tailored to meet the specific needs of the organization. The size of the organization and its growth rate should be considered when designing effective succession plans because smaller companies, which are usually flexible may not be compatible with a rigid and formalized succession plan (Zepeda, 2012). Bigger organizations and those that expect an expansion in the short term may discover more advantages in characterizing the skills and knowledge required to make progress in explicit jobs to recognize individual employees who might be willing and ready to assume those jobs. According to Pissaris et al. (2010), private sector companies are more interested in succession planning to replace top management whilst the public sector often has hierarchy and designs for organizations that advocate for promotions within the company at all levels as a way of developing and retaining talent (Hughes & Rog, 2018).

Succession Planning and Key Leaders

The purpose of succession planning is to ensure that the retirement or exit of a senior officer does not inconvenience the organization through a leadership vacuum. Succession planning guarantees the continuity of the organization's operations (CFI, 2015). The purpose of succession planning, however, is not to prepare one person to take over a particular position; this process is called replacement planning. Succession preparation focuses on a wide pool of qualified employees trained for key positions ranging from entry-level to senior management. These workers have the right knowledge, enthusiasm, and leadership qualities to support the organization.

Replacement planning is linear; a worker is trained to take over or replace a senior management position, but succession planning is about fostering a versatile, wide variety of talent (Rodarte, 2017). Most organizations introduce an emergency succession plan to mitigate the leadership vacuum through retirement or incapacitation or death. A long-term succession plan makes sure a company is ready for workers to take over key management positions (Fusarelli et al., 2018). Succession planning ensures that there is a mechanism in place for someone to step in, get promoted, and take on the responsibilities of that person without productivity loss; there must be efficiency and morale (Clutterbuck, 2012).

The succession of senior management in organizations remains a topic for discussion in business. The process of succession planning starts by assessing the skills of the leader that exited the organization and considering possible replacements to assume responsibilities of leadership in the organization. In large corporations, succession planning is an ongoing occurrence in anticipation of leadership changes (Fusarelli et al., 2018).

The decision to recruit a CEO internally or through an external search must be made with great care since the immediate effect on strategic change and organizational efficiency is crucial in succession planning and implementation (Hutzschenreuter et al., 2012). Karaevli and Zajac (2013) state that either recruiting a CEO externally or internally has benefits and drawbacks. It is usually considered wise to select a CEO from outside the company when a major change in organizational strategy is required. Not only does a replacement carry new insights from outside the organization, but he or she is also often devoid of social connections and other relevant information about the organization.

Andrus et al. (2019) argue that external leadership succession may trigger greater turnover of other executive team members. The authors further contends that inside succession may demoralize inside leadership aiming to fill the gap and may cause them to resign from the organization. New incubated leadership may struggle to adjust to the new organizational culture. New leaders may also feel forced to make improvements simply to prove their authority. The resultant effect is that this may lead to disturbances in the current status quo in the organization, helping to disrupt services (Slatter, 2011).

According to Conger and Fulmer (2003), highly dynamic, multidivisional, and multinational organizations often view internal candidates as the best option in the succession of a CEO. Organizations are generally satisfied with their strategic path, and those wishing to see their strategic plans through to completion often consider internal staff to be a reasonably safe option. But Weisblat, (2018) are of the view that internally promoted CEOs have a reduced capacity in the short term to improve their organizational strategy.

Succession Planning in Public Enterprises

Historically, succession planning has been studied mainly in the private sector rather than in the public sector. 130 succession planning studies were conducted between 1980 and 1993, but only 5 came from the public sector (Wilkerson, 2002). However, over the years, the situation has changed, with significant studies being carried out in the public sector (Wilkerson, 2002).

The public sector is now formalizing succession planning as the private sector has been doing. Similarly, succession planning has not been emphasized for nonprofit organizations, despite their need. In the United States of America, research was conducted on the impact of turnover on the Senior Executive Service of the federal government and found a substantial and immediate adverse effect on an organization if it lacks experienced replacements (Beckett, 2015).

Wilkerson, (2002) states that the public sector lagged in creating succession planning programs because of the complexities in the implementation of these programs in the public sector. The private sector has continuously changed succession plans to align with its business needs and changes. Political leadership, the nature of tenure, and lack of focus and resources contribute to the challenges faced in the public sector in implementing succession plans. Literature on successful systems remains limited, though efficient public models and approaches for the public sector have been adopted in different ways (Wilkerson, 2002). Labor market dynamics have changed the demographics and social conditions between the public and private sectors for talent. This has prompted many public agencies to re-examine their approach to talent management and to consider pursuing better recruitment methods to attract talent like in the private sector. However, some of these efforts remain successful amid problems in the public sector, making it difficult to execute these initiatives (Wilkerson, 2002).

