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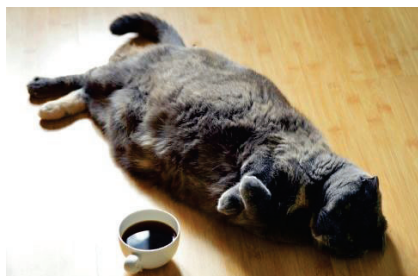
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Research Article

**The Impact of Agency Costs on Investment Efficiency: Evidence from
Overinvestment and Underinvestment in Borsa İstanbul**

Seda Turnacıgil^a

Abstract

Introduction: Agency costs can reduce resource allocation efficiency by distorting firms' investment decisions through conflicts of interest among managers, shareholders, and lenders. Therefore, examining the impact of agency costs on investment efficiency is a significant research area in the corporate finance literature. This study aims to analyze the impact of agency costs on firms' investment efficiency.

Method: To determine the direction of investment inefficiency, overinvestment and underinvestment behaviors are examined through separate models. The study uses quarterly data from 24 firms listed on the BIST Industrial Index for the period 2015-2023. Investment efficiency was measured using the absolute value of residuals obtained from the expected investment model, in accordance with the approach of Biddle et al. (2009). Overinvestment and underinvestment were calculated using the positive and negative components of the residuals.

Results or Findings: The study findings reveal that agency costs significantly affect investment efficiency, and this effect differs depending on the direction of investment divergence.

Discussion or Conclusion: The results reveal that agency costs not only increase overall investment inefficiency but can also influence both overinvestment and underinvestment behaviors of firms. These findings demonstrate that effective corporate governance mechanisms are crucial for optimizing investment decisions.

Keywords: financial management, investment efficiency, agency costs.

JEL Codes: G32, L25, O16

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Araştırma Makalesi

Vekalet Maliyetlerinin Yatırım Verimliliğine Etkisi: Borsa İstanbul’da Aşırı ve Yetersiz Yatırım Üzerine Kanıtlar

Seda Turnacıgil^a

Öz

Giriş: Vekalet maliyetleri, yöneticiler, hissedarlar ve borç verenler arasındaki çıkar çatışmaları yoluyla firmaların yatırım kararlarını bozarak kaynak tahsis verimliliğini azaltabilir. Bu nedenle, vekalet maliyetlerinin yatırım verimliliği üzerindeki etkisini incelemek, kurumsal finans literatüründe önemli bir araştırma alanıdır. Bu çalışma, vekalet maliyetlerinin firmaların yatırım verimliliği üzerindeki etkisini analiz etmeyi amaçlamaktadır.

Yöntem: Yatırım verimsizliğinin yönünü belirlemek için, aşırı yatırım ve yetersiz yatırım davranışları ayrı modeller aracılığıyla incelenmiştir. Çalışma, 2015-2023 dönemi için BIST Sanayi Endeksi’nde listelenen 24 firmanın üç aylık verilerini kullanmaktadır. Yatırım verimliliği, Biddle vd. (2009) yaklaşımına uygun olarak, beklenen yatırım modelinden elde edilen artıkların mutlak değeri kullanılarak ölçülmüştür. Aşırı yatırım ve yetersiz yatırım, artıkların pozitif ve negatif bileşenleri kullanılarak hesaplanmıştır.

Sonuçlar ya da Bulgular: Çalışma bulguları, vekalet maliyetlerinin yatırım verimliliğini önemli ölçüde etkilediğini ve bu etkinin yatırım sapmasının yönüne bağlı olarak farklılık gösterdiğini ortaya koymaktadır.

Tartışma ya da Yapılan Çıkarımlar: Sonuçlar, vekalet maliyetlerinin yalnızca genel yatırım verimsizliğini artırmakla kalmayıp, firmaların hem aşırı yatırım hem de yetersiz yatırım davranışlarını da etkileyebileceğini göstermektedir. Bu bulgular, etkili kurumsal yönetim mekanizmalarının yatırım kararlarını optimize etmede kritik bir rol oynadığını ortaya koymaktadır.

Anahtar Kelimeler: finansal yönetim, yatırım verimliliği, vekalet maliyeti

JEL Kodlar: G32, L25, O16

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Introduction

Investment efficiency determines a firm's long-term performance and value creation capacity. Modigliani-Miller (1958), under the assumption of perfect market conditions, argues that a firm's investment decisions are determined solely by investment opportunities. These opportunities are typically measured through indicators such as Tobin's Q (Stein, 2003). Thus, investments with a positive net present value (NPV) are accepted, whereas those with a negative NPV should be rejected. However, various frictions in capital markets can cause firms' investment decisions to deviate from the optimal level. As a result of these deviations, firms may exhibit overinvestment behavior by investing in projects with negative NPV, or they may face underinvestment problems by rejecting projects with positive NPV.

Agency theory argues that information asymmetry occurs between managers (agents) and shareholders (principals) when management and ownership are separated. This results in shareholders, despite being the actual owners of the firm, not having complete information about the risks they are exposed to (Fama & Jensen, 1983b; Ross, 1973). This information asymmetry is further deepened when shareholders find it costly to monitor the daily activities of their agents and therefore avoid oversight (Fama & Jensen, 1983a). The theory rests on three fundamental assumptions: the tendency of individuals to maximize their own self-interest, the existence of conflicts of interest between parties, and information asymmetry. In this context, conflicts of interest and information asymmetry can lead managers to act against shareholder interests and make inefficient investment decisions, such as over- or under-investing (Ullah et al., 2020).

The aim of this paper is to explore the relationship between agency costs and investment efficiency, and to investigate whether these costs contribute to over- or under-investment behavior in firms. To this end, quarterly data from 24 companies listed on the BIST Industrial Index, with continuously accessible data and similar asset sizes, for the period 2015–2023 were used. The study period ended as of 2023: Q4, when the most current and complete annual financial data for the firms became available. This study is expected to offer several different contributions to the literature. Firstly, to the best of our knowledge, no empirical study has directly examined the impact of multi-dimensional agency costs on investment behavior in the context of Türkiye. Secondly, investment behavior is examined simultaneously in three different dimensions: investment efficiency, over-investment, and under-investment. While a significant portion of existing studies consider investment efficiency in a single dimension, this study examines and compares investment deviations in two ways (over-investment and under-investment). Thirdly, this study includes agency costs in the analysis within the framework of different stakeholder relationships, enabling a detailed and multi-dimensional understanding of this phenomenon.

Literature

Research on managerial behavioral traits shows that overconfidence and agency conflicts can reduce investment efficiency. Asadi et al. (2021), using data from firms listed on the Tehran Stock Exchange (2010–2018), report that firm's manager overconfidence is associated with cash holdings positively, while cash holdings are negatively related to investment efficiency. Overall, their findings suggest that agency costs may increase as overconfident managers tend to allocate resources inefficiently, including investment in negative-NPV projects. Similarly, Bhatta (2025), using panel data from India between 2001 and 2015, examined the relationship between insider ownership and investment efficiency and found that increased insider ownership, particularly by increasing the tendency to over-invest,

reduces investment efficiency. This suggests that insiders may prioritize their personal interests over shareholder value maximization. Furthermore, Shin and Kim (2002), in their analysis of manufacturing firm data from 1984-1994, revealed that corporate investment decisions were significantly affected by agency costs and that capital expenditures were allocated inefficiently. In this context, Chen et al. (2016) also examined the effect of free cash flow on overinvestment and found that firms with high free cash flow showed a higher tendency to overinvest. Also Chowdhury et al. (2023) examined the effect of executive power on investment efficiency and found that CEOs with excessive power tend to over-invest, thus reducing investment efficiency. Furthermore, this negative effect was found to be more pronounced in firms with high levels of information asymmetry, agency issues, and competition in the product market. Similarly Majeed et al. (2025) found a generally negative relationship between CEO power and investment efficiency. However, the study also showed that powerful CEOs under financial pressure can increase investment efficiency by making more strategic decisions. Ali et al. (2024) investigate the impact of board characteristics of firms traded on the Pakistan Stock Exchange (PSX) on investment efficiency (IE) and the role of corporate ownership (IO) in this relationship. The findings show that board size increases investment efficiency, while board activity intensity decreases it; independence and gender diversity generally have no significant effect. Furthermore, corporate ownership was found to both increase investment efficiency and play a regulatory role that strengthens the effect of board independence. Yahaya (2026) examined the effect of CEO overconfidence on investment efficiency for firms traded on the Nigerian stock exchange. The findings show that overconfident CEOs deviate more from optimal investment levels, reducing investment efficiency. Furthermore, firm size and profitability were found to increase investment efficiency, while growth opportunities reinforced the negative impact of CEO overconfidence.

Financial reporting quality and information asymmetry are also among the key factors affecting investment efficiency. Chen et al. (2011), using World Bank Business Survey (WBES) data, analyzed firms operating in different sectors between 2002 and 2005 and found that financial statement quality increased investment efficiency. Similarly, McNichols and Stubben (2008), using data from 1978-2002, examined the investment behavior of firms managing earnings and documented that firms manipulating financial reporting significantly overinvested during those periods. More recent studies also support these findings. For example, Li et al. (2024), in their analysis of publicly traded firms in the US between 2010 and 2022, showed that financial reporting quality was positively correlated with investment efficiency, and this relationship was particularly pronounced in firms with older CEOs. Khuong et al. (2025), in their analysis of firms operating in Vietnam, showed that increasing the comparability of financial statements reduces information asymmetry, thereby strengthening the positive impact of corporate governance on investment efficiency. Furthermore, using a sample of U.S. firms, Alhadi et al. (2021) demonstrate that comparable financial information enhances investment efficiency by limiting deviations caused by insufficient or excessive investment. Also Wu et al. (2024) show that financial flexibility enhances investment efficiency by constraining overinvestment and contributes positively to firm performance, while investment efficiency and scale condition this effect. Pan and Yang (2025) found that the quality of information disclosure in the Chinese A-share market improved investment efficiency. According to the results, when transparency quality increases, it improves asymmetric information and investment quality, and reduces financial constraints, thus preventing underinvestment. Assad et al. (2026) found that the quality of financial reporting in US firms increased investment efficiency. Similarly, Khan et al. (2024) showed that this relationship was positive in frontier markets and stronger in countries with high investor protection.

There are also studies in the literature on corporate governance and investment efficiency. Rim and Sul (2020), using a large sample of 30 countries, showed that reforms to board independence increased investment efficiency. It was determined that firms with an excessive investment tendency, in particular, reduced their investment levels following these reforms. Salehi et al. (2022) provide evidence that ownership structure and board autonomy shape the interaction between investment efficiency and firm value, while also showing that investment efficiency enhances firm value. In a study conducted by Girardone et al. (2024) on US S&P 1500 companies, it was shown that the CEO's internal debt position increased investment efficiency and contributed to more optimal investment decisions by reducing both excessive and insufficient investment problems. Med bechir and Jouirou (2024) showed that board size and firm size increased investment efficiency, while shareholder activism, CEO duality, leverage level, and the proportion of female executives decreased investment efficiency in Asia. Godsel et al. (2023), in their study involving 1,375 global companies, revealed that investor relations activities increase investment efficiency. Specifically, more intensive communication with investors, gathering market information, and conveying this feedback to the board of directors contributes to firms making more effective investment decisions. The findings show that investors provide managers with valuable information about investment opportunities and risks, thereby increasing investment efficiency. Huo et al. (2024) investigated the effect of mixed ownership structure on investment efficiency in publicly traded companies in China. Their findings show that mixed ownership enhances investment efficiency, with agency costs acting as a mediator in this relationship. Furthermore, the results reveal that this effect can change under different agency conflicts and external shocks (e.g., the COVID-19 period).

The impact of financial structure and borrowing decisions on investment efficiency is also an important area of research. Han et al. (2024), in their study on listed firms in China, showed that the use of short-term debt increased investment efficiency. Similarly, Abuhommous (2024), in his analysis with data covering the period 1971-2021 in the USA, revealed that short-term debt disciplined management decisions by reducing information asymmetry and increased investment efficiency. In contrast, Kim et al. (2024) found that financial constraints increase investment inefficiency, and this effect is stronger in firms with high free cash flow, bankruptcy risk, and growth potential. Ling and Wu (2022) examine the effect of leverage level on investment efficiency in China. Their findings show that a decrease in the leverage ratio in state-owned enterprises increases investment efficiency. Furthermore, the policy creates a balancing effect by reducing overinvestment in heavily indebted firms while mitigating underinvestment in less indebted firms. Wei (2023) examines the effect of equity concentration on investment inefficiency in a sample of non-financial companies traded on the A-stock market in China. The findings show a significant and positive relationship between ownership concentration and investment inefficiency, meaning that the concentration of shares in certain partners increases investment inefficiency.

Finally, the impact of sustainability, climate risk and social responsibility dimensions on investment efficiency is also gaining increasing importance. Xu et al. (2024) showed that climate risk reduces investment efficiency by causing firms to deviate from their optimal investment levels in a multi-country firm sample. Lian and Weng (2024), in their study on firms operating in the Chinese A-stock market, showed that ESG performance increased investment efficiency by reducing performance volatility. Similarly, Khediri (2021), in his analysis of firms operating in Western European countries, presented evidence that corporate social responsibility positively affects investment efficiency. Lin et al. (2021) examined how business strategy shapes the relationship between Corporate Social Responsibility (CSR) and

overinvestment in the US, revealing that firms with high CSR activities tend to overinvest more. Furthermore, they presented findings suggesting that business strategy plays a significant moderating role in this relationship. Zhang et al. (2025) investigated the impact of Climate Policy Uncertainty index (CPU) on enterprise investment efficiency using data from non-financial firms traded on the Shanghai and Shenzhen stock exchanges. Their findings show that CPU negatively impacts investment efficiency across all sectors. Furthermore, this effect varies according to firm characteristics; it is more pronounced in non-governmental, technology-intensive businesses with relatively low levels of managerial education.

Overall, the literature reveals that investment efficiency has a multidimensional structure and that managerial behaviors, financial reporting quality, corporate governance mechanisms, financial structure, and ESG/CSR performance play a decisive role in this process. These studies show that reducing information asymmetry, properly structuring managerial incentives, and strengthening corporate governance mechanisms are critically important in increasing investment efficiency.

Methodology

This paper examines whether agency costs affect the efficiency of investment allocation in businesses. Quarterly data from the second quarter of 2015 to the fourth quarter of 2023 for firms traded on the BIST industrial index were used. The starting period was chosen as the second quarter of 2015 because the dataset was only available continuously and reliably from that point onwards. Twenty-four firms were included in the analysis, creating a dataset consisting of a total of 840 observations. Agency costs, variables representing investment efficiency, secondary data used to calculate overinvestment and underinvestment, and the dataset for the control variables was compiled from information available in the Finnet database. Table 1 includes the variables and calculation methods used in the study.

Table 1*Variables and Symbols in the Study*

Variable	Calculation method	Symbol
Shareholder–Lender Agency Costs	Sales / Total Assets	A_1
Manager – Lender Agency Costs	Cash Flows from Operating Activities /Total Asset	A_2
Manager – Shareholder Agency Costs	Operating Expenses /Total Asset	A_3
Investment Efficiency	Biddle et al. (2009) model residuals ($\varepsilon_{i,t}$) see equations (1), (2), (3), and (4).	Inv_eff
Overinvestment	Max ($0, \varepsilon_{i,t}$)	Ov_inv
Underinvestment	Min ($0, \varepsilon_{i,t}$)	Un_inv
Leverage	Total Debt/Total Assets	Lev
Size	Log (total Assets)	Size

Note. Created by the author

Managerial shareholder agency costs arise when company managers use company assets for their own needs, and shareholders prevent this by not keeping idle funds in the company. Furthermore, managers may prioritize short-term investments over long-term ones due to concerns about success. This situation leads to a conflict of interests between managers and shareholders. Managerial lender agency costs, in short, arise because stakeholders who provide external resources to the company want to benefit from the company's profits first. Shareholder lender agency costs stem from the priority of profitability between the two parties. In other words, each party demands that profits be presented to them before the company's earnings. This conflict can lead to agency costs in the company. The calculation of agency costs (A_1 , A_2 , and A_3) is primarily based on the study by Ang et al. (2000). Similar calculations have also been used in the studies by Wang (2010), Singh et al. (2003), Fleming et al. (2005), Topaloğlu (2019), and Nur and Korkmaz (2022).

Following similar studies in the literature (Sharaf et al., 2026; Salehi et al., 2022; Abuhommous, 2024; Han et al., 2024), the Biddle et al. (2009) approach was applied in this study when calculating investment efficiency (*inv_eff*), overinvestment (*ov_inv*), and underinvestment (*un_inv*). The approach developed by Biddle et al. (2009) was used to measure investment efficiency. In this context, the investment level of firm *i* in period *t* was estimated through a model in which sales growth was used as the key indicator reflecting the firm's investment opportunities.

$$INV_{i,t} = \alpha + \beta_1 SG_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

Where,

The investment level of company *i* in period *t*

$SG_{i,t-1}$ = Sales growth in the previous period (indicator of growth opportunities)

$\varepsilon_{i,t}$ = Investment deviation (residual)

Investment efficiency is estimated using the absolute magnitude of the residuals obtained from the specified model:

$$Inv_eff_{i,t} = |\varepsilon_{i,t}| \quad (2)$$

The company's investments exceeded its expected investment level;

$$Ov_inv_{i,t} = \max(0, \varepsilon_{i,t}) \quad (3)$$

Here;

If $\varepsilon_{i,t} > 0$, there is overinvestment. Otherwise, it is taken as 0.

The company's investments are below the expected investment level:

$$Un_inv_{i,t} = \min(0, \varepsilon_{i,t}) \quad (4)$$

Here,

If $\varepsilon_{i,t} < 0$ there is underinvestment. Otherwise, it is set to 0.

Positive residuals reflect overinvestment behavior, whereas negative residuals reflect underinvestment behavior. The absolute residual values represent the magnitude of investment inefficiency, regardless of whether it is positive or negative (Chen et al., 2011).

The regression models created within the scope of the research design are as follows. The main subject of the research is to examine the effect of agency costs on investment efficiency. Investment efficiency is the dependent variable, and 3 agency costs are independent variables. In the study, the control variables were determined as debt ratio and firm size.

$$Inv_eff_{i,t} = \alpha + \beta_1 A1_{i,t} + \beta_2 A2_{i,t} + \beta_3 A3_{i,t} + \beta_4 Lev_{i,t} + \beta_5 Size_{i,t} + \varepsilon_{i,t} \quad (5)$$

The degree of investment inefficiency is captured by the size of the residuals obtained from the estimated investment model, regardless of their sign. In addition, the nature of inefficiency is identified based on residual deviations, where upward deviations from expected investment levels represent overinvestment, whereas downward deviations reflect underinvestment.

The model overinvestment behavior is as follows:

$$Ov_inv_{i,t} = \alpha + \beta_1 A_{1i,t} + \beta_2 A_{2i,t} + \beta_3 A_{3i,t} + \beta_4 Lev_{i,t} + \beta_5 Size_{i,t} + \varepsilon_{i,t} \quad (6)$$

The empirical specification for underinvestment behavior is formulated as follows:

$$Un_inv_{i,t} = \alpha + \beta_1 A_{1i,t} + \beta_2 A_{2i,t} + \beta_3 A_{3i,t} + \beta_4 Lev_{i,t} + \beta_5 Size_{i,t} + \varepsilon_{i,t} \quad (7)$$

Findings

The study first presents the results regarding descriptive statistics, based on the analyses conducted.

Table 2

Descriptive Statistics

	Inv_eff	A ₁	Lev	Size	A ₂	A ₃	Un_inv	Ov_inv
Mean	0.048409	0.694544	0.534607	9.295001	0.046862	0.060249	-0.024187	0.024222
Median	0.024953	0.587835	0.538812	9.277268	0.038211	0.048532	-0.010031	0.000000
Maximum	1.971028	3.042536	1.401248	10.99989	0.636626	0.354774	0.000000	1.971028
Minimum	3.62E-05	0.011374	0.000000	8.142624	-0.347947	0.002296	-0.274583	0.000000
Std. Dev.	0.104206	0.464959	0.224507	0.531026	0.112559	0.047843	0.041301	0.101618
Skewness	11.11718	1.287141	-0.121304	0.451380	0.532052	1.572862	-3.46559	12.50718
Kurtosis	177.3814	5.117805	2.579024	3.047729	6.545043	6.606428	17.45797	207.4630
Jarque-Bera	1080326.	388.4580	8.252931	28.56987	478.9169	800.6124	8986.892	14.83311
Probability	0.000000	0.000000	0.016140	0.000001	0.000000	0.000000	0.000000	0.000000
Sum	40.61542	582.7225	448.5357	7798.506	39.31719	50.54854	-2.02932	20.32222
Sum Sq. Dev.	9.099765	181.1646	42.23813	236.3065	10.61700	1.918156	1.429466	8.653381

Note. Created by the author using e-views

When the descriptive statistics results of the variables are examined, the indicators of agency cost show that variable A1 has a mean value of 0.694 and a high variation (standard deviation: 0.464). Positive skewness (1.28) and leptokurtic structure (kurtosis > 3) indicate that this variable has a right-skewed and thick-tailed distribution. Variables A2 and A3 similarly deviate from normal distribution with positive skewness and high kurtosis values. This indicates that agency costs among firms have a heterogeneous structure. When the investment efficiency (Inv_eff) and the components of investment variance, namely overinvestment (Ov_inv) and underinvestment (Un_inv), are examined, it is seen that they have quite high skewness and kurtosis values.

In general, the fact that the p-value of the Jarque-Bera test is less than the critical value of 0.05 for all variables indicates that the variables do not meet the assumption of a normal distribution.

Multicollinearity occurs when there is strong linear dependence among independent variables in a regression model. As the variables included in the study did not follow a normal distribution, the issue of multicollinearity was examined using the Variance Inflation Factor (VIF) method in conjunction with Spearman's correlation analysis, which is more appropriate in such cases.

Table 3*Spearman Correlation Analysis*

	Inv_eff	A ₁	Lev	Size	A ₂	A ₃	Un_inv	Ov_inv
	1.000000							
Inv_eff	-----							

	-0.003593	1.000000						
A ₁	-0.103950	-----						
	0.9172	-----						
	0.063397	-0.083694	1.000000					
Lev	1.837837	-2.429871	-----					
	0.0664	0.0153	-----					
	0.156240	0.188941	0.377360	1.000000				
Size	4.576384	5.566519	1.178899	-----				
	0.0000	0.0000	0.0000	-----				
	0.050458	0.380952	-0.069550	0.188915	1.000000			
A ₂	1.461647	1.192016	-2.01702	5.565722	-----			
	0.1442	0.0000	0.0440	0.0000	-----			
	-0.122765	0.554069	-0.052350	-0.011417	0.258180	1.000000		
A ₃	-3.57878	1.925562	-1.51662	-0.330335	7.731501	-----		
	0.0004	0.0000	0.1297	0.7412	0.0000	-----		
	-0.260056	0.108995	-0.093528	-0.096222	0.035835	0.222509	1.000000	
Un_inv	-7.791742	3.172227	-2.717766	-2.796777	1.037411	6.602944	-----	
	0.0000	0.0016	0.0067	0.0053	0.2998	0.0000	-----	
	0.919772	0.040615	0.026998	0.121111	0.066307	-0.035456	0.139759	1.000000
Ov_inv	67.80384	1.176005	0.781376	3.529845	1.922567	-1.026407	4.083439	-----
	0.0000	0.2399	0.4348	0.0004	0.0549	0.3050	0.0000	-----

Note. Created by the author using e-views

In Table 3, it is seen that the highest correlation relationship is between the investment efficiency variable and the overinvestment variable. Since the investment efficiency and overinvestment variables are used as dependent variables in different models, they do not have a multicollinearity problem.

Table 4*VIF Test Results*

	First Model		Second Model		Third Model	
Variable	Coef. Variance	VIF	Coef. Variance	VIF	Coef. Variance	VIF
A ₁	0.000168	2.588943	0.000213	2.588.943	1.90E-05	2.588943
Lev	0.000416	1.042944	0.000527	1.042944	4.71E-05	1.042944
Size	7.62E-05	1.107902	9.65E-05	1.107902	8.62E-06	1.107902
A ₂	0.001168	1.245778	0.001479	1.245778	0.000132	1.245.778
A ₃	0.017497	2.373141	0.022156	2.373141	0.001980	2.373141
C	0.006410	NA	0.008116	NA	0.000725	NA

Note.Created by the author using e-views

Variances Inflation Factor (VIF) values below 10 indicate that there is no multicollinearity problem (Hair et al., 1998). Upon examining the VIF results obtained in this context, it can be seen that the values for all models remain below this threshold. Consequently, the absence of multicollinearity among the independent variables has been confirmed both theoretically and empirically.

Table 5

Cross-sectional Correlation Test Based on Model and Variable

	Test	Statistic	Prob
Model1	PesaranCD	14.47432	0.0000
Model2	PesaranCD	14.60709	0.0000
Model3	PesaranCD	33.19852	0.0000
A ₁	PesaranCD	75.80196	0.0000
A ₂	PesaranCD	19.67418	0.0000
A ₃	PesaranCD	73.24514	0.0000
Inv_eff	PesaranCD	19.66568	0.0000
Ov_inv	PesaranCD	27.64109	0.0000
Un_inv	PesaranCD	41.00204	0.0000
Lev	PesaranCD	14.87572	0.0000
Size	PesaranCD	93.40279	0.0000

Note. Created by the author using e-views

The Pesaran CD test statistics confirm cross-sectional dependence in both models and across all variables, under the null hypothesis of cross-sectional independence. However, the fact that all probability values obtained ($p=0.0000$) are statistically significant at the 1% significance level indicates that the null hypothesis is rejected, and therefore, there is strong cross-sectional dependence among the units comprising the panel. When examined on a model basis, the CD test statistics are high and significant for all three models. This indicates that the error terms in the model estimates are not independent among firms; in other words, firms are affected jointly by common shocks or macroeconomic factors. Similarly, the results on a variable basis reveal the presence of cross-sectional dependence in all series. In particular, the very high test statistics obtained for firm size and agency cost indicators (A₁ and A₃) show that these variables behave similarly among firms and are sensitive to common dynamics.

Table 6*CIPS Test for Unit Root*

Variable	Test Statistic	p-Value
A ₁	4.81876	0.00000
A ₂	7.64193	0.00000
A ₃	3.38857	0.00070
Inv_eff	1.49810	0.01341
Un_inv	5.79758	0.00000
Ov_inv	8.30810	0.00000
Size	4.44924	0.00001
Lev	4.55033	0.00001

Note. Created by the author using e-views

To examine the stationarity properties of the panel data variables, the Cross-sectionally Augmented IPS (CIPS) unit root test developed by Pesaran (2007) was implemented. The choice of this test was motivated by prior findings confirming cross-sectional dependence in the dataset. Since first-generation unit root tests (LLC, IPS, etc.) do not yield consistent results in the case of cross-sectional dependence, second-generation tests must be used.

Examining the findings, it is seen that the probability values of the CIPS test statistics for all variables are below the 5% significance level. This indicates that the null hypothesis of the test, "there is a unit root in the series (it is not stationary)," is rejected. Therefore, it is concluded that all variables A₁, A₂, A₃, Inv_eff, Un_inv, Ov_inv, Size, and Lev are stationary at the level (I(0)).

The results of the analysis of the models created regarding investment efficiency and agency costs are presented in the table. In this context, firstly, the F-test, Breuch-Pagan LM and Hausman tests were used to investigate which of the fixed effects model, random effects model and pooled model would be used for estimation.

Table 7*Model Selection*

Test	Model ₁		Model ₂		Model ₃	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
F	14.31976	0.0000	2.931311	0.0000	32.3626	0.000
LM	14.88348	0.0000	5.586529	0.0000	52.7977	0.000
Hausman	329.3517	0.0000	276.8379	0.0000	375.8372	0.000

Note. Created by the author using e-views.

The F-test findings indicate that the pooled OLS assumption is violated, as significant unit-specific effects are detected across all models at the 1% level. Consequently, a panel estimation framework incorporating individual effects is more appropriate. Similarly, the fact that the LM test results are also significant for all models shows that the random effects model is more suitable than the pooled model. The Hausman specification test, which is used to

evaluate the choice between fixed and random effects estimators, yields statistically significant statistics at the 1% level across all model specifications ($p < 0.01$), indicating that the fixed effects approach is more appropriate than the random effects alternative. Therefore, the fixed effects model is selected as the appropriate estimation approach, as the random effects estimator is found to be inconsistent. In line with these findings, the most suitable estimation method for Model 1 (Inv_eff), Model 2 (Over_inv), and Model 3 (Un_inv) was determined to be the fixed effects model. Therefore, in the continuation of the analyses, all models were estimated within the framework of the fixed effects approach.

Table 8

Heteroskedasticity Test Results

Likelihood Ratio	First Model	1842.066	0.0000
Likelihood Ratio	Second Model	1767.393	0.0000
Likelihood Ratio	Third Model	1291.431	0.0000

Note. Created by the author using e-views

According to the Likelihood Ratio test results, the probability values for all models are less than 0.01. This situation indicates that there is a heteroscedasticity problem in the estimated models. Estimation was performed using the Period SUR method developed by Beck and Katz (1995), which takes these problems into account and solves them.

Table 9

Model 1. Agency Costs and Investment Effectiveness

Dependent Variable		inv_eff		
Method		Period SUR		
Period		2015-2023		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
A ₁	0.017059	0.014638	1.165408	0.2442
A ₂	0.080322	0.023892	3.361851	0.0008
A ₃	-0.262370	0.122532	-2.14124	0.0326
Lev	0.011747	0.014973	0.784541	0.4330
Size	0.000714	0.011143	0.064051	0.9489
C	0.034178	0.103361	0.330668	0.7410
R ²	0.331863	F-statistic 13.96082		
Adjusted R ²	0.308092	Prob(F-statistic) 0.00000		

Note. Created by the author using e-views

The Shareholder-Lender Agency Cost (A₁) was found to have no significant effect on investment efficiency. The Manager-Lender Agency Cost (A₂) is positive and highly significant, statistically strong at the 1% level. An increase in agency costs between the manager and the lender reduces investment efficiency. When evaluated, it can be said that the conflict of interest between managers and lenders and borrowing pressure negatively impact the firm's optimal capital allocation. The Manager-Shareholder Agency Cost (A₃) is negative and significant at the 5% level. As the conflict of interest between the manager and the shareholder increases, investment efficiency decreases. On the other hand, the level of debt did not have a

statistically significant effect on investment efficiency. Firm size is also not an explanatory variable in the model.

Table 10

Model 2. Agency Costs and Overinvestment

Dependent Variable		Ov_inv		
Method		Period SUR		
Period		2015-2023		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
A ₁	0.008358	0.009134	0.915045	0.3604
A ₂	0.042941	0.021896	1.961123	0.0502
A ₃	-0.145363	0.075254	-1.931646	0.0537
Lev	-0.007280	0.011639	-0.625513	0.5318
Size	0.021063	0.008966	2.349277	0.0190
C	-0.166703	0.079948	-2.085134	0.0374
R ²	0.095352		F-statistic	3.418422
Adjusted R ²	0.064119		Prob(F-statistic)	0.004596

Note. Created by the author using e-views

The model is generally statistically significant. Shareholder-Lender Agency Cost (A₁) does not explain overinvestment behavior ($p = 0.3604$). Manager-Lender Agency Cost (A₂) shows a positive correlation at the 10% significance level. As agency conflict between manager and lender increases, the tendency to overinvest increases. Manager-Shareholder Agency Cost (A₃) shows a negative correlation, which is considered significant at the 10% level. As manager-shareholder conflict increases, overinvestment behavior decreases. Firm size significantly and positively influences overinvestment behavior. As firm size increases, the tendency to overinvest increases. In large firms, high cash flow, perceived investment opportunities, and management confidence can lead to overinvestment problems. In addition, the level of debt does not affect overinvestment behavior.

Table 11*Model 3. Agency costs and underinvestment*

Dependent Variable		un_inv		
Method		Period SUR		
Period		2015-2023		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
A ₁	0.001492	0.004552	0.327833	0.7431
A ₂	0.023088	0.008526	2.707812	0.0069
A ₃	0.042629	0.035953	1.185685	0.2361
Lev	-0.003694	0.005956	-0.620251	0.5353
Size	0.004102	0.003733	1.098934	0.2721
C	-0.065004	0.034547	-1.881631	0.0602
R ²	0.510228		F-statistic	30.17406
Adjusted R ²	0.493319		Prob(F-statistic)	0.000000

Note. Created by the author using e-views

Overall, the model is statistically quite significant. The independent variables together strongly explain underinvestment behavior. Shareholder-lender agency cost (A₁) does not explain underinvestment behavior. Manager -lender (A₂) is positive and significant at the 1% level. The positive Manager-Lender coefficient, due to the negative residuals calculation of the Biddle et al. (2009) model, leads to the conclusion that agency costs reduce underinvestment. The excessive control mechanisms of lenders discipline the tendency of managers to miss profitable investment opportunities. Shareholder-manager agency cost has no significant effect on underinvestment. Firm size does not affect underinvestment behavior.

Conclusion

This study measures the impact of agency costs on investment efficiency using quarterly data from 2015-2023 for 24 companies with similar asset sizes listed on the BIST industrial index. The study also analyzes the impact of agency costs on firm investment behavior across three dimensions: investment efficiency, overinvestment, and underinvestment. The findings show significant differences between the models in terms of both explanatory power and the effects of the variables. The underinvestment model's high explanatory power (51%) indicates that agency costs play a stronger role in explaining firms' behavior of not investing or missing investment opportunities. In contrast, the overinvestment model's low explanatory power (9%) suggests that this behavior is influenced more by internal managerial preferences, market conditions, or behavioral factors other than agency costs. The moderate explanatory power of the investment efficiency model (33%) indicates that agency costs have a partial but significant effect on the quality of investment decisions. When evaluated in terms of agency relationships, The manager-shareholder agency cost has a significant and negative impact on investment efficiency. In addition, the increase in manager-lender agency costs also reduces investment efficiency. In contrast, no statistically significant effect was found on shareholder-lender agency cost, leverage, and firm size variables. The findings demonstrate that conflicts of interest between managers and shareholders negatively impact investment decisions and are generally consistent with agency theory. The manager-shareholder agency cost has a negative effect, and firm size has a positive and significant effect on overinvestment, revealing that large firms exhibit a higher tendency to overinvest. The findings are generally consistent with agency theory and the free cash flow hypothesis, indicating that managerial behaviors, especially in large firms, can increase the tendency to overinvest. The analysis results show that in all three

models, an increase in manager-lender agency costs increases investment inefficiency and overinvestment tendency. These results may indicate that borrowing pressure and conflicts of interest with lenders push managers towards inefficient capital expenditures. The insignificant agency cost between shareholders and lenders in all models indicates that the impact of indirect agency relationships on investment decisions is limited. When considering control variables, the leverage variable is not significant in any model. The effect of debt level is primarily manifested through agency costs arising from debt relationships. Firm size has a positive and significant effect only on the overinvestment model. This suggests that larger firms exhibit more overinvestment and, when evaluated within the framework of the free cash flow hypothesis, may indicate that increased management influence in large-scale firms can lead to inefficient use of resources.

When compared with other studies in the literature, the findings of this study are generally consistent with those of Asadi et al. (2021), Bhatta (2025), Shin and Kim (2002), Chen et al. (2016), Chowdhury et al. (2023), Majeed et al. (2025), and Wei (2023), which have shown that agency costs can have negative effects on investment decisions. In particular, the reduction of investment efficiency due to manager-shareholder agency costs parallels the findings of Asadi et al. (2021), who found that managers' overconfidence increases cash accumulation, thus reducing investment efficiency. Similarly, Bhatta's (2025) finding that insider ownership increases the tendency to overinvest, thus reducing investment efficiency, and Chen et al.'s (2016) findings that high free cash flows encourage overinvestment also support the tendency to overinvest observed in large firms in this study. Furthermore, Shin and Kim's (2002) findings that capital expenditures are allocated inefficiently due to agency costs are consistent with our results showing that manager-shareholder conflicts reduce investment efficiency.

The results obtained in terms of executive power and behavioral factors are also similar to some studies in the literature. Chowdhury et al. (2023), Majeed et al. (2025), and Yahaya (2026) have shown that CEO power or overconfidence reduces investment efficiency. Although this study does not directly measure CEO power, the fact that the cost of executive-shareholder agency reduces investment efficiency shows that executives can put their own interests before firm value, and this can impair the effectiveness of investment decisions. In this respect, the results of this study support the behavioral corporate finance and agency theory literature.

The results obtained in terms of debt and financial structure show both similarities and differences with some findings in the literature. In this study, the leverage ratio was not found to be significant in any model, but it was determined that the manager-creditor agency cost had a strong and positive effect, especially on underinvestment. This result is consistent with Kim et al.'s (2024) findings that financial constraints increase investment inefficiency and with Ling and Wu's (2022) results showing that high debt negatively affects investment decisions. The strong results obtained, especially in the underinvestment model, coincide with the predictions of Debt Overhang theory. In contrast, Han et al. (2024) and Abuhommous (2024) suggest that the use of short-term debt increases investment efficiency. In this study, however, the debt level did not have a direct significant effect. The reason for this difference may be the differences in financial systems, institutional structures, and the level of development of capital markets between countries.

From the perspective of regulatory bodies and capital markets, some important policies can be developed. Since manager-lender and manager-shareholder agency costs directly affect investment decisions, measures to reduce information asymmetry are necessary. In Turkey, institutions that display companies' investment expenditures, such as public disclosure

platforms, should improve their standards. Increasing transparency and corporate governance will also prevent minority shareholders from suffering losses due to managers' inefficient and excessive investment decisions. The study results differ from some literature assumptions in classical agency theory (Jensen & Meckling, 1976; Myers, 1977) and information asymmetry theory (Myers & Majluf, 1984). The analysis shows that the Manager-Lender agency cost increases inefficiency and overinvestment, indicating that debt pressure can push managers towards riskier and less efficient projects. The negative coefficient of the Manager-Shareholder agency cost in investment inefficiency and overinvestment models reveals that corporate governance mechanisms working in favor of the board of directors and shareholders reduce information asymmetry, preventing managers from inefficiently spending equity. This study also shows that in the Turkish market, which is bank-based and heavily reliant on debt financing, creditor rights and debt contracts have a more decisive theoretical role in shaping investment efficiency compared to equity markets.

This study has some limitations. Firstly, the scope of the analysis is limited to 24 companies included in the BIST industrial index. This may limit the generalizability of the results and may lead to different results for different sectors or larger samples. Secondly, the data period used in the study is limited to quarterly data from 2015 to 2023. Starting the data in 2015 prevents the analysis of longer-term trends. Thirdly, the analysis period was terminated in 2023 because inflation accounting, implemented in Turkey after 2023, creates changes in financial statements. This may result in the exclusion of more recent data from the analysis. Including macroeconomic variables in future studies could increase the explanatory power of the models. Furthermore, calculating the representation cost using different measurement methods could contribute to future research. Another methodological limitation of the study is the risk of endogeneity and bidirectional causality. In this study, the effect of agency costs on investment costs was examined within the framework of static panel data. However, businesses can influence each other simultaneously. In future studies, System GMM or dynamic panel data methods employing lagged instrumental variables can be used to investigate potential endogeneity effects in depth.

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Research Article

The Dynamics of School Dropout in The Turkish Higher Education System

Hüseyin Şentürk^a

Abstract

Introduction: Student dropout is not only an individual failure but also leads to the ineffective use of public resources, the worsening of educational inequalities, and disruption in the labor market, thereby preventing long-term development. The aim of this study is to address the methodological gap in the area by utilising a large-scale dataset of approximately 2.9 million students covering the 2016–2024 period.

Method: The Fine-Gray Competing Risks Model, extended with time-varying coefficients, was employed, which considered graduation not simply as a censoring process, but as a competing risk with dropping out. Based on the higher education students database, the impacts of gender, age, disability status, parental education level, distance of residence, and entrance exam score type on the risk of dropout were explored.

Results or Findings: Students accepted based on quantitative test scores had the lowest dropout risk. Students whose parents were college graduates initially faced a relatively higher risk of dropping out in specific fields; this risk increased dynamically in quantitative and verbal fields; Distance represented a constant marginal risk. The probability of dropping out also increases with age; male students initially had a lower risk, but this difference increased over time.

Discussion or Conclusion: These findings may suggest that student dropout rates at Turkish universities may generally result from relatively stronger social factors. The continued education of students with disabilities in areas outside the quantitative fields and the growing advantage in school retention rates among male students presents a challenge to traditional views on the vulnerability of higher education.

Keywords: university dropout, competing risks, administrative data, disability, parental education

JEL Codes: I23, I24, C41

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Araştırma Makalesi

Türk Yükseköğrenim Sisteminde Okul Terki Dinamikleri

Hüseyin Şentürk^a

Öz

Giriş: Öğrencilerin okulu bırakması yalnızca bireysel bir başarısızlık olmakla kalmayıp, kamu kaynaklarının verimsiz kullanılmasına, eğitim eşitsizliklerinin derinleşmesine ve işgücü piyasasında aksamalara yol açarak uzun vadeli kalkınmayı engellemektedir. Bu araştırma, 2016–2024 periyodunu içeren yaklaşık 2,9 milyon öğrenciyi kapsayan geniş çaplı bir veri seti kullanarak alandaki metodolojik boşluğu doldurmayı ve bir bakış açısı sunmayı amaçlamaktadır.

Yöntem: Çalışmada, mezuniyeti sadece bir sansürleme süreci olarak değil, aynı zamanda okul terkiyle rekabet eden bir risk olarak ele alan zamanla değişen katsayılarla genişletilmiş Fine-Gray Rekabet Eden Riskler Modeli kullanılmıştır. Üniversite öğrencileri veritabanına dayalı olarak, cinsiyet, yaş, engellilik durumu, ebeveynlerin eğitim düzeyi, ikamet yerinin uzaklığı ve giriş sınavı puan türünün okul terk riski üzerindeki etkileri incelenmiştir.

Sonuçlar ya da Bulgular: Sayısal test puanlarına göre kabul edilen öğrencilerin okuldan ayrılma riski en düşükken, ebeveynleri üniversite mezunu olan öğrenciler belirli alanlarda başlangıçta göreceli olarak daha yüksek bir okul terk riskiyle karşı karşıya kalmaktadır. Bu risk, sayısal ve sözel alanlarda dinamik bir şekilde artmaktadır. Mesafe, sabit bir marjinal riske sahip olmakta, okul terk etme olasılığı da yaşla birlikte artmaktadır. Erkek öğrencilerin başlangıçta riski daha düşükken, bu fark zamanla artış göstermektedir.

Tartışma ya da Yapılan Çıkarımlar: Bu bulgular, Türk üniversitelerindeki üniversite terk etme oranlarının genel olarak nispeten daha güçlü sosyal faktörlerle bağlantılı olabileceğini gösterebilir. Engelli öğrencilerin sayısal alanlar dışında eğitimlerine devam etmeleri ve erkek öğrenciler arasında okulda kalma oranlarının artması, yükseköğretimin kırılabilirliğine dair geleneksel görüşleri yeniden değerlendirmeye açmaktadır.

Anahtar Kelimeler: üniversite terki, rekabet eden riskler, idari veriler, engellilik, ebeveyn eğitimi

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Introduction

Human capital accumulation is vital for socio-economic sustainability and has contributed to the expansion of higher education across the globe in recent years (Aina, 2013). The greater inclusion of diverse segments of population in university education has been seen as a sign of the success of education policies. This mass participation process in higher education institutions has, alongside other parallel problems, yielded a noticeable increase in the difference between the number of students enrolling in schools and the number of students graduating, in other words, it has increased the significance of the phenomenon of university dropouts.

University dropout reflects not only a personal failure but also the use of public resources inefficiently, further contributing to educational inequality and labor market disruptions (Behr et al., 2020; Huynh-Cam et al., 2025; Giraldo et al., 2025). This represents a waste of institutional and public resources and stands in the way of long-term development (Jaksztat et al., 2021).

Recent work confirms that dropping out of the university is not just an issue of personal factors but can be caused by a complex combination of academic, economic, and mental factors (Quimiz-Moreira et al., 2025; Valencia-Arias et al., 2025). Throughout the post-pandemic period, in specific, academic stress and mental distress have arisen as significant drivers of students' decisions to leave school (Gonzalez et al., 2025). Using target-oriented surveys on student engagement and performance to determine these risk indicators early on has been crucial for those institutions aiming to apply timely student engagement strategies before students make the final choice to leave school (Lizarte Simon & Gijon Puerta, 2022).

Research into the reasons why students drop out of school has historically focused on students' interactions with their schools and their individual background characteristics, indicating that school dropout essentially stems from weaknesses and failures in social adjustment processes (Tinto, 1975; Bean, 1980). Applied research has also shown that social and economic conditions are key determinants of school dropout, with parental education level and family income having a significant impact on students' motivation to continue to university (Vignoles & Powdthavee, 2009; Aina, 2013). These studies report that students with insufficient intellectual capital and financial support are more vulnerable to being pushed out of the system, even if they have high academic potential. It has been reported that difficult economic conditions within the family, in combination with academic dissatisfaction, are the key factors driving early withdrawal from higher education (Nurmalitasari et al., 2023). Economically disadvantaged students are found to be at a much higher risk of school dropout in comparison to their less disadvantaged fellow students, a disadvantage that is observed even when their previous academic performance is taken into consideration. Continued financial difficulties during the education process, the need to work, and economic pressures such as family responsibility play a key role in students' decisions to drop out by causing them to neglect their academic duties (Apumayta et al., 2024).

Sociocultural and economic status, as well as individual and economic factors, are key factors in the risk of dropping out of university, with physically disadvantaged individuals found to be at higher risk than students without disabilities (Russmann et al., 2024). Geographic factors, which can be considered hidden costs, and opportunities for campus access are also among the risk factors for university dropout. Opening new university campuses is said to lower the risk of university dropout by reducing the time and financial costs of accessing universities (Oppedisano, 2011).

Earlier studies on school dropout have tended to rely on cross-sectional survey data with limited samples and view school dropout as a simple binary outcome (Araque et al., 2009; Pedditzi, 2024; Venkatesan et al., 2024). Standard survival-analysis methods, such as Cox regression, treat graduates as censored data, resulting in an overestimation of dropout risks.

This study aims to fill the mentioned methodological gap and provide a universe-level overview of the literature by utilizing a large-scale administrative dataset obtained from the Turkish Statistical Institute (TurkStat) higher education students database, covering approximately 2.9 million students, instead of survey data, thereby overcoming the sample limitation in the literature (TurkStat, 2026). The Fine-Gray Competing Risks Model, extended with time-varying coefficients, was used as the analysis method, modeling graduation not as a censoring event but as a risk competing with dropout. This approach allowed estimating the effects of variables such as gender, age, disability status, parental education, and entrance exam score type on the pure dropout risk, adjusted for graduation probability. Student risk of dropping out of university was estimated in two ways: overall and by type of entrance exam score.

Literature

The decision to drop out of higher education, and more generally, to leave the education system, is a multidimensional issue resulting from a set of factors, from individual demographic factors to family situation, educational background, and other institutional conditions. School leaving choices are commonly addressed within the concepts of lack of socio-academic adaptability (Tinto, 1975) and cost-benefit evaluation of human capital investments (Becker, 1962); however, conventional approaches tend to view these dropouts as one-dimensional outcomes of failure (Kehm et al., 2019; Behr et al., 2020). To adequately evaluate hypotheses concerning variables such as age, gender, and parents' educational level, it is necessary to model graduation and school dropout not as two independent events, but as strategically competing, alternative risks. Student decisions to remain in school or drop out reflect a choice being made between the expected utility of a degree and the expected utility of alternative pathways outside the higher education system. The key point is that the expected utility of these two alternative pathways is not likely to be constant over the duration of the student's registration. Tinto's integration difficulties are most common in the early periods of academic life, when social and educational challenges are most apparent; nevertheless, Becker's cost-benefit analysis suggests that these problems may become more significant as students approach degree completion, as lost opportunities, family conditions, and external opportunities become more evident.

The traditional expectation in contexts such as Türkiye that men should join the labor force and contribute to their families' livelihoods, together with legal systems such as the postponement of mandatory military service for male students who are in active enrollment, may function as a systemic incentive that not only helps men remain in the education system initially, but also cumulatively widens the retention gap in their favor over time (Mouganie, 2020). It is widely viewed that higher age generally results in an increased risk of dropping out of school owing to higher alternative opportunity costs and social adaptation challenges related to generational differences among students (Portela et al., 2021; Bellare et al., 2023; Sallai et al., 2023); however, this relationship may not be the case in all academic fields; in specific disciplines such as language studies, the intrinsic motivation and integration capabilities of adult learners can progressively mitigate and eventually eliminate the initial disadvantages of older age as the educational process continues (Kasworm, 2010). Personal factors such as physical or intellectual disabilities are typically identified as factors that introduce additional barriers and lead to a higher risk of dropping out of school (Russmann et al., 2024; Giraldo et

al., 2025); however, this can be different in highly centralized and competitive university entrance systems. Students with disabilities who overcome the highly competitive selection procedures to enter higher education may represent a particular subgroup with greater than average academic strength and motivation, and institutional programs of higher education may be better able to provide them with the support they need to remain in their higher education programs. The beneficial value of this sorting effect likely relies on the field of study: in programs with a quantitative focus, where structural barriers such as mandatory physical activity and limited physical access may eliminate the resilience advantage of this subgroup; whereas in verbal or language-based programs, these structural barriers are less apparent, and the protective effects of both institutional support and the selective process can be observed more distinctly. Academic burnout has continued to be a theoretically viable mediating process that could lead to an increased willingness to leave one's job, in particular in high-pressure workplaces (Candelo-Meneses et al., 2026); since administrative datasets are rarely able to directly reflect psychological indicators, this mechanism should be taken as an unobservable pathway that informs future data collection efforts, and not as a concept directly measured in the present research.

Parents' educational backgrounds and socioeconomic status are important background influences on academic continuity. Studies conducted in Italy, Spain, and the United States consistently indicate that low parental educational level and financial constraints significantly contribute to the risk of dropping out of school (Aina, 2013; Araque et al., 2009; Pusztai et al., 2025; Curbani et al., 2026; di Biase & Giusino, 2026). The influence of family background, however, must be viewed in its specific context. Against general expectations, students from well-educated and wealthy families may actually be at higher risk of facing a situation that could be described as luxury dropout (Johnes & McNabb, 2004; Belloc et al., 2011). Highly educated and wealthy parents' children have a degree of economic security that gives them the opportunity to voluntarily drop out of a program that does not meet their expectations and look for alternative possibilities. This socioeconomic safety net has produced a growing and increasing trend of strategic school dropouts over time; as opposed to their vulnerable peers, these students are increasingly leaving the education system as they continuously consider better career and educational opportunities available outside of school (Tinto, 1988; Belloc et al., 2011). Sociologically disadvantaged students, on the other hand, usually see higher education as the main mechanism for social advancement, leading to a situation of compulsory persistence in which they feel obligated to complete their programs regardless of their level of happiness.

Looking at it from the institutional and environmental points of view, the physical distance between a student's place of origin and the university town is a key factor affecting retention during the academic process (Zeragaber et al., 2024; Huynh-Cam et al., 2025). Garza and Fullerton (2018) note that this distance creates a dilemma: it can help students integrate into campus life, while also increasing financial and mental stress; however, geographic distance alone does not affect retention. Students' school leaving decisions are significantly influenced by institutional heterogeneity, which represents unobservable factors such as quality differences among universities, regional inequalities, and variations in institutional support mechanisms across Turkish institutions. Differences in the quality of institutional opportunities offered by universities in different geographic locations thus make the impact of distance more complex. Unlike academic and social integration experiences that evolve progressively over time, geographic distance and the related economic burden serve as a more stable, structural limitation throughout a student's educational experience (Aina et al., 2022).

The type of entrance exam score that shows how academic a student is one of the main drivers of the risk of early school leaving. The studies show that students in quantitative fields generally have lower dropout rates than those in the social sciences (Araque et al., 2009; Opazo et al., 2021). This distinction in Türkiye's higher education system is expressed more correctly by four different entry categories rather than a simple quantitative-verbal distinction: quantitative, equal weighted, verbal, and language score types; each represents a different structural candidates pool with its own specific selection mechanisms. This is often attributed to the difficult nature of mathematics and physics subjects, but it is necessary to account for their strong self-selection characteristics. School dropout risks differ across score types and do not simply reflect curriculum challenges. Students who choose and succeed in math programs may, in fact, differ fundamentally from their classmates in the verbal fields in terms of unobservable academic capacity, personal motivation, and labor market preferences, which suggests that this selection effect directly supports higher academic continuity among these students. The language skills category deserves special focus in this context, as it generally involves a much smaller and more expert pool of applicants than the other three categories; consequently, its estimates may be less precise and more vulnerable to the characteristics specific to a given program or group of students.

The summarized theoretical and empirical studies indicate that the factors related to university dropout may vary according to individual, socioeconomic, and institutional characteristics. Based on this framework, the present study tests the following hypotheses: H1: There is a significant difference in the risk of university dropout between male and female students. H2: The risk of dropping out increases as the age of university enrollment increases. H3: Parental education level has a significant effect on students' risk of dropping out. H4: The effect of disability status on the risk of dropping out differ according to the type of score students were selected based on. H5: An increase in the distance between the student's place of residence and the university increases the risk of dropping out. These hypotheses are tested separately for different score types within the framework of the Fine-Gray model, which treats graduation as a competing risk.

Data

Although the scope, types, and number of exams have changed over time, this study covers scores that are primarily weighted toward quantitative skills, verbal skills, equal weighted of quantitative and verbal skills, or foreign language skills. In addition to these, it is also possible to enter universities through assessments of art skills and basic skills in all fields. Apart from skills tests, exams and scoring systems for entrance to undergraduate programs have changed names over time but are primarily grouped into quantitative (QUANT), verbal (VERB), equal weighted (EW), and language (LANG) categories.