Neither the public nor private sectors classifies succession planning as an integrated talent management plan but as an independent initiative. To be effective, succession planning must be integrated with other human resources (HR) processes and part of the organization's culture (Crumpacker & Crumpacker, 2007).

It is contended that the need for strategic alignment is the main point with the integration of processes to render succession planning a success (Darvish & Temelie, 2014). The organization first needs to provide a transparent vision for the future. Without such important foundations, succession planning programs will not produce their desired outcomes. Once the company defines its priorities and strategy, the targets it must achieve must be determined and the skills to accomplish them (Wilkerson, 2002). Processes that evaluate capacity, measure performance and address gaps will support this decision.

Brans et al. (2016), concluded that the biggest challenge is the preservation of innovation and programs in the face of administration changes, politics, and goals (Brans et al., 2016). Despite this, succession planning cannot be aligned effectively despite this major factor. By focusing on the skills and competencies required to achieve the organization's vision, succession planning is somewhat buffered against changes in targets and services. A project management organization, for example, should develop good skills in future project managers. Despite the changes in leadership and agenda, the primary skills of project management are still needed. The public staff structure places significant limitations on the ability of public sector leaders and HR staff to enforce private-sector style programs. Despite this, new literature points to a shift in succession planning (Wilkerson, 2002). The author further suggests that in the public sector, the most critical shift is to establish a pool of potential leaders capable of fulfilling the organization's needs for succession.

Wilkerson, (2002) mentions that organizations can develop a profile of successful leadership and develop a pool of leaders to match the profiles. This can become handy in the event of a vacancy; the organization can get a replacement from a suitable person from the pool (Wilkerson, 2002). The author further said that avoiding the problems of entitlement and unforeseen succession needs may deliver the extra benefit of boosting performance. By expanding these pools, organizations can take advantage of increased performance in a broader range of employees (Pennell, 2010).

According to Hakweenda (2019), Namibia has created a culture of allowing people to act in positions for long periods, which eventually might affect the process of succession planning. Usually, acting officials would serve in those posts without being considered for a permanent appointment. This is a common occurrence among Namibia's public enterprises (Hakweenda, 2019). Public enterprises are a critical and important part of the country's development, but they have received little attention over the years, except for the government giving money to them when they are in difficulties (Hakweenda, 2019). The purpose of succession planning management is to accommodate talented employees that could be prepared as future leaders. This also allows for passing knowledge and skills from current leaders to their subordinates who might be leaders in the future. Succession planning and management should address the need for backup and individual development in all job positions (Rothwell, 2005).

An institution's operations can be crippled by the unexpected departure of key leadership staff. For several years, Namibia has been experiencing a shortage of skilled staff and specialists, and economic growth has steadily declined (National Human Resources Plan, 2012). Thus, a study on succession leadership planning in CPEs in Namibia becomes relevant and crucial, particularly in the current business environment in the country.

In Rothwell (2010), succession planning and management are systematic approaches to assure continuity, keep and develop human capital for the future, and encourage individual advancement. A succession plan identifies and develops successors. The process is directed at the managerial level. The purpose of succession planning management is to accommodate talented employees that could be prepared as future leaders. In any job category in an organization, succession planning and management should focus on individual development (Rothwell, 2005).

Management and Succession Planning Models

Management and succession planning models abound in many organizations in business because organizations and their situations are different (Rothwell, 2005). The most common models include the Leadership Pipeline Model (Charan et al., 2010), The Seven-Pointed Star Model (Rothwell, 2005), and the Acceleration Pool Model (Byham, 2002). A review of the Leadership Pipeline Model at this stage is important as it is central to the development of many models and frameworks used in improving succession planning.

The Leadership Pipeline Model

The Leadership Pipeline Model helps to build a considerable pipeline of skilled and prepared leaders from within the organization and reduces the hiring of external executives to occupy vacant positions. There are different demands for each management level, and the model helps in understanding those differences. The Leadership Pipeline Model was originated in the 1970s by Walt Mahler, who was a human resources management consultant and a teacher (Landell, 2013). The model encourages the selection process by building a proper suitable prerequisite requirement for leaders in which a proper succession plan can be envisaged. Leadership development plans can be simplified by using this model. According to the tenets of the model for success, managers can learn and adjust between their current position and the next higher position. In addition, they can identify skills gaps, qualifications, and experience gaps. Charan et al.

(2010); Luenendonk (2020) concluded that leaders can assume training and develop themselves.

Methods

Study Design

Empirical data were collected to gain first-hand insight into the attitudes, beliefs, values, and experiences of the targeted managers regarding executive leadership succession planning and its implementation in commercial public enterprises in Namibia. Overall, the study used a qualitative research approach. The interviews were analyzed for common themes across open-ended and Likert scale questions using a combination of content analysis and descriptive statistics. Twenty oral interviews were conducted to determine the understanding of succession planning and its implementation. According to the investigation's multi-methods approach, the collected data was analysed using qualitatively interpretive techniques.

For the executive leadership succession planning and implementation framework proposed in this study, data was descriptively analyzed for indications of theoretical congruence, in the case of commercial public enterprises in Namibia. The executive leadership succession planning and implementation framework was subjected to a more in-depth analysis utilizing the Logical Framework Analysis Model. Data exploration for indications of experience and observation of the results was conducted next (Ritchie & Spencer, 1994). A qualitative and interpretive analysis of the data was made using this matrix-based analytical method, which promotes meticulous and open qualitative data management.

Finally, a no-code text analysis tool, sentiment analysis, was used to allow the organization of the free-form text. Sentiment analysis is a machine learning technique that automatically predicts if the researcher's text is positive, neutral, or negative (Madhushani, 2020). Using powerful sentiment analysis tools, one can automatically categorize huge amounts of Excel data by sentiment. The sentiment analysis feature assigns sentiment labels depending on the highest confidence score found by the service at a sentence and document level. Also, for each document and each sentence inside it, this feature offers confidence values for the positive, neutral, and negative sentiments that range from 0 to 1.

The Long Short-Term Memory algorithm was used for the sentiment analysis to categorize a text blob's sentiment into positive and negative (Madhushani, 2020). The model is trained on user-generated content taken from the preliminary survey dataset. In addition, primary data was analyzed using the open coding approach (Tesch, 1977). To get a sense of the bigger picture, this involved reading and re-reading full transcriptions of all interview sessions. All themes and subthemes were categorized, given codes, and field notes coded as well.

Unit of Analysis and Sampling

The unit of analysis was the board of directors, the nomination committee, incumbent chief executive officers, and earlier CEOs that separated from the commercialized public entities in the last 10 years. It also included the senior management and supervisors of the CPEs. This study used a purposive sample approach since it makes it easier for the researcher to comprehend the issue and the research topic. Hence, only commercialized public enterprises were selected from the 22 commercial public enterprises listed.

Research Ethics

The researcher ensured that all ethical matters were considered during the study and were adhered to according to academic standards. Participants were informed that their participation in the research project is voluntary and anonymous and that they can withdraw at any point from the study even after having given consent. Additionally, the researcher will store the data in a safe place, and the stored data will be destroyed after 5 years by the researcher through shredding. Moreover, the researcher sought ethical clearance from both the Ministry of Public Enterprises and the University of Namibia's Research and Ethics Committee before the commencement of the research.

Every precaution was taken to ensure that the information collected remained confidential. Respondents were informed that any information they provided would be kept strictly confidential, and they were only required to participate in the study if they wished to. To maintain anonymity, participants were not required to provide their names on the questionnaire, but they were required to indicate their positions. The participants were given a thorough explanation of the ethical issues before they were asked to complete the questionnaire. All respondents were also asked to provide written, informed consent.

Ethical Approval

The ethical clearance certificate was issued by the University of Namibia Ethics Committee in accordance with the University of Namibia's Research Ethics Policy and Guidelines (Date: 17.09.2022, Number: DEC FOC/09/03). Ethical approval was given in respect of undertakings contained in the research project outlined below. The certificate was issued on the recommendations of the ethical evaluation done by the ethics committee.

Title of project: "Next in Line": A Framework for Ensuring Effective Executive Succession in Namibian Commercial Public Enterprises.

Results

Views on Executive Succession Planning and Implementation

These conclusions include an analysis of the events and interviews, as well as cited statements from participants on executive succession planning and execution in Namibia's CPEs.

Twenty-two documents were used as primary data. The documents were coded from IP1 to IP21. According to Table 1, the

Table 1.
Main Themes and Subthemes

Main themes	Subthemes
1.0 Succession skills and competencies	1.1 Leadership development
Document data demonstrates specific competencies and the qualities that candidates should possess.	
2.0 Leadership and succession planning	2.1 Readiness and capability
Document data indicate that the organization needs leaders who can foster long-term sustainability	
3.0 Knowledge transfer for succession planning	3.1 Knowledge transfer
Document data indicates that knowledge attributes need to be transferred. To ensure success, knowledge transfer must occur.	

coding revealed these themes. An audio recording of each of the twenty-one documents was transcribed. Using the qualitative analysis program Taguette (Rampin et al., 2019), three themes arose because of trends discovered while analyzing textual material. Table 1 lists the themes, response frequencies, and frequency percentages related to each theme.