The dataset was compiled to cover the years 2016–2024 and was obtained on February 11, 2026, from the Department of Social Statistics at the Turkish Statistical Institute (TurkStat) under a scientific research participation authorization. Data from TurkStat (2026) higher education students database was filtered to eliminate missing records and to include only registered, voluntarily dropped out, and graduates aged 24 and under, thus excluding second university registrations. In this study, the concept of dropping out was limited to voluntary withdrawal from the higher education system; those who transferred between institutions or programs, who temporarily paused their studies, or who were suspended involuntarily due to academic failure, disciplinary measures, etc., were not categorized as dropouts. This narrow definition allows the model to distinguish in a unique way between the model's dynamics of strategic dropouts, which are initiated by students themselves, and involuntary exclusions from

the system. This methodological decision, distinguishing voluntary dropouts from dismissals for academic reasons, basically prevents the mixing of two fundamentally different sociological dynamics. Compulsory dropouts are generally attributed to academic problems and socioeconomic challenges in the literature, whereas voluntary dropouts mainly reflect a rational decision and an assessment of alternative costs (Tinto, 1975; Kehm et al., 2019; Jaksztat et al., 2021), although the present dataset does not include direct survey measures of student motivation or intent that would allow this interpretation to be tested. The exclusion of involuntary withdrawals may allow this study to better capture the effect of strategic decisions and, in this way, enable the possibility of observing phenomena such as luxury dropout, where students from highly educated parents may choose to leave programs that fail to meet their expectations in favor of more beneficial external opportunities. The raw dataset obtained from TurkStat (2026) originally consisted of approximately 10,740,000 student registrations. The final dataset of 2864506 records shown in Table 1 was obtained following a series of filtering steps. The data set used was an unprocessed statistical data set; records with missing cell information were therefore omitted from the analysis. Records from 2016 and later were included in the analysis to ensure the use of more accurate information. The analysis also excluded records in the raw data set that did not concern undergraduate education. Ultimately, only those who voluntarily left school were considered to fall under the definition of university dropouts. The majority of these exclusions reflect structural filtering criteria rather than random data loss; therefore, the estimated relationships are not systematically biased by them. The possibility that unobserved factors jointly affect data quality and the risk of dropping out cannot be entirely ruled out, however, as is the case with any larger administrative records. The time these students spent in university education (DURATION) was taken as the education semester. Due to possible outdated records, the DURATION variable was included in the study for records with a maximum of 20 semesters.

To explain the voluntary withdrawal of students from university, the following variables have been utilized:

- students' gender (GENDER=0 for women and GENDER=1 for men, where women serve as the reference category),
- students' age at enrollment (AGE),
- students' disability status (DISABILITY=0 if not disabled, DISABILITY=1 if disabled, with non-disabled students acting as the reference group),
- students' parental education level, categorized into three groups as low, medium, high (PARENTAL)
- the straight-line distance between the student's residence on the date of registration and the department they enrolled in (DISTANCE); and
- the type of score used for the student's placement in the university department (ENTRY_SCORE_TYPE) which is utilized to stratify the analysis into four distinct sub-models, and the university where the student is registered to control for unobserved heterogeneity at the institutional level.

Preliminary information regarding the variables used in the study is presented in Table 1.

Table 1*Descriptive Statistics*

Variable	Category	Total	Current Students	Dropouts	Graduates
STATUS	Total	2864506	21.49	4.53	73.98
	LANG	3.64	0.87	0.22	2.55
ENTRY_SCORE_	EW	34.34	7.91	1.67	24.75
TYPE (%)	QUANT	42.94	8.66	1.44	32.84
	VERB	19.08	4.05	1.20	13.83
DISABILITY (%)	Without disabilities	99.35	21.35	4.50	73.49
	With disabilities	0.65	0.14	0.03	0.48
GENDER (%)	Women	44.23	10.55	2.71	30.97
	Men	55.77	10.94	1.83	43.00
PARENTAL (%)	Low education	3.54	0.69	0.20	2.66
	Medium education	20.53	4.17	1.04	15.32
	High education	75.93	16.63	3.30	56.00
DISTANCE (Mean)	-	244.64	301.49	377.30	220.00
DURATION (Mean)	-	5.70	2.88	3.36	6.66
AGE (Mean)	-	19.12	19.18	19.30	19.10

Note. The dataset belonging to the TurkStat and calculated by the author using R statistical software.

As detailed in Table 1, the dataset contains 2864506 records: 73.98% graduates, 21.49% current students, and 4.53% dropouts. The population is composed mainly of males and non-disabled individuals, the most frequently entered type is quantitative scores and the vast majority of students have parents with a high level of education. On average, students enroll at the age of 19. Dropouts have the shorter mean duration of education and the greater geographical distance to their universities compared to graduated students.

Methodology

This study employs the competitive risks survival analysis methodology, extended with time-varying coefficients. Graduation in higher education provides a competitive risk against the target event of school dropout (Fine & Gray, 1999). Viewing graduates simply as censored data implies that they are at continued risk of dropping out, which results in an overestimation of dropout probabilities and biased outcomes (Fine & Gray, 1999; Geskus, 2024).

Cumulative Incidence Function (CIF) is used to calculate the probability of an event of type k occurring by a specific time t , taking into account the presence of other competing risks (Kalbfleisch & Prentice, 2002). CIF is mathematically expressed as follows for cause k .

$$F_k(t; Z) = P(T \leq t, \epsilon = k | Z) = \int_0^t \lambda_k(u; Z) S(u; Z) du \quad (1)$$

Here, T represents the time of failure, ϵ represents the event type (e.g., 1=Dropout, 2=Graduation), Z represents the covariate vector, $\lambda_k(u; Z)$ represents the hazard function for the k th event, and $S(u; Z)$ represents the probability of survival without any event occurring (Sestelo et al., 2024). Using this notation, the total probability of events at any given time can be decomposed into the sum of the probabilities of the event of interest and competing events.

Fine and Gray (1999) developed the proportional hazards model, which allows for the direct modeling of the CIF for competing risks. The subdistribution function for the event of interest is defined as follows.

$$\lambda_1^*(t; Z) = \lim_{\Delta t \rightarrow 0} \frac{1}{\Delta t} P\{t \leq T \leq t + \Delta t, \epsilon = 1 | T \geq t \cup (T \leq t \cap \epsilon \neq 1), Z\} \quad (2)$$

Standard survival analysis removes individuals from the risk set when a competing event (graduation) occurs, whereas in the Fine-Gray approach, individuals who experience a competing event are kept in the risk set as if they had an infinite failure time for the event of interest. This situation implies that those who experience the competing risk event have a zero probability of experiencing the event of interest but are represented in the analysis set by being weighted.

The model uses the following proportional hazards structure to estimate the effect of covariates:

$$\lambda_1^*(t; Z) = \lambda_{10}^*(t) \exp(Z^T \beta) \quad (3)$$

The basic subdistribution risk function $\lambda_{10}^*(t)$ and the coefficient vector β showing the effect of covariates on cumulative incidence are shown here. Parameter estimation of the model is carried out by maximizing the partial likelihood function. In the Fine-Gray model, the risk set at time t consists of individuals who have not yet experienced any event and individuals who have previously experienced the competing event.

When the censoring mechanism is random but the competing risk is informative, Fine and Gray used the inverse probability of censoring weighting technique for individuals in the risk set. The weight used for the i th individual in the prediction equation is specified below:

$$w_i(t) = \frac{\hat{G}(t)}{\hat{G}(X_i \Delta t)} \quad (4)$$

The censoring distribution $\hat{G}(t)$ is the Kaplan-Meier estimate, and $X_i = \min(T_i, C_i)$ is the observed duration. The weight is 1 if the individual has not experienced an event at time t and is uncensored, i.e., still at risk. If the individual has experienced the competing event, they continue to be held in the risk set with a weight that decreases over time, depending on the probability of still being under observation at time t .

The coefficients obtained from the Fine-Gray model are interpreted as the subdistribution hazard ratio (SHR). If $\text{SHR} > 1$ for a variable, an increase in that variable raises the cumulative dropout probability; if $\text{SHR} < 1$, it lowers the probability.

One of the key assumptions of the standard Fine-Gray model is the Proportional Sub-Distribution Hazards (PSH) assumption, which states that the hazard ratios of the joint variables remain constant over time. The Schoenfeld residuals method is utilized (Schoenfeld, 1982).

This method evaluates whether the scaled Schoenfeld residuals for each covariate are independent of time; a statistically significant correlation between these residuals and time indicates a violation of the proportional hazards assumption. When the PSH assumption is violated, that is, when it is found that the impact of the variable is constantly changing, the model must be extended by adding time-varying coefficients to avoid parametric deviations. This is implemented by adding an interaction term between the covariates and a time function $f(t)$, and the standard proportional hazard structure is changed as follows:

$$\lambda_1^*(t; Z) = \lambda_{10}^*(t) \exp(Z^T \beta + Z^T \gamma f(t)) \quad (5)$$

Here, γ denotes the coefficient vector for the time interaction. To specify the most suitable functional form for the time component, different forms, such as linear, logarithmic, and square-root, are considered based on the Akaike Information Criterion (AIC). Given that a linear time function $f(t) = t$ provides the best fit and results in the least loss of information, the dynamic SHR for any time period t can be computed algebraically as $SHR(t) = \exp(\beta + \gamma t)$. In this study, to reveal the dynamic and cumulative effects of time-dependent covariates during the training process, these specific hazard ratios were estimated and presented cross-sectionally for the 1st, 4th, 8th, and 12th periods.

Findings

Using the Fine-Gray competing risks model, this study analysed students' risk of dropping out of universities they entered with various types of scores and their graduation status. The Proportional Subdistribution Hazards (PSH) assumption, used to test the hypothesis that parameters of the model are constant over time prior to implementing the Fine-Gray competing risks survival analysis model, was analyzed using the Schoenfeld residuals method. The PSH test results for each model are summarized in Table 2 for the global coefficient.

Table 2

Schoenfeld Residuals Test Results for Proportional Subdistribution Hazards Assumption

Model	Test Statistics	p-Value
Quantitative	151.68	0.00
Equal Weighted	291.46	0.00
Verbal	198.99	0.00
Language	36.11	0.00

Note. The dataset belonging to the TurkStat and calculated by the author using R statistical software.

The summary of the global Schoenfeld test findings in Table 2 suggests that the models are statistically significant, and individual tests also show that all independent variables included in the four models are significant, with the exception of disability status. This result shows that the hazard ratios for the associated variables do not remain constant over time and that the proportional hazards assumption, a critical assumption of the standard Fine-Gray model, is broken. In order to correct for the parametric biases arising from this assumption violations and to model the dynamic effects, time-varying coefficients were integrated into the

model. The disability status was excluded from the time-interaction since it does not violate the proportional hazards assumption.

To determine most proper time function to use in the modeling of time-varying coefficients, different functional forms were checked, then the values obtained for the AIC are listed in Table 3 for purposes of comparison.

Table 3

Model Selection for Functional Forms of Time Components based on AIC

Model	Linear	Log	Square Root
Quantitative	744114	744138	744133
Equal Weighted	840513	840595	840588
Verbal	568315	568375	568373
Language	86833	86837	86838

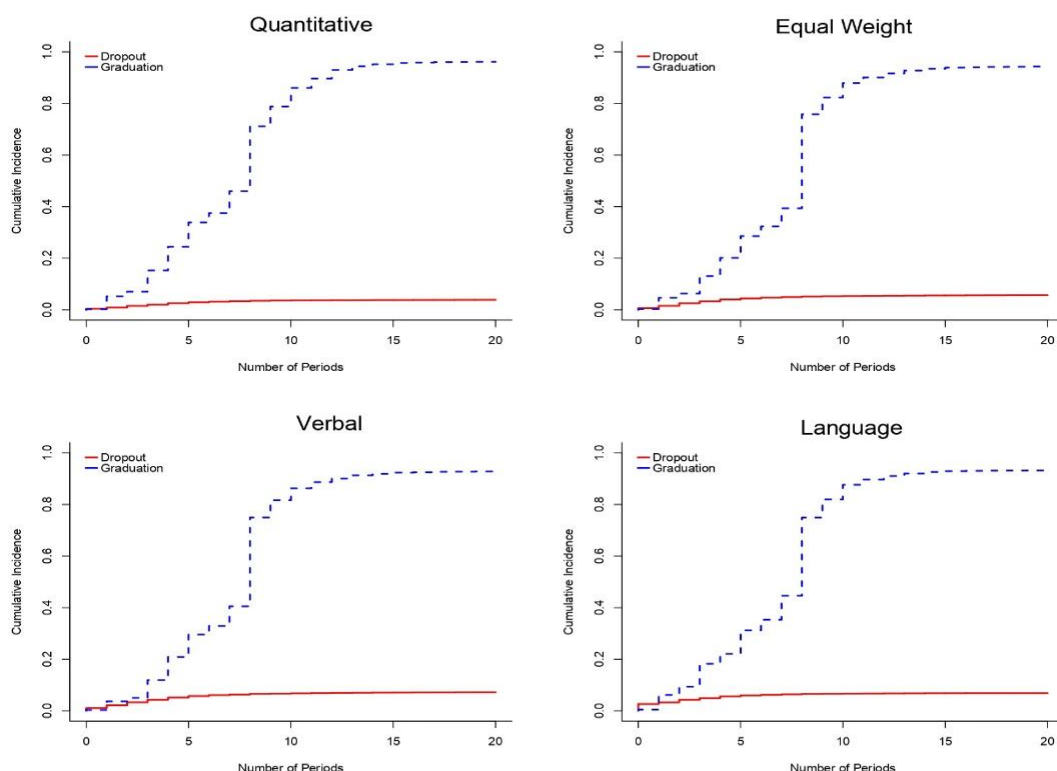
Note. The dataset belonging to the TurkStat and calculated by the author using R statistical software.

Table 3 reveals that the AIC values indicate the linear time form results in the least information loss across all sub-type models; and therefore, in estimating time-varying coefficients, the linear time component was considered as the interaction term. To control for unobserved heterogeneity at the institutional level, the university interaction effect was included in the model.

The time course of the risks to which students are subject throughout their educational lifetime was illustrated graphically using the cumulative incidence function. The CIF graphs developed for the four models are presented together in Figure 1.

Figure 1

Cumulative Incidence Function Estimates for Dropout and Graduation Probabilities



Note. This figure was created via R statistical software where Arial font customization is not supported.

Analysis of the cumulative probabilities of dropout and graduation events encountered by students throughout their educational processes showed that graduation events exhibited a dominant character. The CIF graphs in Figure 1 shows that the probability of graduation rises rapidly as the number of periods increases, approaching 0.90 levels, while the probability of dropout remains at a very low level. This finding indicates that the vast majority of students in the sample complete the system with graduation, but a certain segment cumulatively increases their risk of dropping out over time. The general trend is pretty consistent across all fields, but there are small differences in risk levels based on the specific academic field.

The final Fine-Gray model estimation outputs, after adjusting for assumption violations, clustering effects at the university level and extending with a linear time function, are described in Table 4 in terms of SHR. To allow for a detailed review of the basic model parameters, the raw basic coefficients, standard errors, and p-values for both the main effects and the time-interaction terms are given in Appendix 1. The model estimates are expressed in a way that illustrates the dynamic effects of time-varying coefficients as of the beginning of the study, the 4th period, the 8th period and the 12th period.

Table 4*Fine-Gray Model Prediction Results with Time-Varying Coefficients*

Model	Coefficient	Period 1	Period 4	Period 8	Period 12
Quantitative	GENDER	0.602***	0.536***	0.460***	0.394***
		(0.586, 0.619)	(0.525, 0.548)	(0.443, 0.476)	(0.371, 0.418)
	AGE	1.089***	1.106***	1.129***	1.152***
		(1.076, 1.102)	(1.096, 1.116)	(1.112, 1.145)	(1.125, 1.180)
	PARENTAL-Medium	1.133***	1.142***	1.154***	1.166**
		(1.049, 1.223)	(1.078, 1.209)	(1.054, 1.263)	(1.003, 1.355)
	PARENTAL-High	1.054	1.067**	1.084*	1.102
		(0.980, 1.135)	(1.010, 1.127)	(0.995, 1.182)	(0.954, 1.272)
	DISTANCE	1.001***	1.001***	1.001***	1.001***
		(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)
	DISABILITY	1.327**	1.327**	1.327**	1.327**
		(1.007, 1.747)	(1.007, 1.747)	(1.007, 1.747)	(1.007, 1.747)
Equal Weighted	GENDER	0.590***	0.520***	0.440***	0.371***
		(0.577, 0.604)	(0.510, 0.530)	(0.425, 0.455)	(0.351, 0.393)
	AGE	1.056***	1.090***	1.138***	1.187***
		(1.047, 1.066)	(1.082, 1.098)	(1.123, 1.152)	(1.163, 1.211)
	PARENTAL-Medium	1.041	1.001	0.950	0.901
		(0.978, 1.109)	(0.953, 1.052)	(0.880, 1.025)	(0.796, 1.020)
	PARENTAL-High	1.004	0.983	0.956	0.930
		(0.945, 1.067)	(0.938, 1.031)	(0.889, 1.028)	(0.826, 1.046)
	DISTANCE	1.001***	1.001***	1.001***	1.001***
		(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)	(1.000, 1.001)
	DISABILITY	0.585***	0.585***	0.585***	0.585***
		(0.426, 0.804)	(0.426, 0.804)	(0.426, 0.804)	(0.426, 0.804)
Verbal	GENDER	0.540***	0.486***	0.422***	0.366***
		(0.526, 0.555)	(0.475, 0.497)	(0.404, 0.439)	(0.342, 0.391)
	AGE	1.000	1.038***	1.091***	1.147***
		(0.990, 1.010)	(1.029, 1.046)	(1.076, 1.106)	(1.121, 1.173)
	PARENTAL-Medium	1.035	1.078***	1.137***	1.200**
		(0.977, 1.097)	(1.026, 1.132)	(1.044, 1.239)	(1.044, 1.379)
		1.061**	1.151***	1.282***	1.429***

Language	PARENTAL-High	(1.004, 1.122)	(1.098, 1.206)	(1.182, 1.391)	(1.251, 1.631)
		1.001***	1.001***	1.001***	1.001***
	DISTANCE	(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)
		0.654***	0.654***	0.654***	0.654***
	DISABILITY	(0.494, 0.865)	(0.494, 0.865)	(0.494, 0.865)	(0.494, 0.865)
		0.688***	0.612***	0.568***	0.542***
	GENDER	(0.654, 0.724)	(0.570, 0.658)	(0.513, 0.628)	(0.479, 0.612)
		1.061***	1.046***	1.036*	1.030
	AGE	(1.039, 1.083)	(1.015, 1.077)	(0.994, 1.080)	(0.980, 1.083)
	PARENTAL-Medium	1.040	0.887	0.801	0.751
		(0.869, 1.245)	(0.693, 1.136)	(0.565, 1.136)	(0.494, 1.144)
	PARENTAL-High	1.197**	1.194	1.191	1.190
		(1.011, 1.418)	(0.950, 1.500)	(0.863, 1.645)	(0.806, 1.756)
	DISTANCE	1.001***	1.001***	1.001***	1.001***
		(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)	(1.001, 1.001)
	DISABILITY	0.259**	0.259**	0.259**	0.259**
		(0.083, 0.804)	(0.083, 0.804)	(0.083, 0.804)	(0.083, 0.804)

The values in parentheses denote the limits of the 95% confidence interval. The symbols (*) indicates significance at the 10% level, (**) at the 5% level and (***) at the 1% level.

Note. The dataset belonging to the TurkStat and calculated by the author using R statistical software

Analysis of the estimated coefficients in the model in Table 4 confirms that the time-independent beginning risk ratio for the gender variable is statistically significant and less than 1 in all underlying models. Beyond statistical significance, the magnitude of this effect is highly substantive in practice: findings revealed that male students exhibit a comparatively lower risk of dropping out than female students in the early stages of higher education. Differences in this risk vary by academic field, representing a substantial relative risk reduction ranging from 31% in the Language model to 46% in the Verbal model, and around 40-41% in the Quantitative and Equal Weighted models. Meanwhile, another important finding is that the linear time interaction coefficient for gender is also less than 1 in all of the sub-models. Overall, this finding shows that, as time continues, male students' starting advantage does not disappear but stays strong, causing the risk gap to widen in the long term to the disadvantages of female students. This is consistent with the fact that, as of the 12th semester, the dropout risk for male students is lower than that for female students by 61% in the Quantitative model, 63% in the Equal Weighted model, 63% in the Verbal model and 46% in the Language model.

The increase in age at university entrance increases the risk of dropping out linearly in the early years and each annual increase in age raises the risk of leaving school in the early stages by 9% in the Quantitative Model and 6% in the Equal Weighted Model. While the time-interaction term for the age variable indicates a risk that continues or increases over time in the Quantitative, Equal Weighted, and Verbal models, the Language model represents an exception

in this matter. In the Language model, the starting risk linked to older age gradually decreases and stops being statistically significant in later periods. That means that, unlike their classmates in other areas, language learners actually see the initial struggles of joining the system later in life become less of an issue over time.

Submodel findings indicated that disability status had distinct effects on the cumulative risk of dropping out, differentiated by academic areas. The risk of university dropout among disabled students is considerably lower and statistically significant compared to their non-disabled peers in the Equal Weighted, Verbal and Language models. In the Quantitative model, however, disabilities were found to increase the initial dropout risk by 33%, and this effect is statistically significant at the 5% level. These findings suggest that students with disabilities who have achieved success in Türkiye's highly centralized selection examination system and enrolled in programs such as Verbal, Equally Weighted and Language programs have a high level of academic strength and motivation. The results can also be evaluated as a result of institutional programs of support at universities and the mechanisms of selection, which include quotas for students with disabilities. The analysis results, however, pointed to a requirement for additional institutional support systems to enable students to succeed in quantitative fields that may require laboratory work or extensive physical activities.

The variable of parental education level, analyzed in three groups according to Eurostat's International Standard Classification of Education (ISCED) aggregation (Eurostat, 2025), has presented results that are quite different from those reported in the general literature. Considering families with a low level of education as the benchmark, the early school dropout risk for students whose parents have a medium or high level of education shows differences depending on the field they decide to choose. This risk, however, is not smaller in the Quantitative and Verbal models when compared to the reference value for low educational level; on the contrary, it is bigger and grows as the duration of education rises. The situation is particularly evident in the Verbal model for students with highly educated parents; the relative risks for these students, which are 6% above the reference value in the beginning, reaches 43% by the twelfth period. In contrast, in the Equal Weighted model, neither medium nor high parental education levels exhibit a statistically significant relationship with the risk of dropping out in any period. The Language model, however, displays a different outcome: having a highly educated parent is connected to a statistically significant and important increase in the risk of dropping out at the very early stages of education; while the magnitude of this effect roughly remains constant, it disappears in subsequent periods. The effect of medium-level parental education is not statistically significant at any phase, despite a point estimate that declines over time. The presence of this unique case suggests that the dynamics of early school leaving in Türkiye differ across academic fields. Students from strong social support networks showed a higher initial risk of dropping out in verbal and language fields than their disadvantaged peers. In the long term, however, their patterns of behavior differ: in the quantitative and verbal fields, the chances of dropping out increase over time; in the language field, this initial high risk loses its statistical significance, while in the equal weighted field, parental education does not create a statistically significant difference in the risk of dropping out at any stage. Table 1's raw percentages may initially appear to suggest that a more educated parent is related to lower school dropout rates; however, when controlling for important factors such as types of entrance exam scores, age at enrollment, and university-specific differences, the actual conditional dynamics are revealed, and it is shown that a higher parental education level acts as an increasing risk factor in both quantitative and verbal models. It should also be emphasized that the existing administrative dataset does not enable direct observation of students' family

incomes, personal motivation, tendency to transfer to other programs or available alternative career opportunities in the labor market.

The distance between students' registered residence and the higher education institution where they are registered increases the initial risk of dropping out by a significant but practically negligible marginal amount in all models. While the p-values indicate high significance due to the massive sample, an SHR of 1.001 translates to a mere 0.1% increase in dropout risk per unit of distance. The fact that the interaction coefficient for distance stays at 1.001 shows that geographic distances and the underlying economic pressures they entail do not create added stress as the educational process progresses, but rather remain a steady and constant source of stress throughout the entire academic life.

The interdisciplinary heterogeneity among sub-models categorized by entrance exam types is clearly apparent. As displayed in the Cumulative Incidence Functions in Figure 1, the risk structures vary across fields of study. Descriptive analyses of past academic years have indicated that academic programs that consider Quantitative scores in their acceptance process exhibit a lower trend in dropout rates, in absolute terms, as compared to those that use Verbal and Language-based scores. The higher analytical skills of students who apply to Quantitative fields, and the high earning potential of these programs in the labor market, might encourage students' rational expectations for the future and thereby support their loyalty to the system. That said, it should also be pointed out that these structural differences noticed across disciplines may not stem just from the degree of difficulty of academic programs or labor market conditions; students may be choosing certain score types based on their hidden academic skills, personal confidence levels, and career targets.

To ensure the robustness of the analytical approach, a sensitivity analysis was carried out by estimating a standard Cox proportional hazards model that considers graduation not as a competing risk but simply as a censoring event (in the Appendix 2). The sensitivity analysis showed that the direction and statistical significance of key findings remained remarkably stable, including the gender advantage in favor of males, the protective effect of disability in non-quantitative fields, and the hypothesis that students whose parents are highly educated drop out of school voluntarily. In line with the methodological literature (Fine & Gray, 1999; Geskus, 2024), however, the standard Cox model systematically overestimated the magnitude of hazard ratios relative to competitive risks context. This sensitivity analysis not only verifies the robustness of the empirical findings but also confirms that the empirical necessity of modeling graduation as a competing risk exists in order to prevent upward bias in hazard estimates within the context of higher education in Türkiye.

Summary and Discussion

This study focused on the dynamics of dropout in Turkish higher education system, using approximately 2.9 million records filtered based on various criteria for cleaner data usage, derived directly from the administrative records of TurkStat (2026) higher education students database, beyond survey-based and limited-sample studies. The Fine-Gray approach, extended with time-varying coefficients, was adopted in the study, modeling students' university graduations as a risk competing with university dropout rather than a censoring mechanism, thereby eliminating biased estimates that might arise in standard survival analyses.

The findings of the analysis indicate that academic preparation level and field of study are among the most decisive factors in university completion. It was found that students whose scores were based on quantitative skills had a statistically significant lower risk of dropping out compared to those whose scores were based on equal weighted, verbal, and language skills.

This finding coincides with the previous observations that students in sciences where numerical qualities come to the fore, such as engineering and natural sciences, have lower dropout rates compared to the humanities, while it diverges from international contexts showing that engineering, mathematics, and natural sciences at the undergraduate level in Germany have the highest dropout rates. The fact that students in quantitative fields tend to start university with a stronger analytical basis and that these departments are highly valued in the labor market may have contributed to this situation by strengthening the expected benefit mechanism that increases students' willingness to stay in the system.

One of the most striking findings of the study, which diverges from the general consensus in the literature, is the effect of parental education level on the risk of dropping out. While some international studies argue that higher parental education reduces dropout risk, this study found that students whose parents are university graduates initially face a relatively higher risk of dropping out in certain fields; this risk increased dynamically over time in quantitative and verbal fields, while it lost its statistical significance in the language field and showed no significant impact in the equal weighted area. This situation can be explained by the good match theory and the concept of luxury dropout, or by the fact that completing their education may have become more essential for the future of students whose parents have relatively less education. Financial safety nets give students in high socioeconomic groups the option to leave programs that aren't a fit for them, whereas students from disadvantaged groups tend to stay in school because they view education as a chance to get a better life. Therefore, in the Turkish context, high parental education may trigger a strategic withdrawal in search of a better option rather than dropout, which is an indicator of failure. This said, the results need to be viewed with an understanding of the data's structural limitations. The broad categorization of parents' levels of education, while methodologically required to ensure the model's stability across a large administrative dataset, may mask significant heterogeneity within the categories. Unobservable variations within the broad group of highly educated cohorts, such as household wealth, cultural capital, or specific types of degrees, may influence students' duration of schooling in various ways. The findings thus appear to support the luxury school dropout hypothesis as a general structural trend; however, the aggregate nature of the variable makes it difficult to draw clear causal inferences regarding micro-level class dynamics.

Demographic variables showed that male students had a lower dropout risk than female students, which contradicts international literature suggesting that males have a greater risk of dropping out. This finding, however, aligns with the notion that women face higher risks due to the uncertainties associated with academic careers and the necessity of balancing family and work, as highlighted by Jaksztat et al. (2021). In the specific case of Türkiye, this situation can be explained by the social role pressure on male students to support their families and enter the workforce, which makes a university degree a necessity, and by the provision of mandatory military service delays for men in Türkiye.

The age variable, in line with other studies in the literature, shows that the risk of dropping out rises as the age of starting university increases, however, language-based programs present an exception where this initial risk decreases over time. Rising opportunity costs with increasing age and social incompatibilities resulting from generation differences with classmates contribute to older students leaving the system.

Findings concerning disability also offer a fresh perspective. In contrast to expectations, the risk of dropout among students with disabilities was found to be lower than that of their non-disabled peers in non quantitative fields, whereas it increased the dropout risk in quantitative fields indicate that physical disadvantages increase the risk of dropping out, the

results of this study suggest that individuals with disabilities who make it to university in Türkiye are a group that has undergone a high selection process and has above-average academic resilience and motivation.

It has been observed that the distance variable causes a statistically significant but limited increase in risk in terms of effect size, representing a constant marginal risk over time. This situation can be interpreted as a potential indicator that the costs of moving away from family and the benefits of on-campus integration balancing each other out.

Finally, it is necessary to consider the risk of omitted variable bias associated with the use of large administrative datasets. Control variables at the institutional level, while capturing some of the institutional heterogeneity, do not include variables such as students' academic performance, regional economic factors, or employment status at the time of registration. The lack of these factors, which are commonly associated with both socioeconomic status and the risk of dropping out, may influence coefficient estimates. The observed relationship between parental level of education and dropping out, for example, may be partially confounded by unobserved factors such as school quality or individual student motivation. To better identify the underlying mechanisms and further clarify the causal relationships identified in this study, future research will need to utilize linked datasets that integrate academic achievement records with labor market outcomes.

Conclusion

This study investigates the multi-dimensional characteristics of university dropout in the Turkish higher education using an inclusive administrative dataset containing approximately 2.9 million records. Using the Fine-Gray Competing Risks Model, extended with time-varying coefficients, this study overcomes the typical methodological restrictions that treat educational attainment simply as a censoring process and provides a clearer estimate of dropout dynamics. Results challenge common assumptions in the existing international studies and show the dropout in the Turkish context may be considered as a process mostly shaped by strategic decisions within the investigated subset, given that involuntary exclusions were omitted from the analysis. A major finding relates to the role of academic performance and the subject field chosen. Students admitted using quantitative score types displayed a lower risk of dropping out in comparison to their counterparts in verbal or equal-weighted fields. These findings are in line with the observations of Araque et al. (2009), which indicate lower dropout rates in quantitative fields, but they contradict some international findings, such as those of Behr et al. (2020), which highlight higher dropout rates in these fields in Germany. In the Turkish context, it can be attributed to the fact that students in quantitative fields generally possess a stronger analytical foundation, and the high value of these fields in the labor market strongly supports the desired benefits of the system.

Socioeconomic factors affecting school dropout rates in Türkiye display a considerable deviation from global patterns. Different from international studies (Aina, 2013; Pusztai et al., 2025) that point out that lower parental education is a big factor in the risk of dropping out, the study shows that after accounting for compounding covariates students with parents who have a college degree initially face a relatively higher risk of dropping out; a risk that increases dynamically in quantitative and verbal fields, while losing its statistical significance over time in the language field and having no significant effect in the equal weighted area. This finding is consistent with the luxury school dropout hypothesis suggested by Johnes and McNabb (2004) and Belloc et al. (2011). It implies that socio-economically advantaged students might have a higher tendency to voluntarily leave a program that does not meet their expectations

because they have potentially due to the financial security often associated with higher parental education levels. Disadvantaged students, on the other hand, see higher education as an important mechanism for social advancement and a better life, and therefore continue their studies, which means they are forced to finish the program.

Demographic analyses reinforce the fact that the situation in Turkish schools is unique. Male students initially have a lower dropout risk compared to female students, and this difference increases over time, leading to higher academic retention for males; this finding conflicts with general international findings that indicate higher dropout rates among males. These exceptions could potentially be related to local socio-cultural factors, while female students may increasingly face social pressures related to marriage and family formation as they age, male students may be encouraged by the expected role of providing for their families by participating in the workforce and the deferral of mandatory military service, which is granted only to actively registered males, though further research is needed to empirically test these specific mechanisms. In a similar way, school retention of students with disabilities, who are at lower risk of dropping out in non-quantitative fields, presents a challenge to the traditional view that physical disadvantages inherently make them more vulnerable in education (Rusmann et al., 2024). This finding points to the possibility that students with disabilities who are successful in the highly selective university admissions system may constitute a distinct group exhibiting above-average academic persistence and motivation, or they can take advantage of institutional support mechanisms aimed at encouraging them to continue their studies.

The analysis reveals that the likelihood of dropping out generally rises with age; however, language-based programs stand out as a notable exception, as the initial risk tends to decrease over time. The distance between a student's place of residence and the university constitutes a constant marginal risk throughout the student's academic life.

In conclusion, considering dropping out of university simply as an institutional or personal failure presents an incomplete and arguably misleading view. While direct motivations are unobserved in the administrative data, the empirical patterns are consistent with the hypothesis that school dropout is often a strategic decision aimed at exploring more advantageous socioeconomic or career prospects. Rather than focusing on broad and deficient interventions, policies aimed at retaining students should adopt a more targeted approach that takes into consideration various socio-economic, academic, and demographic variables that shape students' education choices.

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Appendix

Appendix 1: Raw Coefficients and Time-Interaction Parameters of the Fine-Gray Models

Model	Coefficient	Main Effect: β (SE)	Main Effect: SHR(95% CI)	p-value	Time Int.: β (SE)	Time Int.: SHR(95% CI)	p-value
Quantitative	GENDER	-0.468	0.626	<0.001	-0.039	0.962	<0.001
		-0.016	(0.606, 0.646)		-0.003	(0.956, 0.969)	
	AGE	0.08	1.083	<0.001	0.005	1.005	<0.001
		-0.007	(1.069, 1.098)		-0.001	(1.002, 1.008)	
	PARENTAL-Medium	0.122	1.13	0.007	0.003	1.003	0.77
		-0.045	(1.034, 1.236)		-0.009	(0.985, 1.020)	
	PARENTAL-High	0.049	1.05	0.259	0.004	1.004	0.635
		-0.043	(0.965, 1.144)		-0.008	(0.988, 1.021)	
	DISTANCE	0.001	1.001	<0.001	0	1	<0.001
		0	(1.001, 1.001)		0	(1.000, 1.000)	
Equal Weighted	GENDER	0.283	1.327	0.044	-	-	-
		-0.14	(1.007, 1.747)				
	GENDER	-0.485	0.616	<0.001	-0.042	0.959	<0.001
		-0.014	(0.599, 0.633)		-0.003	(0.953, 0.965)	
	AGE	0.044	1.045	<0.001	0.011	1.011	<0.001
		-0.006	(1.034, 1.057)		-0.001	(1.008, 1.013)	
	PARENTAL-Medium	0.054	1.055	0.148	-0.013	0.987	0.065
		-0.037	(0.981, 1.135)		-0.007	(0.973, 1.001)	
	PARENTAL-High	0.011	1.011	0.757	-0.007	0.993	0.301
		-0.036	(0.943, 1.084)		-0.007	(0.980, 1.006)	
Verbal	DISTANCE	0.001	1.001	<0.001	0	1	<0.001
		0	(1.001, 1.001)		0	(1.000, 1.000)	
	DISABILITY	-0.536	0.585	<0.001	-	-	-
		-0.162	(0.426, 0.804)				
	GENDER	-0.581	0.56	<0.001	-0.035	0.965	<0.001
		-0.016	(0.542, 0.577)		-0.004	(0.958, 0.972)	
	AGE	-0.013	0.987	0.029	0.012	1.013	<0.001
		-0.006	(0.976, 0.999)		-0.001	(1.010, 1.015)	
	PARENTAL-Medium	0.021	1.022	0.538	0.013	1.014	0.077
		-0.035	(0.955, 1.093)		-0.008	(0.999, 1.029)	
Language	PARENTAL-High	0.032	1.033	0.328	0.027	1.027	<0.001
		-0.033	(0.968, 1.102)		-0.007	(1.013, 1.042)	
	DISTANCE	0.001	1.001	<0.001	0	1	0.107
		0	(1.001, 1.001)		0	(1.000, 1.000)	
	DISABILITY	-0.425	0.654	0.003	-	-	-
		-0.143	(0.494, 0.865)				
	GENDER	-0.286	0.752	<0.001	-0.128	0.88	<0.001
		-0.037	(0.699, 0.808)		-0.032	(0.826, 0.938)	
	AGE	0.07	1.072	<0.001	-0.016	0.985	0.234

		-0.015	(1.042, 1.103)		-0.013	(0.960, 1.010)	
	PARENTAL-Medium	0.16	1.174	0.214	-0.174	0.84	0.119
		-0.129	(0.912, 1.511)		-0.112	(0.675, 1.046)	
	PARENTAL-High	0.182	1.2	0.136	-0.003	0.997	0.976
		-0.122	(0.944, 1.524)		-0.104	(0.813, 1.223)	
	DISTANCE	0.001	1.001	<0.001	0	1	0.007
		0	(1.001, 1.001)		0	(1.000, 1.000)	
	DISABILITY	-1.351	0.259	0.019	-	-	-
		-0.578	(0.083, 0.804)				

Appendix 2: Sensitivity Analysis: Standard Cox Proportional Hazards Model Estimates

Model	Variable	Cox HR (95% CI)	p-value
Quantitative	GENDER	0.571 (0.560, 0.583)	<0.001
	AGE	1.128 (1.118, 1.138)	<0.001
	PARENTAL-Medium	1.127 (1.064, 1.194)	<0.001
	PARENTAL-High	1.047 (0.991, 1.107)	0.098
	DISTANCE	1.001 (1.001, 1.001)	<0.001
	DISABILITY	1.296 (0.984, 1.706)	0.065
Equal Weighted	GENDER	0.564 (0.554, 0.575)	<0.001
	AGE	1.080 (1.072, 1.088)	<0.001
	PARENTAL-Medium	1.002 (0.954, 1.052)	0.937
	PARENTAL-High	0.988 (0.943, 1.036)	0.622
	DISTANCE	1.001 (1.001, 1.001)	<0.001
	DISABILITY	0.576 (0.419, 0.792)	0.001
Verbal	GENDER	0.528 (0.517, 0.540)	<0.001
	AGE	1.021 (1.013, 1.030)	<0.001
	PARENTAL-Medium	1.066 (1.016, 1.118)	0.009
	PARENTAL-High	1.130 (1.080, 1.183)	<0.001
	DISTANCE	1.001 (1.001, 1.001)	<0.001
	DISABILITY	0.651 (0.492, 0.862)	0.003
Language	GENDER	0.690 (0.656, 0.726)	<0.001
	AGE	1.057 (1.036, 1.079)	<0.001
	PARENTAL-Medium	1.034 (0.865, 1.235)	0.715
	PARENTAL-High	1.217 (1.030, 1.439)	0.021
	DISTANCE	1.001 (1.001, 1.001)	<0.001
	DISABILITY	0.261 (0.084, 0.812)	0.02

Information About the Article/Makale Hakkında Bilgiler

The Ethical Rules for Research and Publication / Araştırma ve Yayın Etiği

The author declared that the ethical rules for research and publication were followed while preparing the article.

Yazar makale hazırlanırken araştırma ve yayın etiğine uyulduğunu beyan etmiştir.

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Below are the question posed to the author concerning the use of artificial intelligence in the preparation of the manuscript and the author response to that question.

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With this declaration, the author(s) accept(s) that, if at any time a situation contrary to the above statement is identified, all ethical, academic, and legal responsibility shall rest with them.



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Research Article

An Exploratory Study on Digital Marketing Strategies in Micro-Enterprises^a

İbrahim Alkara^b

Abstract

Introduction: The aim of this study is to determine the knowledge and usage status of micro enterprises regarding digital marketing applications, to identify the difficulties they face and to reveal their support needs. In addition, the challenges these businesses face in digital marketing, the tools they use most frequently, their performance measurement methods and their support needs were also examined.

Method: A qualitative exploratory-descriptive research design was employed in this study. The sample comprised 12 micro-enterprises in the Bozüyük district of Bilecik. Data were collected through face-to-face interviews using a semi-structured interview guide administered to voluntary participants identified through purposive and snowball sampling.

Results or Findings: The findings indicate that all 12 micro-business representatives interviewed actively use digital marketing, although this usage is largely limited to social media platforms. The vast majority of participants prefer visually-oriented platforms, particularly 'Instagram', and view social media advertising as the cornerstone of digital marketing. Whilst this finding may indicate that digital marketing is replacing traditional marketing methods, it is evident that micro-businesses are operating without strategic depth in this area.

Discussion or Conclusion: The process by which micro-enterprises adopt digital marketing is progressing through a superficial engagement driven by necessity. For this reason, in order for micro-enterprises to remain effective by going beyond merely having a digital presence, it is vital that they are supported by an institutional training and support mechanism, rather than relying on individual initiative. Future research could contribute to the literature by using quantitative methods to test the impact of digital marketing investments on financial outcomes.

Keywords: digital marketing, micro business, qualitative research

JEL Codes: M10, M30, M31, M37

^a This article was produced based on the abstract paper titled "A Qualitative Research on the Digital Marketing Processes of Micro Enterprises," which was presented at the 28th Marketing Congress organized by the Fethiye Faculty of Business Administration of Muğla Sıtkı Koçman University between October 8–11, 2025

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Araştırma Makalesi

Mikro İşletmelerde Dijital Pazarlama Stratejileri Üzerine Keşifsel Bir Araştırma^a

İbrahim Alkara^b

Öz

Giriş: Bu çalışma, mikro işletmelerin dijital pazarlama uygulamaları konusundaki bilgi düzeyini ve kullanım durumunu belirleyerek, karşılaştıkları zorlukları tespit etmek ve bu işletmelerin dijital pazarlama uygulama süreçlerinde en sık kullandıkları araçlar, performans ölçüm yöntemleri ve destek ihtiyaçlarını da belirlemeyi amaçlamaktadır.

Yöntem: Bu çalışmada nitel keşifsel-betimsel araştırma deseni kullanılmıştır. Örneklem, Bilecik'in Bozüyük ilçesindeki 12 mikro işletmeden oluşmaktadır. Veriler, amaçlı örnekleme ve kartopu örnekleme yaklaşımıyla belirlenen gönüllü katılımcılara yarı yapılandırılmış görüşme kılavuzu uygulanarak yüz yüze görüşmeler yoluyla elde edilmiştir.

Sonuçlar ya da Bulgular: Araştırma sonuçları, görüşmelere katılan 12 mikro işletme temsilcisinin tamamının dijital pazarlamayı aktif olarak kullandığını, ancak bu kullanımın büyük ölçüde sosyal medya platformlarıyla sınırlı olduğunu göstermektedir. Katılımcıların büyük çoğunluğu görsel odaklı platformları, özellikle de "Instagram"ı tercih etmekte ve sosyal medya reklamcılığını dijital pazarlamanın temel taşı olarak görmektedir. Bu bulgu, dijital pazarlamanın geleneksel pazarlama yöntemlerinin yerini aldığını gösteriyor olsa da, mikro işletmelerin bu alanda stratejik bir derinlikten yoksun bir şekilde faaliyet gösterdiği belirlenmiştir.

Tartışma ya da Yapılan Çıkarımlar: Mikro işletmelerin dijital pazarlamayı benimseme süreci, zorunluluktan kaynaklanan yüzeysel bir katılımı ilerlemektedir. Bu nedenle, mikro işletmelerin yalnızca dijital ortamda var olmanın ötesine geçerek etkili kalabilmeleri için, bireysel inisiyatiflere güvenmek yerine kurumsal bir eğitim ve destek mekanizması tarafından desteklenmeleri hayati önem taşımaktadır. Gelecekteki araştırmalar, dijital pazarlama yatırımlarının finansal sonuçlar üzerindeki etkisini belirlemek için nicel yöntemler kullanarak literatüre katkı sağlayabilir.

Anahtar Kelimeler: dijital pazarlama, mikro işletmeler, nitel araştırma

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Introduction¹

In today's competitive business environment, digitalisation has become an increasingly important strategic consideration not only for large-scale companies but also for micro-enterprises struggling to survive on limited resources. Given the high costs and regional limitations associated with traditional marketing methods, digital marketing stands as a key tool that provides cost-effectiveness for small-scale businesses, enables direct customer interaction, and offers equal opportunities to overcome market barriers (Sharabati et al., 2024). In addition to these market barriers, the current technological revolution demands a significant restructuring of business operational efficiency, performance strategies, and client relationship networks (Bermeo-Giraldo et al., 2022). Particularly for resource-constrained small business entities, adopting advanced information communication technologies (ICTs) through web-based networking channels has evolved from a simple option into an important tactical and strategic vehicle to ensure long-term viability (Bermeo-Giraldo et al., 2022; Teixeira et al., 2018). Prior literature on organizational innovation adoption emphasizes that digital transformation requires small firms to deeply balance multi-dimensional determinants such as perceived industrial pressure, top management support, and expectation patterns against technological barriers (Bermeo-Giraldo et al., 2022; Teixeira et al., 2018). Within this framework, integrating digital marketing channels serves as a strategic axis for micro-enterprises to optimize scarce resources, reduce coordination costs, and secure an efficient market positioning layout relative to large corporate entities (Bermeo-Giraldo et al., 2022). Thus, the decision to engage in digital business environments is heavily moderated by the baseline capabilities of the entrepreneur to transform technical constraints into dynamic market opportunities (Teixeira et al., 2018).

However, despite the high potential offered by digital marketing, the extent to which micro-enterprises can adopt this process and how they manage it strategically remains a subject of debate in the literature. Recent research indicates that even when micro-enterprises in emerging markets enter digital channels, they are unable to fully integrate these tools into their long-term business plans due to a lack of technical know-how and digital literacy issues (Alharthey, 2023). Similarly, although digital technologies may be more cost-effective compared to traditional marketing, small businesses in particular may face challenges in adopting them, such as limited financial resources for investing in digital infrastructure and tools. Furthermore, they may lack the necessary knowledge and experience to select and implement digital solutions tailored to their specific needs (Zeitschel et al., 2022; Restrepo Morales et al., 2024).

Despite the potential offered by digital marketing, issues such as the extent to which micro-enterprises have adopted this process, the channels they use, and the challenges they face in this process have not been adequately addressed, particularly in the national literature. Adopting a qualitative exploratory-descriptive design, this study examines the digital marketing practices of micro-enterprises, the tools they use, the challenges they encounter, and their expectations for the future. The data for this study were collected through in-depth interviews with 12 micro-enterprises located in the Bozüyük district of Bilecik province. The study aims to fill a gap in the literature by identifying micro-enterprise owners' perspectives on digital marketing, the platforms and methods they commonly use, the time and knowledge constraints

¹ Permission was obtained from the Ethics Committee of Bilecik Şeyh Edebali University with the decision dated 19.11.2025 and document number 24/02

they face, and their strategic shortcomings. The conceptual framework section of the study explains digital marketing and its tools, followed by the literature review section, which provides examples from previous studies. The subsequent section outlines the methodology used in the research, and the findings section interprets the data obtained.

Conceptual Framework

Digital Marketing

The widespread adoption of the internet, coupled with the proliferation of fast, cost-effective communication channels and the ability to reach global audiences, has compelled marketing managers to fundamentally restructure their strategic frameworks (Lamberton & Stephen, 2016). Moving beyond traditional paradigms, digital marketing encompasses all promotional and transactional activities executed through interactive platforms, mobile applications, and interconnected digital networks (Chaffey & Ellis-Chadwick, 2019). Essentially, it represents a comprehensive approach that migrates core marketing processes into dynamic digital environments. In this context, the digital transformation of marketing operations is initiated through continuous web-based market research and consumer insight generation (Verhoef et al., 2021). Consequently, corporate digital ecosystems and web interfaces fulfill entire marketing functions—ranging from automated distribution management and dynamic pricing policies to customized after-sales services—within virtual environments (Ryan, 2020).

Digital platforms bypass traditional red tape, making business-to-consumer exchanges far more direct. This speed gives digitally agile firms a sharp edge: they enter new markets rapidly and capture untapped value (Stephen, 2016). When tied to E-CRM, the domain shifts from broad outreach to precise relationship building. As Chaffey and Ellis-Chadwick (2019) conceptualize it, digital marketing is less about isolated channels and more about orchestrating digital touchpoints to pull in and keep high-value customers.

This perspective aligns closely with the foundational definition provided by Kannan and Li (2017), who argue that digital marketing has transitioned from a novel tactical term into an overarching, multidimensional concept. It encapsulates the holistic process of leveraging cutting-edge digital technologies to attract prospective buyers, establish strong brand preferences, promote corporate identity, cultivate long-term customer loyalty, and ultimately accelerate sales performance (Kannan & Li, 2017). Businesses that successfully integrate these digital strategies can project their offerings onto expansive global audiences at minimal operational costs, while simultaneously exploiting real-time customer feedback loops (Dwivedi et al., 2021). Driven by rapid technological velocity and the exponential rise of consumer reliance on mobile platforms, modern enterprises are systematically reallocating substantial proportions of their total marketing budgets away from legacy media and toward sophisticated digital marketing instruments (Lamberton & Stephen, 2016; Verhoef et al., 2021).

In another definition provided by Kannan and Li (2017), digital marketing has evolved from a simple term at its inception into a comprehensive concept that describes the process of using digital technologies to attract customers, build brand preference, promote brands, foster customer loyalty and increase sales (Kannan & Li, 2017). Digital marketing also enables consumers with shared interests and views to form virtual communities. In this way, consumers can make their voices heard more effectively on digital platforms and come together to pool their strength. Furthermore, companies have now recognised the critical importance of establishing a ‘digital relationship’ with customers. Digital technologies and devices such as smartphones, smart products, the Internet of Things (IoT), artificial intelligence and deep

learning are expected to bring about significant transformations in consumers' lives in the near future (Kannan & Li, 2017; Alkara, 2020).

Unlike traditional brick-and-mortar approaches, digital marketing channels refer to internet-based systems capable of simultaneously creating, promoting, and delivering unique value from producers to consumers via interactive digital networks. The rapid evolution of fast and cost-effective online infrastructures has altered the way businesses discover, learn, and manage their strategic interfaces with target markets. In the contemporary digital economy, managing a corporate web presence enables small-scale operations to optimize scarce resources, reduce coordination costs, and secure an efficient market positioning layout relative to large corporate entities (Bermeo-Giraldo et al., 2022). Furthermore, utilizing technology-based marketing strategies allows smaller businesses to target niche consumer segments with personalized content, thereby creating real-time interactive experiences that foster trust and customer retention without requiring heavy capital investments. Pereira et al. (2025) conducted a bibliometric analysis of 300 scientific articles examining customer loyalty and retention in the digital environment, finding that emerging technologies—including artificial intelligence and big data—significantly shape customer experience, trust, and engagement. Their findings indicate that personalization and digital innovation, rather than the scale of capital investment, emerge as the fundamental drivers of customer retention, offering businesses of any size strategic insights to strengthen their competitiveness in the digital marketplace (Pereira et al., 2025).

Digital Marketing Tools

Nowadays, digital marketing is carried out using a wide variety of tools. The most popular methods include social media marketing, e-mail marketing, mobile marketing, affiliate marketing, PPC advertising, search engine optimisation (SEO), display advertising, viral marketing and location-based digital marketing. These digital marketing tools are briefly summarised below under the following subheadings (Alkara, 2020).

Mobile Marketing

The Mobile Marketing Association (MMA) defines mobile marketing as "*a set of applications that enables organisations to establish interactive and relevant communication and engagement with their target audiences via any mobile device or network.*" Aydin-Gokgoz et al. (2022) traced how these vehicles have developed into essential tools for contemporary business communication and advertising over the past decade, enabling organizations to establish interactive engagement with their target markets through wireless networks. Drawing on a database of 178 articles published in leading marketing journals, their review demonstrates that as handheld smart devices and smartphone applications become integrated into consumers' daily lifestyles, mobile-oriented campaigns offer advertisers a highly persuasive and cost-effective vehicle to send direct responses, streamline internal operations, and connect with ideal clients regardless of time and place parameters, while also reshaping consumer-to-firm, firm-to-consumer, and firm-to-firm marketing relationships more broadly (Aydin-Gokgoz et al., 2022).

Social Media Marketing

With the advancement of information technology, social media has provided consumers with ease and convenience in communication in their daily lives, whilst also becoming the most effective and convenient communication tool for businesses in their corporate marketing activities. Platforms such as YouTube, Facebook, Twitter and Instagram enable businesses to

reach potential customers from various demographic groups through corporate posts, regardless of time and place, to develop existing customer relationships and to acquire new customers (Dwivedi et al., 2021). Kotler and Keller (2016), on the other hand, describe it as "a platform where consumers can interactively share text, visual, video and audio content both with one another and with businesses" (Kotler & Keller, 2016; Alkara & Çalışkan, 2023). In summary, whilst socialising and self-expression are among the primary motivations for people's use of social media, there are also other objectives such as networking, accessing information and economic benefits (Kavak et al., 2020).

E-Mail Marketing

Companies use email to inform their customers and target audiences about their products, services, and other corporate developments. As Eze et al. (2021) note, e-mail marketing is an important digital marketing tool —particularly for micro-scale businesses— that enhances basic customer loyalty and makes it easier to offer special deals directly to the target audience.

Content Marketing

Content marketing encompasses systematic corporate efforts to create, distribute, and automate multimedia-focused, interactive brand content that directly addresses specific consumer questions. Du Plessis (2022) conducted a scoping review of twelve years of academic literature on content marketing's effect on online consumer behavior, synthesising evidence on how digital brand content—including blogs, infographics, and multimedia assets—shapes consumer engagement across various touchpoints. The review found that by leveraging innovative web-based assets and visual storytelling frameworks, this strategy effectively shifts the emphasis of market competition from intrusive advertising behaviours toward building reliable consumer relationships, fostering trust, and capturing high-quality organic prospects (Du Plessis, 2022).

Search Engine Optimisation (SEO)

SEO means improving the ranking of a web page in Internet by optimizing digital content to increase visibility, traffic, and brand authority across search engines. By optimizing web content, selecting relevant keywords, and building a robust backlink profile, micro-businesses can benefit from organic consumer searches; this allows them to direct highly interested prospects to the sections of their web platforms tailored to their target audience and enables them to gain a sustainable competitive advantage (Kovalenko & Kuzmenko, 2020).

PPC Advertising

PPC (Pay-Per-Click) is a digital marketing tool in which advertisers design website advertising campaigns targeting specific audiences via other websites or search engines, and pay per click for the traffic generated. Rezaei et al. (2024) examined this tool empirically within a retail banking context, finding that PPC advertising enables advertisers to swiftly target specific customer segments, enhance online and localized visibility, schedule ads for particular times and places, and maintain better budget and cost control while generating immediate, measurable results. Their path analysis further revealed that customers' attitude toward PPC advertising significantly affects both their continuous search intentions and their intentions to use the advertised services, underscoring PPC's effectiveness as a performance-based digital marketing tool (Rezaei et al., 2024). Consequently, this mechanism provides resource-constrained small and medium-sized enterprises (SMEs) with granular, real-time autonomy over the temporal distribution, messaging frequency, and operational budgetary thresholds of

their digital promotional campaigns, enabling them to maximize their market efficiency despite significant financial and human resource constraints (Ritz et al., 2019).