The analysis of the collected data led to the identification of three primary themes, each with its respective subtheme, which are pivotal in the context of executive succession planning within Namibian CPEs. These themes (Table 1) are integral to the Muadinohamba succession development progression framework, which was developed as part of this study. Interpretation of main themes and subthemes in succession planning was as follows, as shown in Table 1:

1. **Succession Skills and Competencies**
   1.1 Leadership development: The data underscores the necessity of delineating specific competencies and qualities essential for prospective leaders. This finding suggests a strategic emphasis on leadership development, where the focus is not merely on identifying potential leaders but also on cultivating the requisite skills and attributes through targeted developmental initiatives. Such initiatives could encompass a range of activities, from structured training programs to mentorship opportunities, all aimed at preparing individuals for effective leadership roles.
2. **Leadership and Succession Planning**
   2.1 Readiness and capability: This theme emerged as a critical factor in succession planning. The data indicated a need for leaders who are not only capable in terms of skills and experience but also ready to embrace the challenges of leadership roles. This readiness encompasses psychological preparedness and a deep understanding of the organization's vision and strategic direction. The implication here is that succession planning processes should incorporate mechanisms to assess and enhance the readiness and capability of potential leaders, ensuring a seamless transition that supports the organization's long-term sustainability.
3. **Knowledge Transfer for Succession Planning**
   3.1 Knowledge transfer: A significant aspect of effective succession planning, as highlighted by the data, is the transfer of knowledge. This theme stresses the importance of a systematic approach to transferring both explicit and tacit knowledge from current leaders to their successors. The emphasis on knowledge transfer is not limited to procedural know-how but extends to sharing experiences, insights, and a nuanced understanding of the organizational culture. This process is crucial for maintaining continuity in leadership and building upon the legacy of preceding executives.

The results indicate that effective succession planning in Namibian CPEs hinges on a multifaceted approach that encompasses the development of leadership skills and competencies, readiness and capability assessment, and a structured process for knowledge transfer. These elements form the core of the Muadinohamba succession development progression framework, which is proposed as a comprehensive tool for guiding leadership succession in Namibian organizations.

Table 2.
Succession Planning Sentiment Analysis

Sentiment	Aspect	Confidence (%)
Negative		**12**
	Challenges in ELSPI	1
	Happy with ELSPI	1
	Knowledge of ELSPI framework	1
	Leadership development	1
	Leaving the position	1
	Mitigation Strategies	2
	Opinions on ELSPI	1
	Readiness and Capability	3
	Recruitment framework, and effects	2
Neutral		**9**
	Happy with ELSPI	2
	Leadership development	2
	Leaving the position	2
	Mitigation Strategies	3
	Recruitment framework, and effects	1
Positive		**62**
	Challenges in ELSPI	5
	Happy with ELSPI	10
	Knowledge of ELSPI framework	3
	Leadership development	8
	Leaving the position	4
	Mitigation strategies	14
	Opinions on ELSPI	7
	Readiness and capability	6
	Recruitment framework, and effects	5
Grand Total		**84**

Note: ELSPI = ethical, legal, social, and policy implications.

Sentiment Analysis

The opening mining shows a positive sentiment (84%). The words used in the interviews were more positive (62%) than negative (12%) or neutral (9%). The sentiment closer to 100% means that the opinions given by the participants are positive while the one closer to 0% indicates a negative opinion on various parts of succession planning.

According to the findings in Table 2, participants were extremely unhappy with the challenges experienced in the Ethical, Legal, Social, and Policy Implications (ELSPI) knowledge of the ELSPI framework, leadership development, leaving the position, mitigation strategies, opinions on ELSPI, readiness and capability, recruitment framework, and effects. One participant remarked:

> *There is no visible succession plan, and not having a plan also creates serious tensions, which can sometimes affect teamwork and team spirit.* (IP1)

Positive opinions were gathered from various parts of the interview. Participants gave their opinions on leadership

development. Participants had positive sentiments about leadership development as a process in succession planning. One participant stated:

> *Leadership development is like playing a game. You may use the external market for fresh ideas, and this is good if the enterprise needs to be a turnaround. It's good to use an internal candidate, especially in an enterprise doing well. The reason is that until now, our candidate has been part of the success of that company and he knows the strategy and operations of the company.* (IP20)

Theme 1.0: Succession Skills and Competencies

The results highlighted specific skills and abilities that candidates should have. According to Wilson (2018), achieving future strategic goals requires a plan for future capabilities. Participants provided systematic and integrated process steps and methods focusing on key skills judged retainable by skilled staff, for example, crucial areas and jobs. One participant suggested aligning workforce competencies with phased strategic plans. IP9 proposed:

> *Public enterprises in Namibia should strive to strike the right balance between growing internal resources and recruiting from outside. As public enterprises should be cautious of not creating little internal kingdoms, some talent from outside is also critical to introduce a new innovative way of thinking and challenging status. However, the critical skills aligned with the successful delivery of the mandate of the public enterprise and the strategic direction of the public enterprise may also affect the decision to take on from outside or to grow the internal talent.* IP19

Theme 2.0: Leadership and Succession Planning

Document information suggests the organization needs leaders who will encourage long-term sustainability. Johnson et al. (2018) cited charismatic leadership as useful to leadership sustainability. This phenomenon has been discussed in several academic circles as a hallmark of credible leadership. The CEO leadership charisma and transactional leadership styles were investigated as determinants of organizational performance by Bryant (2003). To build a long-term organization, executives must excel in vision, strategy, and scalability. A leader's charisma appears to draw followers. Coding IP7 cited the following human capital hurdles that some companies face:

> *When talented people reach the pinnacle of leadership, they can prevent the next generation's advancement. Some companies avoid these stumbling blocks by creating new positions, collaboration opportunities, and giving assignments that let future leaders develop.* (IP7)

When seeking answers to the question "Who should be hired?," many organizations have struggled with managing chaos, changing cultures, empowering their employees, and reorganizing themselves (Conger, 1999; Fanelli & Misangyi, 2006). Many people feel that transformational, visionary, and charismatic leaders are needed to lead organizations through the chaos. Evidence shows charm (idealized influence), personalized concern (a focus on the follower's growth), the ability to challenge assumptions and question the status quo, and articulate an appealing vision to motivate others to follow them (Groves, 2014; Groves & LaRocca, 2011; Hargis et al., 2011).

A transformational leader is also known as a visionary leader. Others are influenced by visionary leaders because they are emotionally and/or intellectually drawn to the leader's visions of what could be. Vision connects the present and future states, energizes and motivates people, gives meaning to their actions, and serves as a benchmark for measuring performance (Bryant, 2003; Groves, 2014; Moreno & Girard, 2019).

Theme 3.0: Knowledge Transfer for Succession Planning

IP19 remarked, "Succession planning isn't part of the culture." It is necessary to track the organization after succession is completed for it to continue to exist in a healthy state. Whenever there are important leadership changes, new leaders should undergo board review processes every 9–15 months (IP7). The ability to teach and pass on leadership skills to new leaders can help maintain an organization's sustainability. In a circumstance like succession development, which is analogous to apprenticeship or parenthood, it is vital to transfer learned skills through mentorship and training. This is the pinnacle of knowledge management.

IP1 said this:

> *Succession planning at the Executive Leadership level is necessary so that there is enough business continuity. When we lose a leader, we lose knowledge, and we feel the pressure or the vacuum because then there is not a person readily available to step in and no time will be available to allow knowledge transfer. Succession planning and implementation also provide hope for career growth in any institution and would provide hope for career growth. An existing talent pool will also allow for knowledge transfer. Besides, it is also cost-effective to train your talent because the recruitment process itself is expensive.* (IP1).

No one is indispensable, even though we all bring something unique to our jobs (Kotter, 2001; Rothwell, 2011). Even when a highly respected and influential CEO leaves, organizational life goes on. It is part of a true leader's job to groom one or more successors to fill the vacuum when he or she leaves. This is especially true when a leader is on the verge of retirement. Leaders can, however, move at any stage of their careers or ages.

A succession planning initiative that fails to properly document organizational knowledge can be disastrous. While maintaining profitability, productivity, and organizational continuity, it is crucial to reduce knowledge loss that can only be transferred via one-on-one coaching or personal experience.

An Executive Leadership Succession Planning Framework for Commercial Public Enterprises in Namibia

In response to this question, interviewee E responded that there was succession planning in their commercial public enterprise. Other interviewees said that their organizations lacked succession planning. However, IP3 and IP6 stated that their organizations had succession planning, although in a limited capacity. The consensus was that there was succession planning, but the difficulty is that there is no defined structure or method for how it should be done. The lack of policies makes it difficult to show succession planning in most CPEs. The literature, research, and interviews concur that such policies are absent.

The participants agreed that senior management chose important staff without employees' input or consultation (as stated by IP1, IP2, IP6, and IP7). Management chose the senior staff at their discretion. Literature studies indicate that it is possible to find

individuals for specific jobs, but the process should make sure the incumbent is developed. Commercial public enterprises need to develop succession planning strategies and practices that include staff development. The overarching message was that top management owned succession planning.

According to the interviews, most CPEs had a performance appraisal process/system, but it was not used in succession planning. Interviewee IP6 mentioned that performance assessments are important for organizations because executives utilize them to discover skills shortages and to promote or reward employees. Employee performance might be a motivator for advancement. During succession planning, job rotations and promotions are used to train, develop, and keep staff. Lateral transfers let managers examine employees' abilities and key competencies, paving the way for advancement. Performance appraisals help achieve this (Swanepoel et al., 2008). Employees can comprehend their supervisors' expectations, and managers can recognize their subordinates' limitations.