Display Ad

Display advertising involves the presentation of visual brand content—such as banners, images, and video—on third-party websites and applications, enabling firms to reach broad audiences through behavioral targeting (Bayer et al., 2020). As one of the most popular types of online advertising, display ads can target specific consumer characteristics to enhance advertising effectiveness. The first online advertisement was published in 1994 as an AT&T banner in HotWired magazine, at a time when there were approximately 30 million internet users (Wang et al., 2017). Display advertising utilise interactive tools, banners, visual formats, and short video structures to function as a virtual counterpart to traditional billboard advertising, across content-rich websites to capture consumer attention. Giombi et al. (2022) conducted a scoping systematic review of studies examining how interactive advertising features—including website banners, pop-ups, and social network ads—influence consumer engagement, recall, and comprehension. Their findings indicate that while interactive features can enhance consumer engagement, evidence regarding their effect on ad recall and comprehension remains mixed, suggesting that micro-enterprises must carefully calibrate interactivity levels when tailoring brand messaging to different consumer segments and communication channels in order to meaningfully improve baseline ad recall outcomes (Giombi et al., 2022).

Location-Based Digital Marketing

Location-based marketing utilizes advanced technological infrastructures to capture a consumer's real-time geographical position and behavioral data to deliver highly relatable, localized marketing notifications. Garcia (2022) explored this proximity-oriented approach through the development and evaluation of a geomarketing application employing geofencing technology, whereby immediate, context-specific commercial updates are transmitted directly to consumers' mobile devices when they enter predefined geographical target zones. The usability analysis revealed that while performance expectancy, effort expectancy, and hedonic motivation were significant factors driving user acceptance of such location-based marketing applications, businesses must also carefully manage issues related to security, privacy, advertisement relevancy, and notification overload in order to effectively transform the customer journey without alienating targeted consumers (Garcia, 2022).

Viral Marketing

Online marketplaces have rapidly transformed traditional sales methods through the interactive relationships offered by the internet. The development of the internet has altered the dynamics between source and recipient in communication, transforming consumers into active participants and making the process reciprocal and Kanna interactive. Dinh and Lee (2025) demonstrated that viral marketing leverages established social communication networks to promote exponential brand growth, product acceptance, and cost-effective message dissemination, finding that emotional engagement moderates the relationship between consumers' social and personal motivations and their participation in consumer online brand-related activities (COBRAs). By encouraging consumers to act as organic brand advocates who actively share their personal purchase experiences and product reviews online, this word-of-mouth strategy allows firms to trigger favorable customer behaviors, reduce marketing costs, and capture broad digital markets rapidly through authentic, emotionally resonant content (Dinh & Lee, 2025).

Literature Review

This section examines the concept of micro-enterprises and outlines the objectives and findings of previous international and national studies in this field.

Thirtawati et al. (2025) examined the marketing communication strategies of six agricultural social enterprises in Indonesia through a qualitative descriptive approach combining in-depth interviews with SWOT analysis. The findings revealed that limited funding and difficulties in sustaining customer engagement were the most significant barriers to effective marketing communication, while opportunities emerged through digital media utilization and stakeholder collaboration. The study further emphasized that social enterprises often struggle to move beyond ad-hoc, resource-constrained communication efforts toward a more strategic and consistent use of digital channels (Thirtawati et al., 2025).

Luo et al. (2025) employed a quantitative research design to examine the impact of short-form video content on consumer purchase intention on social media platforms, utilising structural equation modelling (SEM) via SPSS and AMOS. In the study, data collected via an online questionnaire from 372 Chinese consumers were analysed to test the effects of short video content characteristics—usefulness, ease of use, and entertainment—on consumer trust and purchase intention, drawing on the Stimulus–Organism–Response (S–O–R) framework. The results of the analyses revealed that all three content characteristics significantly influenced both consumer trust and purchase intention, with entertainment emerging as a particularly strong driver of engagement on platforms such as TikTok and Douyin (Luo et al., 2025).

Fu et al. (2024) investigated the adoption of social media marketing among small and medium-sized enterprises (SMEs) and its impact on business performance, employing the Technology-Organization-Environment (TOE) framework. Survey data were collected from 508 SMEs in Indonesia and analyzed using Structural Equation Modeling. The findings revealed that technological factors—particularly perceived advantage, complexity, and cost—created notable hesitancy among SME owners toward adopting social media marketing. In contrast, organizational factors such as top management support and employee capability, together with environmental pressures from consumers and vendors, were found to significantly drive adoption (Fu et al., 2024).

Matosas-López (2024) examined whether customer engagement (CE) on social media can serve as a predictor of operating revenue among small and medium-sized enterprises, drawing on a sample of 100 Spanish SMEs analyzed over an eight-year period. Employing Autoregressive Integrated Moving Average (ARIMA) time-series modeling, the study distinguished between enterprises managing their social media internally with non-specialized staff and those outsourcing this function to specialized professionals. The findings revealed that CE on social media could not reliably forecast operating revenue when social networks were managed internally by non-specialized personnel. However, when social media management was outsourced to specialists and combined with complementary digital marketing actions such as SEO, SEM, and email marketing, CE emerged as a significant predictor of revenue growth (Matosas-López, 2024).

Buvar and Gati (2023) examined the adoption processes of digital marketing tools among 181 micro-enterprises with limited resources in Hungary, using an online survey method within the framework of the Technology Acceptance Model (TAM). The study also investigated the impact of external information sources (such as Facebook groups and blogs), which represent informal, problem-based learning methods, and the trust placed in digital marketing professionals on the use of digital tools. The data obtained were tested using

Structural Equation Modelling (PLS-SEM), and unlike other studies, no linear relationship was found between the ‘perceived ease of use’ and the ‘perceived usefulness’ of digital marketing tools. However, trust in digital marketing consultants and professionals was identified as the factor that most significantly accelerates adoption by making the technology perceived as both easier to use and more beneficial (Buvar and Gati, 2023).

Ritz et al. (2019) examined the motivations of small business managers to run their own digital marketing campaigns by integrating the ‘Do-It-Yourself (DIY)’ behaviour model with the Technology Acceptance Model (TAM). Data from an online survey of 250 small business managers who manage their own promotional activities was analysed using Structural Equation Modelling (SEM). The research found that the DIY model, developed for consumer behaviour, is also applicable to commercial activities. It was determined that businesses undertake these activities in-house because they find external professional services costly or because packaged services do not fully align with the business ethos; furthermore, a strong sense of control and a desire for self-development were found to be present during the execution of the process (Ritz et al., 2019).

Taiminen and Karjaluoto (2015) examined the current level of use, objectives and barriers to the use of digital marketing tools in SMEs in Finland using a mixed-methods research design. Qualitative data obtained from semi-structured interviews with 16 different marketing managers in the first phase was supported by quantitative data collected via an online survey from 421 SME representatives in the second phase. According to the results, despite the general prevalence of digitalisation, it was found that approximately 46% of SMEs admitted to misusing digital marketing. It was found that most businesses use social media as a one-way announcement tool rather than an interactive dialogue tool; time constraints, staff shortages and a lack of expertise were identified as the major internal barriers delaying technological integration (Taiminen & Karjaluoto, 2015).

A review of the international literature reveals that research on digital marketing in micro-enterprises has primarily focused on topics such as the adoption of new technologies, integration with technological and digital developments, strategy development, and the measurement of performance success; it has been established that these studies have been unable to implement effective digital marketing strategies due to obstacles such as insufficient resources, inadequate levels of digital marketing knowledge, and the limited capabilities of businesses, preventing them from implementing effective digital marketing strategies. Subsequent studies have focused on the adoption of emerging digital technologies, such as artificial intelligence, and the various factors influencing them; however, recent research has been observed to focus more on the factors influencing digital marketing success in micro and small businesses, strategic improvements aimed at enhancing competitive strength, and specific methods used to achieve measurable results.

The contemporary strategic configuration of digital and interactive marketing capabilities within the micro-enterprise ecosystem often exhibits a highly reactive, superficial, and short-term operational posture (Eze et al., 2021). Because micro-scale operations are consistently bedeviled by acute financial limitations, poor institutional infrastructure, and gaps in technical know-how, these firms traditionally target digital platforms that promise instantaneous sales conversions or quick, low-cost customer interactions (Gao, 2025). Consequently, Gao (2025) enhanced the traditional Technology Acceptance Model by incorporating consumer engagement as a critical mediating construct—reflecting the resource constraints and rapidly evolving market conditions characteristic of firms in developing economies such as China and Kazakhstan. Empirical investigation using structural equation

modelling and regression analysis across 390 firms in these emerging countries revealed a highly fragmented outcome: while the implementation of digital marketing tools and investment in digital marketing technologies related directly and positively to business performance, the effect sizes for direct tool implementation remained comparatively modest, with consumer engagement and the resulting capacity for digital transformation emerging as far stronger and more consistent predictors of firm success than the mere adoption of any single marketing channel (Gao, 2025).

In particular, limited research has been found in the national literature in recent years that examines the experiences of micro-enterprises in digital marketing processes using a qualitative research approach. Unlike studies in the national literature, this study focuses on digital marketing processes in micro-enterprises. The primary aim of the study is to determine micro-enterprises' levels of digital marketing knowledge, the tools they use, their practices, and the challenges they face.

Method

Research Design, Sample and Data Collection Process

This study employed a qualitative exploratory-descriptive research design. Qualitative research is a process that centres on participants' perspectives, aims to uncover truths through in-depth analysis, and is conducted using techniques such as observation, interviews and document analysis. The main designs of qualitative research include narrative, ethnography, theory building, case study and phenomenology (Creswell, 2017). Sample sizes vary significantly depending on the design; for instance, Creswell suggests a range of 5 to 25 participants for phenomenological studies. In this study, the qualitative exploratory-descriptive research design was chosen in order to obtain valid data in line with the study objectives and purposive sampling was employed to select participants who possessed direct, in-depth experience regarding the phenomenon under study (Lincoln & Guba, 1985). The final sample comprised 12 participants. Given the qualitative, descriptive nature of the study and the rich, extensive narratives obtained from individual interviews, this group size was deemed adequate to achieve sufficient descriptive depth without imposing predetermined numerical thresholds (Malterud et al., 2016)

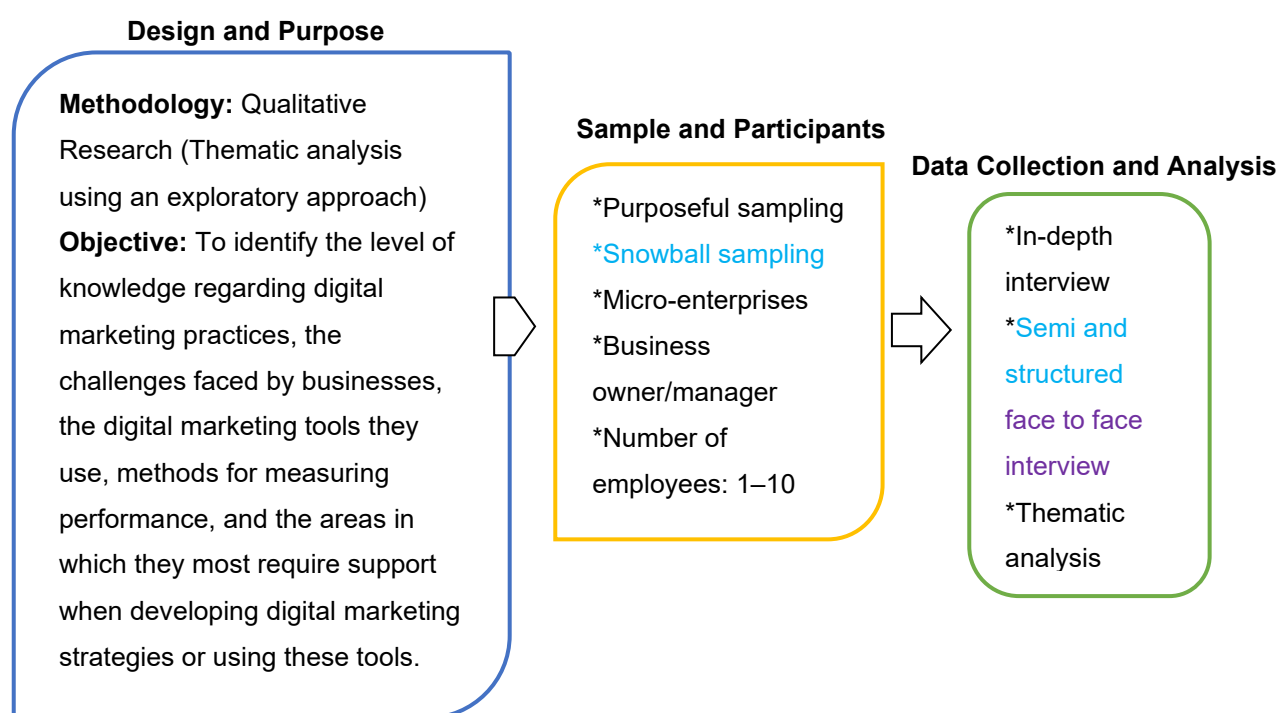
The research design has been structured around the defined research questions and theoretical framework; through the selected qualitative method, the aim is to gain an in-depth understanding of the subject under investigation by drawing on the participants' own experiences. In line with this, a semi-structured interview guide was developed to serve the research objective. In addition, closed-ended questions were asked separately in the interview guide to obtain current demographic information about the businesses. The flexible structure offered by this method enabled participants to express their views freely. Thanks to this design, which is fundamentally exploratory in nature whilst also possessing descriptive characteristics, comprehensive answers were sought to the research questions outlined below.

- What is the level of knowledge regarding digital marketing practices among micro-enterprises?
- Which digital marketing tools are most commonly used by micro-enterprises?
- What challenges do micro-enterprises face when implementing digital marketing processes?

- In which areas do micro-enterprises require the most support when developing digital marketing strategies and using digital marketing tools?
- How do micro-enterprises measure the effectiveness of the digital marketing strategies they implement?

Figure 1.

Research design



Note. This figure was created by the author via using Ms word software.

The sample for this study consists of 12 micro-enterprises in the Bozüyük district of Bilecik. Participants were selected using purposive and snowball sampling strategies. Data were collected through face-to-face interviews conducted with a semi-structured interview guide and Before taking part in the interview, the participants agreed to support the study by completing the informed consent forms. The research process is illustrated in Figure 1.

The study aims to reveal the levels of knowledge and usage of digital marketing among micro-scale businesses. Furthermore, the challenges these businesses face in digital marketing, the tools they use most frequently, their performance measurement methods, and their support needs were also examined. Although the topic of digital marketing is widely covered in the literature, the lack of studies focusing on micro-scale businesses is noteworthy.

Data Collection Process

Since snowball sampling method was used in this study as a data collection method, the permission has been obtained from Ethics Committee of the Bilecik Şeyh Edebali University with a decision on the date of 19.11.2025 and document number 24/02. All participants were informed about the purpose of the study, the voluntary nature of participation, confidentiality procedures, and their right to withdraw. Written informed consent was obtained before the

interviews. The data collection process was carried out between 20 November 2025 and 15 December 2025 through face-to-face interviews with businesses.

Each interview lasted between 50 and 75 minutes on average. Although micro-enterprises constituted the unit of analysis, 11 interviews were conducted with business owners and one interview was conducted with an employee representing the enterprise. As it was necessary for the business representatives taking part in the study to have sufficient knowledge of the business in order to answer the questions, interviews were conducted with business owners and employees who, on their behalf, possessed a sufficient level of knowledge about the business.

Data Analysis

The data were analysed using a deductive thematic analysis informed by Braun and Clarke's (2006) analytical stages. Initial themes were derived from the research questions, while additional patterns emerging from the data were considered during repeated readings of the transcripts. The analysis phase began with the careful listening to and transcription of the interview audio recordings; during this process, the statements were transcribed verbatim. To protect the participants' confidentiality, each was assigned a unique code number. In accordance with the research questions and the structure of the semi-structured interview form, a deductive approach was adopted, and the main themes were established prior to the analysis. Taking into account the volume of data and the scope of the study, and without the need to use any software packages, the transcribed texts were read repeatedly; the coding was conducted manually by the researcher. Following the initial coding, the transcripts and theme classifications were reviewed again to assess consistency between the raw data, codes, and themes. An audit trail documenting the coding and theme-development decisions was maintained to ensure the scientific validity and reliability of the research, the study did not rely on a single method; in line with Lincoln and Guba's (1985) four fundamental criteria, strategies of member validation, detailed (thick) description, audit trail and reflexivity were integrated not only into the data collection and analysis stages but throughout the entire research process.

Validity and Reliability

The research process was conducted with great care, taking into account four fundamental elements (credibility, transferability, reliability and confirmability) to ensure the validity and reliability of the study. In qualitative research, the primary aim is to explore in depth individuals' epistemological feelings, perceptions and the process of meaning-making (Kocaman, 2024). Participants' statements were supported by direct quotations, and interpretations were presented in a manner consistent with the data, thereby strengthening the reliability and credibility of the research in the study. These procedures were used to strengthen the credibility, transferability, dependability, and confirmability of the study. Furthermore, the inclusion of participants from different sectors and with varying statuses has increased data diversity, thereby contributing to the clearer identification of common patterns and divergent experiences during the thematic analysis process. To enhance the transferability of the findings, the research setting, participant characteristics, data-collection process, and analytical procedures were described in detail to ensure that the findings can be transferred to other contexts. A 'participant interview table' was created to take into account the participants' micro-enterprises; sector, title, interview location, date and duration during the analysis process, and is shown in Table 1 below.

Table 1*Characteristics of the Participants and Enterprises*

Companies interviewed	Sector and Title
P 1	Retail Jewellery, Business Owner
P 2	Retail (Clothing), Employee
P3	Retail, services (Stationery), Business owner
P4	Restaurant, café, business owner
P5	Retail (Silver Jewellery), Business owner
P6	Restaurant, café, business owner
P7	Restaurant, café, business owner
P8	Pet shop, business owner
P9	Pet shop, business owner
P10	Restaurant, café, business owner
P11	Service sector, Hairdresser, business owner
P12	Restaurant, café, business owner

Note. Created by the author using Ms Word software.

Findings

In this section of the study, the in-depth interviews conducted with businesses have been summarised under a total of four common themes and presented in tabular form. These are presented under the following headings: General Digital Marketing Profile of Micro-Enterprises; Use of Digital Marketing Platforms and Methods; Challenges Faced in Digital Marketing and Support Needs; and Content Strategies and Future Vision.

The General Demographic Profile and Business Profiles of the Participants

An analysis of the demographic characteristics of the business owners and the employee who participated in the interviews, representing the 12 micro-enterprises involved in the study, reveals that their ages range from 24 to 60. The majority of participants were business owners with staff numbers ranging from 1 to 10. Seven of the businesses were established before 2018, whilst five were established more recently (in 2022 or later). The main sectors in which they operate are classified as Restaurants/Cafes, Retail and Services. Statements regarding participant profiles and the purposes of digital marketing usage are summarised in Table 2 below.

Table 2*The Demographic Profile and General Digital Marketing Profile of Micro-Enterprises*

Partici pant	Age / Gender / Role	Sector	Year of Establis hment	Numb er of staff	Web site	Digital Marketing Objectives
P1	41/F/ Business Owner	Retail (Jewellery)	2012	1	No	Retaining existing customers
P2	42/M/Employee	Retail (Clothing)	2016	2	Yes	To increase sales
P3	60/M/Business Owner	Retail (Stationery)	2013	4	Yes	To increase brand awareness and sales
P4	35/M/ Business Owner	Restaurant/ Café	2018	3	Yes	To increase sales
P5	47/F/ Business Owner	Retail (Silver Jewellery)	2023	1	No	Brand awareness, increasing sales, customer loyalty, acquiring new customers
P6	32/M/ Business Owner	Restaurant/ Café	2023	2	No	To increase brand awareness
P7	35/M/ Business Owner	Restaurant/ Café	2023	1	Yes	To increase sales
P8	24/M/ Business Owner	Retail (Petshop)	2023	10	Yes	Brand awareness, increasing sales, customer loyalty, acquiring new customers
P9	48/F/ Business Owner	Retail (Petshop)	2010	2	No	Brand awareness, to boost sales
P10	37/M/ Business Owner	Restaurant/ Café	2022	8	No	To increase brand awareness
P11	38/F/ Business Owner	Retail	1997	5	Yes	Brand awareness, acquiring new customers, retaining existing customers
P12	59/M/ Business Owner	Restaurant/ Café	2009	1	No	Brand awareness, increasing sales, customer loyalty, acquiring new customers

Note.Created by the author using Ms. Word software.

Participants' Use of Digital Marketing and Their Strategies

During the interviews, participants were asked about their use of digital marketing and were then asked to select the channels they use most frequently. All participants stated that they use digital marketing. The most popular digital marketing platform used by businesses was

Instagram, which all 12 participants actively use. Instagram is followed by Facebook. Whilst the majority of participants do not use a website, those who do have a website generally stated that they also actively use social media platforms.

Table 3

The Most Popular Digital Marketing Platforms and Methods

Participant	Platforms Used	The Most Active Platform	Web site	The-Most Popular Methods	Email Marketing Usage
P1	Facebook, Instagram	Facebook	No	Social Media Advertising	No
P2	Facebook, Instagram, Google my Business	Instagram	yes	Social Media Advertising, Online Reviews	No
P3	Facebook, Instagram, TikTok, YouTube	Instagram	yes	Social Media Advertising	No
P4	Facebook, Instagram, TikTok, YouTube, Twitter	Instagram	yes	Social Media Advertising, Online Reviews	No
P5	Instagram	Instagram	No	Social Media Advertising	No
P6	Instagram	Instagram	No	Social Media Advertising	No
P7	Facebook, Instagram, Twitter	Instagram	yes	Social Media Advertising	No
P8	Facebook, Instagram	Instagram	yes	Social Media Advertising	No
P9	Instagram	Instagram	No	Social Media Advertising, Online Reviews	No
P10	Instagram	Instagram	No	Social Media Advertising	No
P11	Facebook, Instagram	Facebook	yes	Social Media Advertising, Online Reviews	No
P12	Instagram	Instagram	No	Social Media Advertising	No

Note.Created by the author using Ms. Word software.

As can be seen in Table 3, the digital marketing method most preferred by participants was ‘social media advertising’, with all 12 participants stating that they regarded social media advertising as the most important digital marketing method. This was followed in second place by online reviews and customer feedback. It was stated that email marketing, one of the oldest digital marketing tools, was not used by any of the participants.

Participants were also asked a separate question regarding their knowledge and usage of local SEO. Although all participants stated that local marketing is very important, it was found that they did not have sufficient knowledge of local SEO (Search Engine Optimisation) and Google My Business. For example, 11 out of 12 participants stated that they did not use local SEO. P6 emphasised just how low the level of knowledge on this subject was, saying, What is Google My Business? I’ve never heard of it before. Furthermore, in response to the question

“Do you need local SEO?”, P10 replied, We don’t need it. These findings regarding local SEO demonstrate that, micro-business owners recognise the importance of local awareness and visibility but yet they do not know which tools they should use or how they use them effectively.

Participants’ Challenges in Digital Marketing and an Assessment of Their Success

In the next section, participants were asked to describe the challenges they faced in their digital marketing activities, their support needs, and how they assessed their own performance. They were also asked whether they had set aside a specific budget for digital marketing activities. The participants’ responses are summarised in Table 4. In general, participants indicated that they had encountered various challenges. The most frequently cited challenges were:

- Lack of time: More than half of the participants stated that they were unable to allocate sufficient time to digital marketing.
- Lack of digital marketing knowledge: Approximately one-third of the participants have stated that they lack knowledge and strategy in this area.
- Challenges in content creation: It appears that creating regular and engaging content is a challenge. (Approximately one-third of the participants stated that “they struggled to produce content on a regular basis.”)
- Insufficient budget: Although there were participants who set aside a budget, the budget itself was cited as a source of difficulty. Only four of the participants (P3, P4, P7, and P8) indicated that they were able to regularly allocate a budget for digital marketing.

When participants in the field of digital marketing were asked to evaluate themselves in terms of success, the responses varied among participants. While 5 of the participants (P3,P4,P6,P7,P8) stated that they are progressing successfully, 3 (P2,P5,P12) said they think they are failing, and another 4 business (P1,P9,P10,P11) representatives responded they are undecided. This situation also suggests that micro-enterprises lack sufficient knowledge in measuring and evaluating their digital marketing implementation processes, assessing the effectiveness of their investments, and obtaining clear results.

As can be understood from the participants' statements, micro-enterprises indicated that they most need support in the following areas of digital marketing: Professional services (more than half of the participants) the majority of participants stated that they need professional agency or consultancy services; Secondly, while there is need for training and guidance; in third place were the representatives of the participating companies experiencing knowledge gaps emphasized the importance of training and guidance in this field and Software/tool support the need for tools and software that would facilitate digital marketing was also expressed.

Table 4*Challenges in Digital Marketing and Support Needs*

Participant	Challenges in Digital Marketing	Monthly Budget	Performance Review	Support Needs
P1	Do not have	Do not have	indecisive	Education and guidance
P2	lack of time	Do not have	Failed	Education and guidance
P3	lack of time	5,000 TL and over	Successful	Professional services
P4	The difficulty of creating content, Lack of time	500-1500 TL	Successful	Professional services, Software/tool support
P5	Difficulty in reaching the target audience	Do not have	Failed	Professional services
P6	Lack of information, lack of time	Do not have	Successful	Education and guidance
P7	Not enough time	1500-5000 TL	Successful	Professional services
P8	Lack of time, difficulty in reaching the target audience	5,000 TL and over	Successful	Training and guidance, Software/tool support
P9	Insufficient budget	Do not have	indecisive	Professional services, Budget increase
P10	Insufficient budget, lack of information, difficulty in producing content	Do not have	indecisive	Education and guidance
P11	Insufficient budget, lack of information, difficulty in producing content	Do not have	indecisive	Education and guidance, Professional services
P12	Difficulty in reaching the target audience, Difficulty in producing content	Do not have	Failed	Training, Professional services, Software support

Note.Created by the author using Ms. Word software.

5 of the 12 businesses participating in the research consist of newly established businesses founded between 2022 and 2023. The perspectives of these new businesses toward digital marketing differ from those of more established ones. For example:

- Businesses established in 2023, such as P5 and P6, stated that they have allocated no budget at all for digital marketing.
- In contrast, businesses also founded in 2023 and operating in similar sectors (Restaurant/Café and Services), such as P7 and P8, allocate monthly budgets of 1,500–5,000 TL and above 5,000 TL, respectively.

This situation demonstrates that digital marketing has not yet become a standardized investment item among new businesses, and that the decision to allocate a budget depends on the personal initiative and vision of the business owner.

Participants' Content Strategies and Vision for the Future

Participants were asked about topics covering their content strategies and future visions in the subsequent questions. Looking at social media content strategies, 7 of the 12 participants stated that (P2,P3,P4,P5,P7,P8,P12) product promotions are the content that receives the most engagement. Customer reviews/feedback also stand out as an important source of engagement (P1,P4,P6,P7,P8,P9,P11). Regarding content creation, (P2,P4,P5,P7,P9,P11,P12) 7 of the participants indicated that they experience difficulties, 4 of the participants (P2,P9,P11,P12) stated that they occasionally face challenges, and 4 of the participants (P1,P3,P6,P8) (reported having no problems at all. In terms of social media advertising, 4 of participants (P3,P4,P7,P8) are actively running ads, while 5 of participants (P2,P5,P9,P11,P12) stated that they have not yet advertised but they are considering trying it in the future. 3 of participants (P1, P6, P10) stated that they had no experience with social media advertising and did not plan to run ads in the future. The expressions used and answers given by the businesses regarding questions about their content strategies and future visions are presented below in Table 5.

Table 5

Content Strategies and Future Vision

Participant	Content Creation Challenges	Most Engaging Content	Social Media Ads	Lack of Growth on Social Media	Future Plans
P1	No	Customer Reviews	No experience, not interested	Regular content sharing	No changes are planned
P2	Sometimes	Product presentations	No experience, but willing to give it a go	Regular content sharing	A budget increase is planned
P3	No	Product presentations	Use Ads regularly	Advertising budget	Revising the digital strategy
P4	Yes	Product presentations, Customer reviews	Use Ads regularly	Not enough time	Revising the digital strategy
P5	Yes	Product presentations	No experience, but willing to give it a go	Regular content sharing	No changes are planned
P6	No	Customer Reviews	No experience, not interested	Regular content sharing	No changes are planned
P7	Yes	Product presentations, Customer reviews	Use Ads regularly	Not enough time	Revising the digital strategy
P8	No	Product presentations, Customer reviews	Use Ads regularly	Sufficient interaction	Being active on different platforms
P9	Sometimes	Customer Reviews	No experience, but willing to give it a go	Regular content, Advertising budget	Being active on different platforms

P10	Yes	No answer	No experience, not interested	Regular content, Advertising budget, Sufficient engagement	No changes are planned
P11	Sometimes	Customer Reviews	No experience, but willing to give it a go	Regular content, Advertising budget	Being active on different platforms
P12	Sometimes	Product presentations	No experience, but willing to give it a go	Not enough time	Being active on different platforms, Revising the digital strategy

Note.Created by the author using Ms. Word software.

Looking at their future goals, 4 of the participants stated that “they have no changes planning in near future (P1,P5,P6,P10); the other 8 participants (P2, P3, P4, P7, P8, P9, P11, P12) plan to change their digital marketing strategies. In addition, four of these businesses (P8, P9, P11, P12) aim to be active on different platforms.

Discussion and Limitations

Discussion

When compared to studies based on SMEs’ digital marketing practices within the Technology Acceptance Model (TAM) framework, the findings of this study are generally consistent. While previous studies have shown that perceived ease of use and perceived benefits are key determinants of technology adoption, this study found that participants’ perception of Instagram as a digital marketing tool and their active use of it indicated a high perceived ease of use. However, the study also revealed that email and local SEO were not used for marketing purposes, and that the perceived benefits of more complex tools remained limited among participants. This finding supports the results of a study by Alharthey (2023) conducted on micro-enterprises in emerging markets.

From a Technology-Organization-Environment (TOE) perspective, the technological barriers (inadequate digital literacy), organisational constraints (time, budget, single-person operations), and environmental factors (limited peer adoption within the district) identified in this study collectively explain why adoption remains confined to low-complexity, high-visibility platforms. This resonates with Zeitschel et al. (2022), who found that cost sensitivity and knowledge gaps remain persistent adoption barriers for micro-firms regardless of geographic context.

The thoughts and opinions of business representatives participating in the study regarding digital marketing reflect a needs-based approach rather than an opportunity-based one, as seen in the study by Restrepo Morales et al. (2024). However, the findings of the study suggest that, in order to develop and implement a more strategic approach to digital marketing in micro-enterprises located in relatively smaller regions, not only must individual capacities be developed, but institutional and structural support may also be necessary.

Limitations

There are various limitations that must be taken into account when interpreting the findings of this study. As the sample consists of micro-businesses from the Bozüyük district of Bilecik province, this may create selection bias because the participating businesses may not

represent all micro-enterprises in Bozüyük. The findings are context-specific and are not intended for statistical generalisation. However, the detailed description of the research setting and participant characteristics may help readers assess their potential transferability to similar contexts. In addition, the data obtained through interviews is based on the responses to the questions provided by the business owners or an employee representing the participating enterprise. It has not been possible to verify the data using other sources. This situation limits internal triangulation. Another limitation of the study is the sample size. Whilst a sample size of 12 businesses may be sufficient for a qualitative study with an exploratory aim, it is not possible to generalise the findings.

Conclusion

This research offers an in-depth account of the digital marketing experiences of micro-enterprises, spanning their current practices, operational dynamics, and lived experiences. The findings reveal that all 12 micro-enterprise participants actively engage with digital marketing. But this adoption is predominantly confined to social media platforms (especially Instagram). The vast majority of participants exhibit a strong preference for visually oriented channels, particularly Instagram, appearing to associate digital marketing predominantly with social media advertising. Although this shift indicates that digital avenues are supplementing traditional marketing methods, it simultaneously underscores an important limitation: micro-enterprises operate without strategic depth or long-term planning. This pattern is shaped by well-defined internal barriers: insufficient time, notable gaps in specialized knowledge in specialized knowledge, and inadequate budget allocation. Excessive daily workloads prevent micro-enterprises from sustaining consistent efforts, resulting in irregular content deployment and tactical improvisation, while half of the participants lack a dedicated budget and the rest operate under tight financial constraints. These findings are consistent with the existing literature on the resource constraints faced by micro-enterprises. This narrow perception also impedes the development of robust omni-channel strategies, despite recent emphasis by Febriani et al. (2025), who demonstrated that even when MSMEs recognize the strategic value of integrating online and offline channels, limited resources and managerial capacity constrain their ability to progress beyond fragmented, early-stage omnichannel adoption.

Perhaps the most striking finding concerns what micro-enterprises do not use. Low-cost, high-return channels remain almost entirely absent from their repertoire: eleven of the twelve participants had made no attempt at local SEO (Search Engine Optimization), and not a single participant had ever run an email marketing campaign. This limited engagement indicates that micro-enterprises equate popular, consumer-facing platforms with the digital marketing ecosystem as a whole, leaving instruments that are decisive for competitiveness in localized markets largely unused. The pattern points less to deliberate strategic choice than to restricted technical know-how and digital literacy—an interpretation reinforced by the dual bottlenecks of limited time and limited expertise, which closely mirror the internal organizational barriers reported by Taiminen and Karjaluoto (2015).

When contextualized within the specific socio-economic landscape of the Bozüyük district in Bilecik, these empirical insights underscore a broader phenomenon documented across the SME literature: a relatively limited and necessity-driven form of digital engagement rather than a knowledge-based strategic posture. This is reflected in a discernible hesitancy among SMEs to adopt social media marketing strategies, driven primarily by technological apprehensions concerning perceived advantage, complexity, and cost (Fu et al., 2024). This pattern reinforces international evidence concerning small-scale structures in peripheral or non-metropolitan settings, where perceived cost remains a significant negative predictor of the

intention to adopt social media marketing (Abbasi et al., 2022). In these rural or semi-urban environments, smaller firms overwhelmingly rely on scarce, internal human resources to manage digital activities. Structurally, organizational performance in SMEs has been shown to depend heavily on knowledge management capability, financial literacy, and problem-solving skills that are typically in short supply among small, resource-constrained firms. These dynamics align with broader findings that digital marketing capabilities carry significant value relevance for firm performance (Homburg & Wielgos, 2022), underscoring why superficial, low-capability digital engagement prevents firms from converting visual traffic into premium sales conversion rates or sustainable brand awareness.

Moving micro-enterprises from a passive digital presence to genuine digital performance may require a gradual shift from individual improvisation to structural support. Regional policymakers, chambers of commerce, and development agencies should therefore carefully develop low-cost digital literacy training and technical advisory services tailored to the constraints of rural enterprises. Future research could extend these findings through longitudinal, cross-sectoral studies that quantify the returns of local SEO and comparable low-cost tools, and could examine how—or whether—micro-enterprises measure and evaluate their digital marketing investments over time.

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Research Article

**Sustainability and ESG Performance in Renewable Energy Companies: A
Comparative Multiple Case Study of Türkiye and Europe**

Mustafa Zeytin^a

Abstract

Introduction: This study provides a comparative analysis of sustainability performance between Turkish renewable energy companies Aydem, Smart Solar, Galata Wind and European counterparts for the 2020–2022 period. The research addresses the critical gap in understanding how sustainability practices differ between emerging and developed energy markets, and whether convergence trends exist despite structural disparities.

Method: The analysis focuses on three key dimensions of corporate sustainability (financial, environmental, and social indicators). Data was compiled from companies' sustainability and activity reports and analyzed using descriptive statistics, comparative indicator analysis, min-max normalization, and the creation of an equally weighted composite ESG index.

Results or Findings: The findings reveal significant differences between Turkish and European companies. While European companies demonstrate substantially higher financial capacity and installed power, Turkish companies exhibit rapid growth despite scale limitations. In environmental indicators, although European companies have higher absolute values, normalized data show more efficient carbon and water intensities compared to most Turkish companies. Social indicators reveal persistent gender imbalance across the entire sample, yet European companies demonstrate more systematic training practices and lower accident rates.

Discussion or Conclusion: The study highlights the importance of normalization in assessing inter-company ESG performance, emphasizes inconsistencies in reporting standards and data quality issues in emerging markets, and offers policy implications for Turkey's renewable energy sector alignment with international benchmarks.

Keywords: sustainability, ESG performance, sustainability accounting, renewable energy companies, Turkey–Europe comparative

JEL Codes: M14, M40, Q40.

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**Yenilenebilir Enerji Şirketlerinde Sürdürülebilirlik ve ESG Performansı: Türkiye-
Avrupa Karşılaştırmalı Vaka Çalışması**

Mustafa Zeytin^a

Öz

Giriş: Bu çalışma, 2020-2022 dönemi için Türk yenilenebilir enerji şirketleri Aydem, Smart Solar ve Galata Wind ile Avrupalı muadilleri arasındaki sürdürülebilirlik performansının karşılaştırmalı bir analizini sunmaktadır. Araştırma, gelişmekte olan ve gelişmiş enerji pazarları arasında sürdürülebilirlik uygulamalarının nasıl farklılık gösterdiğini ve yapısal farklılıklara rağmen yakınsama eğilimlerinin olup olmadığını anlamadaki kritik boşluğu ele almaktadır.

Yöntem: Analiz, kurumsal sürdürülebilirliğin üç temel boyutuna (finansal, çevresel ve sosyal göstergeler) odaklanmaktadır. Veriler şirketlerin sürdürülebilirlik ve faaliyet raporlarından derlenmiş; tanımlayıcı istatistikler, karşılaştırmalı gösterge analizi, min-maks normalizasyonu ve eşit ağırlıklı bileşik ESG endeksi oluşturma yöntemi kullanılarak analiz edilmiştir.

Sonuçlar ya da Bulgular: Türk ve Avrupa şirketleri arasında önemli farklılıklar tespit edilmiştir. Avrupa şirketleri önemli ölçüde daha yüksek finansal kapasite ve kurulu güç gösterirken, Türk şirketleri ölçek sınırlamalarına rağmen hızlı büyüme sergiliyor. Çevresel göstergelerde, Avrupa şirketlerinin mutlak değerleri daha yüksek olsa da normalleştirilmiş veriler çoğu Türk şirketine kıyasla daha verimli karbon ve su yoğunlukları gösteriyor. Sosyal göstergeler, tüm örnekleme kalıcı bir cinsiyet dengesizliğini ortaya koyarken, Avrupa şirketleri daha sistematik eğitim uygulamaları ve daha düşük kaza oranları sergiliyor.

Tartışma ya da Yapılan Çıkarımlar: Çalışma, şirketler arası ESG performansını değerlendirmede normalleştirmenin önemini vurgulamakta, gelişmekte olan pazarlardaki raporlama standartlarındaki tutarsızlıkları ve veri kalitesi sorunlarını ortaya koymakta ve Türkiye'nin yenilenebilir enerji sektörünün uluslararası kıyaslamalarla uyum sağlaması için politika önerileri sunmaktadır.

Anahtar Kelimeler: sürdürülebilirlik, ESG performansı, sürdürülebilirlik muhasebesi, yenilenebilir enerji şirketleri, Türkiye-Avrupa karşılaştırması

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Introduction

The transition to a low-carbon economic structure on a global scale is possible through structural transformations in the energy sector and the alignment of these transformations with sustainability goals (Kozar & Sulich, 2023; Genc & Kosempel, 2023; Kamali Saraji & Streimikiene, 2023). Greenhouse gas emissions caused by fossil fuels increase climate change risks and price volatility (Romanello et al., 2022), while also reducing energy supply security and creating significant uncertainties in terms of environmental costs (Stepanov & Makarov, 2024). The role of renewable energy sources is of strategic importance not only in terms of environmental sustainability, but also in terms of economic development and social welfare (Omri & Belaid, 2021; Karimi Alavijeh et al., 2024; Lu et al., 2022). According to the International Energy Agency's projections, the share of renewable energy sources in global electricity production will continue to increase rapidly over the next decade; the European Union's 2030 and 2050 targets will make renewable energy investments mandatory for a carbon-neutral future (European Commission, 2020). The European Green Deal, which holds a central position in the European Union's energy transition strategy (Fetting, 2020), sets technical targets for greenhouse gas reduction and strengthens sustainable financing, corporate governance, and transparent reporting standards. Regulations now require energy companies to report their financial performance not only in terms of profit and investment levels, but also in conjunction with environmental and social responsibility indicators (Dathe et al., 2024; Chen et al., 2024). Companies' economic growth targets are pursued within a framework that is consistent with their climate change mitigation strategies (França et al., 2023; Khan et al., 2022). European energy companies such as Iberdrola (Alvarez-Meaza et al., 2020), Ørsted (Thomas, 2025), and EDP Renováveis are emerging as global leaders in the energy transition process not only through their financial capacity but also through their emission reduction strategies, circular economy practices, and social impact programs. Turkey has seen a significant increase in renewable energy investments over the past decade, and the share of renewable energy sources in the country's total installed capacity has approached 50% (Türkiye Elektrik İletim A.Ş., 2022). The development of renewable energy is important not only for ensuring energy security and reducing external dependency, but also for fulfilling Turkey's emission reduction commitments under the Paris Agreement (Erat et al., 2021; Budak, 2025; Kat, 2023). Aydem Renewable Energy Inc., Smart Solar Energy Technologies Inc., and Galata Wind Energy Inc., which are traded on the capital markets in Turkey, contribute to financial growth and the expansion of renewable energy capacity in the national energy market and conduct environmental and social performance reporting (Erdoğan et al., 2026; Sogukpinar et al., 2025). Although there is extensive literature on renewable energy companies, comparative findings regarding emerging markets remain limited. Using intensity-based normalization and a composite ESG (Environmental, Social, and Governance) index, this study compares three Turkish and three European renewable energy companies across financial, governance, environmental, and social indicators for the 2020–2022 period. Research on the sustainability performance of renewable energy companies is primarily based in Europe and the US, focusing particularly on the emission reduction strategies, investment dynamics, and corporate reporting practices of large-scale energy companies (Murugan et al., 2025; Cicchiello et al., 2023; Drago & Gatto, 2022; Hartmann et al., 2021; Crijns-Graus et al., 2022). There appears to be a limited number of comparative studies on the global positioning of energy companies in emerging markets such as Turkey. Given Turkey's rapid increase in renewable energy capacity and the growing importance of energy companies traded on the Istanbul Stock Exchange for international investors, this area stands out as a topic that should be considered in the context of sustainability and investment strategies. The main contribution of this study is that it analyzes renewable energy companies in Turkey and Europe not only in terms of financial performance

but also in a comprehensive manner, taking into account environmental and social indicators. The study examines Aydem, Smart Solar and Galata Wind from Turkey, listed on the BIST 30 index, and Iberdrola, Ørsted, and EDP Renováveis from Europe, listed on the EURO STOXX 50 index, for the 2020–2022 period. The study is designed as a comparative case study on a total of six renewable energy companies selected from Türkiye and Europe. The analysis comparatively evaluated the companies’ financial governance indicators, such as net sales revenue, investment expenditures, installed capacity, and production volume; environmental indicators, such as energy consumption, water usage, waste management, and greenhouse gas emissions; and social indicators, such as the number of employees, female employment rates, occupational health and safety data, and training activities.

Method

Research Scope and Data Set

This study is based on a comparative case study of the financial, environmental, and social indicators of renewable energy companies in Türkiye and Europe for the period 2020–2022. The Turkish sample consists of Aydem Renewable Energy Inc. (Aydem), Smart Solar Energy Technologies Inc. (Smart Solar) and Galata Wind Energy Inc. (Galata Wind), which are traded on the Borsa Istanbul (BIST) 30 index. The European sample consists of Iberdrola S.A. (Spain), Ørsted A/S (Denmark) and EDP Renováveis S.A. (Portugal), which are listed on the EURO STOXX 50 index and are global leaders in the renewable energy sector. The data has been compiled from the companies’ sustainability reports (Iberdrola, 2022b; Ørsted, 2022b; EDP Renováveis (EDPR), 2022b; Aydem, 2022b; Smart Solar, 2022b; Galata Wind, 2022b), annual activity reports (Iberdrola, 2022a; Ørsted, 2022a; EDPR, 2022a; Aydem, 2022a; Smart Solar, 2022a; Galata Wind, 2022a) and official statements published on their corporate websites. To minimise misleading effects arising from exchange rate differences in the comparisons, the financial indicators of European companies are presented in Euros, while those of Turkish companies are presented in Turkish Lira. However, the analysis focuses on revealing trends, growth rates and relative differences rather than size comparisons.

The coding system used in Table 1 was chosen to reduce repetition in the presentation of findings and to enhance comparability in the graphs. It has been used in the presentation of financial, environmental, and social indicators in the subsequent sections of the study. In the coding, the letter ‘T’ represents companies in the Turkish sample, while the letter ‘E’ represents companies in the European sample. This provides visual clarity in the tables and graphs, making the comparative analysis of the Turkish and European samples easier and more understandable.

Table 1

Companies Examined by Country and Serial Codes

Company Name	Series Code	Country
Aydem Renewables	T1	Turkey
Smart Solar Technologies	T2	Turkey
Galata Wind Energy	T3	Turkey
Iberdrola	E1	Spain
Ørsted	E2	Denmark
EDP Renováveis	E3	Portugal

Note. Created by the author. The companies included in this study were selected using purposive sampling based on market representation and data availability.

Indicators and Metrics

The study examined three main dimensions: Financial Governance indicators: Net sales revenue, investment expenditure, total installed capacity (MW) and total energy production (MWh/GWh). Environmental indicators: Direct and indirect energy consumption (kWh), water usage (m³), total waste volume (hazardous/non-hazardous), greenhouse gas emissions (Scope 1, 2, 3, tonnes CO₂e). Social indicators: Total number of employees, percentage of female employees, distribution by age group, gender balance in management positions, training activities (number of participants and hours), occupational health and safety indicators (TRC – total recorded accident frequency, LTIF – lost time injury frequency, employee turnover rate).

Method and Analysis Process

The indicators obtained in the study were evaluated using descriptive, comparative and focused analysis techniques. First, the values for each indicator were presented on an annual basis through tables and graphs, thus clearly revealing the differences between companies. Subsequently, the Turkish and European samples were evaluated internally, followed by comparisons between the two groups in terms of financial size, environmental performance, and social indicators. The trends of increase and decrease observed in the indicators during the 2020–2022 period were examined, with a particular focus on the post-pandemic recovery dynamics and the effects of increased investments being discussed contextually. Methodologically, the study is based on a qualitative comparative analysis approach. The ESG framework, unlike the traditional Environmental (E), Social (S), and Governance (G) dimensions, encompasses Environmental (E), Social (S), and Financial Governance (FG) dimensions. Financial Governance refers to the effectiveness of a company's financial decision-making processes, its resource allocation competence, and its long-term value creation capacity. Since direct governance data is limited, the term "ESG" is used in this study to refer to Environmental, Social, and Financial Governance performance. As the data set only covers the period 2020–2022 and the sample is limited to six companies, advanced statistical tests have not been applied; instead, descriptive findings and comparative assessments are highlighted. However, the consistency of trends and the relationships between indicators have been addressed and interpreted within the analytical framework.

Indicator Construction, Directional Alignment and Normalization

In order to enable comparison between companies and eliminate scale effects, the indicators were converted into intensity measures. Environmental load variables (e.g., total emissions, water withdrawal, and waste generation) were divided by an appropriate scale variable (total energy consumption) to obtain carbon, water, and waste intensity. The use of scale-adjusted indicators is widely adopted in sustainability comparisons between countries and companies to reduce size bias (D'Adamo et al., 2025; Desogus et al., 2024). All indicators have been directionally aligned, ensuring that higher values consistently represent better performance. Cost-type indicators (e.g., carbon intensity, water intensity, waste intensity, and TRC) have been reversed using a modified min–max transformation. This is consistent with the directional alignment principle commonly used in ESG rating methodologies (MSCI ESG Research LLC., 2022).

$$N_{ij}^{cost} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)} \quad (1)$$

Standard minimum-maximum normalization was applied to benefit type indicators:

$$N_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)} \quad (2)$$

All variables were normalized to a range of 0-1, yielding dimensionless and comparable measurements. This prevented any single indicator from dominating the composite index due to differences in measurement units or magnitudes (Qachach et al., 2025).

Sub-Indices, Composite ESG Score and Multi-Year Averaging

Following normalization, the indicators were grouped into three conceptual dimensions: Environmental (E), Social (S), and Financial (F). Within each dimension, the normalized indicators were summed using equally weighted arithmetic means:

$$E_{it} = \frac{1}{k} \sum_{j=1}^k N_{it,j}^* \quad (3)$$

$$S_{it} = \frac{1}{m} \sum_{j=1}^m N_{it,j}^* \quad (4)$$

$$F_{it} = \frac{1}{n} \sum_{j=1}^n N_{it,j}^* \quad (5)$$

k, m, and n denote the number of indicators assigned to each respective dimension, while N represents the directionally adjusted values for cost-type variables. To preserve methodological transparency and minimize subjective bias in the aggregation process, an equal-weighting scheme was adopted. The equal-weighting approach is frequently employed in the construction of composite sustainability indices to maintain normative neutrality and to avoid implicit value judgments regarding the relative importance of individual dimensions (D'Adamo et al., 2025; Desogus et al., 2024).

The composite ESG score was calculated as follows:

$$ESG_{it} = \frac{E_{it} + S_{it} + F_{it}}{3} \quad (6)$$

The use of a composite ESG structure is consistent with current literature that demonstrates that ESG performance cannot be explained by one-dimensional financial indicators and must be evaluated within a multidimensional framework (Yeh & Liao, 2026). To achieve more stable and long-term sustainability performance, a three-year average ESG score has been calculated:

$$\overline{ESG}_t = \frac{ESG_{i,2020} + ESG_{i,2021} + ESG_{i,2022}}{3} \quad (7)$$

The multi-year average approach is considered an effective method for revealing structural sustainability trends by mitigating the impact of cyclical shocks (Çalışkan, 2025). No data completion process was performed. Only the disclosed firm-year data was used to enhance

transparency and reproducibility. This approach is recommended, particularly in emerging markets, for data integrity and methodological reliability (Lavin & Montecinos-Pearce, 2021; Krueger et al., 2024; Dye et al., 2021).

Limitations of the Research

As the data used in this study is based on reports disclosed by companies to the public, differences in reporting standards may lead to limitations in comparisons. For example, while some companies report social indicators in detail, others provide more limited data. Furthermore, the disclosure of financial indicators in different currencies requires careful interpretation when comparing scales. One limitation of the study is that the governance dimension was measured through financial performance indicators rather than traditional indicators such as board structure, independence, supervisory board, and compensation policies. This limitation stems from the fact that corporate governance indicators were not systematically and comparably reported in the 2020-2022 reports of companies in Türkiye. While three companies selected from Türkiye and three from Europe represent the renewable energy sector in their respective markets, they do not cover the entire sector, and the sample size is limited to six companies. The data used is based on sustainability and activity reports that companies voluntarily share with the public. Due to differences in reporting standards and data quality issues in developing markets, some anomalous data may be observed. The lack of sensitivity analysis regarding alternative weighting techniques based on financial materiality, combined with the integration of ESG sub-dimensions using an equal-weighting method, limits the assessment of the robustness of composite ESG scores under different weighting assumptions; this limitation is considered an issue that should be addressed in future research.

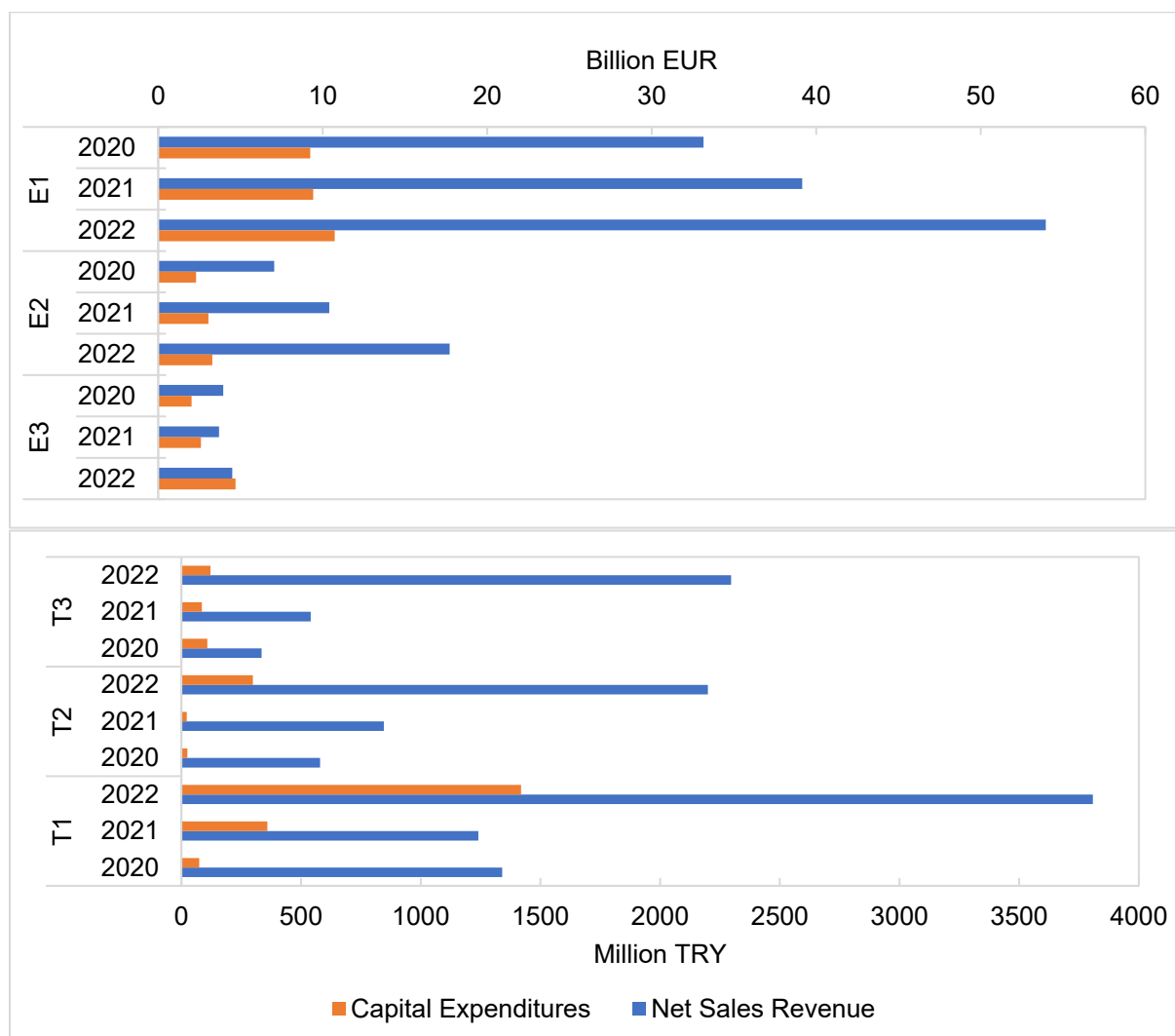
Findings

Financial Indicators

As presented in Figure 1., the net sales revenues of companies in Turkey (T series) have shown significant fluctuations over time. T1, which recorded revenues of 1,340 million TL in 2020, saw a 7.4% decline in 2021, but increased by approximately three times to 3,807 million TL in 2022. Similarly, T3 grew more than sixfold, reaching 2,296 million TL in 2022 from 335 million TL in 2020. T2 increased its revenue from 579 million TL in 2020 to 2,199 million TL in 2022, showing steady growth over the three-year period. It can be said that the expansion of the energy market in Turkey, the increasing investment volume and the global rise in energy prices in the 2021–2022 period played an important role behind these increases. It reveals that the renewable energy market in Turkey grew rapidly, particularly after the public offering, and that companies began to expand their capital bases.