Commercial public enterprises face issues in succession planning. Organizational failure, lack of succession planning policies and plans, and budgetary issues were all mentioned by interviewees as important obstacles faced by firms. According to Magda et al. (2012), corporate politics may favor friends and allies over rivals, despite skills and qualifications. Performance and potential can be replaced by corporate politics. Training, education, and development meetings might take a lot of time to start succession plans (Magda et al., 2012).

A Designed Framework for a Better Practice of Leadership Succession in Namibia's CPEs

Based on the findings of this study, leadership succession in Namibia's CPEs is showing signs of potential. Most managers, however, do not understand succession planning and execution processes, even though they acknowledge their importance. Rather than succession planning, most firms adopt leadership replacement. Due to the factors influencing the ELSPI discussed, this dissertation criticizes the wisdom of universal leadership models for succession in Namibia's CPEs. These models apply, but they do not consider Namibian organizations' level of growth and sophistication in comprehending leadership succession, nor do they consider the impact of national culture on leadership succession practice. While one model may be useful to a Namibian public enterprise like TransNamib, it may differ from another enterprise like the Namibia Wildlife Resorts because of existential differences also picked from the interviews.

Based on the findings of this study, the researcher developed a succession management framework for Namibian organizations called the Muadinohamba succession development progression framework model. The framework was designed using a theoretical model for managing leadership succession, and the tenets of the leadership pipeline model are highly regarded in the literature on succession models (Dai et al., 2011).

The Muadinohamba succession development progression framework model is presented in Figure 1. It depicts the items identified in the study as required in a formalized succession plan. The model also accounts for cultural effects as well as most reported enhancers and inhibitors.

The Muadinohamba succession development progression framework model (Figure 1) begins with successor selection. The identified potential successors are trained in leadership succession management processes such as finding other prospective successors, identifying enhancers and inhibitors, including those generated by the organization, and managing consequences

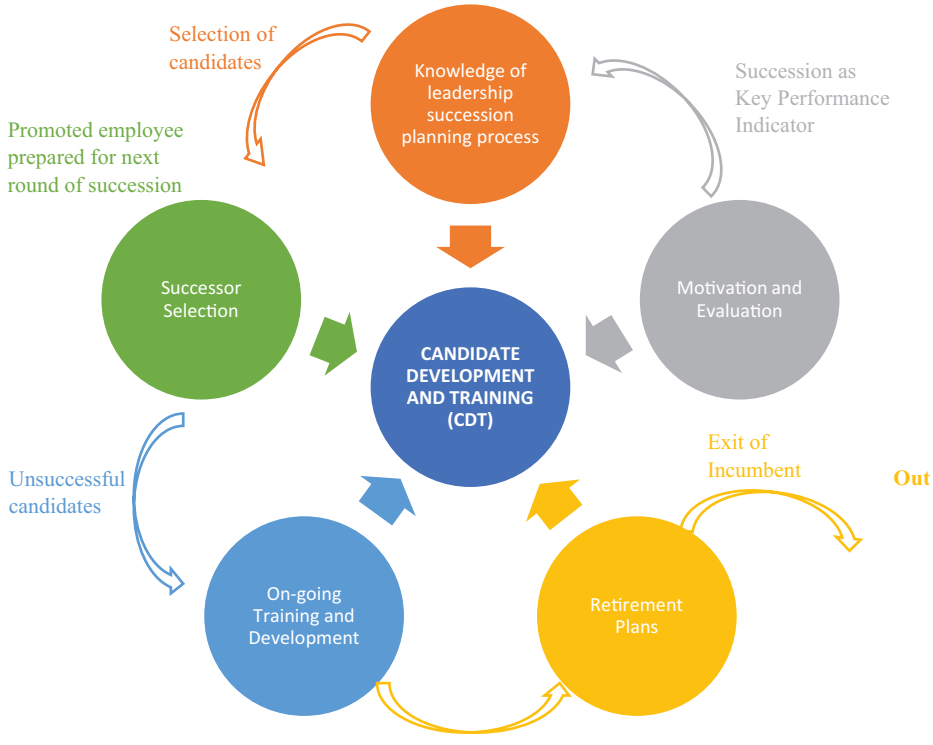

Figure 1.
The Planned Muadinohamba Succession Development Progression Framework for Namibia's Commercial Public Enterprises.

when discovered. The purpose is to teach and instill in the chosen individuals a transformational leadership paradigm. One of the respondents stressed the importance of transformational leadership. Several respondents in the research emphasized the need to educate managers, indicating the need for this among Namibian CEOs/managers.

Motivation and evaluation are included in the framework's next section. Motivational factors include making succession planning a key performance indicator (KPI) and rewarding successful succession planning. Some participants highlighted the importance of succession management as a KPI. Companies should recognize, however, that not everyone is genuinely motivated to participate in an activity that will lead to their eventual replacement. Extrinsic motivators would thus have to ensure the process's success. External motivators could include requiring these managers to identify and develop their successors or providing commensurate rewards. Managers are reminded of their duties in ensuring leadership continuity by making succession a key performance indicator. This part involves an evaluation to show the company's commitment to leadership succession planning and execution.

Another essential element in this model is to provide an exit or have a retirement plan. Standardized application of consequence management processes should remove underperformers. To ensure the uniform application of standards and consequences, culture must be highlighted. Companies should use contract renewals sparingly for retirees to avoid the need for succession planning. Research participants considered the required retirement age an important enhancer, while some participants considered it an inhibitor. Some participants were comfortable working in an organization with no required retirement age.

The framework's next component addresses the necessity for managers to continue their leadership succession training and development to stay current with changes and improvements in the field. Unsuccessful candidates are also expected to undergo more training and development if the potential has been picked. The framework's final part is exit strategies for unsuccessful candidates. It would be a mistake to assume that all selected candidates will succeed and progress up the corporate ladder. It will be necessary to start mechanisms that let rejected candidates resume their normal work or be encouraged to leave the company.

This study acknowledges that the framework cannot include the factors identified. Although formalization may help neutralize some inhibitors identified in this study, such as alerting companies to the need for a succession mindset rather than a replacement mindset and removing entrenched tendencies, a formalized model may neutralize some inhibitors identified in this study, but other inhibitors will remain unaffected. Staff education and organizational and social culture changes must overcome factors such as managers' unwillingness to challenge the status quo and their reluctance to include subordinates. However, this research argues that a formalized model will let companies plot and measure succession planning and implementation.

It would be wise to use as many enhancers as identified in the theoretical framework in any practical succession model. Making succession management a key performance metric, setting a mandated retirement age, educating managers on succession practices, and providing a structured succession process are all parts of the Muadinohamba succession development progression framework. The succession model should also identify and remove any obstacles, including those created by the organization.

Having considered all factors, the framework's elements are incorporated into the Muadinohamba succession development progression framework model, a tool for planning leadership succession in Namibian companies.

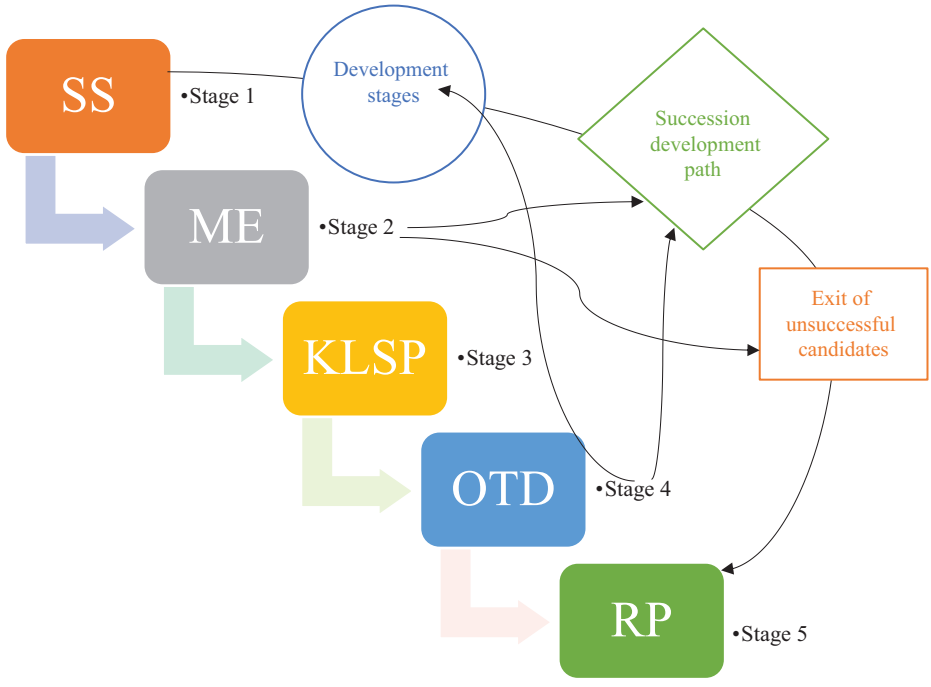

Figure 2.
The Stage Structured Muadinohamba Framework of the Succession Development Progression. SS: Successor Selection, ME: Motivation and Evaluation, KLSP: Knowledge on Leadership Succession Planning, OTD: Ongoing Training and Development, RP: Retirement Plan.

The Muadinohamba succession development progression framework model (Figure 2) may seem to be only beneficial for medium, large, and very large organizations with vast human capital and financial resources, but it can also be applied to small businesses because it's adjusted to meet the needs of small businesses.

To make succession processes work, while enhancers are being added, inhibitory factors must be removed. These were discussed in the previous chapter and will only be briefly mentioned here. Succession planning is a critical organizational task. Companies should approach succession as a strategic process in which top managers are involved and assessed.