Figure 1

Comparison of Companies' Net Sales Revenue and Capital Expenditures.



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' annual reports covering the period 2020–2022.

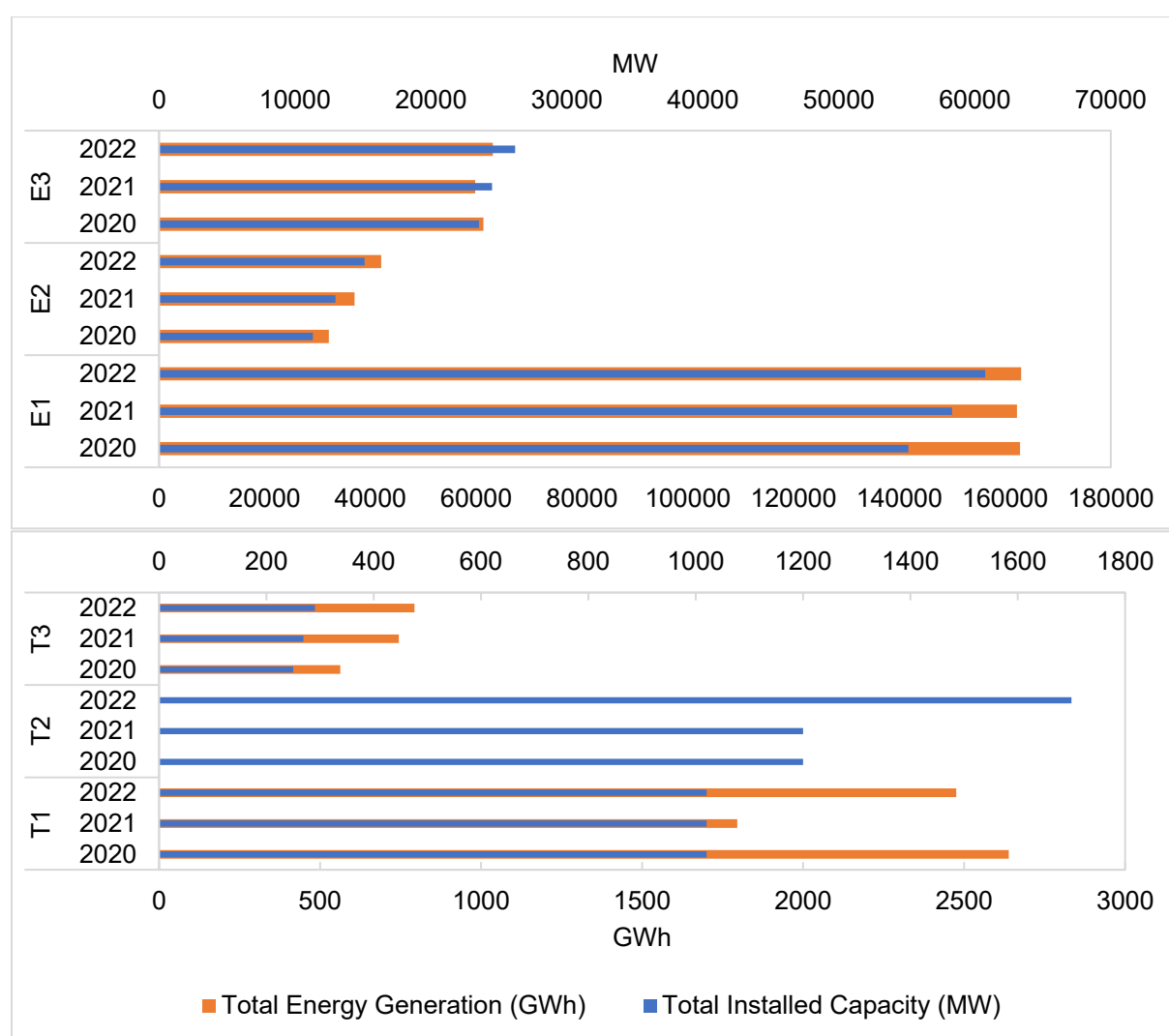
When examining European companies (E series), it is noteworthy that their net sales revenues are significantly higher in terms of scale. E1 increased its revenue from €33.15 billion in 2020 to €53.95 billion in 2022, recording a 62.8% increase during this period. E2 grew by approximately 151%, rising from €7.05 billion in 2020 to €17.72 billion in 2022. E3, on the other hand, saw a relatively more modest increase, raising its revenue from €3.95 billion in 2020 to €4.50 billion in 2022. A similar differentiation is also evident in terms of investment expenditure. In Turkey, T1 increased its investments from 74.6 million TL in 2020 to 1,418.9 million TL in 2022, representing an increase of approximately 19 times. T2 recorded growth of more than tenfold in 2022 with investments of 298.9 million TL compared to 2020. T3 investments saw a more limited increase from 108.2 million TL in 2020 to 121.7 million TL in 2022. European companies stand out with much higher absolute values. E1 made stable investments of approximately €9–11 billion annually between 2020 and 2022. E2 increased its investment from €2.30 billion in 2020 to €3.29 billion in 2022. E3 more than doubled its investment, rising from €2.03 billion in 2020 to €4.70 billion in 2022. These data reveal that

companies in Turkey are growing rapidly but still operate on a relatively limited scale compared to European companies in terms of absolute size.

As presented in Figure 2, in terms of installed capacity, companies in Turkey are relatively small in scale. T1 remained stable at 1,020 MW of installed capacity during the 2020–2022 period, while its production fell from 2,638 GWh in 2020 to 1,796 GWh in 2021, rising to 2,475 GWh in 2022. This fluctuation can be explained by climate-related variability in hydroelectric production. T2 increased its capacity from 1,200 MW in 2020 to 1,700 MW in 2022, but no production data was reported. T3 increased its capacity from 250 MW in 2020 to 290 MW in 2022; its production rose from 563 GWh to 793 GWh during the same period. European companies operate on a much larger scale.

Figure 2

Comparison of Companies' Total Installed Capacity and Total Energy Generation



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability and annual reports covering the period 2020–2022.

E1 increased its installed capacity from 55,111 MW in 2020 to 60,761 MW in 2022; its production remained above 160,000 GWh annually. E2 increased its capacity from 11,318 MW in 2020 to 15,121 MW in 2022 and increased its production from 32,095 GWh to 42,009 GWh

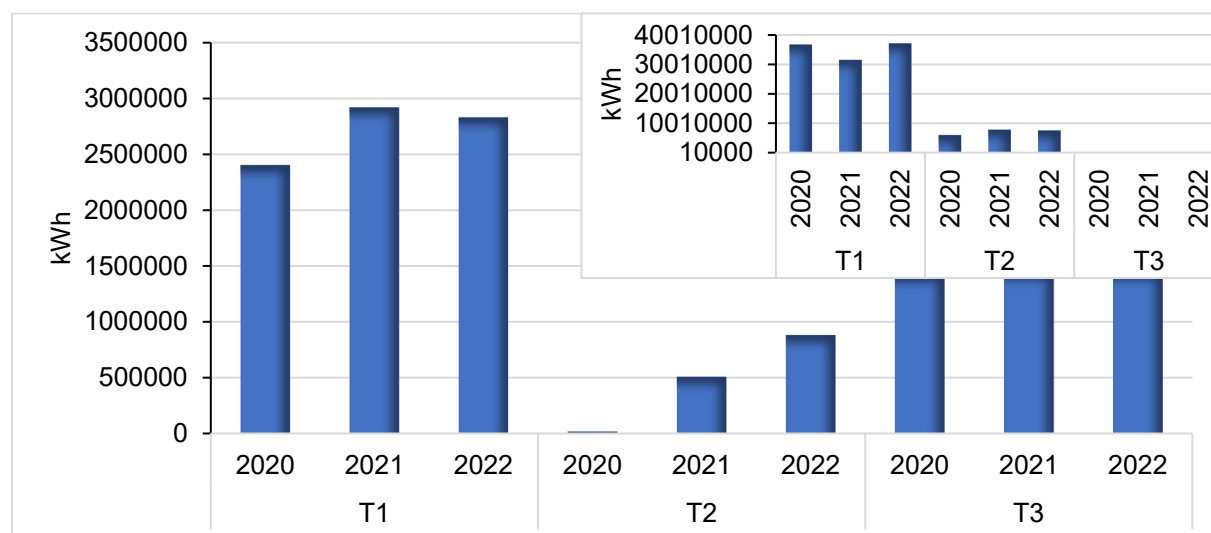
during the same period. E3 increased its capacity from 23,524 MW in 2020 to 26,187 MW in 2022, while its production reached 63,122 GWh from 61,351 GWh. This comparison reveals that European companies operate on a scale over a hundred times larger than Turkish companies in terms of installed power and production capacity. Although the increases in the Turkish sample are relatively more limited, they indicate that growth potential continues, particularly in capacity expansions. When financial indicators are assessed as a whole, it is clear that European companies have a much larger financial and operational capacity in absolute terms. Series E companies have reached billions of euros in revenue and investment volume, tens of thousands of MW of installed capacity, and hundreds of thousands of GWh of production capacity. In contrast, Series T companies are smaller in scale but have demonstrated remarkable performance, particularly in terms of revenue and investment growth rates, during the 2020–2022 period. Therefore, while European companies stand out with their economies of scale and market maturity, Turkish companies attract attention with their growth rates and ability to adapt to the market. This situation shows that Turkey is undergoing a dynamic development process in the renewable energy sector but is still at an early stage when compared to large-scale companies in Europe.

Environmental Indicators

When examining the energy consumption data for the 2020–2022 period between the renewable energy companies in Turkey (T1–T3) shown in Figure 3. and the companies in Europe (E1–E3) shown in Figure 4, differences are observed in terms of both scale and trend.

Figure 3

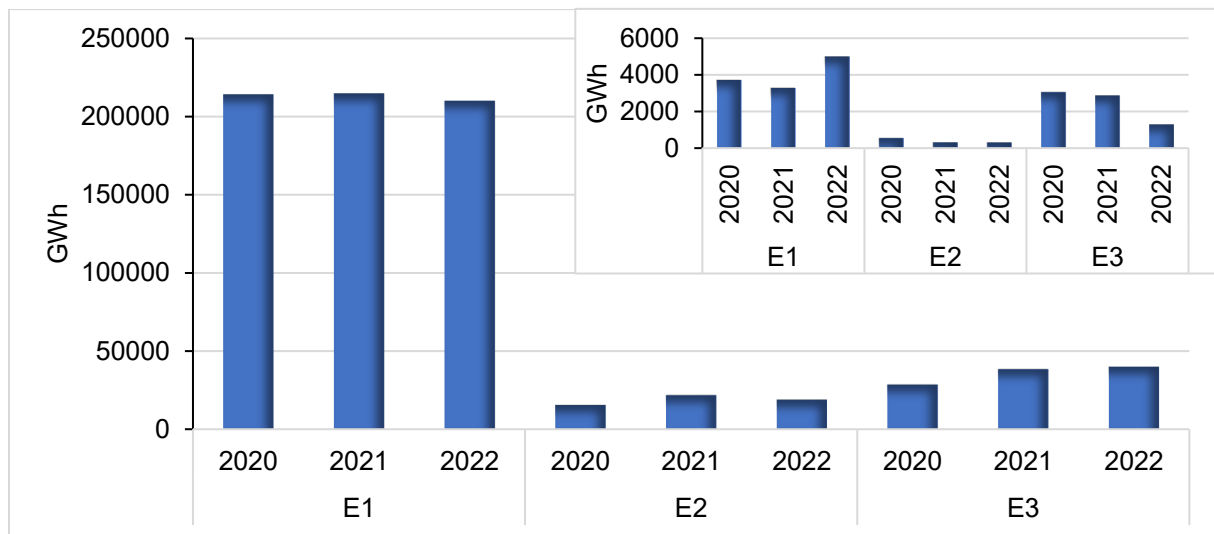
T Series Total Direct Energy Consumption (kWh) Total Indirect Energy Consumption (Electricity, kWh) Values



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability reports covering the period 2020–2022.

Figure 4

E Series Total Direct Energy Consumption (GWh) Total Indirect Energy Consumption (Electricity, GWh) Values



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability reports covering the period 2020–2022.

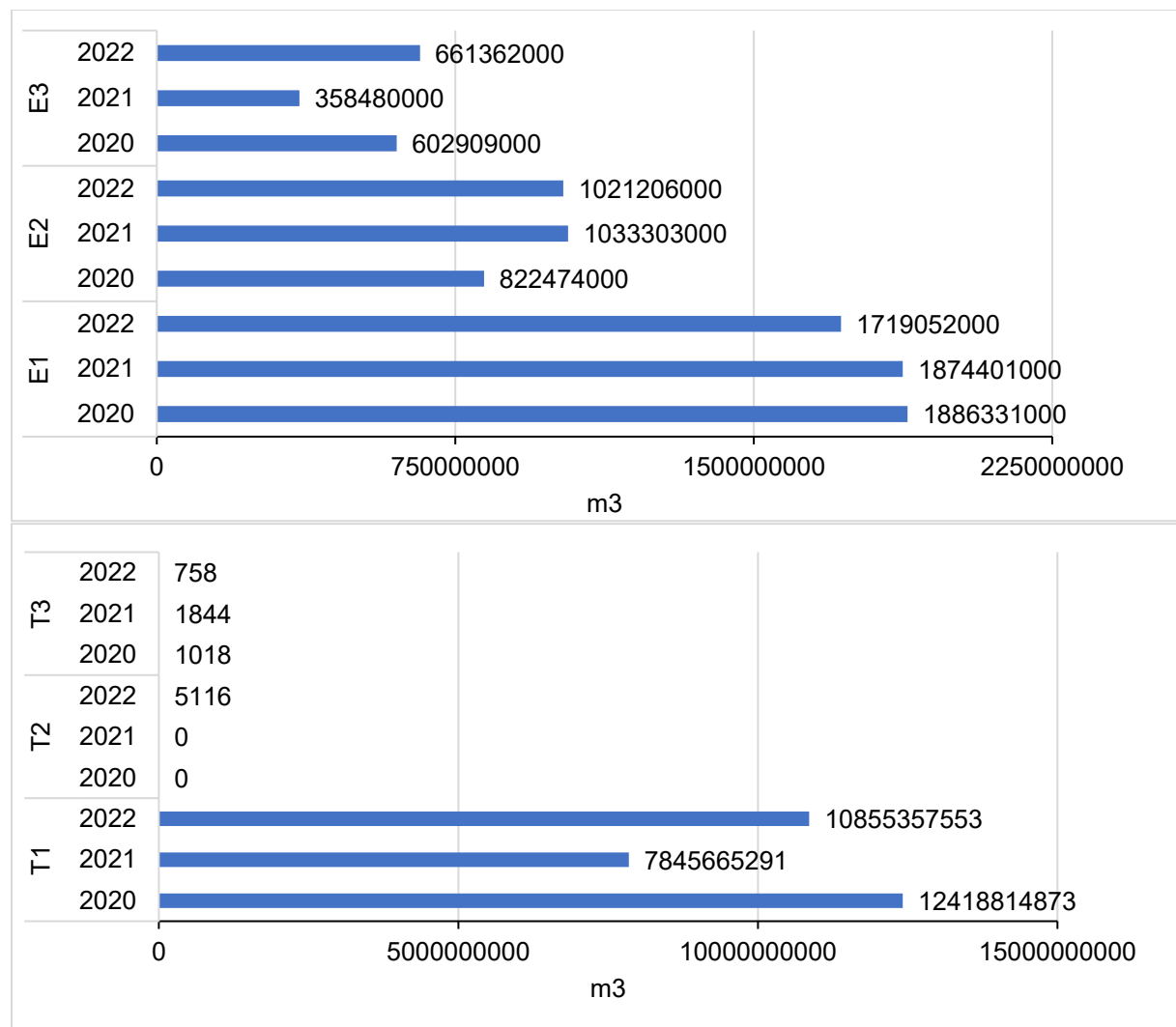
T1 showed a steady increase in direct energy consumption at the level of 2–3 million kWh, while indirect energy consumption fluctuated, falling to 30 million kWh in 2021 and rising again to 40 million kWh in 2022. T2 showed the most notable increase in direct energy consumption; consumption, which was only 20,000 kWh in 2020, reached 900,000 kWh in 2022. In contrast, indirect consumption remained stable in the 6–8 million kWh range. T3 maintained its direct energy consumption at 1 million kWh, while increasing its indirect consumption from 30,000 kWh to 60,000 kWh between 2020 and 2022. This figure shows that the absolute consumption levels of companies operating in Turkey are low, but T3 stands out in terms of growth rates. In Europe, high consumption levels are remarkable. E1 maintained a stable level of 210,000 GWh in direct energy consumption, while increasing its indirect consumption from 3,700 GWh in 2020 to 5,000 GWh in 2022. E2 increased its direct consumption from 15,000 GWh to 22,000 GWh and then reduced it to 19,000 GWh, while reducing its indirect consumption from 550 GWh to 310 GWh, achieving significant efficiency gains. Similarly, E3 increased its direct consumption from 29,000 GWh to 40,000 GWh, while reducing its indirect consumption from 3,100 GWh to 1,300 GWh. This trend shows that large companies in Europe are pursuing strategies to increase efficiency in indirect energy consumption despite their scale growth. When Turkey and Europe are compared overall, companies in Turkey have relatively low absolute energy consumption values but show a rapid growth trend. Companies in Europe, on the other hand, achieve very high absolute consumption levels thanks to their massive operational capacities, but are increasing their relative efficiency through energy efficiency and consumption reduction policies. This situation reveals that renewable energy companies in Turkey are undergoing a dynamic expansion process, while mature market structures in Europe prioritize stability and efficiency in energy management.

Figure 5 shows significant differences between renewable energy companies in Turkey and large-scale energy companies in Europe in terms of both absolute values and intensities in the water withdrawal data for the 2020–2022 period. T1 reports very highwater withdrawal due to its hydroelectric-dominated production structure: 12.4 billion m³ in 2020, 7.8 billion m³ in

2021, and 10.9 billion m³ in 2022. When normalized by production values, these figures correspond to a water intensity of 4,300–4,700 m³/MWh. In contrast, T2 and T3 reported almost negligible water withdrawal. Galata Wind’s reporting of only 758 m³ of water withdrawals for 793 GWh of production in 2022 demonstrates that the water footprint of wind and solar technologies is extremely low compared to hydroelectricity. Europe reports absolute water abstraction values in the billions of cubic meters. E1 reduced its abstraction from 1.89 billion cubic meters in 2020 to 1.72 billion cubic meters in 2022; E2 reported fluctuating values between 0.82 and 1.02 billion cubic meters during the same period. E3 increased its water withdrawal from 0.60 billion m³ in 2020 to 0.66 billion m³ in 2022.

Figure 5

Water Withdrawal (m³) Values for The Series



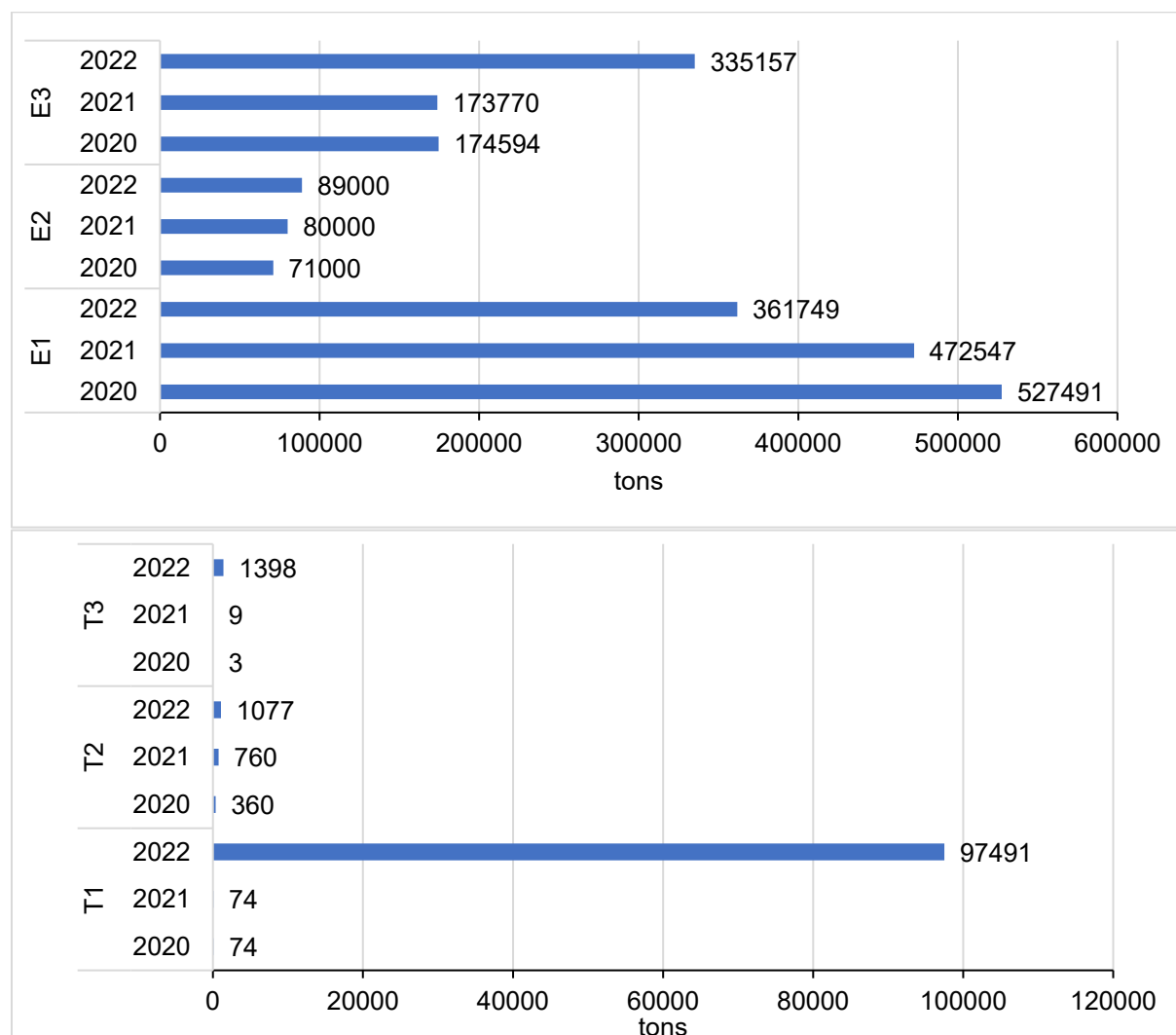
Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability reports covering the period 2020–2022.

However, considering the production scale of these companies, their normalized water intensities are much lower than Aydem's: Ørsted remains at approximately 24–26 m³/MWh, and EDP Renováveis at 9–11 m³/MWh. This shows that despite their high absolute water withdrawals, European companies have relatively lower water intensities due to their scale. When considering the Turkey-Europe comparison holistically, the water withdrawal values of

companies producing hydroelectric power in Turkey exceed even those of major European companies. However, since the water withdrawal of Turkish companies focused on wind and solar power is negligible, the technology mix emerges as the most fundamental factor determining these differences. Although companies in Europe report high values in absolute terms, they appear to be more efficient in terms of water intensity; hydroelectric-heavy production in Turkey, on the other hand, creates a striking difference in terms of environmental sustainability with a much higher water withdrawal per unit.

Figure 6

Total Waste Amount (tons) Values for The Series



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability reports covering the period 2020–2022.

When examining total waste amounts for the 2020–2022 period given in Figure 6, a clear upward trend is observed in Turkish companies, while European companies show more stable or gradually decreasing trends. In Turkey, T1, which remained stable at around 74 tons in 2020 and 2021, increased dramatically to 97,490 tons in 2022. This sudden increase is said to be due to large-scale construction activities carried out during the physical investment process. Therefore, it is understood that this increase is not a reflection of a structural trend, but rather a temporary situation specific to the investment period; it is expected that waste levels

will return to normal after the investment process is completed. T2 recorded a gradual but significant increase, raising its waste from 360 tons in 2020 to 1,077 tons in 2022. Similarly, T3 increased its waste from only 2.9 tons in 2020 to 1,398 tons in 2022. This table shows that waste management is becoming increasingly critical in Turkish companies in parallel with their growth in scale. When examining large-scale companies in Europe, E1 achieved a significant reduction by decreasing its total waste from 527,491 tons in 2020 to 361,749 tons in 2022. E2, on the other hand, showed a limited but steady increase, rising from 71,000 tons to 89,000 tons. For E3, the waste amount, which was 174,594 tons in 2020, increased to 335,157 tons in 2022. European companies generally report much higher absolute waste volumes compared to Turkish companies. However, considering the scale difference, this is not surprising, as European companies have much larger installed capacity and production capacity.

E1 demonstrates that effective waste reduction policies can be implemented despite operational scale. When Turkey and Europe are compared holistically, Turkish companies remain small in terms of absolute waste volume but have shown a rapid upward trend over the past three years. Although companies in Europe report much higher absolute values, they are developing strategies for waste reduction, as in E1. Therefore, it can be said that waste management capacity and reporting standards need to be developed more systematically in Turkey, while sustainable waste reduction practices are relatively more strongly implemented in Europe despite the scale.

Table 2

Emission Values of The Series

Serial	Years	Scope 1 (tons CO ²)	Scope 2 (tons CO ²)	Scope 3 (tons CO ²)
T1	2020	775.5	4729.1	498.3
	2021	1364.7	3534.5	960.9
	2022	1587.9	3120.1	70482.5
T2	2020	N/A	N/A	N/A
	2021	146.7	3398.9	19204.2
	2022	257.6	3934.0	24512.8
T3	2020	73.8	597.7	62.3
	2021	82.9	646.4	76.3
	2022	78.9	611.9	149.8
E1	2020	12518864	1882654	47645574
	2021	12754162	2161984	44614613
	2022	11346356	1879381	42013975
E2	2020	1851000	111000	25333000
	2021	2142000	53000	18179000
	2022	2510000	45000	10983000
E3	2020	9304000	594000	11730000
	2021	9819000	791000	10304000

Note. Emission data were extracted from the companies' sustainability reports for the 2020–2022 period. Missing values (indicated as N/A) were not imputed to maintain transparency. The author used Microsoft Excel for data compilation and descriptive analysis.

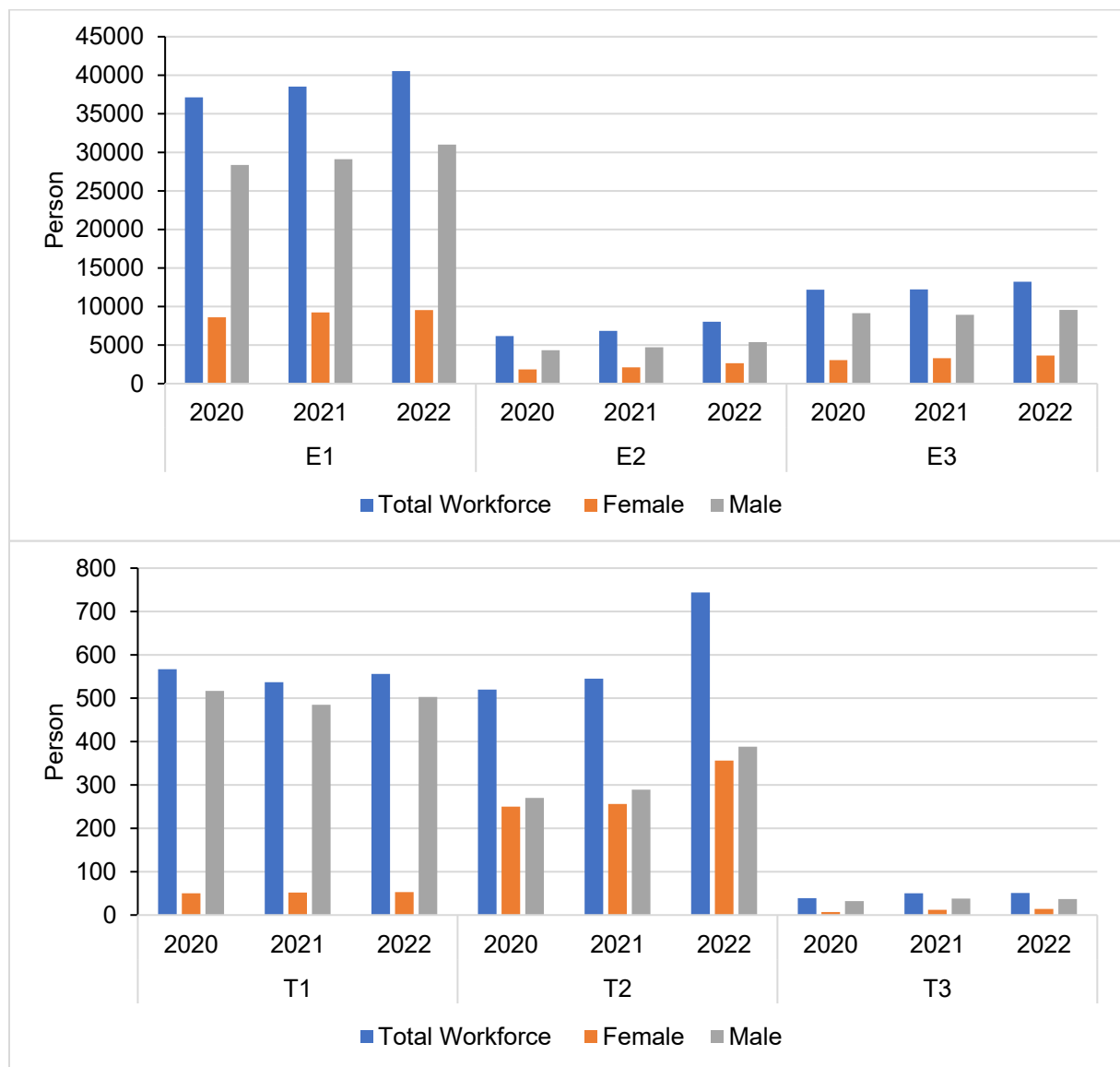
Similarly, the greenhouse gas emission data for the 2020–2022 period provided in Table 2 reveal significant differences between companies in Turkey and large-scale energy companies in Europe in terms of absolute levels, trends, and reporting scope. In Turkey, T1 increased its Scope 1 emissions from 775 tons of CO₂ in 2020 to 1,588 tons of CO₂ in 2022. Scope 2 emissions fell from 4,729 tons to 3,120 tons during the same period, while Scope 3 emissions skyrocketed to 70,482 tons in 2022. This extraordinary increase is considered to be a reflection of temporary circumstances rather than a permanent trend, stemming from construction activities carried out during the investment process and supply chain-related operations. Scope 3 emissions are expected to return to a lower and more stable level once the physical investment process is completed. T2 did not report any emissions in 2020, but reported 147 tons in Scope 1, 3,399 tons in Scope 2, and 19,204 tons in Scope 3 in 2021. In 2022, these values increased to 258 tons, 3,934 tons, and 24,513 tons, respectively. T3, on the other hand, has very low emission levels; Scope 1 emissions are in the 70–80-ton range, Scope 2 emissions are around 600 tons, and Scope 3 emissions are at most 150 tons. In European companies, absolute emissions are in the millions of tons. E1 achieved a partial reduction by lowering Scope 1 emissions from 12.5 million tons in 2020 to 11.3 million tons in 2022. Scope 2 emissions remained stable at 1.88 million tons, while Scope 3 emissions fell from 47.6 million tons to 42 million tons. E2 increased its Scope 1 emissions from 1.85 million tons to 2.51 million tons, but reduced its Scope 2 emissions from 111,000 tons to 45,000 tons; Scope 3 emissions also showed a notable decrease, falling from 25.3 million tons to 10.9 million tons during the same period. E3 kept its Scope 1 emissions steady at 9.3 million tons, reduced its Scope 2 emissions from 594,000 tons to 469,000 tons, and lowered its Scope 3 emissions from 11.7 million tons to 9.3 million tons. The absolute emissions of Turkish companies are extremely low compared to large-scale energy companies in Europe. However, these low levels are largely due to limited production scale and technology preferences (emphasis on wind and solar). In contrast, the extraordinary increase in T1's Scope 3 emissions in 2022 being a temporary situation driven by investments highlights the importance of contextual factors in assessing environmental indicators. Although companies in Europe have much larger absolute emissions, they show clear reduction trends, particularly in Scope 2 and Scope 3 categories, demonstrating the effectiveness of advanced reporting systems and carbon reduction strategies. Therefore, while companies in Turkey appear to have a relative advantage due to their low-scale emissions, their carbon management capacity has not yet been institutionalized due to fluctuations arising from investment processes. European companies, on the other hand, despite their high absolute emission profiles, are in a more advanced position in terms of environmental sustainability with their more stable reduction strategies.

Social Indicators

When examining employee data for the 2020–2022 period in Figure 7, significant differences are observed between renewable energy companies in Turkey and companies in Europe in terms of scale and gender balance.

Figure 7

Companies' Total Workforce, Female and Male Employees



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability and annual reports covering the period 2020–2022.

In Turkey, T1 reduced its total number of employees from 567 in 2020 to 537 in 2021, then increased it to 556 in 2022. The number of female employees remained stable between 50 and 53 over the three years, with the ratio remaining at around 9–10%. T2 showed the most notable increase in both total number of employees and female employment: starting with 520 employees (48% female) in 2020, it reached 743 employees (48% female) in 2022. T3 has a small-scale employment structure, with the number of employees rising from 42 to 57; the number of female employees increased from 7 to 14, with the female ratio ranging between 18% and 27%. This table shows that only T3 stands out in terms of female employment in Turkey, while the other two companies have low female ratios. Large-scale companies in Europe have a much greater employment capacity. E1 started with 36,965 employees in 2020

and reached 40,550 in 2022; the number of female employees increased from 8,599 to 9,545 during the same period. The female employment rate remained at around 23–24%. E2 started with 6,179 employees in 2020 and increased to 8,027 in 2022; the female employee rate varied between 30–33%. E3 increased its number of employees from 11,610 in 2020 to 13,211 in 2022, while increasing female employment from 3,045 to 3,651, maintaining the ratio at 25–27%.

All companies in Europe have seen a steady increase in their total number of employees, with female employment at more balanced rates compared to companies in Turkey. When Turkey and Europe are compared overall, companies in Turkey are limited in terms of employee numbers, but they show remarkable success in terms of female employment, as seen particularly in the T2 example. T1 and T3, on the other hand, remain smaller in terms of total employee numbers and have low levels of female employees. Companies in Europe (E1, E2, E3), on the other hand, have much higher absolute employment levels and present a relatively more balanced picture in terms of female employee ratios, ranging from 23% to 33%. This situation reveals that gender equality policies are implemented more systematically at the corporate level in Europe, whereas in Turkey, the structure varies from company to company and is fragmented and unstable.

When examining female employee ratios in Figure 8, there are notable differences between renewable energy companies in Turkey and companies in Europe in terms of both scale and gender balance. In Turkey, T1 has kept its female employee ratio within the 8.8–9.7% range for three years, remaining at a very low level. This ratio indicates that female employment in the sector is marginal and that gender imbalance continues at the corporate level. T3 increased its female ratio from 15.4% in 2020 to 24% in 2021 and maintained it at 23.5% in 2022.

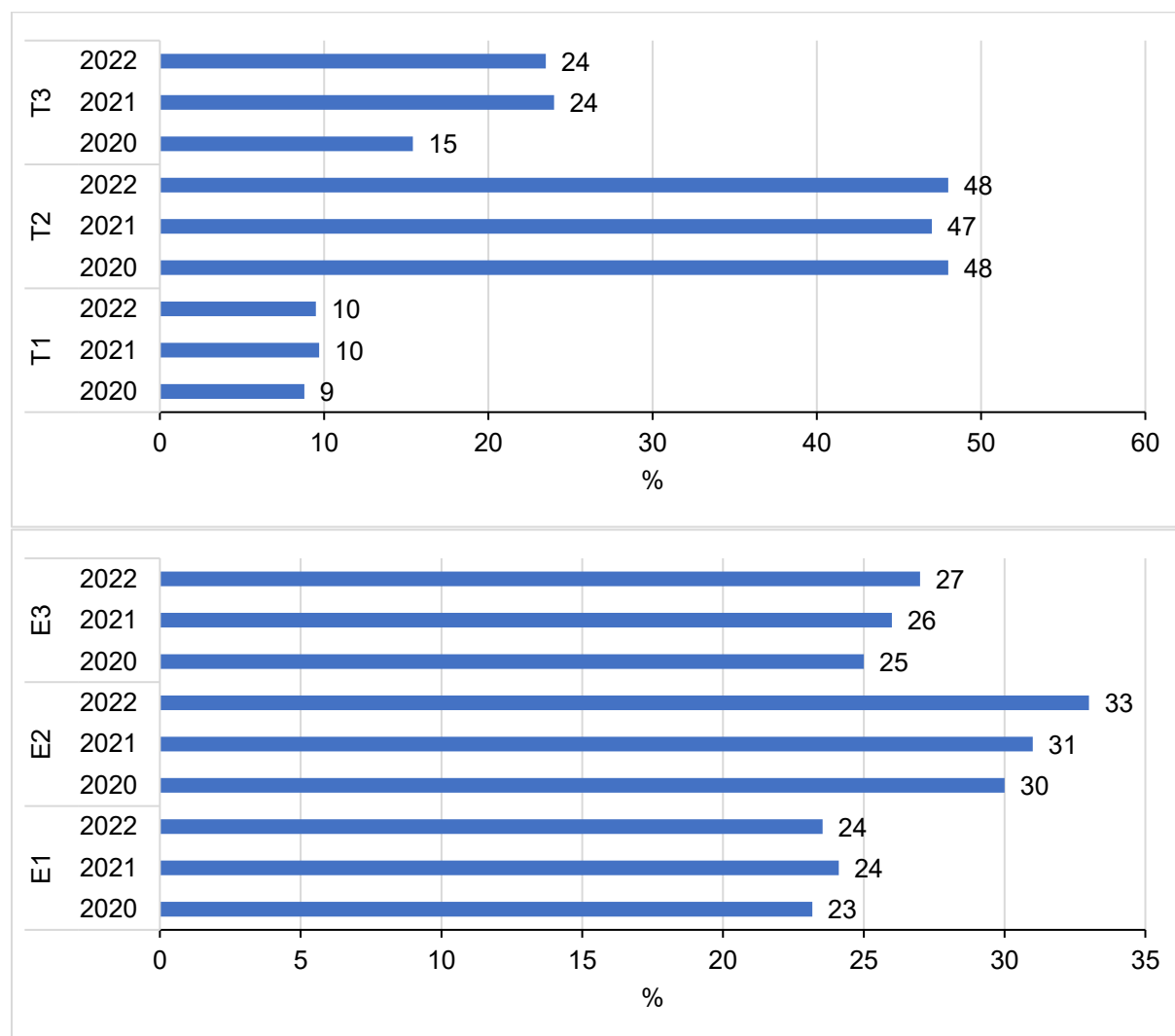
Although these values are higher than Aydem's, they show a fluctuating trend rather than a sustainable increase. In contrast, T2 is the company with the strongest performance in terms of female employment in Turkey. During the 2020–2022 period, the female ratio remained stable at 47–48%, achieving near gender balance. This situation reveals that the employment structure in the solar energy sector may be more inclusive compared to other areas. When companies in Europe are examined, it is seen that female employee ratios are more balanced and based on corporate policies compared to Turkey. E1 maintained female employment at a steady rate of 23–24%, E2 increased female employment from 30% to 33% and performed above the sector average. E3 showed a steady increase, rising from 25% to 27%. These rates in Europe show that companies take gender equality into account in their employment policies and adopt an approach supported by corporate practices at the sector level.

When the Turkey-Europe comparison is evaluated overall, female employment in Turkey shows significant differences between companies. While T2 exhibits an almost equal structure, T1 and T3 remain well below the European average with low rates. Companies in Europe, on the other hand, offer relatively balanced rates in the range of 23–33%; in particular, E2's rise to 33% demonstrates that gender equality policies are yielding results at the corporate level. These findings show that there is a fragmented picture regarding gender equality in Turkish companies, while a more consistent and systematic approach has taken root in European companies. When evaluating training activities within the scope of social indicators, the scale difference becomes even more pronounced. While T1's total training hours were 13,192 in 2022, T2's were 7,311, and T3's were only around 85 hours. In contrast, E1 conducted 2.7 million hours of training in the same year, and E3 conducted approximately 310,000 hours. These figures clearly show that European companies allocate significantly more resources to

employee development, while companies in Turkey are still in the early stages of development in this area.

Figure 8

Female Employee Ratios in Companies



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability and annual reports covering the period 2020–2022.

Table 3

Companies' Direct Labor Force by Age Groups, Senior Management Structure (persons), Middle Management Structure (persons), Gender Distribution of Employees

Serial	Years	Direct Labor Force by Age Groups			Senior Management Structure (person)		Middle Management Structure (person)	
		18-30	30-40	40+	Female	Male	Female	Male
T1	2020	94	217	256	0	4	8	43
	2021	94	207	236	0	4	7	43
	2022	85	219	252	0	4	7	46

T2	2020	157	235	128	3	4	4	15
	2021	146	235	164	5	12	9	21
	2022	228	283	232	6	11	13	29
T3	2020	3	33	6	0	2	1	0
	2021	7	39	9	0	3	2	0
	2022	12	35	10	0	3	2	1
E1	2020	6377	21860	8728	58	1649	627	10816
	2021	7158	24063	8537	41	1649	676	9816
	2022	7442	25068	8040	58	1647	537	10844
E2	2020	N/A	N/A	N/A	30	115	237	675
	2021	N/A	N/A	N/A	33	131	253	590
	2022	N/A	N/A	N/A	43	146	291	647
E3	2020	1937	6556	3117	405	1235	1773	2934
	2021	2052	7213	2971	451	1376	1983	3281
	2022	2328	7973	2910	484	1220	2417	4027

Note. Workforce data by age groups, senior and middle management structures, and gender distribution were compiled from the companies' annual activity reports. Calculations and tabulation were performed by the author using Microsoft Excel.

Table 3 shows that there are differences in terms of scale, diversity and gender representation between renewable energy companies in Turkey and Europe in terms of the distribution of employees by age group and gender balance at management level. In Turkey, T1 concentrated the majority of its employees in the 30–40 and 40+ age groups (a total of 471 people in 2022), while the 18–30 age group remained at a lower level with 85 people. T2 provided more employment opportunities for young workers, employing 228 people in the 18–30 age group in 2022; this ratio reflects the company's growth dynamics and its tendency towards young labour. T3, on the other hand, has a small workforce and increased the number of young employees from only 3 in 2020 to 12 in 2022. Overall, the proportion of young employees in Turkish companies remains limited, with middle-aged and older employees predominating, particularly at Aydem and Galata Wind. In terms of gender balance at management levels, it is evident that there is no equal distribution in Turkish companies. All T1 senior management positions are concentrated among men, with no female managers present. At the middle management level, women are represented by 7–8 individuals, while men dominate with 43–46 individuals. T2 started with 3 women and 4 men in senior management in 2020 and achieved a more balanced gender distribution in 2022 with 6 women and 11 men. In middle management, the number of women rose from 4 in 2020 to 13 in 2022, but with the number of men increasing from 15 to 29, the proportion of women remained low. T3 has a very limited number of managers; between 2020 and 2022, there were no female managers in senior management, while at most 2 female managers served in middle management. This picture shows that women are systematically underrepresented in senior management positions in Turkey. In European companies, however, a more advanced picture emerges in terms of both scale and gender representation. E1 employed 7,442 people aged 18–30 out of a total workforce of 40,550 in 2022, indicating that young employees represent a much higher absolute value compared to companies in Turkey. Female representation in senior management remained stable at between 41 and 58 individuals, while men were concentrated at around 1,647. In middle management, there were 537–676 female employees compared to 9,816–10,844 male managers. Although E2 did not report data on age groups, it increased the number of women in senior management from 30 in 2020 to 43 in 2022, while the number of

men rose from 115 to 146 during the same period. In middle management, the number of women increased from 237 to 291, while the number of men decreased from 675 to 647. This indicates that gender balance is moving towards a relatively more balanced structure. E3 increased the number of young employees from 1,937 to 2,328 between 2020 and 2022, while increasing the number of women in senior management from 405 to 484. At the middle management level, the number of female managers rose from 1,773 to 2,417, while the number of men increased from 2,934 to 4,027. When Turkey and Europe are compared overall, companies in Europe have a more inclusive structure in terms of both employing young workers and the participation of women in management positions. In Turkey, however, the proportion of young workers remains limited, and women are underrepresented in senior management positions. Although it is noteworthy that Smart Solar has moved towards a relatively more balanced structure in terms of the proportion of female managers, the overall picture shows that companies in Europe implement their gender equality policies in a more institutional and systematic manner. When occupational health and safety indicators are examined, the decrease in T1's TRC value from 5.77 in 2020 to 1.6 in 2022 indicates a significant improvement. T2's TRC value rose from 5.16 in 2020 to 18.9 in 2022, indicating an increase in occupational safety risks. T3's accident frequency remained close to zero. In European companies, TRC values are generally in the range of 1–3, with E1 reported at 1.02, E2 at 3.1, and E3 at 1.13. This indicates that European companies have standardised practices in the field of occupational safety.

Table 4

Companies' Recorded Accident Frequency, Lost Time Accident Frequency, Employee Turnover Rate (%) Values

Serial	Years	TRC	LTIF	Turnover Rate (%)
T1	2020	5.77	0.82	4.03
	2021	3.36	0.84	3.53
	2022	1.6	0	5.2
T2	2020	5.16	0.63	29.4
	2021	17.31	0.92	38.16
	2022	18.89	0.63	24.05
T3	2020	0	0	7
	2021	0	0	10
	2022	0	0	15
E1	2020	1.20	0.06	7.53
	2021	1.06	0.06	8.86
	2022	1.02	0.07	12.39
E2	2020	3.60	1.70	8.40
	2021	3.00	1.30	10.60
	2022	3.1	1.60	11.70
E3	2020	1.04	2.07	11.47
	2021	1.4	2.09	13.00
	2022	1.13	2.18	11.80

Note. Occupational health and safety indicators and employee turnover rates were derived from the companies' official sustainability and activity reports for the 2020–2022 period. The author used Microsoft Excel for data processing and rate calculations.

The differences in occupational health, safety and worker mobility in Turkey and Europe are shown in Table 4. The European examples (E1, E2, E3) generally show that accident frequencies remain at low levels. In particular, lost-time accident frequencies ranged from 0.06 to 2.18 during the 2020–2022 period, indicating that the minimum risk in terms of lost working days has been maintained. However, employee turnover rates in European companies ranged from 7–12 per cent in 2020, reaching around 11–12 per cent in 2022 with a slight increase, and remained stable in some examples. This indicates that employee loyalty is relatively high in the European labour market and that occupational safety is managed effectively. The Turkish examples (T1, T2, T3) present a more volatile and high-risk picture. The accident frequencies recorded in the T1 and T2 groups were 5.16–5.77 in 2020, while in 2022, a significant decrease (1.6) was observed in the T1 group, and a serious increase to 18.89 was observed in the T2 group. This situation indicates that occupational health and safety practices in some sectors in Turkey are irregular or inadequate. Furthermore, employee turnover rates ranged from 24 to 38 per cent in the T2 group, while in the T3 group, they rose steadily from 7 per cent in 2020 to 15 per cent in 2022. These high turnover rates suggest that employee loyalty and motivation in

Turkish workplaces are lower than in Europe. Generally speaking, while social indicators in European companies paint a more positive picture in terms of both occupational safety and employee stability, serious fluctuations are observed in accident risks and employee turnover rates in Turkey, pointing to a need for improvement in occupational health and human resources management practices. A comparison between Europe and Turkey clearly shows that Turkey has higher risks and greater variability in terms of social indicators.

Composite ESG Performance and Regional Comparative Analysis

Environmental (E), social (S), financial (F), and composite ESG scores calculated for the 2020–2022 period are presented and analyzed comparatively at the regional level. The values in Table 5 were obtained as a result of a three-stage pre-processing and aggregation process. Environmental indicators (carbon, water, and waste) were converted to intensity metrics to reduce bias stemming from firm scale. The relevant load indicators were scale-corrected by dividing them by total energy consumption. Cost-type variables (carbon intensity, water intensity, waste intensity, and TRC) were transformed using the inverse form of min–max normalization; benefit-type indicators (female employee ratio and financial growth rates) were normalized to the 0–1 range using the standard min–max method.

The sub-indices were constructed using the equally weighted arithmetic mean method. The environmental sub-index was calculated as the average of three intensity indicators; the social sub-index as the average of the female ratio and TRC; and the financial sub-index as the average of net sales revenue growth and capital expenditure growth. The composite ESG score was defined as the equally weighted average of the three sub-dimensions. Since the financial growth rate could not be calculated in 2020, the financial sub-index was taken as a neutral value (0.500) to ensure methodological consistency. This approach prevents the base year from artificially inflating or lowering the composite score.

Table 5

Environmental, Social, Financial and Composite ESG Scores

Serial	Years	E	S	F	ESG
T1	2020	0.565	0.000	0.500	0.355
	2021	0.609	0.403	0.500	0.504
	2022	0.290	0.458	0.424	0.390
T2	2020	0.667	0.553	0.500	0.573
	2021	0.391	0.500	0.404	0.431
	2022	0.649	0.500	0.728	0.626
T3	2020	0.666	0.584	0.500	0.583
	2021	0.651	0.692	0.500	0.614
	2022	0.567	0.682	0.514	0.588
E1	2020	0.949	0.579	0.500	0.676
	2021	1.000	0.663	0.215	0.626
	2022	1.000	0.655	0.029	0.561
E2	2020	0.897	0.458	0.500	0.618

	2021	0.970	0.699	0.467	0.712
	2022	0.944	0.723	0.080	0.583
E3	2020	0.753	0.617	0.500	0.623
	2021	0.845	0.678	0.069	0.531
	2022	0.862	0.697	0.030	0.530

Note. Environmental, social, and financial sub-indices were constructed by the author using min–max normalization and equal-weighted aggregation. The composite ESG score is the arithmetic mean of the three sub-dimensions. The "G" in ESG stands for Financial Governance, which is functionalized through net sales revenue growth and capital expenditure growth as indicators of financial decision-making efficiency and resource allocation ability. All calculations were performed in Microsoft Excel based on raw data from the companies' 2020–2022 integrated reports.

Table 5 presents the normalized Environmental (E), Social (S), Financial (F), and composite ESG scores at the firm-year level. The average environmental sub-index for European-based firms is approximately 0.91, while the average for Turkish firms is approximately 0.56. This difference of approximately 0.35 points indicates that intensity-based environmental performance is more institutionalized and stable in European firms. In the social dimension, European firms also exhibit a more balanced distribution (average 0.64), while Turkish firms show a more wide-band and fluctuating structure (average 0.49). In contrast, the average financial sub-index for the Turkish group (0.51) is higher than that of the European group (0.27). This situation is particularly related to the decline observed in the financial sub-index for European firms in 2021 and 2022.

Considering the composite ESG scores, the average for the European group is approximately 0.61, while that of the Turkish group is approximately 0.52. Therefore, the overall difference is approximately 0.09 points. However, a remarkable convergence is observed when examining the trend over time. While the Europe-Turkey difference was approximately 0.13 points in 2020, this difference decreased to approximately 0.02 points in 2022. The improvement of Turkish firms, especially in social and financial dimensions, supports this convergence process.

When examining the impact of sub-dimensions on composite ESG, it is observed that environmental and social dimensions carry the ESG score more strongly at the overall sample level. In the European group, due to the high and relatively saturated environmental scores, fluctuations in the financial dimension during the 2021–2022 period negatively affected composite ESG. In the Turkish group, ESG performance is more affected by changes in environmental and social dimensions. This result shows that sustainability performance exhibits a multi-dimensional structure that is sensitive to the regional context, rather than a one-dimensional one.

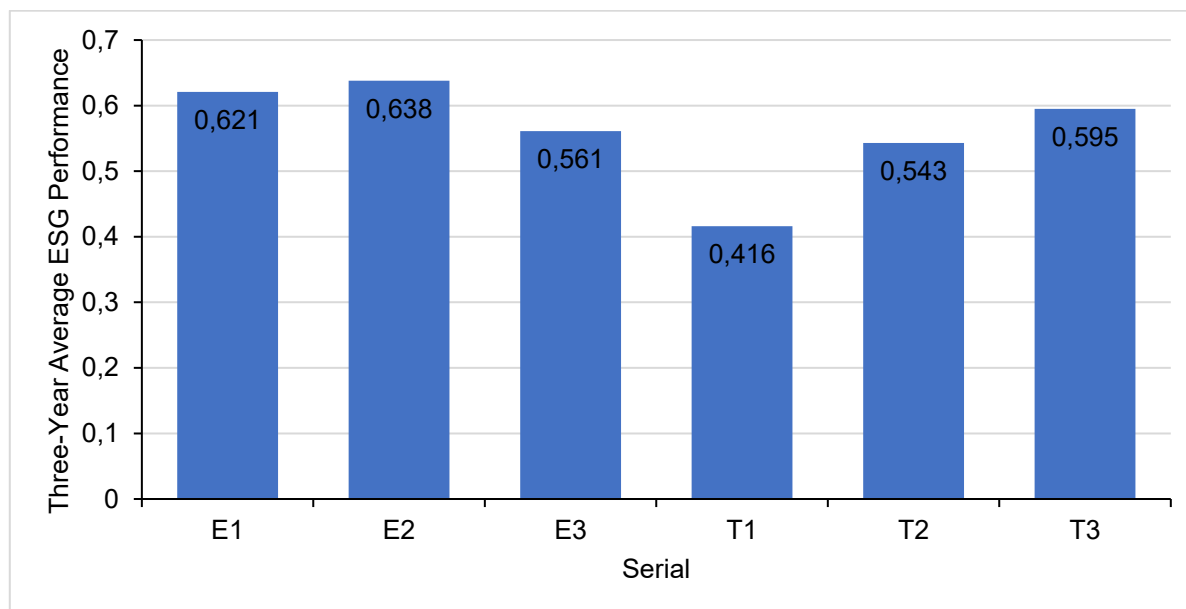
Intra-firm volatility analysis reveals that volatility is relatively higher in the Turkish group. While Turkish firms show wider range of movement in their three-year ESG scores, European firms appear to have more stable environmental and social scores. The volatility observed in the European group stems primarily from financial factors.

The robustness of the findings was evaluated within the framework of methodological assumptions. While min-max normalization is a method sensitive to outliers, calculating the three-year average reduces the impact of periodic jumps. The equal weighting assumption

eliminates the problem of subjective weighting, but it is acknowledged that the contributions of sub-dimensions may change in different weighting scenarios. Nevertheless, European dominance in the environmental and social dimensions and the convergence trend observed as of 2022 are findings that are expected to be structurally preserved in different weighting approaches. The average ESG scores over three years are presented in Figure 9.

Figure 9

Comparative Three-Year Average ESG Performance



Note. This figure was created by the author using Microsoft Excel. The data were extracted from the companies' sustainability reports covering the period 2020–2022.

Figure 9 reveals a filtered long-term performance view of short-term fluctuations. Examining the average values, European firms are seen to have a higher and more stable ESG performance. However, the improving trend shown by Turkish firms as of 2022 indicates a potential for gradual convergence in sustainability integration. The three-year average approach reveals the structural sustainability position of firms more clearly by mitigating the impact of investment cycle-related financial volatilities and periodic environmental spikes.

Discussion

This study compares the environmental and social performance indicators of renewable energy companies in Turkey (T1–T3) and Europe (E1–E3). It reveals that European firms have higher absolute Scope 1–3 emission levels, a difference largely attributed to variations in operational scale and production capacity. The literature emphasizes that ESG performance is closely related to firm size and operational scale (Alareeni & Hamdan, 2020; Gillan et al., 2021), after a comprehensive review of the ESG and corporate social responsibility literature, demonstrate that firm size and corporate maturity play a decisive role in ESG practices (Khan et al., 2016). The high absolute emission levels observed in European firms reflect scale differences rather than poor performance, and comparisons made using normalized indicators yield more meaningful results. The data used in this study is obtained from reports that companies have publicly disclosed. Differences in reporting standards in developing countries bring about problems such as scope inconsistencies and the risk of greenwashing. The 2,000% jump in Scope 3 emissions by T1 and T2's failure to report its 2020 data are concrete examples

of this. Voluntary disclosure regimes limit the reliability of comparative analyses. Although the normalization and multi-year averaging methods applied in this study reduce the impact of these deviations, independent auditing of the data will increase reliability.

According to the findings, differences were identified in Scope 3 emission reporting. The incomplete or limited reporting of some Scope 3 data in Turkish companies makes comparability difficult. This is consistent with the literature showing that voluntary disclosure regimes in ESG reporting can lead to heterogeneous results. It is stated that ESG statements are shaped by institutional structure, regulatory pressure, and investor demand (Christensen et al., 2021; Gillan et al., 2021). The more institutionalized sustainability framework in Europe encourages more comprehensive reporting, including Scope 3. Therefore, the data gaps observed in our study are not a methodological weakness, but a natural consequence of differences in reporting practices between countries. A more balanced gender distribution and organizational diversity have been observed in European firms in terms of social indicators and governance structure (Birindelli et al., 2018), who examined the effect of board composition on ESG performance, showed that the structure and activity intensity of the board are significantly related to ESG performance (Manita et al., 2018). The more institutionalized governance structure observed in European firms can be attributed to the more systematic integration of sustainability performance. The difference in management diversity between groups T and E in our study supports the governance-ESG link emphasized in the literature.

One of the study's notable findings is that European firms are reporting their social and governance indicators in a more holistic manner. This aligns with the literature showing that ESG is not only an area of environmental performance but also closely related to corporate strategy and risk management (Gillan et al., 2021; Krueger et al., 2020). It is emphasized that ESG practices have now become central to the corporate finance literature and are becoming decisive in investor decision-making processes (Boubaker et al., 2022; Broadstock et al., 2021). The comprehensive reporting approach of European firms is relevant not only to regulatory requirements but also to capital market expectations.

This study parallels the literature showing that ESG performance is related to firm resilience during crisis periods (Broadstock et al., 2021; Albuquerque et al., 2020), found that firms with high ESG performance were more resilient to the COVID-19 market shock. In this context, the more holistic ESG integration observed in European firms can be considered an indicator not only of reporting practices but also of corporate resilience potential.

In conclusion, the findings of this study reveal certain structural differences in environmental and social performance between Turkish and European renewable energy companies. However, a significant portion of these differences stem from scale, regulatory framework, and level of corporate maturity (Christensen et al., 2021; Gillan et al., 2021). When considered alongside the literature, our study does not claim statistical generalization but provides a structured comparative analysis explaining how country-based ESG performance differences manifest at the indicator level.

Conclusion

This study presents a comparative case study based on financial governance, environmental, and social indicators between renewable energy companies operating in Türkiye (Aydem, Smart Solar, and Galata Wind) and leading European companies (Iberdrola, Ørsted, and EDP Renováveis) for the period 2020-2022. The findings show differences between the two regions regarding the scale, reporting standards and corporate maturity. In terms of

financial governance, European companies have higher net sales revenues, investment volumes and installed capacities than Turkish companies. Therefore, the European companies possess economies of scale in the global energy market. In 2022, Iberdrola generated revenues of €53.9 billion and had an installed capacity of 60,761 MW, whereas Aydem's revenues in 2022 stood at TL 3.8 billion with a capacity of 1,020 MW. These results are consistent with previous research showing that large, well-established firms in the renewable energy industry tend to have stronger financial capabilities and more advanced sustainability management systems. The impressive growth that Turkish companies showed in the years 2020-2022 is remarkable. The sixfold increase in revenue of Galata Wind in 3 years, Smart Solar's gender balance approach in female employment and the nineteenfold increase in Aydem's investment volume prove that Turkey is in a dynamic development process although the scale is limited in the renewable energy sector. Emerging renewable energy markets are making big strides toward sustainability with constant investment and capacity growth. Sustainability performance should be evaluated in terms of the level of current performance and the processes by which firms integrate sustainability with long-term corporate development.

Environmental indicators also highlight structural differences in the two regions. European companies, despite very high levels of absolute energy consumption, waste generation and emissions, display a more stable and systematic performance when observing normalized intensity indicators. Ørsted's reduction in Scope 3 emissions from 25.3 million tons of CO₂ in 2020 to 10.9 million tons in 2022 reflects significant institutional progress in carbon management and supply-chain sustainability practices. Turkish companies have lower absolute emissions, which can be attributed mainly to their smaller scale and technology choices, particularly the emphasis on wind and solar power systems. So lower emissions are not automatically a sign of better environmental performance. Aydem's increase of Scope 3 emissions by over 70,000 tons in 2022 should be viewed as a temporary situation during the investment period, not a structural trend. Aydem's water intensity is significantly higher than European companies (10–25 m³/MWh) with its hydroelectric-based production structure (4,300–4,700 m³/MWh) creating a large difference in terms of environmental sustainability. The results show that renewable energy technologies have very different environmental footprints and that sustainability assessments should not be based on aggregated indicators but on technology-specific impacts. It is stressed that intensity-based environmental indicators provide a meaningful basis for comparing companies operating at different scales and under different production conditions.

Regarding social indicators, European businesses have a more institutionalized and balanced framework. While high training hours show great business capacity and human capital growth, the percentage of female workers stays constant at 23–33% at Iberdrola, Ørsted, and EDP Renováveis. These results corroborate earlier research underlining how diversity and workforce development help to guarantee long-term sustainability. Only Smart Solar in Türkiye has reached a comparable balance to Europe—that with roughly 48% women employees; Aydem is still at 9–10% and Galata Wind is in the 18–27% range. Indicators of occupational health and safety also reveal a like divergence. Although the frequency of lost-time accidents in European businesses varied from 0.06 to 2.18 between 2020 and 2022, the rise in the TRC value to 18.9 at Smart Solar points to possible flaws in occupational safety procedures during times of fast organizational growth. Employee turnover rates in Turkish businesses—which range from 15 to 38 percent—suggest less corporate stability than the 7–12% range seen in European businesses. These variations show that the Turkish renewable energy industry still has to be much more socially sustainable. Long-term sustainability success also relies on

environmental accomplishments, good governance systems, human capital growth, and sensible social policies.

Given these results, the study's original contribution is the analysis of sustainability performance not only in terms of absolute values but also inside a multidimensional framework employing normalized intensity indicators (per MW, per MWh, and per employee). The intensity-based transformation and minimum–maximum normalization technique used to remove scale bias has helped to make emerging-market companies structurally similar to those in mature Europe. Hence, it has been feasible to examine comparative performance instead of just absolute size. The suggested structure helps with sustainability evaluations by offering a fair basis for comparison of businesses working under varied organizational sizes and market situations.

The study additionally developed an overall ESG performance index combining sub-dimensions for environmental (E), social (S), and Financial Governance (FG). Using the minimum-maximum technique, these sub-dimensions were normalized then combined with equal weighting. Correlation analysis shows that environmental ($r = 0.688$) and social ($r = 0.656$) factors mostly drive ESG performance; financial ($r = 0.117$) aspects have a comparatively weak correlation. This finding points to a structural higher sensitivity of sustainability performance in the renewable energy industry to social institutionalization and environmental efficiency than to short-term financial development. The claim that financial indicators mostly show short-term corporate dynamics calls for a multidimensional ESG assessment of corporate sustainability.

During the years 2020–2022, regional analysis based on composite ESG ratings reveals that European businesses have a greater average ESG performance (0.607) than Turkish companies (0.518). But over time the ESG gap is narrowing, which suggests a convergence rather than a static structural separation. This demonstrates how Turkish renewable energy businesses are progressively including sustainability policies into their strategic management processes and matching their reporting techniques with worldwide norms. The noted variations point to various levels of sustainability maturity rather than as permanent structural flaws. The narrowing of the ESG gap in 2022 reflects a temporary decline in the financial sub-index of European companies due to macro-shocks; it should not be interpreted as a permanent convergence dynamic. While the findings point to the partial resilience of Turkish firms, they do not offer evidence of a lasting leap in corporate maturity.

Still, the study has some restrictions notwithstanding these contributions. Only six renewable energy businesses are included in the study, which runs just 2020–2022. Furthermore, changes in sustainability reporting standards and data availability could affect the comparability of certain indicators. Future research could increase the sample size, cover more nations' renewable energy companies, and use different weighting techniques for ESG index building. Moreover, looking at the cause-and-effect link between ESG performance and long-term financial performance could offer more thorough understanding of sustainability management in the renewable energy industry.

The results show that although European renewable energy companies now have higher sustainability maturity levels, Turkish companies have shown great improvement across several ESG areas during the study period. Gradual narrowing of the ESG gap points to the great potential of the Turkish renewable energy industry to reach sustainability criteria like those of top European businesses in the next years. These results could help corporate executives and

legislators to create better ESG plans, raise the caliber of sustainability reporting, and strengthen institutional sustainability initiatives inside the renewable energy industry from a practical standpoint.

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Research Article

**The Impact of Global Value Chains on Business Cycles: A Comparative Analysis
of G7 and D8 Countries**

Veysel Karagöl^a, Ali Benli^b & Ayşegül Şahin^c

Abstract

Introduction: This study investigates the effects of global value chain (GVC) participation on domestic business cycles in developed (G7) and developing (six selected D8) countries. Understanding this relationship is crucial, as increasing global integration may generate asymmetric macroeconomic outcomes across country groups.

Method: The analysis employs panel data covering the period 1995–2022. Business cycles are represented by the cyclical component of real GDP obtained through filtering techniques. GVC participation is examined alongside fixed capital formation and labor productivity. The empirical analysis is conducted using the Cross-Sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) approach, which accounts for cross-sectional dependence and heterogeneity.

Results or Findings: The results indicate that fixed capital formation and labor productivity are positively and significantly associated with cyclical economic activity in both country groups. However, the relationship with GVC participation differs markedly: while GVC participation exhibits a positive co-movement with expansionary phases in G7 countries, it is negatively associated with cyclical momentum in the six selected D8 countries.

Discussion or Conclusion: These findings suggest that the macroeconomic effects of GVC integration are heterogeneous, depending on countries' positions within value chains and their modes of integration. The results highlight the importance of upgrading within GVCs for developing countries. Future research may explore sectoral dynamics and the role of institutional factors in shaping these outcomes.

Keywords: global value chain participation, business cycles, CS-ARDL

JEL Codes: F13, F15, E32

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Araştırma Makalesi

**Küresel Değer Zincirlerinin İş Döngüleri Üzerindeki Etkisi: G7 ve D8 Ülkelerinin
Karşılaştırmalı Analizi**

Veysel Karagöl^a, Ali Benli^b & Ayşegül Şahin^c

Öz

Giriş: Bu çalışma, küresel değer zinciri (GVC) katılımının gelişmiş (G7) ve gelişmekte olan (seçilmiş altı D8 ülkesi) ülkelerde yurt içi iş çevrimleri üzerindeki etkilerini incelemektedir. Artan küresel entegrasyonun ülke grupları arasında asimetrik makroekonomik sonuçlar doğurabilmesi nedeniyle, bu ilişkinin anlaşılması önem taşımaktadır.

Yöntem: Analizde 1995–2022 dönemini kapsayan panel veri seti kullanılmıştır. İş çevrimleri, reel GSYH serisinin filtreleme yöntemleriyle elde edilen çevrimsel bileşeni ile temsil edilmektedir. GVC katılımı, sabit sermaye oluşumu ve emek verimliliği değişkenleriyle birlikte ele alınmaktadır. Ampirik analizde, yatay kesit bağımlılığını ve heterojenliği dikkate alan Kesitlerarası Genişletilmiş Otokoregresif Dağıtılmış Gecikme (CS-ARDL) yöntemi kullanılmaktadır.

Sonuçlar ya da Bulgular: Elde edilen sonuçlar, sabit sermaye oluşumu ve emek verimliliğinin her iki ülke grubunda da döngüsel ekonomik faaliyetlerle istatistiksel olarak anlamlı ve pozitif bir ilişki sergilediğini göstermektedir. Buna karşılık, GVC katılımı ile olan ilişki belirgin biçimde farklılaşmaktadır: GVC katılımı G7 ülkelerinde genişleme dönemleriyle pozitif bir birlikte hareketlilik gösterirken, seçilmiş altı D8 ülkesinde döngüsel ivmeyle negatif yönde ilişkili bulunmuştur.

Tartışma ya da Yapılan Çıkarımlar: Bu bulgular, GVC entegrasyonunun makroekonomik etkilerinin homojen olmadığını; ülkelerin değer zincirlerindeki konumlarına ve entegrasyon biçimlerine bağlı olarak değiştiğini ortaya koymaktadır. Sonuçlar, özellikle gelişmekte olan ülkeler için değer zincirlerinde yukarı yönlü dönüşümün önemine işaret etmektedir. Gelecek çalışmalar, sektörel dinamikleri ve kurumsal faktörlerin rolünü daha ayrıntılı biçimde inceleyebilir.

Anahtar Kelimeler: küresel değer zincirine katılım, iş çevrimleri, CS-ARDL

JEL Kodlar: F13, F15, E32

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Introduction

International trade was known in the classical economic literature to support growth by improving resource allocation. However, global value chains have shifted trade from final goods to production stages, giving rise to the phenomenon of task trade (Tian et al., 2022). This transformation shows that production activities are not only about the exchange of goods between countries but also about the restructuring of production processes on an international scale, dividing them into stages (Montalbano & Nenci, 2022). Therefore, a global value chain (GVC) perspective has become indispensable for understanding the relationship between trade and growth.

GVCs encompass the activities performed by firms, producers, and workers throughout the lifecycle of a product or service, from initial design and production to distribution, final delivery, reuse, and recycling (Oliveira et al., 2026). These activities include manufacturing, logistics, commercial operations, financial services, after-sales services, and end-of-life management. Since the 1980s, trade liberalization, lower transportation costs, and technological advances have enabled the division of production processes into stages and their location across different countries, contributing to the development of GVCs (Cigna et al., 2022; Singh et al., 2023). Over the same period, intermediate goods have come to account for more than half of world trade, while foreign direct investment and intra-firm trade have gained importance. Multinational corporations have played a central role in this process by coordinating different stages of production through their subsidiaries and independent suppliers, and now account for a substantial share of global trade (Osabohien et al., 2024). GVCs also allow firms to organize production across countries according to differences in labor conditions, taxation, legal frameworks, and market access. As a result, production has increasingly been organized around vertical specialization across countries. Countries' economic performance has therefore become linked not only to domestic demand and technological capacity but also to their position within global production networks (Chen & Xing, 2022).

GVC participation may shape cyclical output through production and productivity channels, but its relationship with domestic economic activity may differ depending on countries' exposure to external shocks (Mao, 2022; Wang et al., 2022; Jangam & Rath, 2024; Jithin et al., 2023; Zhu & Wang, 2025; Lee et al., 2025). Backward linkages increase reliance on imported inputs and may transmit external supply shocks to domestic production. Forward linkages connect domestic value added to foreign demand and may therefore transmit demand-side changes across countries. These two forms of integration can also affect the degree of business cycle synchronization across economies. The relationship between GVC participation and business cycles may thus vary with a country's position in the value chain, type of integration, and sectoral structure (Jangam & Rath, 2024). Differences between developed and developing economies are also documented in the literature. Zhu and Wang (2025) find that GVC linkages strengthen business cycle co-movement, particularly between developed and developing country pairs. Wang et al. (2022) show that developed economies benefit from productivity gains associated with complex and forward-linked activities. In contrast, developing economies rely more heavily on backward linkages and experience sharper contractions during crises. These differences provide the basis for examining the relationship between GVC participation and domestic cyclical output separately for developed and developing economies. Accordingly, this study expects the relationship between GVC participation and cyclical output to differ between the two country groups. Macroeconomic transmission channels provide the theoretical basis for examining this relationship. In this framework, cyclical output dynamics are associated with productive factors such as capital accumulation and labor performance (Chen & Yao, 2024; Mandal & Taku, 2025; Yin & Wang,

2026). The expansion of global value chains, however, has added an international dimension to production processes (Montalbano & Nenci, 2022). GVC participation is linked to production through technology transfers, information flows, and cross-border intermediate linkages. Cyclical output movements may therefore be associated not only with domestic investment and labor productivity but also with countries' participation in international production networks. On this basis, the empirical analysis examines GVC participation alongside domestic investment and labor productivity within an augmented macroeconomic empirical framework.

This study is motivated by a significant gap in the literature. Existing studies have primarily examined the contribution of trade ties to cross-country business cycle synchronization or analyzed the impact of GVCs on growth. Yet, the systematic effects of GVC participation on countries' own domestic business cycles have not been addressed. In particular, findings on how differences between developed and developing countries are reflected in business cycles via GVCs are extremely limited. Thus, the main objective of our study is to empirically examine the effects of GVC participation on business cycles in both developed and developing countries. The analysis aims to reveal the consequences of different positions in value chains on cyclical dynamics by evaluating developed and developing countries as separate panel groups. Thus, it contributes to the literature on how GVCs influence not only the international coordination dimension but also domestic cyclical fluctuations. The reason CS-ARDL is preferred for the analysis is that it allows the simultaneous examination of long-term relationships and short-term dynamics while accounting for cross-sectional dependence and heterogeneity within the panel. In light of this information, the expected contributions of this study can be summarized at three levels: (i) In terms of contribution to the literature, it is one of the rare studies analyzing the impact of GVCs on domestic business cycles. (ii) In terms of comparative analysis, it systematically reveals the effects of GVCs at different levels of development by separating developed and developing countries. (iii) As a methodological contribution, thanks to the CS-ARDL approach, more reliable results are obtained by considering both heterogeneity and cross-sectional dependence in the panel dataset.

The rest of the study is organized as follows: The second section details the literature on the effects of GVCs on business cycles. The third section describes the model, the dataset, and the methodology, and the fourth section presents the empirical findings. Following a Discussion section that compares the analysis findings with the existing literature, the study concludes with a Conclusion section.

Literature Review

The relationship between trade integration and business cycles has long been debated in the literature. Frankel and Rose (1998) provided the first evidence that stronger bilateral trade linkages are associated with greater business cycle synchronization. However, subsequent studies have shown that greater trade integration does not necessarily imply lower output volatility. For example, Di Giovanni and Levchenko (2009) found that trade openness can increase output volatility through greater sectoral specialization and export concentration. Haddad et al. (2013) demonstrated that export diversification plays a key role in explaining these seemingly contradictory effects. According to their findings, the effect of trade openness on growth volatility depends on the degree of export diversification, and more diversified economies benefit more from greater openness. The role of trade in business cycle dynamics has also been examined through various transmission channels. Using firm-level data for France, Di Giovanni et al. (2018) showed that firms with direct trade or multinational linkages to a country tend to exhibit stronger co-movement with that country's economy. At a general level, Caselli et al. (2020), emphasizing the diversification channel of international trade,

demonstrated that its volatility-reducing effect may outweigh the volatility generated by specialization. D'Aguanno et al. (2021) extended this debate to global value chains (GVCs), emphasising that integration can increase efficiency but that its effects on volatility depend, amongst other factors, on supplier diversification. These studies demonstrate that the effects of trade integration depend not only on the degree of openness but also on the structure of international linkages. Subsequent studies have revealed that the relationship between trade and business cycles varies depending on the source of shocks and the channels of international integration. Using an open-economy model calibrated for China, Ma et al. (2022) found that the effect of trade openness on volatility differs depending on the type of shock affecting the economy. On the other hand, Azcona (2022), approaching the issue from the perspective of shared trade exposure, demonstrated that countries sharing major trading partners—even if their bilateral trade is limited—may exhibit a higher degree of business cycle synchronisation. Other studies have examined the non-trade and institutional dimensions of this relationship. For example, Beck and Nzimande (2023) found that labour mobility in South Africa weakened business cycle synchronisation over time; whilst Gnanon (2023) demonstrated that longer GATT/WTO membership is associated with lower growth volatility, particularly when accompanied by higher export diversification. Recent studies continue to emphasise the importance of economic structure and external exposure. Ardelean et al. (2024) have shown that the balance between market diversity and specialisation plays a significant role in determining growth volatility. Avila Montealegre and Mix (2024), focusing on the co-movement of business cycles, found that part of the effect attributed to bilateral trade reflects countries' shared exposure to third markets. When this shared exposure is taken into account, the direct effect of bilateral trade is significantly weakened. On the other hand, Casal and Guntin (2025) have linked the higher volatility observed in developing economies to these economies' high dependence on more volatile sectors. Overall, these findings reinforce the view that the relationship between international integration and business cycle dynamics depends to a large extent on countries' trade patterns and structural characteristics.

A separate strand of research asks not how global value chains affect business cycles, but how they affect growth and structural change; this is a related but distinct question. Montalbano and Nenci (2022), focusing specifically on agricultural and food value chains, found that forward participation tends to support economic stability, whilst backward participation may accelerate the transmission of shocks; this is a sector-specific rather than a general finding, but it foreshadows a pattern observed elsewhere. Working with a panel comprising 63 developed and emerging economies, Mao (2022) identified a U-shaped relationship: middle-income economies benefit from first withdrawing from foreign-dominated global value chains to establish local value chains, and then re-engaging more deeply once these chains are in place. Wiryawan et al. (2023) also found that participation in global value chains, largely through forward and backward linkages, yields gains in industrial upgrading. Their data showed that, for the most part, low-technology manufacturing contracted rather than improved. Although Mancini et al., (2024) did not themselves test a causal relationship, their new datasets comprising upstreamness and downstreamness indicators have become the standard tool used by other researchers to ask precisely this question: Where does a country stand in the chain, and what does this position mean in terms of the risks it faces and its growth prospects? Owusu (2025), using a sample of 46 emerging countries, confirmed that participation in GVCs increases total labor productivity, that the structural transformation component of this gain is as significant as the intra-sectoral component, and that the benefits are strongest in Asia and Latin America. Lee et al. (2025) compared South Korea and Spain and found that forward linkages in the global value chain had negative effects on growth in both countries, particularly in certain sectors, whilst backward linkages were beneficial only in specific Spanish sub-sectors

and continued to have a negative impact on Korean growth. Zou (2026) modeled the relationship not as linear or U-shaped, but as N-shaped. An initial learning phase leads to a 'scale-up trap' in which the benefits of participation actually diminish; in a subsequent breakthrough phase, deeper linkages finally bear fruit once more. Although these studies have focused primarily on growth and structural transformation rather than business cycles, they point to a significant source of heterogeneity in the effects of participation in GVCs. In particular, differences in income levels, structural transformation and position within value chains suggest that the cyclical effects of GVC integration may also vary between developed and emerging economies.

Studies linking GVCs directly to business cycles have focused primarily on shock transmission and the synchronized movement of economic activity. Altomonte et al. (2012), examining the 2008–2009 global crisis, demonstrated how adjustments in demand for intermediate goods and in inventories contributed to the transmission and amplification of the decline in final demand throughout supply chains. Subsequent studies have focused on the synchronization of business cycles through value-chain trade. Jiang et al. (2019) found that value-added trade reinforced the synchronization of business cycles in East Asia. Yu et al. (2023) reported a similar relationship for China and Belt and Road partner countries, noting that GVC trade is positively associated with business cycle synchronization. These findings suggest that production linkages can transmit fluctuations between economies and interlink production processes. The transmission of shocks via GVCs has also been examined from different perspectives. Cook and Patel (2023), using a dollar-invoiced DSGE model, demonstrated that GVC trade and traditional bilateral trade respond differently to interest rate shocks, and that these responses depend on the invoicing currency. This finding highlights the role of monetary conditions in the transmission of shocks via international production networks. Adopting a different approach, Angelidis and Varsakelis (2023) analyzed global value chains as networks and found that greater interdependence between countries facilitates the transmission of shocks across the network. Taken together, these studies demonstrate that the transmission of shocks via global value chains depends on both the structure of production linkages and the conditions under which international transactions take place. More recent studies have examined the channels through which GVC linkages contribute to business cycle synchronization. Drawing on data from 72 economies over the period 2010–2019, Lee et al. (2024) found that trade integration, particularly in intermediate goods, is a significant determinant of synchronization, alongside foreign direct investment and debt market integration. Choi (2025) focused more directly on the role of intermediate goods and estimated, through model simulations, that they accounted for approximately 31–33 percent of trade-output synchronization, when value-added rents were included, this proportion rose to approximately 55 percent. Kang (2025) demonstrated that synchronization is not limited to direct bilateral trade relations. Using Korean data, the study found that shared exposure to third-country markets, primarily through intermediate inputs, also contributes to business cycle synchronization. Zhu and Wang (2025), using data for 43 countries, similarly found a positive relationship between global value chain linkages and production cycle correlation. However, the magnitude of this relationship varies across different types of value chain linkages. However, much of this literature focuses on cross-country business cycle synchronization or co-movement, rather than on how participation in GVCs affects local business cycle fluctuations. Furthermore, relatively little attention has been paid to whether this relationship differs systematically between developed and emerging economies. This study aims to address this gap by examining the impact of participation in global value chains on business cycles separately for these two groups of countries.

More recent studies have broadened this debate to include the effects of geoeconomic fragmentation and geopolitical tensions on international trade. Bonadio et al. (2025) found that, rather than collapsing under geopolitical tensions, global trade reorganized itself into blocs aligned with the US and China respectively. That intra-bloc trade costs actually fell whilst inter-bloc costs rose. Salvatore and Tripathi (2025), who examined 132 countries between 2017 and 2023, approached the question of fragmentation through the lens of growth rather than cycles: they found that, with the rise of protectionism, trade's role as a driver of growth has weakened and that it now acts as a facilitator rather than a driving force.

Across all three strands, the same tension keeps resurfacing. A significant portion of the literature suggests that deeper trade and global value chain integration could strengthen the synchronization of business cycles across countries. However, the same channels may also facilitate the transmission of shocks, and the resulting effects appear to depend on countries' structural characteristics and their positions within value chains. Taken together, these findings suggest that the cyclical outcomes of participation in GVCs may differ across countries and provide a basis for examining advanced and emerging economies separately.

Model, Data, and Methodology

Model

In order to examine how integration into the global value chain (GVC) interacts with business cycle dynamics, an extended macroeconomic framework has been developed that takes cyclical fluctuations into account and is based on the fundamental macroeconomic transmission channels. In line with empirical studies in the open economy literature (Constantinescu et al., 2019), output dynamics and cyclical deviations (BC_{it}) have been modelled as a function of foreign trade integration, capital accumulation and labour performance:

$$BC_{it} = f(GVC_{it}, GCF_{it}, LP_{it}) \quad (1)$$

Accordingly, the baseline econometric model is formulated as follows:

$$BC_{it} = \beta_0 + \beta_1 GVC_{it} + \beta_2 GCF_{it} + \beta_3 LP_{it} + \varepsilon_{it} \quad (2)$$

In this empirical specification, the explanatory variables are defined as standard macroeconomic proxies rather than direct factor stocks:

BC_{it} represents the business cycle component, obtained by detrending real GDP using the Hodrick-Prescott filter ($\lambda = 6.25$). Expressed in billions of US dollars, this signed measure captures cyclical movements in economic activity (output gap dynamics) rather than the magnitude of volatility per se. GVC_{it} measures total participation in global value chains (the sum of forward and backward linkages) and operates as an indicator of external integration, cross-border production sharing, and international technology diffusion channels. GCF_{it} is gross fixed capital formation as a percentage of GDP, capturing the pace of domestic investment activity and capital accumulation dynamics. LP_{it} denotes labor productivity, calculated as real GDP divided by total employment and expressed in thousands of US dollars for numerical scaling and coefficient readability. While LP_{it} reflects output per worker, it enters the model in normalized levels to capture productive efficiency, organizational capacity, and workforce performance alongside detrended cyclical output.

From a theoretical perspective, increases in GCF are expected to enhance productive capacity through capital deepening (Acemoglu & Guerrieri, 2008) and the demand-side

momentum of investment. Similarly, improvements in *LP* reflect gains in organizational efficiency and skills, exerting an upward effect on cyclical economic activity. In contrast, the net macroeconomic impact of *GVC* participation on business cycle dynamics is theoretically ambiguous. On the one hand, deeper *GVC* integration can support cyclical output through technology transfers, productivity spillovers, economies of scale, and expanded market access. On the other hand, it can heighten vulnerability to external demand and supply shocks, accelerate cross-border shock transmission, and disrupt production during global supply bottlenecks.

Ultimately, the net effect of *GVC* integration depends on country-specific structural characteristics—such as sectoral composition, trade orientation, domestic value-added content, and financial depth. While *GVC* participation tends to bolster economic activity in well-diversified economies embedded in advanced supply networks, it may be associated with weaker cyclical output performance in economies characterized by high financial vulnerability and excessive reliance on imported intermediate inputs (World Bank, 2020).

Data

The effect of *GVC* integration on production is conditioned by country characteristics. To account for this heterogeneity, two country groups were analyzed: The Developing Eight (D8) is an intergovernmental economic cooperation which was established in 1997 by eight founding members: Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Türkiye. Although Azerbaijan joined as the ninth member in 2024, it falls outside the institutional scope of the historical sample period (1995–2022). Among the founding members, Iran and Nigeria were excluded due to data constraints: OECD TiVA does not provide *GVC* participation indicators for Iran, while continuous gross capital formation (GCF) series could not be retrieved for Nigeria across the entire sample period. Consequently, the empirical developing country panel focuses on the remaining six founding members (Bangladesh, Egypt, Indonesia, Malaysia, Pakistan, and Türkiye) with continuous and balanced data, referred to throughout as the “six selected D8 countries”. The remaining six selected D8 countries had a combined nominal GDP of approximately USD 4.5 trillion in 2024, accounting for about 4% of global GDP. Their exports of goods and services reached USD 1.2 trillion (3.5% of global exports), while their population of roughly 950 million accounted for 11.6% of the global total (World Bank, 2025).

The G7 is an informal group of advanced industrialized democracies comprising the United States, Canada, Germany, France, Italy, Japan, and the United Kingdom. Members convene annually to assess global economic and geopolitical developments. In 2024, the G7’s combined GDP is approximately USD 57 trillion, accounting for about 29% of global output (Council on Foreign Relations, 2025). Their exports are projected to reach USD 6.7 trillion, accounting for roughly 32% of global exports (United Nations, 2025). With a population of about 785 million, the G7 constitutes 9.6% of the global population (World Bank, 2025).

GVC data were obtained from the OECD’s Trade in Value Added (TiVA) database, widely regarded as the most comprehensive source for value chain indicators. As TiVA covers the 1995–2022 period, the analysis is restricted to these years. Data for BC, GCF, and LP were sourced from the World Bank’s World Development Indicators (WDI). All variables are annual.

Methodology

The baseline econometric model estimated in this study is as follows:

$$BC_{it} = \alpha_i + \lambda_t + \beta GVC_{it} + \gamma_1 GCF_{it} + \gamma_2 LP_{it} + \varepsilon_{it} \quad (3)$$

In the sample, the time dimension ($T=28$) is larger than the cross-sectional dimension ($N=6, 7$). In macro panels where $T > N$, traditional static panel estimators such as fixed effects and random effects may produce biased and inconsistent estimates if issues of slope heterogeneity, cross-sectional dependence, and non-stationarity are present. Therefore, before selecting the appropriate estimation technique, preliminary diagnostic tests including cross-sectional dependence, slope homogeneity, unit root, and cointegration must be conducted.

Slope Heterogeneity

In panel data models, testing whether the slope coefficients are homogeneous across units is important for selecting the appropriate estimator. For this purpose, the Slope Homogeneity test developed by Pesaran and Yamagata (2008) was used in the study. This test produces consistent results even in cases of heteroscedasticity. The delta ($\tilde{\Delta}_{HS}$) and adjusted delta ($\tilde{\Delta}_{AHS}$) test statistics from the Pesaran and Yamagata (2008) test are formulated as follows:

$$\tilde{\Delta}_{HS} = (N)^{\frac{1}{2}}(2k)^{-\frac{1}{2}}\left(\frac{1}{N}\tilde{S} - k\right) \quad (4)$$

$$\tilde{\Delta}_{AHS} = (N)^{\frac{1}{2}}\left(\frac{2k(T-k-1)}{T+1}\right)^{-\frac{1}{2}}\left(\frac{1}{N}\tilde{S} - 2k\right) \quad (5)$$

Blomquist and Westerlund (2013) extended Pesaran and Yamagata's (2008) slope heterogeneity tests with a bootstrap-based approach and presented the HAC (Heteroskedasticity and Autocorrelation Consistent) estimator. This modification has made the method resistant to heteroskedasticity and autocorrelation. As a result, consistent results have been obtained even with small samples.

$$\tilde{\Delta}_{HAC} = (N)^{\frac{1}{2}}(2k)^{-\frac{1}{2}}\left(\frac{1}{N}\tilde{S}_{HAC} - k\right) \quad (6)$$

Here, $\tilde{S}$ represents the Swamy test statistic, k represents the number of explanatory variables in the model, N represents the number of cross-sectional units, and T represents the number of time periods.

Cross-sectional Dependence (CSD) Test

Cross-sectional dependence (CSD) arises when the units comprising a panel (for example, countries or firms) are not independent of one another, and a shock occurring in one unit affects the other units as well. Given the structure of global value chains, such interactions between countries are economically inevitable. Spillover effects arising from global integration—such as financial crises, fluctuations in oil prices and other common macroeconomic shocks—lead to interdependence amongst panel units.

To account for CSD and guide estimator selection, Pesaran's (2021) CD test was employed. The test statistic is defined as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right) \rightarrow N(0,1) \quad (7)$$

Panel Unit Root Test

The stationarity properties of the series were investigated using the CIPS (Cross-sectionally Augmented IPS), a second-generation unit root test developed by Pesaran (2007). CIPS also accounts for cross-sectional dependence. The Pesaran (2007) CIPS test is a simple arithmetic mean of individual CADF statistics, calculated by including the lagged levels and differences of the series, along with the cross-sectional means, in the standard ADF regression to control for cross-sectional dependence. The CIPS test examines the null hypothesis that the series contains a unit root for all cross-sectional units, against the alternative hypothesis that the series is stationary for at least one unit.

$$CIPS = \frac{1}{N} \sum_{i=1}^N t_i(N, T) \quad (8)$$

Cointegration Test

The cointegration relationship between the variables included in the study must be verified before estimating long-term coefficients. To obtain robust and reliable results and to account for cross-sectional dependence, the Westerlund (2007) panel cointegration test was applied. Westerlund's (2007) estimation equation is as follows:

$$\Delta y_{it} = \delta'_i d_t + \alpha_i(y_{it-1} - \beta'_i x_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{it-j} + \sum_{j=-q_i}^{p_i} \gamma_{ij} \Delta x_{it-j} + e_{it} \quad (9)$$

Westerlund (2007) calculates four different statistics for the cointegration test. Group mean statistics (G_t , G_a) allow for heterogeneity across units and test the alternative that the panel has cointegration in at least one panel. Panel statistics (P_t , P_a) assume a homogeneous structure and are based on the alternative hypothesis that the panel is cointegrated as a whole.

$$G_t = \frac{1}{N} \sum_{i=1}^N \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \quad (10)$$

$$G_a = \frac{1}{N} \sum_{i=1}^N \frac{T \hat{\alpha}_i}{\hat{\alpha}_i(1)} \quad (11)$$

$$P_t = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \quad (12)$$

$$P_a = T \hat{\alpha} \quad (13)$$

Westerlund's (2007) tests evaluate panel cointegration using an error-correction approach. In addition, Westerlund (2008) applied tests to account for cross-sectional

dependence and to control for the effect of global shocks. Westerlund (2008) generates two test statistics: the panel statistic (DH_p) and the group statistic (DH_g).

$$DH_g = \sum_{i=1}^n \hat{S}_i (\tilde{\phi}_i - \hat{\phi}_i)^2 \sum_{t=2}^T \hat{e}_{it-1}^2 \quad (14)$$

$$DH_p = \hat{S}_n (\tilde{\phi} - \hat{\phi})^2 \sum_{i=1}^n \sum_{t=2}^T \hat{e}_{it-1}^2 \quad (15)$$

The DH_p statistic tests for the existence of a common cointegration relationship across all units. The DH_g statistic accounts for heterogeneous structures. It tests whether cointegration exists in at least one unit. The countries in the dataset differ in their economic structures. Therefore, the Group Mean (DH_g) statistic, which allows the coefficients to vary across units in the panel, provides more reliable results.

CS-ARDL

Cross-sectional dependence and parameter heterogeneity were detected in the panel, and a cointegration relationship was confirmed. In macro panels where $T > N$, these empirical properties render traditional static panel models (e.g., Fixed Effects) and standard micro-panel dynamic estimators (e.g., GMM) biased and inconsistent. Beyond these econometric considerations, the CS-ARDL framework developed by Chudik et al. (2016) is specifically aligned with the core research questions of this study: it allows the estimation of dynamic adjustment speeds (ECT_{t-1}) through which external supply-chain shocks propagate across business cycles, accommodates structural asymmetries by permitting flexible slope estimation across separate G7 and six selected D8 panels, and filters out unobserved global common shocks (e.g., global trade contractions) via cross-sectional averages ($\bar{Z}_t$) to isolate the true domestic cyclical associations of GVC participation. Accordingly, the baseline CS-ARDL specification is formulated as follows:

$$\begin{aligned} BC_{it} = & \alpha_{it} + \sum_{j=1}^P \beta_{ij} BC_{i,t-j} \\ & + \sum_{j=0}^P (\gamma_{1,ij} GVC_{i,t-j} + \gamma_{2,ij} GCF_{i,t-j} + \gamma_{3,ij} LP_{i,t-j}) \\ & + \sum_{j=0}^3 (\delta_{1i} \overline{\Delta BC}_{t-j} + \delta_{2i} \overline{GVC}_{t-j} + \delta_{3i} \overline{GCF}_{t-j} + \delta_{4i} \overline{LP}_{t-j}) + \varepsilon_{it} \end{aligned} \quad (16)$$

To estimate the short-term dynamics between variables and the speed of adjustment of the system back to equilibrium following shocks, the error correction (ECM) form of the CS-ARDL model has been estimated.

$$\begin{aligned}
\Delta BC_{it} = & \phi_i (BC_{i,t-1} - \theta_{1i} GVC_{i,t-1} - \theta_{2i} GCF_{i,t-1} - \theta_{3i} LP_{i,t-1} - \omega'_i \bar{Z}_{t-1}) \\
& + \sum_{j=1}^{p-1} \psi_{1ij} \Delta BC_{i,t-j} + \sum_{j=0}^{q-1} \psi_{2ij} \Delta GVC_{i,t-j} \\
& \sum_{j=0}^{q-1} \psi_{3ij} \Delta GCF_{i,t-j} + \sum_{j=0}^{q-1} \psi_{4ij} \Delta LP_{i,t-j} + \sum_{s=0}^s \kappa'_{is} \Delta \bar{Z}_{t-s} + \mu_i + \tau_t + \varepsilon_{it}
\end{aligned} \tag{17}$$

Here, ϕ_i , is the error correction coefficient and represents the process of fitting the model to long-term equilibrium. θ_{1i} , θ_{2i} and θ_{3i} are the coefficients of the variables GVC, GCF, and LP, respectively. ψ_{1ij} , ψ_{2ij} and ψ_{3ij} , are the short-run dynamic relationship coefficients. p and q denote orders of lag and reflect the lagged effects of the relevant variables. The $\bar{Z}_t$ vector consists of the cross-sectional means of the BC, GVC, GCF, and LP variables and is included in the model with both level and difference terms to control for cross-sectional dependence. Furthermore, μ_i represents country-specific fixed effects, while τ_t represents time effects common to all cross sections. In addition to handling cross-sectional dependence and slope heterogeneity, the dynamic specification of the CS-ARDL estimator plays a crucial role in mitigating potential endogeneity and simultaneity concerns between the dependent variable (BC_{it}) and explanatory variables—most notably labor productivity (LP_{it}). Because BC_{it} is the detrended, cyclical component (output gap) extracted via the HP filter ($\lambda = 6.25$), whereas LP_{it} is measured in normalized levels (thousands of USD) as a structural efficiency proxy, the model substantially mitigates concerns over a direct mechanical accounting identity. Moreover, by incorporating autoregressive distributed lags of the regressors and dependent variable alongside cross-sectional averages ($\bar{Z}_t$), the CS-ARDL framework helps mitigate biases arising from dynamic feedback effects and unobserved common shocks. However, because dynamic macro-panel estimators cannot fully rule out contemporaneous simultaneity in the absence of strictly exogenous quasi-experimental variation, the estimated parameters are interpreted with caution as robust long-run dynamic associations rather than strict unidirectional causal effects. The inclusion of dynamic cross-sectional averages in the CS-ARDL specification effectively partials out strong, pervasive unobserved common factors across units, thereby mitigating potential parameter distortions arising from synchronized global macroeconomic shocks such as the 2020 COVID-19 pandemic.

Although the asymptotic theory of dynamic CCE and CS-ARDL estimators is formally developed for panels with large cross-sectional and time dimensions ($N, T \rightarrow \infty$), Monte Carlo evidence in Chudik and Pesaran (2015) suggests that the approach performs reasonably well with acceptable finite-sample properties in moderate time horizons ($T \approx 30$). Accordingly, the CS-ARDL framework has become widely adopted in empirical macroeconomics for naturally bounded, country-specific panels characterized by small N and moderate T , such as the G7 ($N = 7$), BRICS ($N = 5$), and Nordic groups ($N = 5$) (Adebayo et al., 2023; Dogan & Pata, 2022; Liu et al., 2023; Sharif et al., 2023).

Findings

Preliminary Test Results

Table 1

Heterogeneity Test Results

Test	Parameters	Group of 7		Six selected D8	
		Delta	P-Value	Delta	P-Value
Pesaran and Yamagata, 2008	$\overline{\Delta_I}$	7.262	0.000	5.659	0.000
	Δ_{adj}	8.081	0.000	6.297	0.000
Blomquist and Westerlund, 2013	(Δ_{HAC})	6.286	0.000	26.397	0.000
	$(\Delta_{HAC})_{adj}$	6.994	0.000	29.372	0.000

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

The results of the Pesaran and Yamagata (2008) and Blomquist and Westerlund (2013) heterogeneity tests, presented in Table 1, indicate that the slope coefficients are not homogeneous across units. This finding reveals significant slope heterogeneity in the panel and suggests that second-generation panel estimation methods that account for heterogeneity are appropriate.

Table 2

CSD Test Results

Test	Group of 7		Six selected D8	
	Statistic	P-Value	Statistic	P-Value
Breusch-Pagan LM	226.10	0.000	86.55	0.000
Pesaran scaled LM	80.29	0.000	32.76	0.000
Pesaran CD	14.68	0.000	5.22	0.000

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

The Breusch–Pagan LM, Pesaran-scaled LM, and Pesaran CD test results presented in Table 2 show significant cross-sectional dependence between units in both country groups. This finding highlights the importance of common shocks and cross-sectional interactions within the panel, underscoring the need for second-generation panel methods that account for cross-sectional dependence.

Table 3

Pesaran CIPS Panel Unit Root Test Results

Variable	Level, Constant	1st difference, Constant	Level, Constant & Trend	1st difference, Constant & Trend	Order
Group of 7					
BC	−2.116 (0.166)	−3.547 (0.000)	−2.180 (0.644)	−3.436 (0.001)	I(1)
GVC	−2.027 (0.233)	−4.265 (0.000)	−2.251 (0.567)	−4.239 (0.000)	I(1)
GCF	−1.411 (0.829)	−3.765 (0.000)	−1.159 (0.999)	−4.129 (0.000)	I(1)
LP	−0.949 (0.987)	−3.755 (0.000)	−1.642 (0.971)	−3.882 (0.000)	I(1)
six selected D8					

BC	-2.218 (0.124)	-3.859 (0.000)	-2.318 (0.491)	-3.698 (0.000)	I(1)
GVC	-1.869 (0.391)	-4.816 (0.000)	-2.436 (0.370)	-4.874 (0.000)	I(1)
GCF	-2.178 (0.146)	-4.637 (0.000)	-2.484 (0.323)	-4.518 (0.000)	I(1)
LP	-1.998 (0.274)	-3.291 (0.000)	-1.819 (0.902)	-3.638 (0.000)	I(1)

Values in parentheses are p-values.

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

The panel unit root test results reported in Table 3 indicate that all variables are non-stationary in levels but stationary in first differences, confirming they are integrated of order one, I(1). This common I(1) order of integration satisfies the prerequisite for panel cointegration analysis. It supports the use of the CS-ARDL approach to estimate long-run and short-run dynamics under cross-sectional dependence. Although the HP cyclical component is mean-reverting by construction, severe macroeconomic shocks over the 1995–2022 period induce substantial finite-sample persistence and hysteresis, resulting in an empirical (1) behavior that justifies the dynamic CS-ARDL specification.

Table 4

Westerlund (2007) Cointegration Test Results

	Group of 7		Six selected D8	
	Statistics	Robust p -value	Statistics	Robust p -value
Gt	-1.134	0.320	-2.458	0.020
Ga	-5.376	0.020	-2.482	0.050
Pt	-1.264	0.000	-4.416	0.040
Pa	-2.743	0.000	-3.519	0.110

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software. Reported robust p-values are empirically generated via 100 bootstrap replications to account for cross-sectional dependence.

Table 5

Westerlund (2008) Durbin-Hausman Cointegration Test Results

	Group of 7		Six selected D8	
	Statistics	Prob.	Statistics	Prob.
DHg	7.095	0.000	1.651	0.049
DHp	1.468	0.071	5.204	0.000

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

The cointegration test results reported in Tables 4 and 5 provide strong evidence of a long-run equilibrium relationship among the variables across both country groups. In Table 4, the Westerlund (2007) test rejects the null hypothesis of no cointegration across the majority of statistics in both the G7 (G_a, P_t, P_a at $p < 0.05$) and the six selected D8 panels (G_t, G_a, P_t at $p \leq 0.05$). The Westerlund (2008) Durbin–Hausman cointegration test (Table 5), which explicitly accounts for cross-sectional dependence, also supports the evidence of cointegration across both panels.

CS-ARDL Test Results

The empirical specification of the CS-ARDL model was configured as follows: Optimal lag lengths for the variables and their cross-sectional averages were selected based on the Akaike Information Criterion (AIC) under a maximum lag constraint of 2 (to preserve degrees of freedom in a moderate time horizon), combined with post-estimation diagnostic checks to minimize residual serial correlation and substantially mitigate cross-sectional dependence. Accordingly, for the G7 panel (effective $N \times T = 7 \times 21 = 147$), an ARDL(1,1,0,2) model was estimated with cross-sectional average lags of (1,1,2,2) across (*BC*, *GVC*, *GCF*, *LP*). For the six selected D8 panel (effective $N \times T = 6 \times 23 = 138$), an ARDL(1,1,0,1) model was specified with cross-sectional average lags of (1,0,0,1).

Taken together, the CS-ARDL long-run results in Tables 6 and 7 indicate that the drivers of economic expansions and contractions are broadly similar across G7 and six selected D8 countries. However, the effects of global value chain participation (*GVC*) differ between the two groups.

Table 6

CS-ARDL Test Results for G7 Countries

Variables	Coefficient	T-Stats	P-Value
Long run			
GVC	26.12**	2.55	0.011
GCF	50.45**	2.09	0.036
LP	23.37***	3.44	0.001
Short run			
ECT(-1)	-0.77***	-7.40	0.000
Δ GVC	9.71	1.23	0.219
Δ GCF	22.37***	4.81	0.001
Δ LP	17.88***	2.97	0.003
Obs.	147		
Residual CD	1.65		0.098

*** $p < .01$, ** $p < .05$, * $p < .10$

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

The long-run coefficient of *GCF* is positive and statistically significant for both G7 and six selected D8 economies, indicating that capital accumulation consistently co-moves with expansionary phases. Physical capital investment is associated with enhanced productive capacity, while the significant positive coefficient on *LP* suggests that labor productivity improvements are closely linked to cyclical output expansion.

Table 7*CS-ARDL Test Results for Six Selected D8 Countries*

Variables	Coefficient	T-Stats	P-Value
Long run			
GVC	-1.20**	-2.31	0.021
GCF	3.56***	3.49	0.000
LP	6.13***	2.83	0.005
Short run			
ECT(-1)	-0.85***	-4.56	0.000
Δ GVC	-0.40	-1.06	0.287
Δ GCF	1.96**	2.53	0.012
Δ LP	5.18**	2.39	0.017
Obs.	138		
Residual CD	3.28		0.001

*** $p < .01$, ** $p < .05$, * $p < .10$

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

In contrast, the relationship between GVC participation and business cycles varies across country groups. In G7 economies, GVC participation is positively and significantly associated with expansionary cyclical dynamics, whereas in the six selected D8 countries, the relationship is characterized by a conditional, statistically significant and negative association. Although the empirical model uses aggregate GVC participation, this difference is consistent with the broader structural distinctions identified in the literature. Advanced economies often participate in higher-value-added production segments, while emerging economies may be more exposed to external shocks. To formally verify whether the estimated long-run coefficients differ across panels, a two-sample Z-test was conducted. The results confirm statistically significant structural differences between G7 and D8 economies for GVC ($Z = 2.66, p = 0.008$).

The error correction term is negative and statistically significant in both groups, indicating that short-run deviations in economic activity are corrected over time, guiding economies back to their long-run equilibrium. This points to a strong adjustment mechanism that mitigates economic fluctuations in both the G7 and six selected D8 countries.

Post-estimation Pesaran CD tests show that the inclusion of cross-sectional averages reduces residual cross-sectional dependence to statistically insignificant levels in the G7 panel ($CD=1.65, p=0.098$). For the six selected D8 panel, although the test statistic declines relative to the raw series, the residual CD statistic remains statistically significant ($CD=3.28, p=0.001$) under the lag structure chosen to preserve degrees of freedom in a moderate sample ($N=6, T=23$). This divergence may partly reflect the higher structural homogeneity of G7 economies relative to the geographically and structurally more diverse D8 group. While this indicates that unobserved common factors are not completely eliminated in the developing panel, the qualitative consistency and sign stability observed across alternative mean-group specifications (AMG and CCEMG in Table 8) provide supportive evidence for the baseline empirical findings.

Robustness Tests

To assess robustness, two additional estimators are employed: Augmented Mean Group (AMG) and Common Correlated Effects Mean Group (CCEMG). Both estimators are well-suited for macro panels exhibiting slope heterogeneity, non-stationarity, and cross-sectional

dependence. The CCEMG method controls for unobserved common factors by incorporating the cross-sectional means of the dependent and explanatory variables into the model. The AMG estimator tackles similar econometric concerns but models unobserved common factors as a dynamic process rather than through cross-sectional averages (Shen et al., 2021).

Table 8

Robustness Test: Results of AMG and CCEMG Models

Variables	Group of 7		Six selected D8	
	AMG	CCEMG	AMG	CCEMG
GVC	2.425** (1.086)	3.758*** (1.449)	-1.283** (0.594)	-0.766** (0.326)
GCF	15.319** (7.252)	18.804*** (5.701)	1.697* (0.998)	2.142** (0.916)
LP	20.408*** (0.613)	15.438*** (3.745)	5.113** (2.251)	3.181*** (1.146)
Constant	-269.9 (548.22)	470.9 (454.62)	39.15 (27.15)	87.51 (234.29)

*** $p < .01$, ** $p < .05$, * $p < .10$

Standard errors are reported in parentheses.