The organization would profit if managers were motivated to plan and start succession properly. A cash incentive for retirees and a promotion conditioned on selecting and developing a successor were discovered. Other forms of incentives may be used, but they were not mentioned by the participants in this study and may be investigated further. Employees will be reminded of the strategic relevance of leadership succession with strong top-management support. This will ensure a smooth transition of power in the event of a death or resignation. When the succession process has been done properly, this is most likely to help boost employee loyalty.

Theoretical Managerial Implications

The Muadinohamba Succession Development Progression Framework model, as delineated in this study, posits significant theoretical and managerial implications that extend beyond the practical succession planning processes within Namibian CPEs. The framework's theoretical underpinnings offer a structured lens through which the dynamics of executive succession can be analyzed and understood.

First, the model theoretically underscores the importance of a multi-dimensional approach to succession planning that integrates both individual leadership development and organizational strategic foresight. The implication for management theory is the shift from a transactional to a transformational leadership development approach, where the potential successors are not only identified but also actively developed through strategic knowledge transfer and ongoing training. This aligns with modern leadership theories that emphasize the development of leaders who are adaptable and capable of navigating complex organizational landscapes.

Secondly, the framework suggests that the effective management of succession planning should consider cultural, economic, and operational nuances specific to the organizational context. This is particularly pertinent in the Namibian CPE context, where local cultural elements play a crucial role. The implication here is a departure from one-size-fits-all managerial theories towards more culturally nuanced and context-specific models that recognize the uniqueness of each organizational environment.

Moreover, the framework theoretically informs the notion of succession planning as a core strategic function, challenging the traditional view of it as a reactive and tactical HR activity. The model places succession planning at the heart of strategic management, advocating for its integration into the organization's core objectives and performance metrics. This shift reflects recent trends in management theory advocating for a more holistic and integrated approach to human capital development within strategic management.

Lastly, the framework highlights the potential for a structured succession planning process to serve as a catalyst for organizational change and innovation. By institutionalizing the process and embedding it into the organizational culture, the model implies that succession planning can drive strategic renewal, ensuring that the organization remains agile and responsive to external changes.

The Muadinohamba succession development progression framework model contributes to management theory by advocating for a comprehensive, integrated, and strategic approach to succession planning. It provides a theoretical basis for reimagining succession planning as a dynamic capability that can significantly influence an organization's long-term success and sustainability.

Discussion and Conclusion

The study has confirmed that there is little executive leadership succession planning and that Namibian public enterprises are unprepared for succession events. The study concentrated on developing a successful succession planning model for Namibia's CPEs. The research further focused on the models for implementing succession planning and their effectiveness, given the new proposed model. Due to the influence of organizational culture on leadership succession planning and implementation, this study showed that Western approaches may not be as effective in addressing cultural peculiarities in Namibia. According to Gummesson (2000), it is not uncommon for consultants to bring theory and general answers to practice with them, but this is not always the case. The study acknowledges the challenge and proposes the Muadinohamba succession development progression framework for Namibia's CPEs. This study suggests that, in addition to researching leadership succession, companies within a specific cultural context should research leadership succession planning and implementation processes due to existential differences.

Limitations and Future Research

This research has provided valuable insights into the development of the Muadinohamba succession development progression framework for Namibian CPEs. However, it is not without its limitations, which open avenues for future research endeavors.

One of the primary limitations of this study is its focus on CPEs within the Namibian context. While this provides a detailed exploration of the Namibian landscape, the findings may not be generalizable to other contexts or regions. Future studies could test the framework in different cultural and organizational settings to enhance its universality and applicability.

Another limitation is the reliance on qualitative data, which, while rich and insightful, may be subject to the biases of the respondents and the researcher's interpretation. Quantitative studies could be employed to validate and expand upon the findings presented here, potentially leading to a more robust, data-driven understanding of succession planning processes.

Additionally, while the framework has been developed and its components identified, its practical implementation and efficacy in real-world scenarios have not been empirically tested. Longitudinal studies that observe the application of the framework over time could provide empirical evidence of its effectiveness and impact on leadership succession within organizations.

Moreover, the current study highlights the exit of unsuccessful candidates as a part of the succession planning process but does

not delve deeply into the strategies for their management and future incorporation. Future research could explore the pathways for these candidates, including reintegration into the organization or the development of new competencies that align with organizational needs.

Lastly, this study opens the discussion on the integration of succession planning into the broader strategic management activities of an organization. Further research might explore how succession planning can be effectively integrated with other strategic initiatives and how this integration impacts organizational performance and adaptability.

While the Muadinohamba succession development progression framework provides a structured approach to succession planning in Namibian CPEs, future research is needed to refine the framework, test its applicability in various settings, and integrate it into a holistic strategic management approach.

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