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

According to Table 8, both the AMG and CCEMG estimators confirm the sign and statistical significance of the core relationships across both country groups. For G7 economies, GVC participation, capital accumulation, and labor productivity remain positively associated with cyclical activity, while for the six selected D8 countries, the negative GVC association and positive capital and productivity linkages persist. While consistency on coefficient signs confirms the qualitative robustness of the CS-ARDL results, noticeable variations in coefficient magnitudes emerge across estimators. These numerical divergences result primarily from foundational differences in model specification, dynamic structures, and cross-sectional filtering mechanisms across the estimators. First, while CS-ARDL is a dynamic error-correction framework whose long-run coefficients capture cumulative steady-state relationships adjusted by the error-correction mechanism, AMG and CCEMG operate as static mean-group estimators that average unit-specific parameters without incorporating lagged dynamic multiplier effects. Second, the treatment of unobserved common shocks differs across methods: CCEMG and CS-ARDL proxy unobserved factors using cross-sectional averages of the variables, whereas AMG extracts an explicit dynamic common process from first-stage difference regressions. Because this common process absorbs shared macroeconomic trends and productivity trajectories across units, it naturally scales the estimated slope parameters of structural regressors. Consequently, the AMG and CCEMG estimations serve to verify the sign persistence and statistical reliability of the baseline findings across alternative cross-sectional dependence structures rather than implying parameter magnitude equivalence across differing dynamic specifications.

Discussion

The key finding of this study is that participation in global value chains (GVCs) is positively associated with cyclical output in G7 countries. In contrast, there is a statistically significant and negative relationship between GVC participation and cyclical economic activity in the six selected D8 countries. This discrepancy is consistent with the 'double-edged sword'

approach in the literature, which suggests that the effects of trade integration depend on country-specific conditions (D'Aguanno et al., 2021).

The positive coefficient obtained for the G7 group is consistent with literature suggesting that diversified production and trade structures may be associated with greater resilience to external shocks (Caselli et al., 2020). Because the empirical model focuses on aggregate GVC participation, the distinction between forward and backward integration channels is presented here as a theoretical interpretation rather than a directly tested proposition. Whilst our empirical model does not distinguish between the different components of participation in the GVC, the positive relationship found is conceptually consistent with the view that advanced economies participate in the GVC primarily through upstream or forward-linked activities (Montalbano & Nenci, 2022). Such activities, which are characterized by higher technology intensity and domestic value added, can help to mitigate the effects of cyclical fluctuations.

Conversely, the negative relationship observed in the six selected D8 countries may reflect structural characteristics discussed in the trade literature. Developing economies frequently engage in downstream or backward-linked activities based on assembly operations and the processing of imported intermediate inputs. Such participation can increase the extent to which economies are exposed to external demand shocks (Cook & Patel, 2023) and amplify the impact of transmission mechanisms such as the 'bullwhip effect' (Altomonte et al., 2012). Although the aforementioned transmission channels were not directly tested in this study due to the aggregated nature of the data set, these mechanisms provide a plausible theoretical framework for the limited cyclical momentum observed in developing country panels (Zou, 2026).

As emphasized in the literature, the dependence of developing countries on a limited number of products or export markets (Di Giovanni & Levchenko, 2009; Casal & Guntin, 2025) amplifies the cumulative impact of global shocks. Our findings also support the need for structural transformation highlighted by Wiryawan et al. (2023). Should this transformation fail to materialize, developing economies may become trapped in low-value-added production segments and become highly dependent on external demand. The negative GVC coefficient obtained for the six selected D8 countries also indicates that the cyclical output position weakens as participation in the GVC increases.

The negative and statistically significant error correction term (ECT) indicates that deviations from the long-run relationship occurring in the short run are corrected over time. The estimated ECT coefficient for both country groups confirm the existence of a long-run equilibrium relationship between the variables and suggests that short-run deviations disappear over time. This finding is consistent with the co-integration-based literature, which demonstrates that the dynamics associated with the GVC are not merely temporary in nature but, on the contrary, reflect structural relationships (Wang et al., 2022). However, the negative association between GVC participation and cyclical output in the six selected D8 economies suggests that these countries' integration strategies may need to be reassessed. Rather than focusing solely on increasing the volume of GVC participation, these countries should prioritise functional upgrading and the development of domestic value chains (Mao, 2022).

Consequently, the relationship between GVC integration and cyclical output varies across country groups. Whilst GVC participation is positively associated with cyclical output in advanced economies (G7), it is negatively associated with cyclical output in the six selected D8 economies. This finding is consistent with the literature emphasising the decisive role

played by countries' positions within value chains and their structural characteristics in shaping the relationship between global integration and domestic economic dynamics (Mancini et al., 2024; Wiryawan et al., 2023).

Conclusions

This study examines the relationship between global value chain participation and business cycles in developed and developing economies. Previous research has largely focused on the relationship between GVCs and economic growth or on business cycle synchronization across countries. This study instead considers how GVC participation is associated with domestic cyclical movements within individual economies. It therefore adds to the relatively limited literature examining GVC participation in relation to domestic business cycles.

The results show that capital accumulation and labor productivity are positively and significantly associated with business cycles in both country groups, in line with their expected relationships with economic activity. The relationship between GVC participation and cyclical output, however, differs between the two groups. For G7 countries, the positive association is consistent with the view that advanced economies occupy more sophisticated positions in global production networks and are more closely integrated into higher value-added activities. For the six selected D8 economies, the negative association is consistent with studies that point to greater reliance on imported intermediate inputs, lower-value-added assembly activities, and exposure to external demand conditions in developing economies. These characteristics may provide a channel through which changes in global economic conditions are transmitted to domestic activity. Since the analysis uses an aggregate measure of GVC participation, it does not separately estimate the roles of forward and backward linkages. The results nevertheless show that the relationship between GVC participation and cyclical output is not the same across the two country groups. This difference may be related to the form of GVC integration and the development level of the countries concerned. This interpretation is consistent with the double-edged sword perspective discussed in the literature.

Policy implications for emerging economies relate not only to the extent of GVC participation but also to the form that this participation takes. The negative relationship observed for the six selected D-8 economies suggests that higher GVC participation may coincide with weaker cyclical output performance. One policy option is to support domestic firms in moving toward higher-tier intermediate goods production. Supplier development programmes and matching grants could help SMEs obtain international quality certifications in the fields of precision engineering, chemicals and electronics. Support for industrial R&D, product design and accredited testing infrastructure could also help domestic firms produce and export more sophisticated intermediate goods with higher domestic value added. Regional value chains can also be strengthened through arrangements such as the D-8 Preferential Trade Agreement, with the aim of developing complementary production networks before final goods reach advanced markets. For advanced economies, supplier diversification can help reduce dependence on single-source inputs whilst maintaining existing efficiency gains.

The study also has several limitations. Iran and Nigeria were excluded because of data constraints. Their commodity dependence and different economic structures limit the extent to which the results for the six selected countries can be generalized to the wider D8 group. The use of an aggregate GVC participation measure is another limitation, as it does not allow forward and backward linkages to be examined separately. Future research could formally decompose GVC integration into forward and backward components to empirically validate the interpreted transmission channels. Sector-level data, disaggregated trade linkages, and higher-

frequency observations could also be used to examine the relationship between GVC participation and business cycles in greater detail.

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Appendix

Appendix 1: Additional Tables

Table A1

Variable Descriptions, Definitions, and Data Sources

Variable	Indicator Code	Definition / Measurement	Unit	Source
BC	NY.GDP.MKTP.KD	Cyclical component of real GDP extracted using the Hodrick–Prescott filter ($\lambda = 6.25$)	Billion, constant 2015 USD	World Bank (WDI)
GVC	EXGR_GVC	Total GVC participation rate, computed as the sum of backward and forward linkages	% of gross exports	OECD TiVA
GCF	NE.GDI.FTOT.ZS	Gross fixed capital formation (formerly gross domestic fixed investment)	% of GDP	World Bank (WDI)
LP	SL.GDP.PCAP.EM.KD	Labor productivity, calculated as real GDP divided by total employed population	Constant 2017 USD (thousands)	World Bank (WDI)

Note. Created by the author

Table A2

Sample Country Coverage and Group Classifications

Group	N	Included Countries	Excluded / Note
G7 (Developed)	7	Canada, France, Germany, Italy, Japan, United Kingdom, United States	None (balanced panel)
Selected D-8 (Developing)	6	Bangladesh, Egypt, Indonesia, Malaysia, Pakistan, Türkiye	Iran (missing TiVA GVC metrics); Nigeria (missing continuous GCF series); Azerbaijan (joined in 2024, post-sample period)

Note. Created by the author

Table A3

Descriptive Statistics for G7

Variable	Obs	Mean	Std. dev.	Min	Max
BC	182	-3.609	111.337	-651.202	477.082
GVC	182	36.604	4.768	24.800	45.900
GCF	182	21.489	2.939	14.966	32.027
LP	182	109.982	17.106	72.541	142.243

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

Table A4*Descriptive Statistics for Selected D8*

Variable	Obs	Mean	Std. dev.	Min	Max
BC	156	-0.358	12.851	-59.207	45.049
GVC	156	36.258	9.884	22.600	57.800
GCF	156	23.747	6.146	13.643	43.640
LP	156	33.367	20.733	7.016	83.855

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

Table A5*Correlation Matrix for G7*

	BC	GVC	GCF	LP
BC	1.000			
GVC	0.090 (0.225)	1.000		
GCF	0.201 (0.007)	-0.236 (0.001)	1.000	
LP	-0.016 (0.829)	0.272 (0.000)	-0.424 (0.000)	1.000

Values in parentheses are p-values.

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

Table A6*Correlation Matrix for Selected D8*

	BC	GVC	GCF	LP
BC	1.000			
GVC	-0.042 (0.600)	1.000		
GCF	0.198 (0.013)	0.354 (0.000)	1.000	
LP	-0.035 (0.666)	0.723 (0.000)	0.122 (0.129)	1.000

Values in parentheses are p-values.

Note. Calculated using OECD's TiVA and World Bank's WDI data using Stata 17 statistical software.

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The Ethical Rules for Research and Publication / Araştırma ve Yayın Etiği

The author declared that the ethical rules for research and publication were followed while preparing the article.

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Research Article

**Compliance Strategies in Emerging Digital Markets:
A Comparative Qualitative Analysis of Platform Regulatory Strategies**

Meral Dülger Taşkın^a

Abstract

Introduction: As rapid platform innovation collides with legal frameworks, digital market regulation in emerging economies creates strategic tension. Accordingly, for digital platforms, this endeavor explores the way in which country of origin influences regulatory response, architecture conditions regulatory exposure, and how these two attributes interact within a single institutional environment.

Method: Through exploratory qualitative multi-case design, the study compares the compliance strategies of Trendyol, a foreign-backed hybrid platform and Sahibinden.com, a domestic broker operating without foreign investment. Each firm's regulatory trajectory is analyzed and reconstructed using the documentary record of the Turkish Competition Authority.

Results or Findings: The results indicate that although the regime drives both firms toward eventual accommodation, their responses differ. Firm origin shapes the range of non-market tools available, with Trendyol drawing on a broader set of statutory mechanisms than Sahibinden.com. Platform architecture shapes where compliance cost is absorbed. Trendyol shifts its concessions into peripheral activity through structural separation, whereas Sahibinden.com internalizes them within its core data asset.

Discussion or Conclusion: This article develops a model of segmented compliance in which regulatory adaptation is distributed across distinct layers of platform organization. The model shows that the regulatory regime fixes the outer bounds of response, firm origin shapes the depth of the repertoire deployed within those bounds, and platform architecture determines the organizational location at which compliance costs are absorbed. The model contributes to the institution-based view, non-market strategy, and research on multi-sided markets.

Keywords: digital platforms, regulatory compliance, non-market strategy, platform architecture, emerging markets

JEL Codes: K21, L51, L81, L86, M16

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Araştırma Makalesi

**Gelişmekte Olan Dijital Pazarlarda Yasal Uyum Stratejileri: Platformların
Düzenlemelere Yönelik Stratejilerinin Karşılaştırmalı Nitel Bir Analizi**

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Öz

Giriş: Dijital platformların hızlı yenilik döngülerinin yasal çerçevelerle çatışması gelişen ekonomilerdeki dijital pazar düzenlemeleri stratejik gerilimlere yol açmaktadır. Bu çalışma, bir platformun menşe ülkesinin düzenleyici kurumlara verilen yanıtı nasıl şekillendirdiğini, platform mimarisinin düzenlemelere maruziyeti nasıl koşullandırıldığını ve bu iki niteliğin tek bir kurumsal çerçevede nasıl etkileşime girdiğini incelemektedir.

Yöntem: Keşfedici, nitel, çoklu vaka tasarımının kullanıldığı bu çalışmada, yabancı sermaye destekli bir hibrit platform olan Trendyol ile yabancı yatırımı bulunmayan yerli aracılık platformu Sahibinden.com'un yasal uyum stratejileri karşılaştırılmaktadır. Analiz kapsamında, her iki firmanın düzenleme süreci Rekabet Kurumu'nun kamuya açık karar kayıtlarına dayanarak yeniden kurgulanmıştır.

Sonuçlar ya da Bulgular: Bulgular, mevcut düzenleme rejiminin her iki firmayı da sonuç olarak bir uzlaşya yönelttiğini, ancak firmaların yanıtları bakımından ayrıştıklarını göstermektedir. Firmanın menşe ülkesi, kullanılabilecek pazar dışı araçların kullanılabilirlik kapsamını şekillendirmekte; Trendyol, Sahibinden.com'a kıyasla daha geniş bir yasal mekanizma yelpazesinden yararlanmaktadır. Platform mimarisi ise yasal uyum maliyetlerinin nasıl üstlenileceğini belirlemektedir. Trendyol, yapısal ayrıştırma yoluyla uzlaşmalarını çevre faaliyetlere kaydırırken, Sahibinden.com ise bu maliyetleri kendi temel veri varlığı çerçevesinde içselleştirmektedir.

Tartışma ya da Yapılan Çıkarımlar: Bu makale, düzenleyici uyumun platformun katmanları arasında dağıldığı bölümlenmiş bir uyum modeli geliştirmektedir. Buna göre, düzenleyici rejimin tepkinin dış sınırlarını çizdiği; firma kökeninin, bu sınırlar içindeki yöntem derinliğini şekillendirdiği; platform mimarisinin ise uyum maliyetlerinin organizasyonel olarak nerede üstlenileceğini belirlediği ortaya konulmuştur. Model, kurum temelli yaklaşım, piyasa dışı strateji ve çok taraflı pazarlar araştırmalarına katkı sağlamaktadır.

Anahtar Kelimeler: dijital platformlar, yasal uyum, piyasa dışı strateji, platform mimarisi, gelişmekte olan pazarlar

JEL Kodlar: K21, L51, L81, L86, M16

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Introduction

Digital platforms govern multi-sided ecosystems by embedding private rule systems, algorithmic logic, and data architectures within overriding public legal regimes (Koo, 2024). This dual governance structure creates tension between platforms and regulators where the platforms' core architectural designs and value-capture mechanisms diverge from statutory regulatory mandates. As platform innovation outpaces statutory evolution, and platform authority is borrowed rather than sovereign, this friction represents a fundamental incompatibility between platform architecture and state regulatory objectives. Navigating this structural alignment challenge presents a strategic obstacle, particularly within the volatile institutional environments of emerging markets.

The regulatory task in such settings is a calibration between restricting anti-competitive conduct and preserving incentives for domestic innovation. That trade-off is aggravated where large domestic platforms compete with internationally backed rivals (Lee & Saha, 2025). In these contexts, regulatory frameworks evolve rapidly and along non-linear paths, while institutional support for compliance remains underdeveloped, and firms are substantially different in terms of the resources they can organize (Khanna & Palepu, 2010; Peng et al., 2008). Accordingly, emerging markets offer a productive setting for examining the institution-based view of strategy, which holds that the formal and informal rules of the institutional environment are foundational for the strategic choices available to firms (Peng et al., 2008, 2009). These conditions make emerging markets a productive setting for examining that proposition.

Compliance scholarship has nevertheless developed largely within mature Western institutional environments leaving the emerging markets comparatively under examined. European Union and United States regulatory regimes furnish the empirical foundation for most of the dominant theoretical models (Eskhita et al., 2025; Kornelakis & Hublart, 2022). This concentration limits the generalizability of existing theory to emerging markets, where institutional trajectories, resource constraints, and platform architectures differ substantially from Western settings and norms (Yeşilbağ, 2022). Long standing scholarly argument holds that strategy theory should be developed from emerging-market settings rather than imported from Western contexts (Hoskisson et al., 2000; Wright et al., 2005).

Three limitations in the related literature particularly stand out. First, non-market strategy comprises actions directed at political, legal, and social arenas rather than at the product market, undertaken to secure competitive advantage (Baron, 1995; Mellahi et al., 2016). Yet, little is known about how a platform's country of origin influences its strategic response to host-country regulatory pressure, particularly the non-market capabilities available to internationalized platforms versus domestic incumbents (García Canal & Guillén, 2026; Khan et al., 2026). Second, platform architecture refers to the configuration of a platform's technical design and governance rules (Tiwana et al., 2010). The multi-sided markets literature conceptualizes platforms as intermediaries coordinating exchange between distinct user groups (Rochet & Tirole, 2003). One architectural distinction separates broker platforms, that only intermediate, from hybrid provider platforms, that also retail on their own account. The literature nevertheless lacks a systematic account of how that distinction shapes the regulatory exposures firms face (García Canal & Guillén, 2026). Third, the two gaps identified above have not been addressed jointly, so how firm origin and platform architecture interact to shape compliance behavior within a single regulatory environment remains for further inquiry.

Correspondingly, with e-commerce volume rising to TL 4.57 trillion in 2025, up 52.2 percent year on year, Türkiye offers a compelling context for analysis (Republic of Türkiye Ministry of Trade, 2026, p. 18). Its digital economy is governed by the Law on the Protection of Competition (No. 4054) and the Electronic Commerce Law (No. 6563), which was substantially amended in 2022. Alongside parallel provisions with the European Union Digital Markets Act, the regime imposes highly specific domestic mandates concerning intermediary liability, transaction thresholds, and structural prohibitions (Kocabaş & Malinauskaite, 2025; Sanlı, 2024). The Competition Authority (TCA) and the Ministry of Trade oversee different aspects of the regime, and this duality intensifies the compliance burden on platforms operating in the market.

This study aims to address these gaps by examining two Turkish digital platforms that differ on both attributes through an exploratory comparative qualitative design to trace how firm origin and platform architecture shape their compliance behavior. Trendyol is a domestically established but foreign controlled digital platform following Alibaba's acquisition of the majority stake (Reuters, 2021). It is architecturally hybrid as it intermediates third-party sellers and consumers while also retailing under its own brands. Sahibinden.com is a domestically owned broker platform (Turkish Trade Registry Gazette, 2026) that operates as a pure intermediary across horizontal classified categories such as real estate, vehicles and general goods without selling on its own account. Since both firms are subject to the same dual regulatory regime, the comparison holds the institutional environment constant and allows variation in firm origin and platform architecture to be observed. The regulatory trajectories of Trendyol and Sahibinden.com are reconstructed from the documentary record of the TCA, drawing on its decisions issued to each platform between 2018 and 2025.

Accordingly, three research questions guide the study. The first examines how firm origin shapes the range and form of compliance strategies digital platforms adopt under the same regulatory regime. The second examines how platform architecture shapes the regulatory pressures platforms face and the compliance strategies they use in response. The third examines how firm origin and platform architecture together explain differences in platform compliance within the same institutional environment.

In addressing these questions, the study makes three contributions. First, it opens the compliance response to structural inspection. Institutional theory characterizes a firm's answer to a regulatory demand as a posture arranged along a continuum from acquiescence to defiance (Oliver, 1991). This vocabulary carries no term for the location of where the demand is absorbed within the organization. The evidence here shows that platform architecture determines that location, since a hybrid provider can meet a mandate by redrawing the boundary of firm scope whereas a broker must meet it at the data interface that constitutes its core asset. Second, the study joins the non-market strategy and multi-sided markets literatures, which rarely address one another, by showing that firm origin governs the depth of the repertoire available and architecture governs the incidence of compliance cost. Third, it develops theory from an emerging-market setting rather than testing Western-derived theory within one. The three are drawn together in a model of segmented compliance developed in the discussion.

The next section develops the theoretical background and presents the conceptual framework followed by research methodology. The fourth section reports the findings for each platform accompanied by the cross-case synthesis. The fifth section develops the segmented-compliance model while the final section offers conclusions.

Theoretical Background

Institutional Environments and Platform-Regulator Exposure in Emerging Digital Markets

In responding to regulation, firms confront a problem of institutional fit, reconciling established routines with regulative demands that are embedded in normative and cultural-cognitive expectations (Di Maggio & Powell, 1983; Scott, 2014; Suchman, 1995). Firms are not passive recipients of institutional requirements. Oliver (1991) identifies a continuum of strategic responses to institutional processes, ranging from acquiescence and compromise through avoidance to defiance and manipulation. Which response a firm adopts depends on the character of the pressure and the firm's own position.

For digital platforms, innovations such as algorithmic pricing, data-driven scaling, and architectural reconfiguration routinely outpace regulatory rulemaking. This gap creates a case of platform-regulator tension, when a platform's competitive practices fall under regulatory requirements that the platform was not designed to satisfy. This tension therefore surfaces as an incompatibility between the model through which a platform creates value and the public rules that bind it. Regulatory violation is different, since a violation is a legal finding about a specific act and is resolved once that act stops, while strategic tension rests in the operating model that generated the act and persists until that model changes.

The institution-based view of strategy (Peng et al., 2008) treats firm behavior as an outcome of industry conditions as well as formal and informal rules of the institutional environment (North, 1990; Scott, 2014). In emerging markets, the evolution of regulatory frameworks is rapid and uneven while the institutional structure that supports meeting compliance obligations is thin. Further, whereas firm-specific resources are the primary drivers of performance in developed economies, country-level institutional differences have a more notable impact in emerging markets (Khanna & Palepu, 2010). Compliance therefore operates as a strategic problem rather than an administrative one and the costs of falling short directly reflect on the firm.

The institution-based view is occasionally interpreted as treating rules as fixed, which understates the reciprocity between platforms and regulators. The industrial-institutional co-evolution framework captures this dynamic (Cantwell et al., 2010; Gong & Hassink, 2019; Lewin et al., 1999). Regulators revise mandates in response to observed platform behavior and platforms adjust routines and architectures in response to enforcement. In emerging digital markets this reciprocity intensifies as the regulator's learning curve and the platform's innovation cycle move forward simultaneously.

Jurisdictions confronting identical platform behavior reach divergent outcomes, which indicates that a competition regime carries ideational commitments and does not function as a neutral technical mechanism (Kornelakis & Hublart, 2022). Yeşilbağ (2022) documents that Turkish platforms consolidated monopoly positions through data extraction, network externalities, and expansion into adjacent areas while dependent on technical infrastructure held by global technology firms. Türkiye therefore constitutes a distinct analytical setting, as the combination of domestic status and external dependence becomes an object of analysis.

Firm Origin and the Non-Market Repertoire

Non-market strategy literature treats firms as actors who manage their political, social, and regulatory environments through deliberate action alongside their market activities (Baron, 1995; Boddewyn & Brewer, 1994; Hillman & Hitt, 1999). Integrative reviews establish the

framework as central to explaining regulatory engagement that goes beyond compliance (Doh et al., 2012; Mellahi et al., 2016).

Internationalized firms accumulate institutional knowledge, political connections and procedural sophistication across jurisdictions and redeploy these resources when facing unfamiliar host country mandates (Henisz, 2003; Kostova & Zaheer, 1999; Sun et al., 2021). Firm origin therefore becomes a determinant of non-market capability, and compliance depth varies with the structural position of the firm rather than with the scope of the mandate.

Platform multinationals internationalize rapidly by scaling digital infrastructure instead of physical assets (Nambisan et al., 2019; Parente et al., 2018). Hence, survival under demanding regimes depends on non-market strategies such as lobbying, institutional entrepreneurship, regulatory negotiation, and user mobilization (Doh et al., 2012; Sun et al., 2021). Country of origin consequently shapes the instruments available to a platform as well as the credibility to use them (García Canal & Guillén, 2026; Khan et al., 2026; Khan et al., 2023). Through its Alibaba affiliation, Trendyol holds cross-border capital, dedicated regulatory capacity, and structurally separable business units. Configurations of this kind widen the non-market repertoire available to a platform. This also attracts regulatory scrutiny, since operating a marketplace while retailing on it creates a conflict of interest that regulators have increasingly addressed through ex-ante rules on self-preferencing (Kocabaş & Malinauskaite, 2025).

Sun et al. (2025) show that platforms retain non-market instruments unavailable to conventional firms, as they operate the infrastructure their users depend on and shape the flow of information across it. For platforms, structural position is constituted by operational control as much as by resource endowment. One dimension of that operational control is the geographic reach of the network. Stallkamp and Schotter (2021) distinguish within-country from cross-country network externalities. A broker matching users inside a single market generates the former, whereas a marketplace whose network extends across borders generates the latter, and the two carry different exposures to host-country mandates.

Domestic incumbents do not possess comparable cross-border resources, and they face narrower compliance options. Mandates targeting core data assets or pricing autonomy may translate more directly into structural constraints (García Canal & Guillén, 2026; Khan et al., 2026). Sahibinden.com fits this profile, since it operates without foreign-backed capital or separable business units. Platforms in that position have fewer structural options for distributing regulatory pressure, so mandates tend to reach core assets directly.

Firm origin is recognized here as a composite rather than as a matter of nationality alone. Cross-border ownership supplies a bundle of non-market assets, comprising financial slack, dedicated legal capacity, engineering depth, and experience accumulated across jurisdictions, and origin operates through that bundle rather than alongside it (Henisz, 2003; Sun et al., 2021). Scale, capital, and technical infrastructure are accordingly constituent mechanisms of the construct rather than rival explanations standing outside it. These assets work together in platform markets, since cross-border capital is what permits a platform to reach the size at which the remainder become affordable. Compliance depth is therefore expected to vary systematically with origin so understood. Architecture nonetheless governs how a given mandate is absorbed, so origin does not account for the response on its own.

Platform Architecture and the Broker–Provider Regulatory Divide

Digital platforms operate as multi-sided markets that mediate value-creating exchanges between distinct user groups (Rochet & Tirole, 2003, 2006). Their growth rests on network effects, since each group's value increases as participation on the other side rises (Evans, 2003; Katz & Shapiro, 1994). The strength of these effects pushes digital markets toward concentration and winner-takes-all outcomes, creating structural barriers to entry (Cennamo & Santaló, 2013; Eisenmann et al., 2006; Evans & Schmalensee, 2016). Correspondingly, the resulting dominance attracts regulatory attention. The form that attention assumes, nevertheless, depends on how the platform is structured.

A central distinction is between broker, or marketplace, platforms and provider, or reseller, platforms (Hagiu, 2007; Hagiu & Wright, 2015). In terms of control rights, a broker platform matches users and leaves control of the transaction with them whereas the provider platforms hold residual control over what is exchanged and frequently retail alongside third-party sellers (Hagiu & Wright, 2015). Many large platforms operate as hybrids, since they sell on their own account while continuing to match third-party sellers. Such dual role places the platform in competition with the firms it hosts. Architectural configuration determines which assets the platform controls, which counterparties it competes with, and therefore where it is exposed to regulatory scrutiny (García Canal & Guillén, 2026).

Architecture and industry are separable properties even though they are frequently observed together. Platform architecture is defined here by control rights and by the configuration of firm boundaries, namely whether the platform holds residual control over what is exchanged and whether it retails on its own account. Conversely, industry structure refers to the product market that a competition authority defines when it assesses conduct. The two vary independently. Pure brokers operate in general merchandise commerce, where marketplaces match buyers and sellers without retailing on their own account (Hagiu & Wright, 2015). Hybrid architecture likewise appears in classifieds, where listing platforms add proprietary inspection, financing, or transaction services alongside the listings they host. Architecture therefore describes what a platform controls rather than what it sells.

Modular architecture is defined by the degree to which a platform's components can be separated and recombined (Tiwana et al., 2010). Gawer (2021) identifies three interdependent platform boundaries, namely firm scope, the configuration of sides, and the digital interfaces governing data exchange, so that a decision at one propagates to the others. For instance, a remedy aimed at proprietary retail addresses firm scope, whereas one aimed at data portability addresses the interface. These boundary decisions have no counterpart in a linear firm, which is one reason multisided platforms are treated as a distinct organizational form (McIntyre et al., 2021). Modularity is a property of design rather than of market segment, so two platforms trading in unrelated markets may have the same architecture while two competitors in a particular market may not. Architecture in this paper refers to these three boundary decisions, and the vocabulary of horizontal and vertical markets is reserved for the product market definitions that competition authorities apply.

The core asset of a broker platform is accumulated user activity, which locates its regulatory exposure in data control and in the pricing of access rather than in the treatment of rival sellers (Crémer et al., 2019). By contrast, as provider and hybrid platforms retail alongside the sellers they host, regulators consequently examine self-preferencing, ranking practices, and the use of third-party seller data to support proprietary brands (Khan, 2017; Kocabaş & Malinauskaite, 2025). Platforms examined under the same statutory provision face different

allegations and receive different remedies, since market position determines whether scrutiny arrives whereas architecture determines what it targets. The Turkish market brings these conditions together, since platforms of contrasting architecture operate under a single regulatory regime, which allows the influence of architecture to be observed while the institutional environment is held constant.

Extending Gawer's (2021) boundary framework, platform architecture conditions a firm's decoupling capacity, namely the technical and structural ability to separate a regulated activity from the core business asset during enforcement. Hybrid provider architectures exhibit high scope modularity, since proprietary retail operates as an adjacent module attached to the multi-sided marketplace. A mandate directed at self-preferencing or at dual-role conflict can therefore be absorbed by redrawing the boundary of firm scope, whether through unbundling or through relocation of the proprietary unit, while the core intermediation engine remains intact (Tiwana et al., 2010). Broker architecture, conversely, couples the value proposition tightly to the digital interface. Because a broker's core asset consists of aggregated user data together with the network lock-in that data sustains, an intervention such as mandated data portability or interface access reaches that asset directly. No peripheral scope boundary is available for relocation, so the broker cannot structurally isolate the regulated activity, and the cost of compliance settles on the core asset itself.

Conceptual Framework and Research Questions

Taken together, the institutional view, non-market strategy and multi-sided market literatures suggest that strategic response to regulation is conditioned by firm origin and platform architecture, operating within a common institutional environment.

Figure 1 arranges these attributes along two dimensions. Firm origin distinguishes platforms with foreign backing from domestic incumbents, and platform architecture distinguishes hybrid providers that retail on their own account from brokers that do not. Trendyol and Sahibinden.com are selected because they occupy diagonally opposite positions in this space, differing in both dimensions at once. This typology serves a sensemaking and exploratory purpose rather than a predictive one, since it compares firms relative to one another without specifying the compliance strategy each position produces.

Figure 1

Conceptual Framework: Firm Origin, Platform Architecture, and Regulatory Exposure

Platform Architecture \ Firm Origin	Foreign-backed (cross-border funding)	Domestic (no foreign investment)
	Trendyol Global hybrid provider (focal case)	Domestic hybrid provider (conceptual reference)
Broker	Foreign-backed broker (conceptual reference)	Sahibinden.com Domestic broker (focal case)

Note. Created by the author. Cells are defined by control rights and firm scope rather than by the product markets in which each firm trades. The two cells in bold writing constitute a polar comparative pairing and denote the focal cases examined in this study. The other two cells denote conceptual reference positions within the typology and are not examined empirically.

The study therefore asks how firm origin shapes the depth and form of compliance strategy, how platform architecture shapes both regulatory exposure as well as the response deployed, and how the two attributes jointly account for divergence within a shared institutional environment.

Research Methodology

Research Design and Theoretical Posture

An exploratory qualitative comparative multi-case design was adopted for this study. Since the research questions concern how origin and architecture shape compliance behavior rather than how frequently particular responses occur, a small number of information-rich cases analyzed through interpretive coding is suitable (Buyukbalci & Dulger, 2023; Yin, 2014). The explored phenomena cannot be separated from their setting, as the tension between platform conduct and an interventionist regime arises from the Turkish institutional environment itself. A case design retains that environment as a part of the analysis.

Comparison across cases permits patterns observed in one firm to be tested against the other, which supports analytic generalization to theory rather than to a population (Eisenhardt & Graebner, 2007; Yin, 2014). Compliance scholarship is anchored in mature Western institutional environments and offers limited insight for emerging-market contexts (Peng et al., 2008; Wright et al., 2005). The study therefore follows a gaps and holes design, which begins from tentative theory and refines it by addressing empirical gaps through pattern matching (Ridder, 2016, 2017). The framework in Figure 1 supplies the direction for that exploration.

Case selection follows a theoretical sampling logic where cases are chosen for their capacity to illuminate the relationships under study rather than for their representativeness (Eisenhardt & Graebner, 2007). Trendyol and Sahibinden.com are polar types on both dimensions of the framework, and such a contrast renders the underlying patterns more visible than a comparison of similar firms would (Pettigrew, 1990; Seawright & Gerring, 2008). Three further underlying considerations justify the selection. Both firms hold leading positions in their respective segments, so each has accumulated a substantive record of regulatory engagement to support a trajectory analysis. Both firms have faced proceedings under Article 6 on abuse of dominance, which supplies a common point of comparison. For episodes resting on other provisions, the difference in legal standard is noted rather than treated as variation in response for analysis. Both operate under the dual regime of Law No. 4054 and Law No. 6563, so the institutional environment is held constant across the comparison while origin and architecture vary. The assignment of each firm to a cell in the conceptual framework rests on architectural criteria alone, namely whether the platform holds residual control over transactions and retails on its own account, and not on the product-market definitions applied by the TCA in the decisions examined.

A comparability objection arises at this point, because the TCA examined the two firms for different practices and under partly different provisions. This is resolved once the source of that difference is considered. As argued above in relation to the broker and provider divide, architecture governs what a regulator finds available to examine, so a hybrid provider that retails alongside the sellers it hosts attracts self-preferencing and dual-role inquiries whereas a broker whose position rests on aggregated user data attracts portability and access inquiries (Crémer et al., 2019; Gawer, 2021; Hagiu & Wright, 2015). Variation in the allegation therefore expresses the mechanism under study rather than confounding it. Comparability rests instead on an institutional baseline held constant in three respects. The TCA examined both firms under Law No. 4054 across the period, and the core proceedings for each rest on Article 6 concerning

abuse of dominance. The same statutory closure options, namely settlement and commitments under Article 43, stood open to both from late 2021 onward. Divergence in the mechanisms used accordingly reflects selection by the firm rather than differential availability.

For the study, the firms analyzed are the cases, and the embedded unit is the regulatory engagement, understood as a single sequence running from the opening of a formal file to its resolution (Yin, 2014). A decision is treated as documentary evidence of an engagement rather than as the unit itself, since one engagement may extend across several decisions. The Otobid proceeding illustrates this pattern, having moved from an interim measure to a commitment decision.

An engagement entered the corpus where four conditions were satisfied. The conduct under examination formed an established element of the firms' operating model rather than an isolated act. The TCA opened a formal file under a specified provision of Law No. 4054. The proceedings assessed that conduct on its merits under the cited provision. The resolution bore on the operating model rather than leaving it intact, whether the firm modified the practice, defended it formally, or closed the matter through negotiated commitments. A corrective act that remedied a particular instance without touching the underlying practice was not included, since it fails the fourth condition. Engagements failing any of the four conditions fall outside the corpus. A settlement in which the firm admitted the infringement and abandoned the practice satisfies the fourth condition, since the operating model changed in the absence of an imposed behavioral remedy. The third condition excludes merger control decisions under Article 7, which authorize transactions rather than assess conduct. Correspondingly, Tables 1 and 2 list decisions in date order, and follow-on decisions appear alongside the engagement they continue, so that each firm's trajectory can be examined as a sequence rather than as a set of separate encounters.

Table 1

Regulatory Frame of the Decision Episodes

Episode	Decision	Provision	Market affected	Conduct investigated	Regulatory objective
E1. Labor market	Trendyol, 2021 (21-67/922-447)	Art. 4	Labor market for employees	No-poaching agreements with other firms	Protection of competition in labor markets
E2. Self-preferencing	Trendyol, 2023 (23-33/633-213)	Art. 6	Online marketplace services	Algorithmic self-preferencing of private-label brands and use of third-party seller data	Neutrality of intermediation and separation of seller data
E2. Self-preferencing	Trendyol, 2024 (24-29/689-M)	Art. 6	Online marketplace services	Reassessment after private-label sales moved off the marketplace under the 2022 e-commerce amendment	Continuing necessity of the 2023 remedies
E3. Automatic pricing	Trendyol, 2024 (24-40/950-409)	Art. 4	Online marketplace services	Automatic-pricing mechanism	Prevention of algorithmic price coordination
E4. Excessive pricing	Sahibinden.com, 2018 (18-36/584-285)	Art. 6	Online platform services for	Excessive pricing to corporate agents and dealers, 2014 to 2017	Exploitative abuse by a dominant undertaking

Episode	Decision	Provision	Market affected	Conduct investigated	Regulatory objective
			vehicle and real estate listings		
E5. Data portability	Sahibinden.com, 2023 (23-39/754-263)	Art. 6	Online platform services for vehicle and real estate listings	Obstructing data portability and imposing exclusivity, impeding multi-homing	Contestability through multi-homing and data mobility
E5. Data portability	Sahibinden.com, 2025 (25-23/574-365)	Art. 6	Online platform services for vehicle and real estate listings	Compliance with the 2023 portability remedy	Effectiveness of an existing remedy
E6. Otobid separation	Sahibinden.com, 2025 (25-02/47-29)	Art. 9	Online vehicle listing and vehicle purchasing services	Interim measure during the Otobid investigation	Prevention of irreparable harm pending investigation
E6. Otobid separation	Sahibinden.com, 2025 (25-49/1208-683)	Art. 43	Online vehicle listing and vehicle purchasing services	Commitment decision closing the Otobid investigation	Separation of data between adjacent services

Note. Compiled by the author using Microsoft Excel software

Table 2

Firm Response and Outcome Across the Decision Episodes

Episode	Decision	Remedy type	Firm response	Degree of contestation	Outcome
E1. Labor market	Trendyol, 2021 (21-67/922-447)	Fine, reduced	Admitted the violation and elected settlement	None	Settled with 25 percent reduction, no behavioral obligations
E2. Self-preferencing	Trendyol, 2023 (23-33/633-213)	Fine and behavioral remedies	Complied with the interim measure, proposed commitments, engaged through the investigation	Partial commitments proposed and rejected in part	Fine of TL 61,342,847.73, algorithm-neutrality, data-separation and code-retention remedies
E2. Self-preferencing	Trendyol, 2024 (24-29/689-M)	Reassessment of existing remedies	Relocated private-label sales and petitioned for mootness, requested an extension	Procedural only	Algorithmic remedies held moot, data remedies maintained
E3. Automatic pricing	Trendyol, 2024 (24-40/950-409)	Commitment	Proposed commitments	None	Commitments accepted, matter closed
E4. Excessive pricing	Sahibinden.com, 2018 (18-36/584-285)	Fine	Contested the finding through the judicial channel	Full, judicial challenge	Fine of TL 10,680,425.98, non-unanimous, no remedial price set

Episode	Decision	Remedy type	Firm response	Degree of contestation	Outcome
E5. Data portability	Sahibinden.com, 2023 (23-39/754-263)	Fine and structural remedies	Rewrote contract clauses and built portability infrastructure at no charge	Partial, self-preferencing claims contested and rejected	Fine of TL 40,150,533.15, contract rewrite and free portability infrastructure
E5. Data portability	Sahibinden.com, 2025 (25-23/574-365)	Verification of an existing remedy	Offered a file-download method, then developed an API-with-callback method	Partial, initial method defended before revision	File-download method rejected, API accepted, three-year monitoring added
E6. Otobid separation	Sahibinden.com, 2025 (25-02/47-29)	Interim measure	Complied with the imposed separation	None recorded	Display obstruction and redirection stopped, listing data barred from the vehicle service
E6. Otobid separation	Sahibinden.com, 2025 (25-49/1208-683)	Commitment	Offered commitments	None	Commitments accepted, investigation terminated

Note. Compiled by the author using Microsoft Excel software

Here, analytical identification does not rest on the between-case contrast alone. Rather, the research design pairs polar cross-case synthesis with longitudinal within-case process tracing. Within each firm, the sequence of episodes holds origin, market segment, and regulator constant, so a change in the standing of a remedy can be attributed to a change in architecture (Langley, 1999). Decision 24-29/689-M for Trendyol shows this directly, since the separation of private-label retail from the marketplace made the algorithmic remedies moot while the data remedies survived, and TCA conditioned that outcome on the separation being maintained. The design accordingly establishes how regulatory pressure is absorbed and under what conditions, rather than what each dimension contributes on its own.

Case Backgrounds

Trendyol was founded in 2010 and is the largest e-commerce platform in Türkiye. The Alibaba Group holds majority ownership, with international and Gulf sovereign wealth funds as strategic investors, and the firm now earns a substantial share of its revenue from European and Gulf markets. Its architecture combines intermediation for third-party sellers with proprietary retail, which places it in the foreign-backed provider cell of the theoretical model in Figure 1. The boundary between those two activities shifted during the period studied, and the analysis explores that shift.

Founded in 2000, Sahibinden.com is the leading horizontal classifieds platform in Türkiye and has been found dominant in both the online real estate and vehicle listings markets. The firm has remained under domestic ownership and has operated without foreign investment. Its competitive position rests on aggregated user data and on its role as intermediary rather than on retail of its own, which makes it a broker in architectural terms and places it in the domestic broker cell of the theoretical model. The firm is classified as a broker based on its core listing business, which remained a pure intermediation service throughout the period examined. The Otobid vehicle-purchasing service is treated here as an adjacent extension rather than as a change in the architecture of the platform.

The two firms therefore differ in both dimensions concurrently. Divergence in their compliance patterns is accordingly explained by the framework through origin and architecture. Where the patterns converge despite the contrast, the institutional environment emerges as the stronger influence.

Data Sources and Triangulation

Collection proceeded in three ordered moves. The regulatory database was first queried under the names of each firm to retrieve every decision on record. The results were then screened against the four inclusion conditions stated above, which fixed the corpus of engagements. The two secondary streams were finally assembled around that corpus and read against it under the evidentiary hierarchy set out below.

The study draws on documents assembled from three distinct streams of evidence, summarized in Table 3. Triangulation across independent sources strengthens the credibility of qualitative findings, because a pattern that appears consistently across different kinds of evidence is more trustworthy than one resting on a single source (Ridder, 2017; Yin, 2014). The regulatory primary sources form the evidentiary core, since they record both the conduct found to raise concern and the remedies imposed in response, and they also document the firm side of each encounter through the written defenses, commitment proposals, and settlement choices they contain. The strategic conduct of each firm is therefore recoverable directly from the regulatory record, with the two secondary streams used for interpretation and triangulation.

Table 3

Data Sources and Use

Stream	Source and characteristics	Use in the study
Regulatory primary sources	TCA decisions on the two firms; the full texts of Law No. 4054 and Law No. 6563 including the 2022 amendment	Primary evidence: Establishes conduct in episodes, statutory basis and the remedy.
Secondary scholarship	Turkish legal commentary and academic articles on the two statutes and on the decisions of TCA	Interpretation: Clarifies the doctrinal meaning of provisions and situates decisions within the Turkish competitive landscape and e-commerce law to support accurate coding
Media and industry reporting	News and trade coverage of the decisions and the firms	Triangulation: Establishes timing and sequence of events and corroborates the coded readings against the regulatory record

Note. Compiled by the author using Microsoft Excel software

The regulatory stream was assembled as a census and not as a sample. The TCA public decision database was searched under both the brand name and the corporate name of each firm, using the terms Trendyol, DSM Grup, Sahibinden, and Sahibinden Bilgi Teknolojileri. No date restriction was applied to the search, so the corpus opens in 2018 because that is the year of the earliest decision the database returned rather than an imposed starting date. Retrieval of the decisions ran from January to May 2026, which fixes the endpoint of each firm's trajectory, and rulings issued after that date fall outside the corpus. Applying the four inclusion conditions to the results produced the nine decisions listed in Tables 1 and 2, which document six regulatory engagements. The exclusions comprise merger control decisions under Article 7,

namely the clearance of Alibaba's acquisition of sole control over DSM Grup and the 2026 Zip Finansman clearance. Nothing else returned by the search was set aside.

The scholarly stream was assembled through a systematic search conducted on 10 May 2026. Records were retrieved from Scopus and Web of Science using keywords covering regulatory compliance, digital platforms, and firm strategy. No date restriction was applied, so the search returned the full coverage of both databases on these terms rather than a bounded window. The two sets were merged and deduplicated using Bibexpy software (Kara et al., 2026), which returned 270 unique records. Screening then proceeded in two stages. The first assessed each record against the scope, theoretical framing, and method of study, which reduced the pool to 120 sources. The second assessed those sources against the constructs of the conceptual framework, which yielded 76 records forming the substantive literature base from which theoretical development proceeded. The methods literature, the Turkish legal commentary, and the primary regulatory sources were assembled separately and lie outside this search.

Neither firm issued public statements on the decisions examined here, so their own accounts of these proceedings are not on record. Reading the available sources against one another supports a chain of evidence linking each analytical claim to the material on which it rests (Yin, 2014). The reasoned decision was treated as authoritative on matters of fact, including conduct, provision, remedy, and procedural history. Where a secondary source departed from a reasoned decision on such a matter, the decision was to govern and the secondary account to be set aside. No such departure arose in the corpus. The secondary streams instead corroborated the reading taken from the regulatory record and supplied doctrinal and contextual material the decisions do not carry. Every analytical claim accordingly is traced to the regulatory record.

The media stream was assembled by a different route. Coverage was gathered while each decision was traced, by following reporting on the proceedings already identified through the regulatory search rather than by querying a news database against a fixed list of terms. The stream is therefore decision-led rather than systematic, and no claim to completeness attaches to it. Its use is confined to establishing timing and sequence and to supplying context the decisions do not record.

Data Analysis

The documentary corpus was analyzed through three coding cycles and a temporal bracketing stage. The procedure moves from deduction to induction, in line with a design that elaborates existing theory rather than testing or generating it. Before starting any interpretation of strategy, deductive coding fixed the legal ground of each episode, and the strategic patterns were then derived from the conduct recorded in the decisions.

The first cycle established the legal ground of each episode by coding every relevant segment of the decision texts against the provision it engaged. The principal coding categories were drawn from the Law on the Protection of Competition. Articles 4 and 6 supply the substantive grounds, covering anti-competitive agreements and abuse of a dominant position, while Articles 9 and 43 cover the procedural powers to terminate infringements and to accept commitments. The relevant provisions of the Electronic Commerce Law were coded alongside them. This cycle established the legal basis of regulatory concern and the formal nature of the remedy imposed in each episode.

The second cycle turned to strategic response. Each firm engaged with the regulatory process through a series of moves, and these were coded inductively from the conduct documented in the decision texts. The first-order codes stayed close to the language of the evidence. Codes sharing strategic logic were grouped into second-order themes, and the themes were finally aggregated into overarching dimensions. This three-level structure follows the data-structure logic associated with the Gioia methodology (Corley & Gioia, 2004; Gioia et al., 2013) and appears in the findings as Tables 4 to 7. Since each table sets the evidence beside the constructs built from it, the abstraction can be weighed against the material it rests on (Eisenhardt & Graebner, 2007).

The third cycle consisted of cross-case synthesis through pattern matching. The aggregate dimensions of each firm were set against one another, and the resulting pattern of divergence and similarity yielded the compliance archetypes. The comparison tested the theoretical expectation that origin and architecture relate systematically to compliance behavior. It also weighed rival explanations against the same evidence, which is what pattern matching requires if the fit of a single account is not to be assumed (Yin, 2014). The alternatives are set out in the discussion.

The Gioia methodology was developed for informant-centric interview research, where the first-order level preserves the terms in which participants describe their own conduct. There are no informants in a documentary corpus, so the transfer requires justification. The decisions nevertheless record each firm's procedural moves, since written defenses, settlement elections, commitment proposals, and appeals are reproduced directly or summarized by the TCA. These records document strategy as enacted rather than as recalled, though they were produced for a regulator and shaped accordingly. The corpus therefore records action rather than the deliberation preceding that conduct. The apparatus is adopted here as a discipline on aggregation rather than as a claim to informant voice. The Gioia template has drawn criticism for licensing interpretation rather than disciplining it (Gioia et al., 2022; Köhler et al., 2022; Mees Buss et al., 2022). This study constrains that latitude by fixing the corpus before analysis and by subjecting aggregation through the decision rules set out below. Content analysis would group the same manifest material without requiring the analyst to state why any grouping holds together, so categorizing the decision texts by their legal subject matter would yield an inventory of regulatory topics. Instead, the second-order stage requires that each grouping be stated as a strategic posture, which forces the analysis past the terms in which the TCA framed each matter.

Within each case, the episodes were then ordered chronologically and bracketed into successive phases, which allows each firm's posture to be followed across its regulatory encounters (Langley, 1999). Sahibinden.com's sequence runs from 2018 to 2025 covering three episodes, and Trendyol's from 2021 to 2024 spanning three. The details of both sequences are exhibited in Tables 1 and 2. The temporal stage establishes the order in which each posture developed rather than the internal reasoning behind it.

The analysis rests on a single coder working from the public record, without fieldwork or contact with either firm. This position frees the account from negotiated access, and it also means that each firm's position reaches the analysis only as the TCA recorded it. Three safeguards stand in place of intercoder agreement. The first was a set of explicit decision rules governing the move from first-order codes to second-order themes. A theme was formed only where a shared strategic logic recurred across more than one episode and could be stated as a posture toward the regulatory process rather than as a description of the conduct. Codes describing the legal subject matter of a decision were held at the first-order level. The second

safeguard was a further reading of the corpus, in which every assignment was tested against these rules and unstable ones were revised rather than carried forward. The third safeguard required every theme to account for all the evidence beneath it, which prevents a construct from resting on the examples that suit it best (Eisenhardt, 1989; Eisenhardt & Graebner, 2007).

Dependability rather than reliability is the standard this analysis meets (Lincoln & Guba, 1985), and it is the appropriate standard where a single analyst works from a corpus that is fixed and publicly available. Agreement between independent coders cannot be measured where only one coder worked, and a statistic derived from a second reading by the same analyst would capture stability rather than agreement, so no reliability coefficient is reported. coding scheme and data structure were subjected to peer debriefing and informal expert verification with competition law and non-market strategy scholars to demonstrate active qualitative dependability. The audit trail carries the dependability standard in place of both, since it places the move from evidence to construct where a reader can test it (Aguinis & Solarino, 2019).

Three difficulties arose during the procedure (Gibbert & Ruigrok, 2010). The first concerns redaction. Parts of the decisions are withheld for commercial confidentiality, which confined the analysis to the TCA's reasoning and the non-redacted findings, and the secondary streams were read alongside the decisions to corroborate each reading before it entered the coding. The second concerns the coding itself, since an early pass grouped the first-order codes by the legal subject matter of each decision and yielded categories describing regulatory topics rather than strategic logic. Applying the decision rules exposed the problem, and the coding was reworked so that each theme captured a strategic posture rather than a legal topic. The revision confirmed the necessity of the second-order stage, since the discarded grouping reproduced the TCA's own framing of the disputes rather than the firms' strategic conduct. The third is the absence of corporate disclosure, which leaves every first-order code resting on conduct as the TCA recorded it, with no independent statement from either firm against which to examine it.

Quality Criteria

Quality was assessed against the four tests articulated by Yin (2014) and applied to management case research by Gibbert and Ruigrok (2010). Three of these apply directly, namely construct validity, internal validity, and external validity. The fourth asks whether another investigator following the same procedure would obtain the same result, which presumes independent coders. For the reasons set out above, dependability stands in its place.

Two procedures were followed to support construct validity. The first corroborated each coded reading across the documentary streams, subject to the hierarchy under which the reasoned decision governs matters of fact. The second sets the representative evidence beneath each construct in Tables 4 to 7, so that every abstraction can be tested against its material (Gioia et al., 2013).

Internal validity was addressed through pattern matching and explanation building (Yin, 2014). Compliance patterns in each case were read against the theoretical expectations rather than in isolation, and the most plausible rival explanations were weighed at the same stage. Temporal bracketing supports the same test, since tracing each firm across successive encounters allows an alternative reading of a single episode to be checked against the wider trajectory. The most plausible alternative accounts are reported in the discussion, where the limits of documentary evidence in excluding them are also addressed.

External validity concerns the domain to which the findings extend. Case research supports generalization to theoretical propositions rather than to populations (Yin, 2014). The polar-type design serves that end, since it allows the findings to speak to the relationships among firm origin, platform architecture, and compliance behavior. These propositions apply where more than one statute governs platform conduct and the platforms differ in architecture and origin.

A formal case study protocol standardized the collection and coding of evidence across both cases, so that it remained constant while the cases differed (Yin, 2014). The protocol, the coding scheme, the three-cycle procedure, and the temporal bracketing stage are reported in sufficient detail for the analysis to be repeated. A public documentary corpus allows a reader to return to the sources directly. A public documentary corpus allows a reader to return to the sources directly and to test the audit trail against them.

Findings

Trendyol

Trendyol's regulatory record comprises three substantive matters brought by the TCA between 2021 and 2024, namely the no-poaching settlement, the abuse-of-dominance decision on algorithmic self-preferencing with its 2024 mootness coda, and the automatic-pricing commitment. This subsection reports the coded patterns in the firm's documented responses across these matters. Tables 4 and 5 present the full data structure.

Table 4 groups six first-order codes under the dimension of procedurally bounded compliance. The first three record elections. Trendyol entered the settlement procedure in the labor-market matter, proposed commitments and later petitioned for mootness in the self-preferencing matter, and proposed commitments again in the automatic-pricing matter. Each selects a statutory route to closure without answering the substance, and that shared logic rather than their sequence makes them one theme, namely strategic use of statutory closure mechanisms. The remaining three record what the firm did not do. Trendyol neither appealed on the merits nor disputed jurisdiction nor sought annulment, complied with the interim measure throughout, and requested an implementation extension rather than refusing the surviving obligations. Accepting the finding while retaining control of the route amounts to substantive concession without contestation of authority. The two themes name a posture in which the procedure is worked and the substance is not, and that posture holds across all three matters while only the route changes.

Table 4*Coding Scheme for Trendyol's Procedurally Bounded Compliance*

Representative Evidence	First Order Codes	Second Order Themes	Aggregate Dimension
Admitted the no-poaching violation and accepted the maximum 25 percent reduction (21-67/922-447)	Settlement-mechanism use		
Proposed automatic-pricing commitments (24-40/950-409); proposed cost, advertising, exclusivity, and contract-term commitments accepted in part (23-33/633-213)	Commitment-procedure use	Strategic use of statutory closure mechanisms	
Petitioned to have the algorithmic remedies declared moot after the e-commerce amendment (24-29/689-M)	Mootness-procedure use		
Did not contest the cartel finding and did not appeal on the merits (21-67/922-447)	Non-contestation of findings		Procedurally bounded compliance
Complied with the interim measure and engaged through the investigation phase (23-33/633-213)	Cooperation through procedural phases	Substantive concession without contestation of authority	
Requested an implementation extension rather than refusing the surviving obligations (24-29/689-M)	Timeline negotiation rather than refusal		

Note. Compiled by the author using Microsoft Excel software

Six further codes make up Trendyol's foreign-backed non-market capacity, which Table 5 sets out. Three of them rest on capability already in place. Trendyol executed three distinct statutory routes across three years, implemented algorithm-neutrality undertakings together with three-year versioned and tamper-evident code retention, and separated third-party seller data from its private-label teams. Resources of this kind stand ready before a file opens, since a specialized legal unit, an auditable retention system, and an internal data boundary cannot be assembled once a proceeding is under way, and the three codes therefore form the theme of mobilization of institutional capability. The other three reach beyond the proceeding itself. Trendyol invoked the 2022 e-commerce amendment to argue that the algorithmic remedies had become moot, relocated private-label sales to the Trendyol Milla application from 1 January 2024, and retained both the marketplace and the proprietary-retail operation in restructured form rather than divesting. Each draws on ground the proceeding did not supply, whether an adjacent statute or the firm's own scope boundary, and the second theme names that reach as leveraging adjacent regulation and architecture. Together they describe capacity a proceeding can call on but not create.

Table 5*Coding Scheme for Trendyol's Foreign-Backed Non-market Capacity*

Representative Evidence	First Order Codes	Second Order Themes	Aggregate Dimension
Executed three distinct statutory routes across three years	Specialized legal deployment		
Implemented algorithm-neutrality undertakings and three-year versioned, tamper-evident code retention (23-33/633-213)	Technical compliance capability	Mobilization of institutional capability	
Separated third-party seller data from private-label teams (23-33/633-213)	Data-governance capability		Foreign-backed non-market capacity
Invoked the 2022 e-commerce amendment to argue the algorithmic remedies were moot (24-29/689-M)	Cross-statute argumentation	Leveraging adjacent regulation and architecture	
Relocated private-label sales to the Trendyol Milla application from 1 January 2024 (24-29/689-M)	Architectural reconfiguration		
Retained both the marketplace and the proprietary-retail operation in restructured form rather than divesting (24-29/689-M)	Business preservation through separation		

Note. Compiled by the author using Microsoft Excel software

Sahibinden.com

Sahibinden.com's regulatory record comprises three substantive TCA proceedings between 2018 and 2025, namely the excessive-pricing decision, the dominance and data-portability decision with its 2025 compliance verification, and the Otobid matter that moved from an interim measure to a commitment decision. The facts of each decision are set out in Table 1. This subsection reports the coded patterns in the firm's documented responses, and Tables 6 and 7 present the full data structure.

Sahibinden.com's record yields six codes under contested structural compliance, presented in Table 6. Three of them cover moves the firm initiated. Sahibinden.com contested the excessive-pricing findings through the judicial channel. In the data-portability matter it offered an initial file-download method the TCA found inadequate, and it declined certain proposed API revisions until a non-compliance finding followed. Each narrows or delays an obligation rather than refusing it outright, and the first theme groups them accordingly as resistance to substantive findings. The other three cover obligations imposed on the firm. In the same portability matter it built the infrastructure for corporate members to port listing data to rivals at no charge and rewrote its contracts to remove the exclusivity and non-compete terms, and in the Otobid matter it operated under an interim measure separating listing-platform data from the adjacent service. Each reached the firm's contracts or its data architecture rather than the disposition of the proceeding, so the second theme reads as externally imposed structural remediation. Both themes attach to the same matters rather than alternating across them, so resistance and structural change ran together rather than in sequence.

Table 6*Coding Scheme for Sahibinden.com's Contested Structural Compliance*

Representative Evidence	First Order Codes	Second Order Themes	Aggregate Dimension
Contested the excessive-pricing finding through the judicial channel (18-36/584-285)	Judicial contestation of findings		
Offered an initial file-download portability method found inadequate by the TCA (25-23/574-365)	Minimal first-response provision	Resistance to substantive findings	
Declined certain proposed API revisions, prompting a non-compliance finding before later revising (25-23/574-365)	Partial pushback on remedy detail		Contested structural compliance
Built, at no charge, the infrastructure for corporate members to port listing data to rivals (23-39/754-263)	Mandated data-portability provision		
Rewrote contract clauses to remove the exclusivity and non-compete terms (23-39/754-263)	Mandated contractual restructuring	Externally imposed structural remediation	
Subjected to an interim measure separating listing-platform data from the Otobid service (25-02/47-29)	Mandated data siloing		

Note. Compiled by the author using Microsoft Excel software

The remaining six codes form the dimension of bounded operational accommodation, shown in Table 7. In the data-portability matter Sahibinden.com developed an API-with-callback method the TCA accepted as compliant and accepted monitoring and reporting obligations running for three years, and in the Otobid matter it offered commitments that terminated the investigation under Article 43. None of these moves reopens an obligation, since each works within one the TCA had already set, and the three therefore form the theme of engagement under structural constraint. The other three record what the accommodation cost. In the Otobid matter the firm removed Otobid displays and ended user redirection within its own interface, and it agreed not to use non-public listing data for the adjacent service. The record shows no relocation or restructuring of the core classifieds business through which a contested practice might have been maintained. Each concession therefore bore on the classifieds asset itself, which the theme of concession affecting the core asset records. Accommodation of this kind is bounded throughout by obligations the firm did not set.

Table 7*Coding Scheme for Sahibinden.com's Bounded Operational Accommodation*

Representative Evidence	First Order Codes	Second Order Themes	Aggregate Dimension
Developed an API-with-callback portability method accepted as compliant (25-23/574-365)	Negotiated technical compliance		
Offered commitments to terminate the Otobid investigation, accepted under Article 43 (25-49/1208-683)	Commitment-procedure use	Engagement under structural constraint	
Accepted ongoing monitoring and reporting obligations over a three-year period (25-23/574-365)	Acceptance of continued oversight		
Agreed to remove Otobid displays and end user redirection within its own interface (25-49/1208-683)	Self-imposed interface constraint		Bounded operational accommodation
Agreed not to use non-public listing data for the Otobid service (25-49/1208-683)	Surrender of the data-combination advantage	Concession affecting the core asset	
No relocation or restructuring of the core classifieds business to maintain a contested practice	Absence of architectural workaround		

Note. Compiled by the author using Microsoft Excel software

Cross-Case Synthesis

Table 8 arranges the two trajectories side by side through the pattern-matching procedure, and the comparison yields one shared element and two divergent ones. Neither firm defied a final remedy, and both closed every matter within the statutory framework, so convergence appears in the destination rather than in the route. Trendyol moved between settlement, commitment, and mootness, and Sahibinden.com contested judicially, then built portability infrastructure, then offered commitments. The locus of concession diverges with them. Trendyol conceded on peripheral conduct and preserved its dual-role business through separation, whereas Sahibinden.com surrendered the data-combination advantage and the lock-in it sustained, which is the core asset itself. The aggregate dimensions carry an asymmetry of their own. Each firm displays a compliance posture, but Trendyol's second dimension records capacity rather than a second posture, since the record attributes to Trendyol resources that Sahibinden.com does not command.

Table 8*Cross-Case Comparison of Aggregate Dimensions*

Dimension of comparison	Trendyol	Sahibinden.com
<i>Firm origin</i>	Alibaba-affiliated, cross-border capital	Domestic, Aksoy Group, no foreign investment
<i>Platform architecture</i>	Hybrid provider, intermediation plus proprietary retail	Broker, pure intermediary in horizontal classifieds
<i>Statutory bases engaged</i>	Article 4 and Article 6 of Law No. 4054; Law No. 6563	Article 6 of Law No. 4054
<i>First aggregate dimension</i>	Procedurally bounded compliance	Contested structural compliance
<i>Second aggregate dimension</i>	Foreign-backed non-market capacity	Bounded operational accommodation
<i>Closure mechanisms used</i>	Settlement, commitment, mootness	Judicial contestation, then portability build, then commitment
<i>Locus of concession</i>	Peripheral conduct; core dual-role business preserved through separation	Core asset; data-combination advantage and lock-in surrendered

Note. Compiled by the author using Microsoft Excel software

Correspondingly, the cross-case comparison yields three patterns that are stated as propositions. Propositions in the inductive case-study tradition are the analytic output of cross-case comparison rather than hypotheses specified in advance (Eisenhardt & Graebner, 2007; Ridder, 2017). Each states a mechanism the evidence renders plausible rather than a relationship the design can establish, and each is offered for subsequent testing. First, matters close with procedural accommodation for both firms even if they differ in terms of origin and architecture. Accordingly, the following proposition is presented:

Proposition 1. Jurisdictional density combined with credible enforcement narrows the feasible range of platform responses toward accommodation. The narrowing is expected to hold across differences in firm origin and platform architecture of the kind observed here.

Second, the two firms differ in the breadth of capability each deployed. Trendyol deployed specialized legal capacity, technical compliance infrastructure, and argument across more than one statute. Sahibinden.com worked through a narrower repertoire, contesting the initial finding and then negotiating the technical details of one mandated remedy at a time. Correspondingly, the following proposition is provided:

Proposition 2. Firm origin conditions the depth of the non-market repertoire available within the feasible range, with the effect running through the financial, legal, and technical resources that cross-border ownership supplies. Where a domestic platform assembles a comparable bundle without foreign capital, the difference in repertoire depth is expected to narrow.

Third, the firms diverge in terms of their compromises. Trendyol relocated the contested activity and preserved its core dual-role business, so the concession fell on peripheral conduct.

Sahibinden.com's settlement reached the core, since portability and data siloing removed its exclusive hold on aggregated user data. Hence, the proposition below is offered:

Proposition 3. Scope modularity conditions where the cost of compliance is absorbed, so the concession is expected to fall on peripheral conduct where the contested activity is separable from the core asset and on the core asset itself where it is not.

Discussion

Procedural Accommodation

Despite differing in origin and architecture, both firms close their regulatory encounters through accommodation rather than sustained defiance. In institutional terms, this pattern is one of coercive isomorphism, in which organizations exposed to the same concentrated regulatory pressure grow alike in conduct irrespective of their internal differences (Di Maggio & Powell, 1983). The convergence likewise lends direct support to the emerging-economies claim that country-level institutions outweigh firm-specific attributes as determinants of strategic outcomes in such settings (Hoskisson et al., 2000; Khanna & Palepu, 2010; Wright et al., 2005). It thereby adheres to the institution-based view of strategy, in which institutions constitute an independent determinant of firm behavior rather than background conditions (Peng et al., 2008, 2009). Since this convergence is predicted by the classical account, it is treated here as a baseline for interpreting the divergence reported below.

This convergence reflects the regulatory architecture established by the amended Electronic Commerce Law No. 6563, which ties obligations to net annual transaction volume and escalates them across annually revalued thresholds of 10, 30, and 60 billion Turkish Liras (Çekin, 2024; Kocabaş & Malinauskaite, 2025). Firms in the upper tiers face advertising and promotion caps as well as mandatory data sharing and restrictions on proprietary financial services. Both platforms fall within the scope of this regime. The TCA and the Ministry of Trade exercise overlapping jurisdiction, which raises the cost of open non-compliance. Even Sahibinden.com, the more resistant of the two firms, ultimately accommodated. Such a pattern supports accounts of the Turkish regime as interventionist and far-reaching (Kocabaş & Malinauskaite, 2025; Sanlı, 2024), and it locates the institutional environment as a binding constraint on strategy.

Gilbert et al. (2024) extend Suchman's (1995) typology to gatekeeping platforms, contending that moral legitimacy is restored through agreement-seeking and hybrid governance rather than through compliance alone. Yates (2023) finds that platforms in contested regulatory settings frequently mobilize users as political advocates. Neither firm advanced legitimacy claims of this kind within its proceedings. Trendyol worked through procedure and Sahibinden.com through technical detail, and both remained at the pragmatic register. This absence reflects the regime rather than the firms. Public authority in Türkiye occupies the governance space in which platforms elsewhere establish themselves as private rule-makers, and neither firm had ground on which to make such a claim. Self-regulation succeeds where a credible threat of state action stands behind it (Cusumano et al., 2021), and two agencies exercising overlapping jurisdiction supply that threat. The same jurisdictional density that forecloses the legitimacy route produces the convergence stated in Proposition 1.

Within that boundary, two compliance archetypes emerge, and both fall among the more accommodative of the strategic responses Oliver (1991) identifies. Trendyol's posture approximates compromise throughout, accepting the institutional demand while negotiating its form. Sahibinden.com opens with judicial contestation and settles into compromise once the

structural mandate is met. Neither firm reached manipulation, and neither avoided the demand. Accordingly, the Turkish evidence indicates that a regime combining jurisdictional density with credible enforcement confines the available responses toward accommodation.

Firm Origin and the Depth of the Non-Market Repertoire

Within the regime's boundary, the two firms differ in the non-market capabilities that each could deploy. Research on non-market strategy treats firm origin as a determinant of that capability, since cross-border operation builds the legal and political resources a purely domestic firm has less occasion to develop (Doh et al., 2012; Mellahi et al., 2016; Sun et al., 2021).

Trendyol's conduct displays the wide repertoire associated with an internationalized firm. It moved between three distinct statutory closure mechanisms, deploying the technical infrastructure required to implement detailed algorithm-neutrality and code-retention remedies, while arguing across statutory regimes by invoking the e-commerce amendment to narrow its competition-law obligations. Capability of this kind is what Henisz (2003) terms the management of institutional idiosyncrasies, accumulated through repeated exposure to hazardous institutional environments and redeployable across them. The firm's engagement was relational rather than transactional in the sense of Hillman and Hitt (1999), since it treated the regulator as a continuing counterpart across successive matters. A repertoire of this depth requires specialized legal capacity, engineering depth, and organizational slack, and Trendyol's cross-border affiliation is the most plausible source of them.

Sahibinden.com engaged from a narrower base. The firm contested the excessive-pricing decision judicially, then negotiated technical detail one remedy at a time. The opening move is a conflict posture in the typology of international political behavior (Boddewyn & Brewer, 1994). The firm did not argue across statutes, and no adjacent statutory development bore on its matters. Position rather than strategic choice appears to account for this, since a domestic incumbent without foreign backing commands fewer non-market options. In the Otobid matter Sahibinden.com used Article 43 commitment mechanism to terminate the investigation without a finding of infringement, which reflects procedural pragmatism under a statutory opening rather than any widening of the repertoire.

An internationally backed firm might be presumed to bear a liability of foreignness in a sovereignty-sensitive regime (Zaheer, 1995), with legitimacy complexity weighing on the multinational side of the pairing (Kostova & Zaheer, 1999). The evidence points the other way. Trendyol's domestic brand identity, coupled with cross-border resources, appears to have supplied local standing alongside the resource depth of a multinational, and nothing in the proceedings suggests that foreignness raised the cost of its engagement.

Sahibinden.com's domestic embeddedness, conversely, brought no comparable advantage in repertoire. The finding refines the origin argument advanced in recent work on platform multinationals under tightening regimes (García Canal & Guillén, 2026; Khan et al., 2026; Khan et al., 2023), since compliance depth follows from the alignment of legitimacy and resources that origin produces rather than from foreignness as such.

Platform Architecture and the Locus of Compliance Cost

The two firms absorbed compliance cost at different points in their businesses, Trendyol at the periphery and Sahibinden.com at the core, and platform architecture offers the most plausible account of the difference. For Trendyol, the e-commerce amendment prohibited marketplace operators from selling private labels, so the separation was compelled rather than

elected. Architecture determined what that compulsion cost. Proprietary retail operated as a separable module within the hybrid configuration, so the firm could redraw the boundary and relocate the activity while preserving both the marketplace and the retail operation in restructured form. Redrawing of this kind is the co-evolution of architecture and governance that Tiwana et al. (2010) theorize. The relocation carried non-market consequence as well, in the sense Baron (1995) gives to integrated strategy, since the TCA subsequently declared algorithmic remedies moot once the conduct they addressed had moved off the marketplace.

Sahibinden.com, as a broker, had no equivalent escape. Its core competitive asset is what the remedies targeted, namely the aggregation and combination of proprietary user data together with the lock-in that advantage produced. That lock-in was the direct product of the network effects that push classifieds markets toward concentration and winner-takes-all outcomes (Cennamo & Santaló, 2013; Eisenmann et al., 2006; Katz & Shapiro, 1994; Rochet & Tirole, 2003). The data-portability mandate can accordingly be read as an instrument aimed at network effects themselves, of the kind advocated for restoring contestability where data aggregation forecloses entry (Crémer et al., 2019). No activity here was separable from the asset the remedy reached, since the intermediation function and the core asset coincide. Boundary redrawing offered no relief, and the cost of compliance fell on the asset itself.

The Trendyol episode is a boundary decision in Gawer's (2021) sense, since the firm reset what its platform included rather than altering how it operated. The firm moved a contested activity across the boundary of firm scope while leaving the platform's sides and data interfaces intact, so the algorithmic concern was extinguished while the data-based remedies survived. Conventional competition law addresses the product market rather than the ecosystem of complementors in which platform conduct occurs (Jacobides & Lianos, 2021), and remedies inherit that framing. A remedy directed at scope can therefore be answered by a change of scope, whereas one directed at the interface cannot, and Sahibinden.com had no scope adjustment available to it.

The architectural account developed here connects to the broker and provider distinction in the multi-sided markets literature (Hagiu & Wright, 2015) and lends a regulatory dimension that the original framing did not anticipate. Architecture accordingly shapes competitive logic and regulatory vulnerability alike, since it governs whether the conduct under scrutiny can be separated structurally from the core business. The strategic response literature has treated the question of response as one of organizational posture, and the evidence here locates it instead in the design of the platform.

Alternative Explanations

Several other accounts require consideration before the mechanisms proposed here can be accepted. These assessments bound the findings rather than displacing them. Origin and architecture are identified as mechanisms operating under specified conditions rather than as the only attributes at work. The first concerns timing. Trendyol's episodes run from 2021 to 2024 while Sahibinden.com's begin in 2018, so the wider repertoire might reflect a richer procedural environment rather than any property of the firm. The settlement and commitment mechanisms were available to both firms from late 2021, and the divergence in repertoire persists within that shared window, which weakens the timing account without eliminating it.

A second explanation concerns firm-level resources rather than origin, namely scale, financial capacity, technological infrastructure, and accumulated regulatory experience. Each could secure procedural access independently of foreign backing, so none is rejected here.

Origin, as defined above, comprises foreign ownership together with the resource bundle that ownership supplies, so scale and capacity are constituents of the construct rather than rivals to it. The qualification this imposes is nonetheless real. A domestically owned platform of comparable resource depth would test the account directly, and no such firm operates in the Turkish setting.

Market segment is the principal rival to architecture, since the two firms trade in different segments and segment rather than architecture might explain where the cost of compliance fell. The remedies imposed under Law No. 4054 nonetheless tracked architectural layers rather than sectoral product rules. The remedy reaching Sahibinden.com addressed data aggregation at the interface and the remedy reaching Trendyol addressed the scope of the firm, and both layers exist in any multi-sided platform irrespective of the goods transacted (Gawer, 2021). The 2022 amendment to Law No. 6563 did impose category-specific obligations, yet it acted as an external trigger rather than a source of remedy, prompting the relocation of private-label sales after which the antitrust outcome followed the redrawn boundary. The 2024 mootness episode makes this visible, since segment was held constant within a single firm while the scope boundary moved. The qualification remains partial, because architecture and market segment are correlated across the two cases.

Divergence might finally reflect the nature of regulatory intervention rather than the conduct of the firms. The two trajectories differ in allegation, and a response shaped principally by what the TCA demanded would not testify to origin or architecture. Two features of the record bound this reading. The first is the pairing of the 2023 decisions. Both rested on Article 6, both fell in the same year, and both imposed obligations on the handling of platform data, so the intervention is held approximately constant across them. The firms nonetheless engaged from repertoires of different depth, Trendyol through commitment proposals and argument across statutory regimes and Sahibinden.com through technical negotiation conducted one remedy at a time. Architecture is identified separately, through the within-firm sequence in which the standing of the Trendyol remedies changed once the scope boundary moved while segment, origin, and regulator were held constant. The second feature is the allocation of procedural initiative, since Turkish procedure places the initiation of settlement and commitment applications with the party throughout. The scope of each investigation and the remedies sought remained with the TCA, so the account here is bounded rather than excluded.

Toward a Model of Segmented Compliance

The model advanced here, termed segmented compliance, brings three mechanisms into a single account, since the regulatory regime fixes the outer boundary of feasible response, firm origin sets the depth of the repertoire deployed within it, and platform architecture determines the organizational location at which compliance cost is absorbed. Segmented compliance describes the simultaneous operation of the three rather than the primacy of any one of them. This division of labor among environment, firm, and structure recalls the strategy tripod (Peng et al., 2009), though the third element here is a property of platform design rather than of the industry in which a firm competes.

Segmented compliance extends the institution-based view by specifying a condition under which Oliver's (1991) range of strategic responses narrows. Where the regime is dense and enforcement credible, only the accommodative responses remain available. The extension does not stop at that narrowing. Oliver's continuum records how far a firm concedes and remains silent on where the concession is absorbed. The two cases show that the second question has a determinate answer once architecture is specified. The model also joins the non-market strategy and multi-sided markets literatures, which are rarely brought together. Origin

conditions repertoire depth and architecture determines where the cost is absorbed, so the two address one compliance problem from different sides. The model is developed from a demanding emerging-market setting, which answers the call to theorize from emerging economies rather than to test Western-derived theory within them (Hoskisson et al., 2000; Wright et al., 2005).

Both episodes exhibit reciprocal adjustment over time. A change in the e-commerce statute reshaped the obligations owed under the competition statute, and Trendyol tracked that interaction and reduced its burden accordingly. Sahibinden.com's portability remedy was renegotiated from an inadequate first proposal into a working technical standard. Compliance in each case was iterative rather than settled at the moment of decision, which a co-evolutionary account captures more reliably than a static institutional one (Cantwell et al., 2010; Gong & Hassink, 2019; Lewin et al., 1999).

Han et al. (2024) apply a co-evolutionary framework to Chinese cross-border electronic commerce and find that platform firms legitimizing their sectoral role through government engagement and lobbying, exercising more agency than a state-led environment would ordinarily permit. The Turkish evidence converges on agency and diverges on mechanism, since agency in China worked through the policy-making process and here through architectural reconfiguration. Where an ex ante threshold regime fixes obligations by transaction volume, the latitude for shaping the rule is narrow and that for restructuring the business is wide.

Lee and Saha (2025) examine jurisdictions where large domestic platforms operate alongside multinational ones, identifying the trade-offs regulators face in choosing set rules over ex post enforcement. This study supplies the firm-side counterpart, specifying the mechanism through which ex ante rules bear unevenly across platform types, namely the differential capacity of hybrid and broker architectures to relocate a contested activity.

Conclusion

Under a dense regulatory regime, compliance proves to be a joint product rather than an expression of firm character. Two firms differing on both attributes reached the same terminal state while the differences that survived followed from what origin made available and architecture made possible. The pattern displaces a common treatment of compliance as a firm-level disposition, a matter of whether a company is cooperative or resistant. A firm cannot select its posture freely, and a regulator cannot assume that an identical remedy imposes an identical burden.

Institutional dominance has generally been read as a reduction in strategic freedom. The account developed here holds that, instead, it fixes the terminal state while leaving the route and the incidence of cost open, so what institutions determine and what they leave undetermined are separable questions (Peng et al., 2008).

The findings carry implications for firms and for regulators. For platforms with separable operations, a remedy can be answered by relocating the contested activity, so the business survives the intervention at the cost of reconfiguration. For domestic incumbents, the asset that generates the advantage is the asset the regulator targets, so there is nowhere to absorb the remedy short of leaving the business. For regulators, an obligation on firm scope can be met by changing scope while one on the data interface cannot, so the boundary a remedy touches determines whether it can be answered at all.

Still, findings from one regime should be read with care beyond it, since regulatory instruments travel further than the enforcement logics that give them effect (Zhan et al., 2026).

The Turkish regime borrows from the European template while resting on its own enforcement logic.

The design carries scope conditions that bound the claims advanced here. Two firms in a single jurisdiction support analytical generalization to theory rather than statistical generalization to a population, so segmented compliance stands as a candidate for testing rather than as an established regularity. Origin and architecture vary together across the pair, as do the market segments in which the two firms trade, and cross-border capital is not observed apart from the resource depth it supplies. For the reasons weighed above, the account offered here therefore reads as a plausible interpretation of the observed divergence rather than as an attribution of effect. The documentary design records conduct rather than deliberation, and each firm's position reaches the analysis as the TCA recorded it. A single coder worked the corpus, so what is absent is an independent interpretation rather than coding reliability, for which the audit trail stands in place. The trajectories themselves remain open, since several remedies are under continuing monitoring, and the terminal state reported here holds only within the observation window.

These limitations indicate the future directions the study leaves open for research. The model could be examined in other regimes combining ex ante thresholds with active ex post enforcement and tested against platforms of intermediate origin or mixed architecture. A domestic hybrid provider and a foreign-backed broker occupy the remaining cells of the framework, and evidence from either configuration would test whether the model holds where origin and architecture do not vary together. Firm-side accounts would reach what the documentary design cannot, and independent coding of the same corpus would establish whether the interpretation holds across readers. A longer observation window would establish whether segmented compliance is a stable configuration or a stage in a longer adjustment. The scope conditions of the model are regulatory rather than geographic, since what produces the pattern is a regime that forecloses sustained resistance while leaving architectural reconfiguration open. A comparison of platforms differing in architecture within a single market segment would separate architecture from the market conditions that accompany it here.

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The Ethical Rules for Research and Publication / Araştırma ve Yayın Etiği

The author declared that the ethical rules for research and publication were followed while preparing the article.

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Research Article

**Trade Openness, Foreign Direct Investment, and Human Capital as Drivers of
Total Factor Productivity: Evidence from Türkiye**

İbrahim Ethem Akyıldız^a

Abstract

Introduction: This article explores the role of trade openness, foreign direct investment, human capital, and R&D in shaping total factor productivity (TFP) in Türkiye. TFP is used as an indicator of how effectively an economy transforms its inputs into output, reflecting efficiency improvements, technological capability, and resource-use performance.

Method: The analysis relies on annual time-series observations for Türkiye. The TFP series is drawn from the Penn World Table, whereas trade openness and foreign direct investment are sourced from the World Bank database. Human capital is proxied by the ratio of university graduates to total population, calculated using data from the Turkish Statistical Institute (TurkStat) and the Council of Higher Education. The R&D series is obtained from TurkStat. The empirical strategy combines Fourier ADF unit root testing, RALS Fourier ADL cointegration analysis, DOLS estimation, and Toda–Yamamoto and Fourier Toda–Yamamoto causality procedures.

Results or Findings: The results provide evidence that the variables are connected over the long run. The DOLS estimates indicate positive productivity effects for human capital, trade openness, and foreign direct investment. R&D has a positive estimated coefficient, but the effect remains statistically insignificant. The causality findings reveal a one-directional link from trade openness to TFP.

Discussion or Conclusion: The results suggest that Türkiye's productivity performance is closely linked to external integration, foreign investment, and human capital accumulation. However, innovation efforts should be transformed more effectively into productivity gains through stronger absorptive capacity, university–industry cooperation, and technology-oriented policy design.

Keywords: total factor productivity, trade openness, Türkiye, foreign direct investment.

JEL Codes: O47, F43, F21, O32, J24

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Araştırma Makalesi

**Ticari Açıklık, Doğrudan Yabancı Yatırımlar ve Beşeri Sermayenin Toplam
Faktör Verimliliğinin Belirleyicileri Olarak Rolü: Türkiye'den Kanıtlar**

İbrahim Ethem Akyıldız^a

Öz

Giriş: Bu çalışma, Türkiye’de toplam faktör verimliliğinin belirleyicilerini ticari açıklık, doğrudan yabancı yatırımlar, beşeri sermaye ve araştırma-geliştirme değişkenleri çerçevesinde incelemektedir. Toplam faktör verimliliği, uzun dönemli ekonomik performansın temel göstergelerinden biri olarak, ekonominin kaynakları ne ölçüde etkin kullandığını, teknolojik kapasitesini ve üretim sürecindeki verimlilik kazanımlarını yansıtmaktadır.

Yöntem: Çalışmada Türkiye’ye ait yıllık zaman serisi verileri kullanılmıştır. Toplam faktör verimliliği Penn World Table veri tabanından, ticari açıklık ve doğrudan yabancı yatırımlar Dünya Bankası’ndan, beşeri sermaye TÜİK ve YÖK verilerinden, Ar-Ge değişkeni ise TÜİK’ten elde edilmiştir. Ampirik analizde Fourier ADF birim kök testi, RALS Fourier ADL eşbütünleşme testi, DOLS tahmincisi ile Toda–Yamamoto ve Fourier Toda–Yamamoto nedensellik testleri uygulanmıştır.

Sonuçlar ya da Bulgular: Analiz sonuçları, değişkenlerin uzun dönemde birlikte hareket ettiğini ortaya koymaktadır. DOLS sonuçları, ticari açıklık, beşeri sermaye ve doğrudan yabancı yatırımların toplam faktör verimliliğini pozitif etkilediğini; Ar-Ge değişkeninin ise pozitif ancak istatistiksel olarak anlamsız bir katsayıya sahip olduğunu ortaya koymaktadır. Nedensellik analizi, ticari açıklıktan toplam faktör verimliliğine doğru nedensellik ilişkisi bulunduğunu göstermektedir.

Tartışma ya da Yapılan Çıkarımlar: Sonuçlar, Türkiye’nin verimlilik performansının dışa açıklık, yabancı yatırım ve beşeri sermaye birikimiyle yakından ilişkili olduğunu göstermektedir. Bununla birlikte, Ar-Ge faaliyetlerinin verimlilik kazanımlarına dönüşebilmesi için beşeri sermaye niteliğinin, üniversite-sanayi iş birliğinin ve teknoloji odaklı politika tasarımının güçlendirilmesi gerekmektedir.

Anahtar Kelimeler: toplam faktör verimliliği, ticari açıklık, Türkiye, doğrudan yabancı yatırımlar.

JEL Kodlar: O47, F43, F21, O32, J24

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Introduction

Total factor productivity (TFP) helps explain long-run economic performance by showing the growth component that cannot be explained by labour and capital accumulation alone. In this respect, TFP reflects how efficiently economies combine inputs, organise production, adopt new technologies, and transform knowledge into output. Rather than being treated as a narrow indicator of technological change, TFP should be understood as a broader measure of productivity performance that may reflect efficiency gains, technological progress, organisational improvements, resource allocation, and other factors shaping production outcomes (Haider et al., 2021; Radlo & Tomeczek, 2022). Historical studies further indicate that TFP growth has been an important driver of labour productivity and long-term economic development, especially during periods of technological, organizational, and infrastructural change. For this reason, identifying the factors that shape TFP is important for understanding how economies can maintain growth beyond the accumulation of labour and capital. These determinants include knowledge creation, technology transfer, human capital formation, trade openness, imports of advanced goods, institutional quality, financial development, infrastructure, competition, and absorptive capacity, all of which may influence the extent to which economies convert resources and knowledge into productivity-based development (Isaksson, 2007).

Within this context, the four variables considered in the study—trade openness, foreign direct investment, human capital, and R&D—are treated as factors that may support improvements in total factor productivity. Trade openness may enhance productivity by increasing exposure to foreign competition, imported intermediate goods, capital equipment, and external knowledge flows, while FDI may contribute to productivity through technology transfer, managerial know-how, and spillover effects. Evidence from Pakistan shows that patents, imported machinery, trade openness, education, and financial development support TFP growth, indicating that external integration and domestic capability may jointly shape productivity performance (Saleem et al., 2019). Similarly, evidence from Asian economies suggests that ICT, governance, investment, and technological capability are important for TFP, although R&D does not always produce statistically significant productivity gains when domestic absorptive capacity remains limited (Afzal & Ahmad, 2018). Recent studies suggest that R&D is closely linked to technological progress, whereas external channels such as imports, ICT investment, and foreign technology linkages may contribute to productivity through efficiency improvements and diffusion effects (Haider et al., 2021; Santos, 2023). Overall, these studies suggest that openness, FDI, human capital, and R&D do not affect productivity in isolation; rather, their contribution to TFP depends on the extent to which economies can absorb external knowledge, strengthen domestic innovation capacity, and transform technological interaction into sustained efficiency and productivity gains.

Türkiye provides a relevant case for examining these channels because its recent growth experience combines increasing external integration, foreign capital inflows, expanding higher education, and efforts to strengthen domestic R&D capacity. Despite these developments, transforming openness, FDI, human capital, and innovation efforts into sustained productivity gains remains a central challenge for the Turkish economy. This makes Türkiye a suitable case for analysing whether external knowledge channels and domestic absorptive capacity jointly contribute to total factor productivity. In this respect, the Turkish case allows the study to evaluate how an emerging economy seeking productivity-based growth converts trade integration, foreign investment, human capital formation, and R&D efforts into efficiency and technological upgrading. Previous studies on Türkiye provide important evidence on different dimensions of productivity. FDI is found to support both TFP and economic growth in the long

run, while financial openness, innovation, FDI, financial development, macroeconomic stability, and institutional quality are identified as important determinants of productivity performance (Arisoy, 2012; Serdaroğlu, 2015). The role of human capital, however, appears more nuanced. Although cross-country evidence suggests that education contributes to productivity growth, this effect does not clearly materialize in Türkiye, while more recent regional evidence shows that human capital is an important factor behind output growth but that scale inefficiencies may limit overall TFP performance (Saygılı et al., 2005; Yiğiteli & Şanlı, 2024). Sectoral and firm-level studies also indicate that Türkiye's productivity performance differs across banking, agriculture, energy, manufacturing, and regions. In the banking sector, productivity gains are mainly linked to efficiency improvements rather than technological progress; in agriculture, some studies report weak technological change, while others find productivity gains driven mostly by efficiency improvements; and at the firm level, productivity dispersion remains high across manufacturing firms (Isik & Hassan, 2003; Ozden, 2014; Sözen & Alp, 2013). However, the existing Turkish literature generally examines these channels separately or focuses on specific sectors, regions, or institutional dimensions. Therefore, there is a need for a more integrated empirical framework that evaluates how trade openness, FDI, human capital, and R&D jointly affect TFP in Türkiye. Such a framework is particularly important because the productivity effects of external openness and foreign investment depend on domestic absorptive capacity and innovation capability.

This study contributes to the literature by examining Türkiye's productivity dynamics through an empirical model that combines external integration variables with domestic capability indicators. In this framework, trade openness and foreign direct investment capture external channels, while human capital and R&D represent the domestic capacity to absorb and generate knowledge. By doing so, it evaluates both external knowledge channels and domestic absorptive and innovation capacities in explaining Türkiye's productivity performance. From a methodological perspective, the analysis is designed as a time-series investigation that allows for possible structural changes. To this end, the Fourier ADF test is employed to assess unit-root properties, followed by the RALS Fourier ADL approach for the cointegration analysis. DOLS is then used to obtain the long-run coefficients, whereas the direction of causality is evaluated through the Toda–Yamamoto and Fourier Toda–Yamamoto tests. This empirical design allows the study to capture the long-run and causal dynamics among productivity, external openness, foreign investment, human capital, and innovation capacity more comprehensively. Beyond its empirical contribution, the study is also expected to provide policy-relevant insights for Türkiye by clarifying how productivity-enhancing channels can be strengthened in an economy characterized by external integration, technological upgrading needs, and the challenge of transforming human capital and innovation efforts into sustained efficiency gains. In this respect, the findings may also be relevant for emerging economies with comparable structural features, particularly those seeking to convert openness, investment, and domestic capabilities into long-term productivity growth.

Theoretical Framework and Related Literature

Theoretical Framework and Research Question

The study's theoretical argument is developed from growth theory and the growth-accounting tradition. In this tradition, Tinbergen (1942), Abramovitz (1956), and Solow (1957) show that output growth is not driven only by labour and capital accumulation. The remaining part of growth is therefore associated with technological progress, efficiency improvements, and the way inputs are used over time. The human capital approach developed by Schultz (1961) further emphasizes that education, skills, and knowledge improve the productive

capacity of labour. Endogenous growth theory, particularly Romer's (1990) contribution, extends this view by treating knowledge creation, innovation, and R&D as internal sources of technological progress.

Building on this theoretical background, total factor productivity in this study is explained through the interaction between external knowledge channels and domestic absorptive capacity. Trade openness and foreign direct investment represent external mechanisms through which economies may access foreign technologies, imported intermediate goods, capital equipment, managerial knowledge, competitive pressure, and international production networks. However, these external channels do not automatically generate productivity gains. Their impact depends on the ability of the domestic economy to absorb, adapt, and use external knowledge effectively. Human capital strengthens this absorptive capacity by improving workers' skills, learning capacity, and ability to adopt new technologies. R&D, in turn, represents the domestic innovation effort required to transform knowledge into new production processes, efficiency improvements, and technological upgrading. In this sense, trade openness, FDI, human capital, and R&D function as interrelated determinants of TFP. While openness and FDI create channels for accessing foreign knowledge and technology, human capital and R&D shape the economy's ability to transform this knowledge into lasting productivity gains.

Within this theoretical framework, the research is guided by the following question:

RQ: How do foreign investment, trade openness, human capital formation, and R&D activity influence Türkiye's total factor productivity?

This research question is designed to examine whether Türkiye's productivity performance is shaped mainly by external integration channels, domestic capability-building mechanisms, or the interaction between the two. Trade openness and FDI are expected to capture the role of external knowledge diffusion, international competition, and technology transfer, while human capital and R&D represent the domestic capacity to absorb, adapt, and generate knowledge. In this respect, the study does not treat these variables as isolated determinants, but as interconnected channels through which external openness and domestic innovation capacity may jointly influence total factor productivity in Türkiye. This objective is particularly relevant for Türkiye, where the coexistence of external integration, human capital expansion, and R&D efforts raises the question of whether these channels can be transformed into sustained productivity gains.

Literature Studies

In the Turkish context, the literature on TFP has developed around the broader question of whether productivity gains are mainly driven by external openness, foreign direct investment, human capital accumulation, technological capability, sectoral efficiency, or regional development dynamics. Earlier evidence highlights foreign direct investment as an important mechanism through which capital accumulation and technology spillovers may strengthen productivity and growth, as shown by Arisoy (2012), who reports a positive long-run relationship between FDI, TFP, and economic growth in Türkiye. This external-openness perspective is complemented by studies focusing on financial liberalization and financial openness. Isik and Hassan (2003) report that productivity improvements in Turkish commercial banking after deregulation were driven mainly by efficiency gains rather than advances in technology, while Serdaroğlu (2015) provides broader macroeconomic evidence that financial openness, together with human capital, innovation, FDI, financial development, macroeconomic stability, and institutional quality, contributes positively to TFP. However, the

role of human capital appears more complex in the Turkish case. Although Saygılı et al. (2005) find that education generally supports productivity growth across countries, they report that this effect does not clearly materialize for Türkiye, suggesting that increases in educational attainment do not automatically translate into productivity gains unless they are supported by quality improvements and a suitable technological and institutional environment. More recent regional evidence by Yiğiteli and Şanlı (2024) reinforces the importance of human capital for output growth, but also shows that scale inefficiencies may limit overall TFP performance across Turkish regions. Sectoral studies further indicate that Türkiye's productivity problem is not uniform across the economy. In agriculture, Ozden (2014) reports a decline in TFP mainly due to weak technological change. Energy-related studies also point to an efficiency challenge: Sözen and Alp (2013) and İskender and Sözen (2016) show that although Türkiye has achieved some improvements in energy performance, it still lags behind European benchmarks in the effective use of energy inputs. In addition, Ursavaş (2020) shows that demographic indicators such as income, urbanization, life expectancy, and population density are associated with a higher probability of TFP growth, whereas dependency ratios and fertility may weaken this probability. Finally, Olomola and Osinubi (2018), by placing Türkiye within the MINT country group, report that human capital and government stability contribute to long-run TFP performance, whereas FDI and corruption are found to have negative effects in their panel framework. The literature suggests that TFP is closely associated with external openness, FDI, human capital formation, and technological capability. Trade openness and FDI may affect productivity through competition, technology transfer, imported inputs, and knowledge spillovers, while human capital determines the economy's capacity to absorb and effectively use these external gains. R&D, in turn, represents the domestic innovation capacity required to transform knowledge, skills, and external linkages into sustained productivity improvements. However, the Turkish evidence also indicates that these channels do not operate automatically. The effects of openness, foreign investment, human capital, and R&D on productivity depend on human capital quality, technological capacity within the economy, and the ability to turn external integration and innovation efforts into efficiency gains and technological progress.

International evidence on total factor productivity shows that productivity dynamics are shaped by a wide set of factors, including technological capability, R&D, human capital, trade openness, imported technology, digital transformation, environmental regulation, energy efficiency, and regional heterogeneity. In this literature, technological progress and innovation appear as central channels through which economies improve productivity. Haider et al. (2021) find that R&D supports technological progress in advanced manufacturing sectors, whereas imports and ICT investment contribute to productivity mainly through efficiency gains and delayed technology diffusion. In emerging economies, Saleem et al. (2019) provide evidence from Pakistan that patents, imported machinery, trade openness, education, and financial development support TFP growth, while inflation weakens productivity performance. Recent evidence further strengthens the view that trade openness is one of the key channels through which productivity gains may emerge. Wu and Han (2022) show that economic openness enhances city-level TFP in China through trade facilitation, infrastructure connectivity, technical efficiency, and technological progress. de Almeida et al. (2024) reach a comparable conclusion for Brazil, showing that trade openness is positively associated with TFP over both short- and long-term horizons, whereas absorptive capacity does not have a statistically significant direct effect. In their analysis of BRICS and D-8 economies, Iftikhar et al. (2025) report an overall positive link between openness and TFP and further suggest that innovation reinforces this productivity channel, although the size and direction of the estimates vary across country groups. Dai et al. (2025) add evidence from China by showing that digital trade raises green TFP, with trade openness and FDI further supporting this improvement. These findings

suggest that openness can enhance productivity when it facilitates access to foreign technology, imported machinery, knowledge spillovers, infrastructure connectivity, and broader market integration. However, the effect of external integration depends on domestic absorptive capacity, especially human capital and innovation capability. Afzal and Ahmad (2018), focusing on Asian economies including Türkiye, also report that ICT, governance, and investment are positively linked to TFP, whereas R&D has a positive but statistically insignificant coefficient, indicating that innovation inputs may not automatically generate productivity gains unless they are supported by institutional and technological capacity.

Recent studies also emphasize that the productivity effects of FDI are not automatic and depend on spillover mechanisms, firm linkages, ownership structure, institutional conditions, and absorptive capacity. Bournakis et al. (2022) examine how multinational enterprises shape domestic firms' TFP and show that productivity gains mainly arise through backward vertical spillovers, while horizontal spillovers are weaker and depend on foreign ownership structure and domestic firms' ability to absorb external knowledge. Santos (2023), reviewing macroeconomic and microeconomic models on the FDI–productivity nexus, concludes that empirical evidence remains mixed and that forward linkages, absorptive capacity, institutional quality, human capital, and technology transfer mechanisms should be more explicitly incorporated into empirical models. Makiela and Ouattara (2026) provide additional evidence that FDI contributes to TFP growth in developing countries only when it exceeds a certain threshold and follows a sustained upward trajectory. Malik and Sah (2026), in contrast, find that FDI inflows are positively associated with GDP and trade openness but negatively associated with TFP in expanded BRICS economies, indicating that the FDI–productivity link may vary across country samples and periods. Evidence from middle-income and emerging economies further links FDI, openness, and productivity to growth performance. Duong et al. (2022) report growth-enhancing effects of FDI and trade openness in middle-income economies, while Le et al. (2024) show that FDI and TFP jointly support growth performance in the same country group. Hao (2023) also reports that FDI supports China's industrial growth, whereas the long-run role of trade openness remains statistically limited. Taken together, this literature suggests that FDI can support productivity when it generates technology transfer, vertical linkages, knowledge spillovers, and learning effects, but its impact may remain limited or even ambiguous when domestic absorptive capacity, institutional quality, or productive linkages are weak.

More recent studies broaden the productivity discussion by incorporating digitalization, environmental quality, and energy efficiency. Pan et al. (2022) report a positive and nonlinear association between the digital economy and TFP in China, especially in more developed eastern regions, while Zhang et al. (2023) find that digitalization improves agricultural green TFP through agricultural technological innovation. Environmental and energy-related studies also indicate that productivity gains increasingly depend on sustainable production capacity. Fan et al. (2022) show that environmental technological progress and environmental regulation can improve green TFP, while Liang and Wang (2023) find that TFP growth contributes to better environmental quality through innovation input. Santos et al. (2021) add another perspective by showing that energy efficiency is strongly linked to TFP in Portugal and may act as an important driver of technical change. Finally, Zhang et al. (2024), using data from 171 economies, show that both TFP and green TFP support clean energy transition, although the effect of green TFP is stronger, particularly through green efficiency improvements. A broader review-based literature also supports this multidimensional view of productivity. Radlo and Tomeczek (2022) identify FDI, globalization and international trade, human capital, ICT, R&D and innovation, global value chains, labor allocation, and regional differences as major

productivity-related factors. Zhang et al. (2021) group the drivers of green total factor productivity under technical, economic, and government-related dimensions and show that technological progress and technological efficiency play a decisive role. Sharma et al. (2025), based on a review of 425 green total factor productivity studies, identify environmental regulation, green financing, industrial structure, digital technologies, technological innovation, and energy transition as major themes in this literature. Çetin et al. (2025) find that green growth and higher energy productivity are associated with lower CO₂ emissions in G7 economies, whereas Yaqoob et al. (2022) provide sectoral evidence from Pakistan that climate variation and changing consumption patterns have important implications for agricultural TFP.

Data and Model

The empirical model focuses on Türkiye's total factor productivity and four potential drivers: trade openness, foreign direct investment, human capital, and R&D. The dataset consists of annual observations for the period 1990–2023, with the sample range limited by the joint availability of the variables. The specification follows the productivity-oriented studies of Saleem et al. (2019) and Olomola and Osinubi (2018), which relate productivity outcomes to external integration, innovation capacity, human capital formation, and macroeconomic conditions. TFP is taken from the Penn World Table. Trade openness is defined as exports plus imports relative to GDP. FDI corresponds to net inflows as a share of GDP, whereas R&D is represented by R&D expenditures relative to GDP. The human capital proxy is constructed as the number of higher education graduates divided by total population, using data from TurkStat and the Council of Higher Education. Before estimation, all variables are transformed into logarithmic form.

Table 1

Description of Variables

Symbol	Variable	Definition	Source
TFP	Total factor productivity	Total factor productivity index	Penn World Table
TRADE	Trade openness	Sum of exports and imports as a percentage of GDP	World Bank
FDI	Foreign direct investment	Foreign direct investment, net inflows (% of GDP)	World Bank
HC	Human capital	Ratio of higher education graduates to total population	TurkStat and Council of Higher Education
RD	Research and development	R&D expenditures as a percentage of GDP	TurkStat

Note. Created by the author.

Following the theoretical framework and the empirical literature, the model is specified as follows:

$$\ln TFP_t = \alpha_0 + \alpha_1 \ln TRADE_t + \alpha_2 \ln FDI_t + \alpha_3 \ln HC_t + \alpha_4 \ln RD_t + \varepsilon_t$$

where TFP_t denotes total factor productivity, $TRADE_t$ represents trade openness, FDI_t refers to foreign direct investment, HC_t denotes human capital, and RD_t represents

research and development. The subscript t indicates time, α_0 is the constant term, and ε_t is the error term. The coefficients α_1 , α_2 , α_3 , and α_4 capture the long-run elasticities of total factor productivity with respect to trade openness, FDI, human capital, and R&D, respectively.

The model assumes that trade openness may affect TFP through international competition, access to imported intermediate and capital goods, and technology diffusion. FDI is expected to influence productivity through capital accumulation, managerial knowledge, production technologies, and spillover effects. Human capital reflects the economy's absorptive capacity and its ability to use and adapt external knowledge. R&D represents domestic innovation capacity and the potential to generate technological improvements. Therefore, the model evaluates both external knowledge channels and domestic capability-building mechanisms as factors that shape productivity performance in Türkiye.

Econometric Methodology

The empirical strategy proceeds in two stages: first, it examines whether a long-run relationship exists among the variables; second, it investigates the direction of causal interactions. Total factor productivity is specified as the outcome variable, while trade openness, foreign direct investment, human capital, and R&D are included as explanatory factors. All series are log-transformed before the estimation stage to limit scale-related variation and to express the coefficients in elasticity terms.

The analysis first determines whether the series contain unit roots. To do so, the study applies the standard Augmented Dickey–Fuller test together with the Fourier ADF test introduced by Enders and Lee (2012). After the integration structure of the variables is clarified, the study turns to the RALS Fourier ADL test to evaluate cointegration. The advantage of this approach is that it combines the Fourier ADL framework of Banerjee et al. (2017) with a structure that can account for gradual breaks in the long-run relationship. The use of Fourier-based techniques is also consistent with Ilkay et al. (2021), who emphasize the usefulness of Fourier terms in modelling smooth structural shifts in macroeconomic time series. When the cointegration relationship is verified, the long-run parameters are estimated with the Dynamic Ordinary Least Squares approach of Stock and Watson (1993). In the final stage, causal interactions are tested through the Toda–Yamamoto (1995) procedure and its Fourier-augmented version developed by Nazlioglu et al. (2016).

Fourier ADF Unit Root Test

The integration properties of the variables are evaluated before the cointegration stage. For this purpose, the study uses the conventional ADF test together with the Fourier ADF procedure developed by Enders and Lee (2012). The Fourier-based test is appropriate for macroeconomic series because such variables may be affected by gradual shifts, nonlinear movements, or regime changes over time. Its main advantage is that it can account for smooth structural changes endogenously, without imposing a predetermined break date or break form. The Fourier ADF specification can be written as follows:

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_1 \sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{i=1}^p \delta_i \Delta y_{t-i} + \varepsilon_t$$

where y_t denotes the variable being tested, k is the Fourier frequency, T is the number of observations, p is the optimal lag length, and ε_t is the error term. The unit root null hypothesis is tested against the alternative of stationarity. The relevance of the Fourier components is assessed through the F-statistic. When these components are significant, the Fourier ADF

findings are used; when they are not significant, the results of the standard ADF test are taken as the basis for interpretation.

RALS Fourier ADL Cointegration Test

Once the integration order of the series is identified, the study tests whether total factor productivity, foreign direct investment, human capital, trade openness, and R&D share a stable long-run association by using the RALS Fourier ADL cointegration procedure. The Fourier ADL framework of Banerjee et al. (2017) is suitable for this purpose because it permits the cointegration relationship to be analysed in the presence of smooth and gradual structural changes. This feature is important for Türkiye, where productivity dynamics may be affected by trade liberalisation, financial integration, economic crises, policy changes, and transformations in the innovation environment.

The RALS Fourier ADL approach extends the Fourier ADL framework by incorporating the residual augmented least squares procedure. This extension improves the power of the test by using additional information from non-normally distributed residuals. Therefore, the RALS Fourier ADL test provides a more flexible and robust framework for testing cointegration under possible nonlinearities and structural changes.

The general Fourier ADL specification can be written as follows:

$$\Delta y_t = \alpha_0 + \phi y_{t-1} + \theta' x_{t-1} + \sum_{i=1}^p \beta_i \Delta y_{t-i} + \sum_{j=0}^q \lambda_j \Delta x_{t-j} + \alpha_1 \sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 \cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_t$$

where y_t represents total factor productivity, x_t denotes the vector of explanatory variables including trade openness, FDI, human capital, and R&D, and the sine and cosine terms capture smooth structural changes. The test is conducted under the null hypothesis of no cointegration. If this null hypothesis is rejected, it indicates that the variables are linked by a stable long-run equilibrium relationship.

Dynamic Ordinary Least Squares Estimator

After the presence of cointegration is established, the study estimates the long-run coefficients by applying the Dynamic Ordinary Least Squares estimator of Stock and Watson (1993). DOLS is used because it addresses potential endogeneity and serial correlation problems through the inclusion of leads and lags of the first-differenced explanatory variables. This makes the estimator suitable for long-run parameter estimation in cointegrated systems.

The DOLS specification used in this study can be expressed as follows:

$$\ln TFP_t = \alpha_0 + \alpha_1 \ln TRADE_t + \alpha_2 \ln FDI_t + \alpha_3 \ln HC_t + \alpha_4 \ln RD_t + \sum_{j=-q}^q \delta_j \Delta X_{t-j} + \varepsilon_t$$

where TFP_t denotes total factor productivity, $TRADE_t$ represents trade openness, FDI_t refers to foreign direct investment, HC_t denotes human capital, and RD_t represents research and development. Because the variables are transformed into logarithms, the estimated parameters can be interpreted as long-run elasticities. In this context, α_1 , α_2 , α_3 , and α_4 represent the long-run effects of trade openness, FDI, human capital, and R&D on total factor

productivity, respectively. The long-run specification also includes a linear trend and its squared term to account for possible nonlinear deterministic movements in TFP over time.

Toda–Yamamoto and Fourier Toda–Yamamoto Causality Tests

The final stage investigates causal directions among the variables by applying the Toda–Yamamoto and Fourier Toda–Yamamoto approaches. The Toda–Yamamoto approach conducts causality analysis within an augmented VAR structure. This procedure is suitable when the variables are either stationary at level or integrated of order one, provided that the maximum order of integration is properly determined.

The augmented VAR model can be written as follows:

$$Y_t = \alpha + \sum_{i=1}^{k+d_{max}} A_i Y_{t-i} + \varepsilon_t$$

where Y_t is the vector of variables, k is the optimal lag length, d_{max} is the maximum integration order, and ε_t is the error term. The causality relationship is tested through Wald restrictions imposed on the first k lagged coefficients.

The optimal lag length of the VAR model is determined using the Schwarz Information Criterion (SIC). The Toda–Yamamoto causality procedure is then implemented by augmenting the selected VAR lag order (p) with the maximum order of integration (d_{max}). The standard Toda–Yamamoto test, however, does not directly consider structural changes. Therefore, the Fourier Toda–Yamamoto causality test proposed by Nazlioglu et al. (2016) is also applied. This approach adds Fourier sine and cosine terms to the causality model, enabling the analysis to account for gradual shifts in the causal relationships among the variables. Thus, the Fourier Toda–Yamamoto test provides a more flexible approach for analysing whether trade openness, FDI, human capital, and R&D have predictive power for total factor productivity in Türkiye, and whether feedback effects exist from productivity to these explanatory variables.

Results

Unit Root Test Results

Before testing for cointegration, the integration order of each variable is assessed with the conventional ADF and Fourier ADF unit root tests. The choice between the two test results is based on the statistical significance of the Fourier terms. Specifically, the F-statistic is first used to test whether the Fourier components are statistically significant. When the Fourier terms are significant, indicating the presence of smooth structural changes, the Fourier ADF statistic is used to determine stationarity. When the Fourier terms are not significant, the conventional ADF statistic is used instead. For example, for LNTTP, the Fourier terms are significant at the level ($F = 19.697$); therefore, the Fourier ADF statistic (-1.399) is used, which fails to reject the unit root null hypothesis. At the first difference, the Fourier terms are not significant ($F = 2.321$), so the conventional ADF statistic (-6.705) is used, indicating stationarity. Hence, LNTTP is classified as $I(1)$. The same decision rule is applied consistently to all variables. Table 2 summarizes the unit root test findings.

Table 2*ADF and Fourier ADF Unit Root Test Results*

Variable	Form	Frequency	Fourier ADF F-stat.	ADF	Decision
LNTPP	Level	1	-1.399	19.697*	-2.576 I(1)
LNTPP	First difference	4	0.410	2.321	-6.705*
LNTRADE	Level	4	-0.164	4.758	-3.065 I(1)
LNTRADE	First difference	4	-4.493	5.126	-5.043*
LNFDI	Level	1	-3.630	4.314	-1.264 I(1)
LNFDI	First difference	5	-6.470	1.015	-6.391*
LNHC	Level	1	-3.420	8.919***	-0.608 I(1)
LNHC	First difference	4	-4.555	0.400	-6.110*
LNRD	Level	4	0.016	2.304	-0.486 I(1)
LNRD	First difference	4	-4.517	2.505	-7.244*

Note. Created by the author using data obtained from the Penn World Table, World Bank, TurkStat, the Council of Higher Education, and EViews statistical software. The symbols *, **, and *** refer to significance at the 1%, 5%, and 10% levels, respectively.

Applying the decision rule described above, none of the variables is found to be stationary at the level based on the appropriate unit root test selected according to the significance of the Fourier terms. After first differencing, however, the unit root null hypothesis is rejected for all variables. The results indicate that all variables are non-stationary in their level forms. However, after taking first differences, all variables become stationary. Therefore, LNTPP, LNTRADE, LNFDI, LNHC, and LNRD are integrated of order one, I(1). This finding provides the necessary basis for proceeding with the cointegration analysis.

Cointegration Test Results

After all variables are found to be integrated of order one, I(1), the study proceeds to examine whether total factor productivity, trade openness, FDI, human capital, and R&D are connected through a long-run relationship. For this purpose, the RALS Fourier ADL cointegration test is applied. The appropriate test specification is determined on the basis of the minimum AIC value, and the results are presented in Table 3.

Table 3*RALS Fourier ADL Cointegration Test Results*

Test specification	Value
Lag length of LNTPP	3
Lag length of LNTRADE	3
Lag length of LNFDI	3
Lag length of LNHC	3
Lag length of LNRD	2
Frequency	2
Minimum AIC	-5.015
Rho	0.420

Test	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Decision
Fourier ADL	-5.913	-5.645	-4.934	-4.593	Cointegration
RALS Fourier ADL	-12.484	-4.182	-3.495	-3.123	Cointegration

Note. Created by the author using data obtained from the Penn World Table, World Bank, TurkStat, the Council of Higher Education, and EViews statistical software.

The Fourier ADL statistic is calculated as -5.913, and its absolute value is greater than the critical values at the 1%, 5%, and 10% significance levels. The RALS Fourier ADL statistic, reported as -12.484, also exceeds all corresponding critical values in absolute terms. These findings lead to the rejection of the null hypothesis of no cointegration. Therefore, the results provide evidence of a stable long-run equilibrium relationship among total factor productivity, trade openness, FDI, human capital, and R&D in Türkiye.

Long-Run Coefficient Estimates

Since the cointegration tests indicate a long-run association among the variables, the next step is to estimate the long-run coefficients by using the DOLS estimator. This estimator is employed because it reduces possible endogeneity and serial correlation problems by incorporating leads and lags of the first-differenced explanatory variables. To assess the sensitivity of the long-run findings to the choice of estimator, the Canonical Cointegrating Regression (CCR) estimator is additionally employed as an alternative cointegration estimator. Table 4 presents the DOLS estimates.

Table 4*DOLS Long-Run Estimation Results*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTRADE	0.549643	0.094810	5.797339	0.0000
LNHC	0.439569	0.222322	1.977172	0.0667
LNFDI	0.059999	0.023531	2.549811	0.0222
LNRD	0.008327	0.095252	0.087420	0.9315
C	-0.873441	0.520206	-1.679028	0.1139
Trend	-0.072675	0.025004	-2.906535	0.0108
Trend²	0.000800	0.000251	3.182182	0.0062
Fourier sine term	-0.009079	0.009023	-1.006216	0.3303
Fourier cosine term	0.004285	0.011231	0.381570	0.7081

Note. Created by the author using data obtained from the Penn World Table, World Bank, TurkStat, the Council of Higher Education, and EViews statistical software. The dependent variable is LNTPP. Fixed leads and lags are set to 1.

The DOLS results show that trade openness, human capital, and FDI have positive long-run effects on total factor productivity. The coefficient of trade openness is positive and statistically significant, indicating that a 1% increase in trade openness increases TFP by approximately 0.550%. This result suggests that trade openness is the strongest long-run determinant of total factor productivity in the model.

The coefficient of human capital is also positive, showing that a 1% increase in human capital raises TFP by approximately 0.440%. However, the statistical significance of this coefficient is weaker than that of trade openness and FDI. This indicates that human capital contributes positively to productivity, but its effect may be more dependent on structural conditions such as education quality, skill formation, and the effective use of knowledge in production.

The coefficient of FDI is positive and statistically significant. A 1% increase in FDI increases TFP by nearly 0.060%. Although this effect is smaller than the effects of trade openness and human capital, it shows that foreign investment contributes to Türkiye's long-run productivity performance.

In contrast, the coefficient of R&D is positive but statistically insignificant. This indicates that R&D does not have a statistically meaningful direct effect on TFP over the examined period. Therefore, the results suggest that R&D expenditures may require stronger commercialization channels, production linkages, and innovation capacity before generating measurable productivity gains.

As a sensitivity analysis, the long-run coefficients were also estimated using the CCR estimator, and the results are reported in Appendix 1. The CCR estimates provide support for the main DOLS findings regarding trade openness and FDI, as both coefficients remain positive and statistically significant. R&D remains statistically insignificant under both estimators.

However, the human capital coefficient becomes statistically insignificant in the CCR estimation, indicating that the long-run evidence for human capital is sensitive to the choice of estimator.

To further examine the adjustment toward the long-run equilibrium, an error correction model (ECM) is estimated. The ECM results are presented in Table 5.

Table 5

Error Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTRADE)	0.149352	0.087269	1.711400	0.0985
D(LNHC)	-0.076463	0.084334	-0.906663	0.3726
D(LNFDI)	-0.023913	0.019447	-1.229682	0.2294
D(LNRD)	0.038243	0.090281	0.423601	0.6752
ECT(-1)	-1.057711	0.363999	-2.905805	0.0072

To further examine the adjustment toward the long-run equilibrium, an error correction model (ECM) is estimated. The coefficient of the lagged error correction term, ECT(-1), is negative and statistically significant ($\beta = -1.058$, $p = 0.007$), confirming the presence of a long-run adjustment mechanism. Its magnitude slightly above unity indicates a relatively rapid adjustment process with some overshooting around the long-run equilibrium. Among the short-run coefficients, only trade openness is statistically significant at the 10% level ($\beta = 0.149$, $p = 0.099$), while human capital, FDI, and R&D are statistically insignificant.

Causality Test Results

In the final stage, the causal relationships among the variables are examined using both the Toda–Yamamoto and Fourier Toda–Yamamoto causality tests. The Fourier Toda–Yamamoto approach is useful because it allows for gradual structural shifts in causal dynamics. The results are presented in Table 5.

Table 5

Toda–Yamamoto and Fourier Toda–Yamamoto Causality Test Results

Causality Direction	Toda–Yamamoto Wald Stat.	Bootstrap p-value	Fourier TY Frequency	Fourier TY Wald Stat.	Bootstrap p-value
LNTRADE→LNTTP	10.356**	0.013	1	10.363*	0.004
LNHC → LNTTP	1.085	0.309	1	0.284	0.592
LNFDI → LNTTP	0.504	0.485	1	2.492	0.130
LNRD → LNTTP	0.391	0.824	1	0.580	0.747
LNTTP→ LNTRADE	1.476	0.485	1	0.023	0.877

Causality Direction	Toda– Yamamoto Wald Stat.	Bootstrap p- value	Fourier TY Frequency	Fourier TY Wald Stat.	Bootstrap p- value
LNTTP → LNHC	0.951	0.341	1	1.728	0.196
LNTTP → LNFDI	0.234	0.636	1	0.208	0.648
LNTTP → LNRD	3.360	0.212	1	1.852	0.414

Note. Created by the author using data obtained from the Penn World Table, World Bank, TurkStat, and the Council of Higher Education, and EViews statistical software. Bootstrap p-values are reported.

Both causality tests point to the same result: changes in trade openness help explain subsequent movements in total factor productivity. This outcome indicates that openness plays a predictive role in Türkiye’s productivity dynamics. However, no statistically significant causal relationship is found from human capital, FDI, or R&D to total factor productivity. Similarly, there is no evidence of reverse causality from total factor productivity to trade openness, human capital, FDI, or R&D. Overall, the causality evidence highlights trade openness as the most dynamic channel among the explanatory variables in explaining changes in total factor productivity.

Conclusion

This study examined how foreign direct investment, trade openness, human capital, and R&D influence Türkiye’s total factor productivity. The empirical findings provide a clear answer to the main research question: Türkiye’s total factor productivity is shaped mainly by external integration and domestic absorptive capacity, while innovation-related inputs require stronger institutional and productive linkages to generate statistically significant productivity gains. The cointegration evidence shows that the variables move together in the long run, suggesting that productivity dynamics in Türkiye reflect structural interactions rather than only short-term fluctuations. Instead, they reflect deeper structural relationships between openness, foreign investment, human capital formation, and innovation capacity.

The strongest long-run effect is found for trade openness. This result suggests that external integration is a central productivity-enhancing channel for Türkiye. In economic terms, trade openness may improve TFP by increasing access to imported intermediate and capital goods, exposing domestic firms to international competition, expanding market opportunities, and facilitating knowledge diffusion. The causality findings reinforce this interpretation by indicating that changes in trade openness help explain subsequent movements in TFP. This means that trade openness is not merely associated with productivity in the long run, but also has predictive power for productivity dynamics. This finding is supported by the results of Saleem et al. (2019), Wu and Han (2022), de Almeida et al. (2024), and Iftikhar et al. (2025), where openness is linked to productivity gains through trade, imported technology, infrastructure connectivity, market access, and innovation channels. Therefore, the Turkish evidence supports the broader view that openness contributes to productivity when it strengthens technology diffusion and efficiency-enhancing competition. The DOLS estimates indicate a positive long-run association between human capital and TFP; however, this finding should be interpreted cautiously, as the human capital coefficient is not statistically significant in the alternative CCR estimation. This finding is theoretically important because human capital

reflects how effectively an economy can absorb and apply knowledge from external sources. The result is consistent with studies emphasizing the role of education, skills, and absorptive capacity in productivity performance, such as Serdaroğlu (2015), Olomola and Osinubi (2018), Yiğiteli and Şanlı (2024), and Radlo and Tomeczek (2022). However, the relatively weaker statistical significance of human capital suggests that education and skill accumulation may not automatically generate productivity gains. For Türkiye, this implies that the quality of human capital, vocational skills, university–industry cooperation, and compatibility between education and technological transformation are crucial for converting human capital accumulation into productivity growth.

The FDI estimate is positive and statistically significant, showing that foreign investment contributes to Türkiye’s productivity performance, although its magnitude remains modest relative to the effects associated with openness and human-capital accumulation. Thus, FDI supports TFP but does not appear to be the dominant productivity channel. The result is consistent with Arısoy (2012) and Serdaroğlu (2015), who report positive productivity effects of FDI in Türkiye. It also aligns with Bournakis et al. (2022) and Santos (2023), who emphasize that the productivity impact of FDI depends on technology transfer, vertical linkages, spillover mechanisms, institutional quality, and absorptive capacity. However, recent evidence also shows that FDI does not always generate productivity gains automatically. For example, Makiela and Ouattara (2026) show that FDI contributes to TFP growth in developing countries only under certain threshold and trajectory conditions, while Malik and Sah (2026) report a negative association between TFP and FDI inflows in expanded BRICS economies. In this respect, the Turkish evidence suggests that FDI can support productivity more effectively when it is technology-intensive, connected with domestic firms, and embedded in stronger local production networks. In contrast, R&D has a positive estimate that is not statistically significant. This result should not be interpreted as evidence that R&D is unimportant for productivity. Rather, it indicates that R&D expenditures may not directly translate into measurable TFP gains unless they are effectively commercialized and linked to production processes. This finding is consistent with Afzal and Ahmad (2018), who report that R&D is positively related to TFP but lacks statistical significance in Asian economies. It also corresponds to the broader literature emphasizing that innovation-related productivity gains depend on absorptive capacity, institutional quality, technology-transfer channels, and well-functioning innovation systems. For Türkiye, the weak statistical role of R&D may reflect weaknesses in commercialization, private-sector R&D capacity, university–industry cooperation, and the time lag between innovation investment and productivity outcomes. The absence of statistically significant causality linking FDI, human capital, and R&D with TFP does not contradict their positive long-run coefficients. Instead, it suggests that these variables may influence productivity through slower and more structural mechanisms. Human capital accumulation, FDI spillovers, and R&D activities generally require time, institutional support, sectoral transformation, and firm-level linkages before they produce measurable productivity effects. Therefore, the causality findings identify trade openness as the most immediate and dynamic productivity channel, while FDI, human capital, and R&D appear to operate through long-run structural conditions.

The policy implications of the study follow directly from these findings. First, trade openness should be supported by policies that increase the technological content of exports, improve access to high-quality imported intermediate and capital goods, and help domestic firms integrate into global value chains. Second, FDI policies should go beyond attracting capital inflows and prioritize technology-intensive investments, stronger linkages between foreign and domestic firms, and greater spillover effects. Third, human capital policies should

give priority to raising education quality, strengthening vocational training, developing digital skills, and expanding university–industry cooperation. Finally, R&D policies should aim to improve the effectiveness of innovation expenditures by supporting commercialization, private-sector innovation, research infrastructure, and cooperation between firms, universities, and public institutions. This study has some limitations that may guide future research. First, the empirical analysis relies on aggregate Turkish time-series data, which does not allow sectoral or firm-level heterogeneity to be examined. Second, the study focuses on selected determinants of TFP, whereas additional factors, including institutional quality, the development of financial systems, and green transformation, may also shape productivity dynamics. Third, the R&D variable captures innovation input, but it may not adequately represent the quality, efficiency, or commercialization capacity of innovative activities. Future studies may therefore examine sectoral differences, firm-level spillovers, regional productivity gaps, and the role of digital and green transformation in Türkiye’s productivity performance. Overall, the findings suggest that Türkiye’s productivity challenge should be understood as a structural issue that requires stronger connections between openness, foreign investment, human capital formation, and innovation capacity.

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Appendix

Appendix 1: CCR Long-Run Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTRADE	0.362501	0.021438	16.908950	0.0000
LNHC	-0.022196	0.027053	-0.820455	0.4200
LNFDI	0.012192	0.005755	2.118540	0.0447
LNRD	-0.018891	0.027639	-0.683509	0.5008
C	-1.232859	0.065933	-18.698550	0.0000
Trend	-0.017267	0.004017	-4.298082	0.0002
Trend²	0.000263	0.000044	6.016116	0.0000
Fourier sine term	-0.003724	0.003337	-1.116096	0.2754
Fourier cosine term	0.015423	0.003262	4.728199	0.0001

Note. Created by the author using data obtained from the Penn World Table, World Bank, TurkStat, the Council of Higher Education, and EViews statistical software. The dependent variable is LNTPP

Information About the Article/Makale Hakkında Bilgiler

The Ethical Rules for Research and Publication / Araştırma ve Yayın Etiği

The author declared that the ethical rules for research and publication were followed while preparing the article.

Yazar makale hazırlanırken araştırma ve yayın etiğine uyulduğunu beyan etmiştir.

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The author has no conflict of interest to declare.

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Below are the question posed to the author concerning the use of artificial intelligence in the preparation of the manuscript and the author response to that question.

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With this declaration, the author(s) accept(s) that, if at any time a situation contrary to the above statement is identified, all ethical, academic, and legal responsibility shall rest with them.



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Research Article

**Extra-Role Behavior in Organizations: A Thematic Synthesis of the Most Cited
Studies**

Ayşegül Yalçın Özyurt^a & Gülşah Karavardar^b

Abstract

Introduction: Although extra-role behavior is widely recognized as a decisive factor in organizational efficiency, current literature remains highly fragmented across disciplines. This fragmentation hinders a cohesive understanding of its antecedents and consequences. To address this gap, this study systematically examines the core themes, relational structures, and accompanying variables present in the foundational literature on extra-role behavior.

Method: Following PRISMA guidelines, a qualitative systematic review and thematic synthesis were conducted on the fifty-two most highly cited publications indexed in the Web of Science (WoS) Core Collection. Data collection was carried out between April-May 2026.

Results or Findings: Findings reveal that the antecedents and consequences of extra-role behavior cluster into four primary dimensions as leadership dynamics, individual psychological drivers, organizational climate and job design, and negative dynamics. While extra-role behavior flourishes under positive leadership paradigms, job autonomy, and intrinsic psychological states, the findings also reveals a critical dark side. Specifically, excessive formalization and perceived compulsory citizenship suppress voluntary behavioral tendencies and increase employee burnout.

Discussion or Conclusion: This research helps to better understand the concept of the extra role by bringing together fragmented findings in the literature. In doing so, it provides decision-makers with actionable strategic insights to encourage voluntary employee behavior.

Keywords: extra-role behavior, organizational citizenship, leadership dynamics, systematic review, web of science

JEL Codes: M1, M21, M120

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Araştırma Makalesi

Örgütlerde Ekstra Rol Davranışı: En Çok Atıf Alan Çalışmaların Tematik Sentezi

Ayşegül Yalçın Özyurt^a & Gülşah Karavardar^b

Öz

Giriş: Ekstra rol davranışı örgütsel verimlilik üzerinde belirleyici bir faktör olarak kabul edilmesine rağmen, mevcut alanyazın farklı disiplinler arasında oldukça parçalı bir yapıdadır. Bu durum, ekstra rol davranışının öncülleri ve ardıllarının bütüncül bir şekilde anlaşılmasını engellemektedir. Bu boşluğu gidermek amacıyla bu çalışma, ekstra rol davranışına ilişkin temel literatürde öne çıkan ana temaları, ilişkisel yapıları ve birlikte ele alınan değişkenleri sistematik olarak incelemektedir.

Yöntem: Çalışmada PRISMA yönergeleri izlenerek, Web of Science (WoS) Core Collection'da dizinlenen ve en çok atıf alan 52 yayın üzerinde nitel bir sistematik derleme ve tematik sentez gerçekleştirilmiştir. Veriler Nisan-Mayıs 2026 tarih aralığında toplanmıştır.

Sonuçlar ya da Bulgular: Bulgular ekstra rol davranışının öncüllerinin ve ardıllarının; liderlik dinamikleri, bireysel psikolojik itici güçler, örgüt iklimi ve iş tasarımı ile negatif dinamikler olmak üzere dört temel boyutta kümelendiğini ortaya koymaktadır. Ekstra rol davranışı pozitif liderlik paradigmaları, iş özerkliği ve içsel psikolojik güdüler altında gelişirken, bulgular aynı zamanda kritik bir "karanlık yüz" de ortaya koymaktadır. Buna göre özellikle aşırı formelleşme ve zorunlu vatandaşlık algısı gönüllü davranış eğilimlerini baskılamakta ve işgören tükenmişliğini artırmaktadır.

Tartışma ya da Yapılan Çıkarımlar: Bu araştırma, alanyazındaki parçalı bulguları bir araya getirerek ekstra rol kavramının daha iyi anlaşılmasına yardımcı olmaktadır. Böylece karar alıcılara, çalışanların gönüllü davranışlarını teşvik etmeleri için eyleme dönüştürülebilir stratejik bilgiler sağlamaktadır.

Anahtar Kelimeler: ekstra rol davranışı, örgütsel vatandaşlık, liderlik dinamikleri, sistematik inceleme, web of science

JEL Kodlar: M10, M21, M120

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Introduction

The modern organizational environment is characterized by constant change, rapid technological advancements, and intense global competition (Adobor, 2025). These ongoing dynamic environmental conditions compel organizations to be proactive, adaptive and flexible. In the modern era, organizations differ from the mass-production-oriented businesses of the past century, particularly in how they utilize their human capital (Wright, 2021). In this respect, the traditional hierarchical, static, and highly structured approach to managing employees is insufficient in today's rapidly changing business environment. Accordingly, human capital stands out as a critical driver for sustainable competitive advantage. Consequently, for organizations seeking to optimize efficacy, the study of employee behaviors in their workplace has become an important focus for both researchers and practitioners (Guo & Chen, 2022).

When analyzing employee conduct, organizational literature traditionally distinguishes between two primary categories: in-role behaviors, which encompass the formally mandated job requirements necessary to maintain baseline operations, and extra-role behaviors, which transcend official job descriptions to drive continuous improvement (Sulea et al., 2012). Extra-role behavior is defined as the voluntary undertaking of tasks that are not stipulated in formal employment contracts or compensation structures, yet are inherently expected to enhance organizational effectiveness. Today, as rapidly changing business environments demand greater flexibility from workforces, these contributions are increasingly regarded as a vital metric for evaluating holistic individual performance (Kundi et al., 2023). Because extra-role behavior is fundamentally rooted in voluntary, prosocial action, such as assisting overburdened colleagues, taking unprompted initiative, or defending the organization's reputation—it is neither formally expected of employees nor can it be reliably compelled through explicit organizational directives or traditional reward systems (Panaccio et al., 2015).

As organizations increasingly acknowledge extra-role behavior as a key determinant of organizational effectiveness and productivity, and employee performance, scholarly interest in this field has grown substantially (Demerouti et al., 2015; Yu et al., 2021; Liao, 2022; Liu et al., 2023; Kruesi et al., 2026). A plethora body of empirical research has investigated this construct from the perspectives of the organization, employees, and customers (Xia et al., 2025; Castro-Casal et al., 2025). Nevertheless, despite the expanding volume of research, the literature remains fragmented since it has been researched by different disciplines including management (Kruesi et al., 2026), psychology (Lv et al., 2026), marketing (Guttena et al., 2024), education (Shams, 2026), and public sector (Hansen, 2025). This fragmentation has limited the development of a comprehensive understanding of the field, making it difficult to trace its intellectual evolution, identify persistent research gaps, and determine future research priorities (Lim, 2022). While there are some systematic review studies (Sleman et al., 2026; Schepers & Van der Borgh, 2020; Srivastava & Shree, 2019) aimed at compiling and summarizing research findings in this field, it appears that these studies are limited to a specific research area in the field. In this respect, a holistic examination of this field is an important approach to better understanding the concept.

In response to this limitation, the present study seeks to systematically review and synthesize the most influential contributions to the extra-role behavior literature regardless of the discipline. Specifically, the study focuses on highly cited publications indexed in the Web of Science (WoS) database. From a methodological perspective, the examination of highly cited studies enables the identification and classification of the most influential scholarly contributions within a broad and complex body of literature (Rodríguez-Navarro & Brito, 2024). Although extra-role behavior has attracted substantial academic attention, no

comprehensive study has yet adopted this particular perspective to systematically map the intellectual structure of the field. By employing a rigorous systematic review approach, this study aims to consolidate fragmented findings, reveal the thematic development of literature, and provide an overview of the field's intellectual landscape. Ultimately, the research intends to offer scholars and practitioners a more structured, comprehensive, and objective understanding of the existing knowledge base, thereby contributing to the establishment of a stronger theoretical foundation for future studies and strategic insights for decision makers.

Literature Review

Behavior encompasses how individuals perceive, interpret, and respond to internal and external stimuli (Bandhu et al., 2024). Understanding human behavior, which is fundamentally a subject of psychology, is a key agenda item, especially for labor-intensive sectors that rely on human interaction. Employee behavior plays a decisive role in success and productivity in service sector. Furthermore, employee behavior in organizations directly impacts organizational culture, employee relations, and customer satisfaction. Therefore, understanding employee behavior, particularly in the workplace, has become a crucial research topic in social sciences (Wulani et al., 2022; Schnieder et al., 2022; Sidorenkov et al., 2023)

In the rapidly transforming and complex business environments of the modern era, adhering to formal job descriptions is rarely sufficient to achieve organizational success. In this respect, labor-intensive organizations, in particular, place greater emphasis on the voluntary extra-task efforts of their employees to maintain agility, encourage innovation, and sustain a competitive advantage (Haydaroğlu, 2025). Since these voluntary extra contributions are crucial for overall operational efficiency, different disciplines are extensively researching this phenomenon (Kalmaz & Tozkoparan, 2020; Kottwitz et al., 2024; Kruesi et al., 2026). Consequently, various terminologies such as organizational citizenship behavior (OCB), prosocial behavior, contextual performance, organizational spontaneity, and extra-role behavior are used to describe these proactive efforts. However, the literature contains different research findings regarding the underlying motivation for this behavior. For example, researchers such as Guo et al. (2026) suggest that extra-role behaviors are driven by altruism, obedience, and commitment. Liu et al. (2026) on the other hand, reveal that extra-role behavior develops through cognitive and affective pathways, and that this process is shaped according to the level of relational dependency of individuals. Conversely, scholars such as Wulani et al. (2022) argue that employees engage in such actions primarily for personal gain or impression management. Fröhlich et al., (2025) on the other hand, emphasize that workplace happiness is a determining factor in extra-role behaviors, especially among newly hired employees. Therefore the emergence of these non-mandatory workplace behaviors is frequently linked to employees' positive emotional states, which are influenced by favorable perceptions of their work environment. Therefore, apart from intrinsic motives such as altruistic tendencies and impression management (Hoxha & Ramadani, 2024), the development of extra-role behavior is also influenced by organizational context, including organizational culture, group interactions, and employee brand perception (Costa et al., 2022; El Baroudi et al., 2023).

Ultimately, the cultivation of extra-role behaviors offers significant benefits for both the employee and the organization. The advantages it creates for employees include increasing their informal knowledge, enriching their social capital, and accelerating career advancement (Kane et al., 2012; Liao, 2022). Moreover, engaging in extra-role behavior boosts employees' creative abilities, contributing to better overall performance (Demerouti et al., 2015). Research also shows that when employees believe their discretionary actions lead to improved performance, this perception fosters positive emotional states that result in better organizational outcomes

(Balkin & Werner, 2023). On a macro level, these behaviors are vital for enhancing employee performance and reducing turnover intentions (Caillier, 2016a), which ultimately drives organizational effectiveness, boosts operational efficiency, and supports long-term sustainability. Hence, by prioritizing these practices, organizations can position themselves for success and resilience in a constantly evolving environment and for competitive advantage.

Although extra-role behaviors are widely associated with positive organizational outcomes, recent studies have increasingly emphasized their potential adverse consequences. Employees who continuously undertake responsibilities beyond their formally defined roles may be more vulnerable to role overload, heightened stress, and work–family conflict (Bolino et al., 2013). Sustained expectations to demonstrate such discretionary behaviors may also result in “citizenship fatigue,” which can negatively affect employee well-being as well as subsequent in-role performance (Bolino & Grant, 2016). Consequently, identifying and managing the balance between the beneficial and detrimental dimensions of extra-role behavior has emerged as a significant concern in contemporary management research.

Systematic reviews and meta-analyses on extra-role performance in specific fields reveal clear findings. A systematic review of public service studies in Indonesia (Miarni & Ibrahim, 2025) shows that intrinsic motivation is a fundamental antecedent of extra-role behavior in public service, and that contextual factors such as leadership and reward systems also have a significant impact on this concept. Another systematic review study (Sleman et al., 2026) examining nurses' extra-role behaviors reveals that leadership style is a key determinant of extra-role behavior. Compiling findings from 18 studies across four different databases, including WoS and Scopus, between 2014 and 2024, this research shows that transformational leadership has a positive impact on nurses' job satisfaction, motivation, and organizational commitment levels. In this respect, patient satisfaction, organizational efficiency, and corporate image perception are shaped by the leadership skills of managers. Another meta-analysis study (Schepers & Van der Borgh, 2020). examined the extra-role behaviors of employees who have direct contact with customers, such as customer representatives or sales consultants, within the context of culture. This research, which included 105 studies conducted in 35 different countries, revealed that customer expectations were the strongest determinant of extra-role behavior. However, the study also indicated that culture was a significant determinant in these employees' role development processes.

The novelty of this systematic review is that, unlike the studies mentioned above, it does not limit extra-role behavior to a specific sample or discipline but rather compiles the most frequently cited studies in the literature. Thus, it classifies common findings regarding the extra-role behavior concept that emerge in these most referenced studies in the literature. Therefore, by refining the findings of the most prestigious studies, this review contributes to a better overall understanding of the extra-role behavior concept.

Data and Methodology

This study, designed according to qualitative research methods, employed the systematic review technique as its data collection method. Systematic review involves examining and refining the existing literature according to various criteria in order to better understand a field (Harris et al., 2014). This method is considered highly reliable since it is based on verifiable findings. This method also allows for the simplification and clarity of a field by summarizing the findings of numerous studies conducted in a specific field. Thus, by revealing contradictory results in this field and identifying research gaps, it also guides researchers for future studies (Verdecchia et al., 2023). This study, which will employ a

systematic review process, primarily focuses on two research questions: 1) What are the main themes and variables researched alongside extra-role behavior in the most influential studies? and, 2) What are the key findings regarding the antecedents, mediators, and consequences of extra-role behavior? To answer these questions, the research specifically focuses on the most cited studies indexed in the Web of Science (WoS) database. The WoS database is described as a leading database that indexes the most reputable scientific journals, focusing on quality and transparency in scientific processes (Zhu & Liu, 2020). In this respect, the WoS database is a fundamental database where leading scientific developments are recorded and monitored. This database also serves as a key criterion for researchers' career development, considered in terms of academic advancement, awards, and prestige (Birkle et al., 2020). In this respect, examining the most cited studies in the WoS database is important for compiling high-quality research findings in any research field.

In line with the study's objective, inclusion and exclusion criteria were determined prior to the screening process. Based on the research questions, the inclusion and exclusion criteria were determined as follows. Inclusion: a) Extra-role behavior is examined as a separate, either dependent or independent variable, b) Findings regarding the antecedents of the extra-role behavior are included. c) Findings regarding the consequences of the extra-role behavior are included, d) Findings regarding the mediating nature of the extra-role behavior are included, f) Publications written exclusively in English language, f) All document types such as peer-reviewed journal articles, conference proceedings, and book chapters are included, g) Entire publication year available in the database is included and lastly, h) indexed in the WoS Core Collection. Exclusion criteria were defined as follows: a) Extra-role behavior was not examined as one of the main variables of the study, b) Extra-role behavior was not one of the sub-variables of the study, c) no findings related to extra-role behavior were included in the findings, d) no findings related to antecedents or successors of extra-role behavior were included in the findings, and lastly e) Non-English publications.

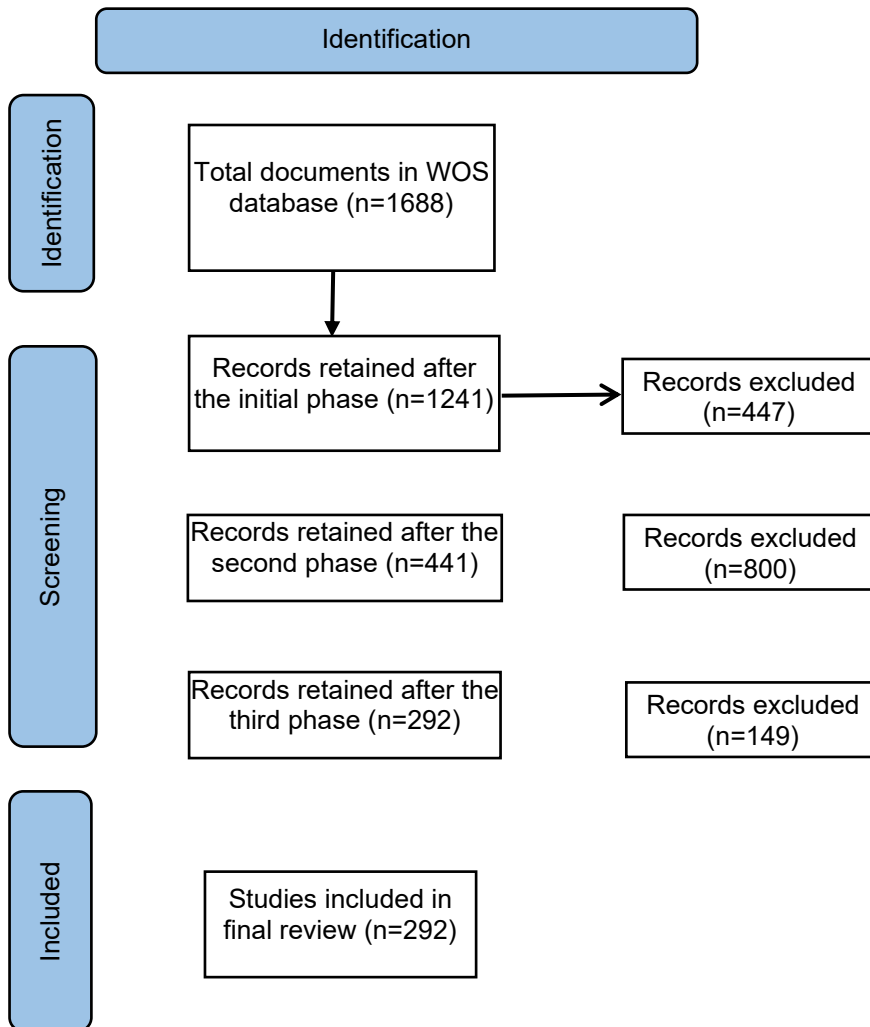
The data scanning and selection process was carried out based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. PRISMA provides verifiable characteristics such as reliability, transparency, and reproducibility in systematic review studies. It also allows the research to remain within a predetermined framework, thus facilitating the research process for researchers. (Sarkis-Onofre et al., 2021). PRISMA flow diagram showing the study's screening process is presented in Figure 1 below.

The data collection process was carried out between April and May 2026 by the authors together. The search of the WoS database was performed using the advanced search feature and by typing keywords related to extra-role behavior obtained from the existing literature, including “extra role behavior”, OR “extra-role behavior”, OR “extra role behaviour”, OR “extra-role behaviour”, OR “extra role”, OR “extra-role”.

In the identification phase, the following criteria were initially selected: publication language (English), publication type (any type), and publication year (any year available in the database). Then, the relevant keywords mentioned above were written in the “Topic” field, resulting in a total of 1688 records.

Figure 1

PRISMA Flow Diagram of the Study Selection Process



Note. This figure was created by the authors using MS Word

During the screening phase, the obtained records were systematically evaluated according to pre-defined inclusion and exclusion criteria. In this phase, titles, abstracts, and keywords were examined to identify studies that did not explicitly address the concept of extra-role behavior. Accordingly, many of these studies did not directly examine the concept but were indexed in the topic section. A second search, limited to the “Abstract” section, yielded 1241 results. These results were also evaluated within the scope of the study's objective, and since some studies were found to be irrelevant to the research aim, a third search was conducted. In this stage, a search limited to the “Keywords” group yielded a total of 441 results. Upon reviewing these studies, it was found that extra-role behavior was not the main theme in some research, which therefore did not meet the inclusion criteria of the study. In this regard, a fourth scan was conducted, limited to the “Title” section. As a result, 292 records were obtained.

In the eligibility phase, the 292 studies obtained were evaluated for their suitability to the research aim through a full-text review. Thus, this detailed review confirmed that all final records were suitable for the research topic. To ensure that extra-role behavior was the primary

focus of investigation, this rigorous process was intentionally selected in accordance with the aim of the research.

In the included phase, citation counts were applied, and initially the documents were ranked by their total citation counts on WoS Core Collection. Although there were a total of 292 research, only 52 of them had 50 or more citations. Therefore, for the final qualitative synthesis only these 52 highly cited articles were included, considering the researcher's time constraints and the complications that might have occurred if all 292 records had been analyzed. An overview of the articles included in the research is presented in Appendix 1.

To improve the comprehensibility of the research findings and to better reflect the relationships between variables, the Flourish program was used. Flourish visualizes the findings, revealing thematic relationships more clearly. Thus, it assists researchers in the process of visually reporting the findings. These visual representations also allow for the simplified presentation of complex relationships and a better understanding of the network of relationships between variables, helping both the researchers and the readers. This program, which does not include analysis features, was used solely for the purpose of visualizing the research findings.

Findings

The analysis included fifty-two highly cited articles focusing on extra-role behavior, each receiving at least fifty citations, with publication dates spanning from 1993 to 2023. According to the Web of Science database, the two most cited articles were foundational works focused on scale development: Van Dyne and Le Pine (1998) with 2,217 citations, and Van Dyne et al. (1995) with 885 citations. Excluding these methodological studies, the most highly cited empirical paper was MacKenzie et al. (1998), which accrued 465 citations for its investigation into the effects of job satisfaction, organizational commitment, role perceptions and turnover intention on extra-role behavior. Underscoring a growing contemporary interest in this research domain, the majority of the selected papers ($n = 33$) were published in 2010 or later. Appendix 1 summarizes these top-cited articles, detailing their total citation counts and annual citation rates.

The second stage of the study focused on analyzing the variables and key findings reported across the fifty-two highly cited articles on extra-role behavior. A thematic synthesis approach was used to systematically analyze the fifty-two highly cited articles. The primary coding unit was defined as the different findings, conceptual models, and theoretical discussions presented in the result and conclusion sections of each research. The analysis followed an inductive coding approach, that is, codes were generated directly from the data. This allowed for a data-driven examination of the articles. The synthesis was carried out in three main stages. Firstly, line-by-line coding was used to create initial codes that captured key concepts related to extra-role behavior in the examined studies. Secondly, descriptive themes were developed by grouping the initial codes according to their similarities and differences. Lastly, the descriptive themes were synthesized and interpreted to create analytical themes, answering the research questions and mapping variable relationships. To ensure the reliability and rigor of the analysis, two researchers conducted the coding process independently. After completing the initial coding, they assessed inter-coder agreement through a series of discussions. Any discrepancies in their coding decisions were resolved through mutual agreement, resulting in a unified analytical framework.

During the synthesis, extra-role behavior and other variables examined alongside it were systematically extracted and classified according to their structural placement in the research

models. Additionally, the result sections were cross-checked to verify these findings. Therefore, this process allowed the researchers to categorize the variables accurately as independent, dependent, or moderate.

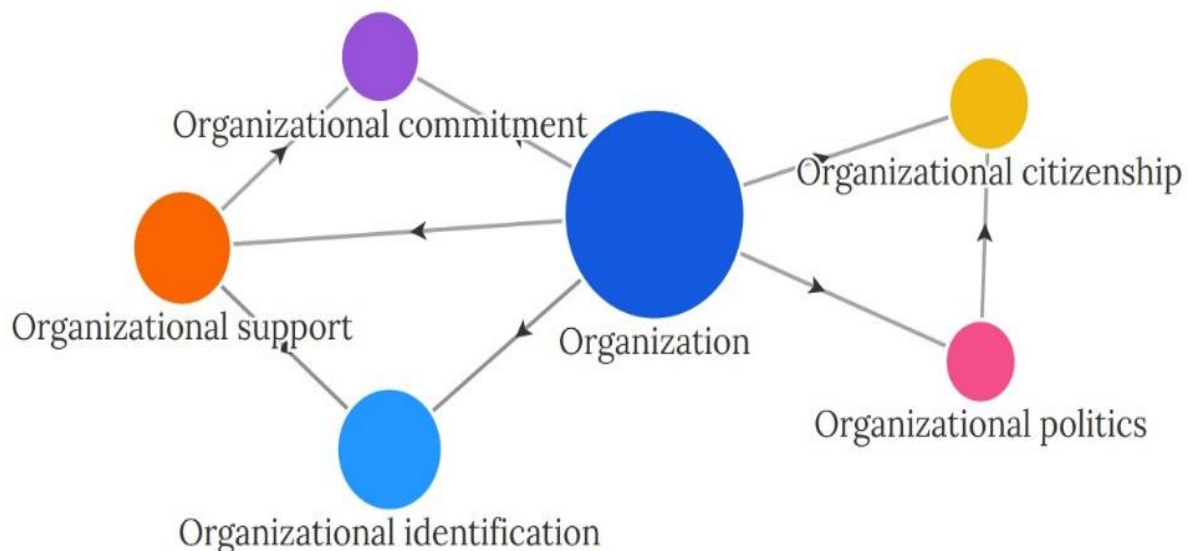
Thematic Analysis of Research Variables

The variables investigated across the selected articles were categorized based on their conceptual similarities. This classification revealed that the examined variables group into six primary themes: leadership, organizational factors, human resources management, customer-related variables, job attributes, and negative attitudes.

According to the findings, studies examining extra-role behavior from an organizational perspective predominantly focused on variables such as organizational identification, commitment, politics, support, and citizenship. Organization-wide findings are visualized in figure 2.

Figure 2

Variables Examined in Organization-Focused Studies

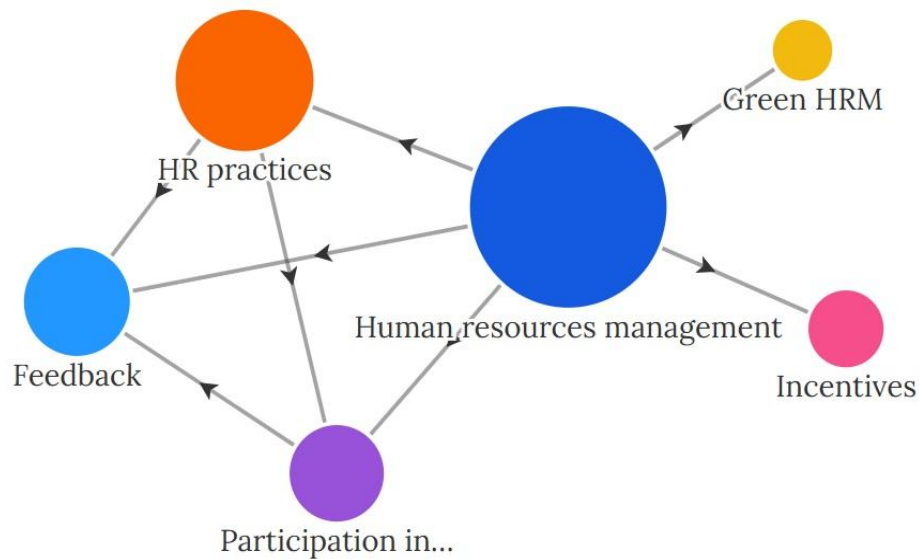


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The findings indicate that research addressing the human resources management dimension of extra-role behavior primarily concentrated on variables including positive and negative feedback, participation in decision-making, incentives, HR practices, and green HRM. Human resources management-focused findings are shown in figure 3.

Figure 3

Variables Examined in Human Resources-Focused Studies

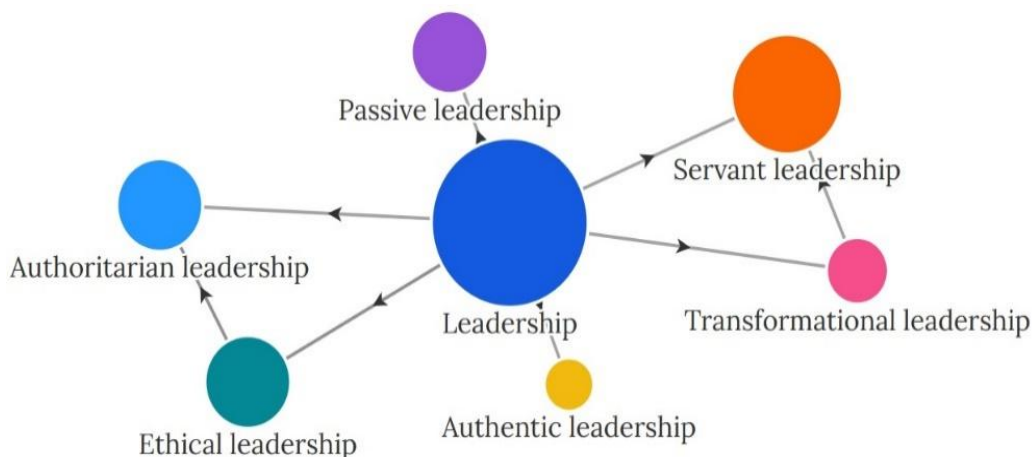


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Within the leadership category, the findings indicate that studies frequently examined the influence of diverse leadership styles on extra-role behavior, specifically highlighting authoritarian, passive, transformational, servant, authentic, and ethical leadership. Figure 4 represents leadership-focused findings.

Figure 4

Variables Examined in Leadership-Focused Studies

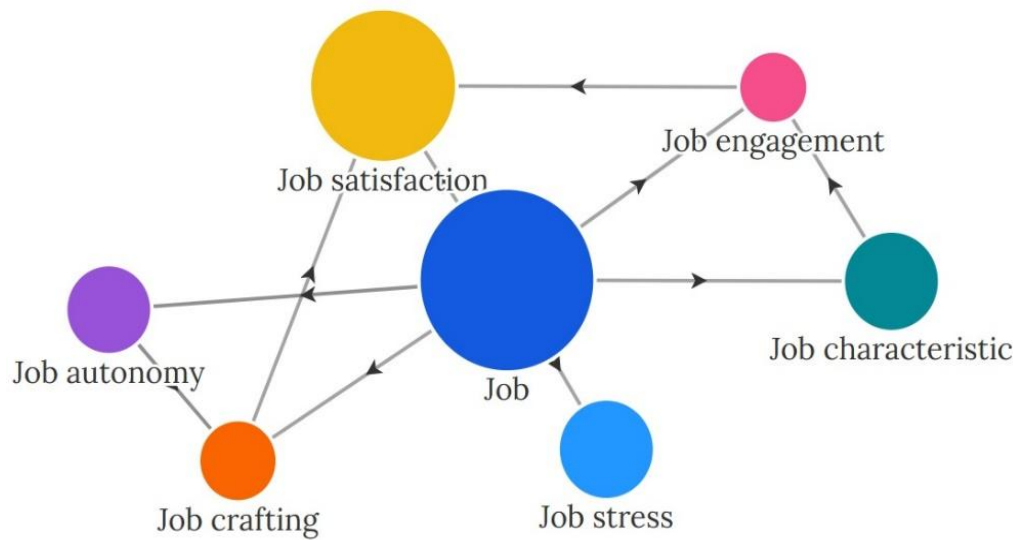


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Studies associating extra-role behavior with job attributes focused on variables such as job satisfaction, job crafting, job stress, job autonomy, job characteristics, and job engagement. Notably, among these variables, the concept of job satisfaction was examined in five different studies. Job-related findings are illustrated in figure 5.

Figure 5

Variables Examined in Job Attributes-Focused Studies

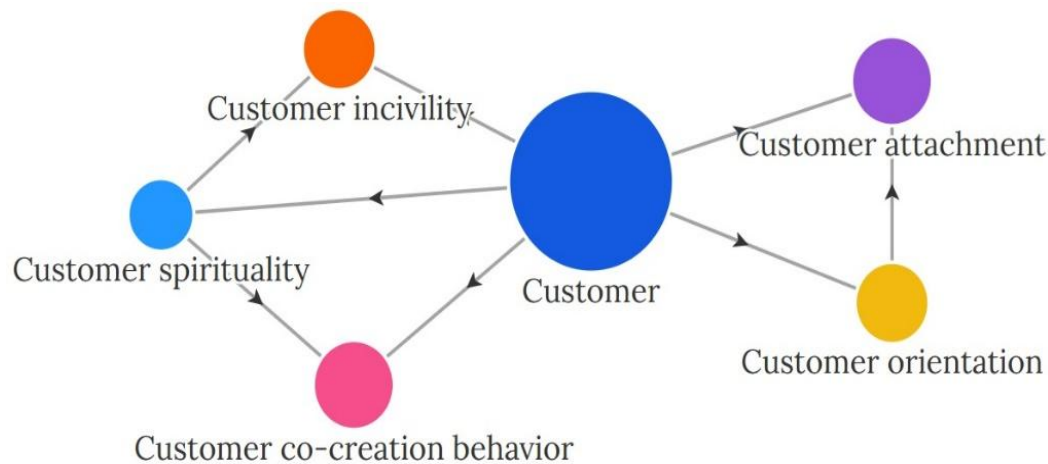


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Studies examining extra-role behavior from a customer perspective primarily focused on the following variables: customer spirituality, customer attachment, customer co-creation behavior, customer incivility, and customer orientation. Customer-related findings are shown in Figure 6.

Figure 6

Variables Investigated from the Customer Perspective

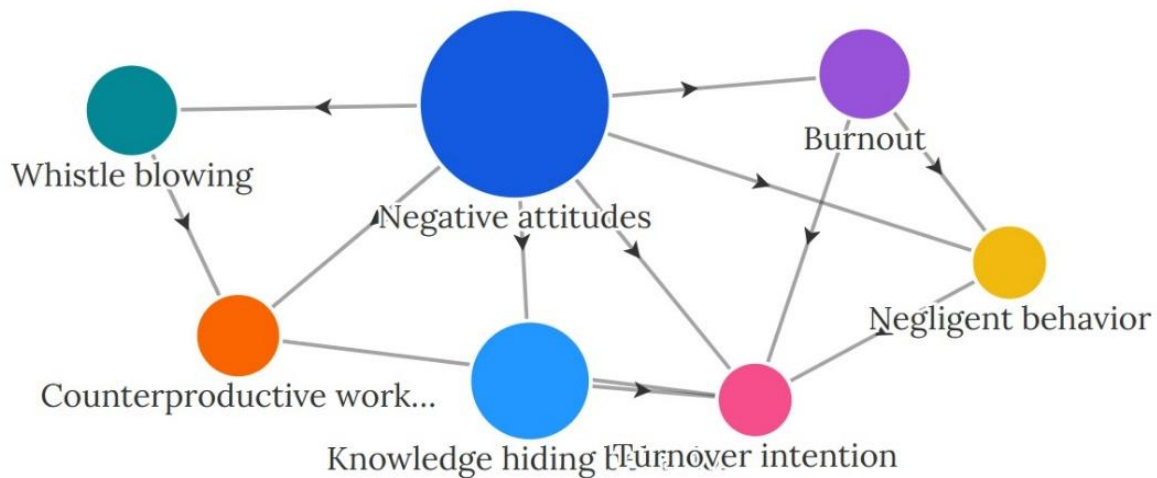


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Research exploring the negative dimensions associated with extra-role behavior predominantly concentrated on variables such as turnover intentions, burnout, knowledge hiding behavior, whistleblowing, counterproductive work behavior, and negligent behavior. Figure 7 depicts the negative attributes.

Figure 7

Variables Examined in Relation to Negative Attitudes



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Thematic Analysis of the Research Findings

The empirical findings from the most cited articles on extra-role behavior can be grouped into four core dimensions: leadership dynamics, individual psychological drivers and attitudes, organizational climate and job design, and negative dynamics. This classification helps in understanding the complex web of antecedents, mediators, and outcomes associated with these voluntary actions.

Leadership Dynamics

This cluster focuses on how top-down management styles trigger or inhibit extra-role behaviors. A significant cluster of findings highlights the vital role of leadership styles in extra-role behavior.

Positive leadership approaches: Transformational, servant, authentic, empowering, and ethical leadership styles all exhibit positive relationships with ERB (Islam et al., 2021). These relationships are often indirect, mediated by mechanisms such as mission valence (transformational), work engagement (servant), and psychological capital (authentic leadership, moderated by autonomy) (Raub & Robert, 2010). Empowering leadership specifically drives challenging extra-role behaviors, while ethical leadership stimulates extra-role green behaviors.

Destructive leadership approaches: Conversely, authoritarian leadership indirectly decreases extra-role behavior (ERB) by increasing subordinate role conflict and role overload. Interestingly, while authoritarian behavior increases role ambiguity, this specific ambiguity was not found to be directly associated with OCB (Zhang & Xie, 2017).

Individual Psychological Drivers & Attitudes

This category group factors are internal to the employee, their feelings, personality traits, and cognitive evaluations of their job. Findings strongly support the premise that positive psychological states, personality traits, and internal motivations act as primary antecedents to ERB.

Attitudes & satisfaction: Job satisfaction, a sense of efficacy, organizational identification, and commitment are consistently and positively associated with ERB (Van Dick et al., 2008; Bowling, 2010). Furthermore, emotional reactions, stemming from feedback—mediate the relationship between the feedback received and subsequent citizenship behaviors (Belschak & Den Hartog, 2009).

Personality & capability: Conscientiousness is a key personality antecedent (Sulea et al., 2012). Furthermore, a sense of efficacy and psychological capital (PsyCap) empower employees to go beyond their formal roles (Malik & Dhar, 2017).

Motivational orientations: General motivational orientations (such as communion and status striving) drive ERB. In public service contexts, Public Service Motivation (PSM) and goal clarity are positive antecedents (Caillier, 2016b), with person-job fit acting as a stronger mediator than person-organization fit for PSM's impact on these behaviors (Van Loon et al., 2017).

Organizational Climate and Job Design

The structural and cultural environment created by the organization significantly dictates the frequency of ERBs. Shared ethical atmosphere of a workplace is a strong predictor of ERB behavior.

Work design and autonomy: Job characteristics positively influence ERB, both directly and indirectly through work engagement (Sulea et al., 2012). Autonomy demonstrates a significant effect on ERB, which is fully mediated by employee commitment (Knies & Leisink, 2014).

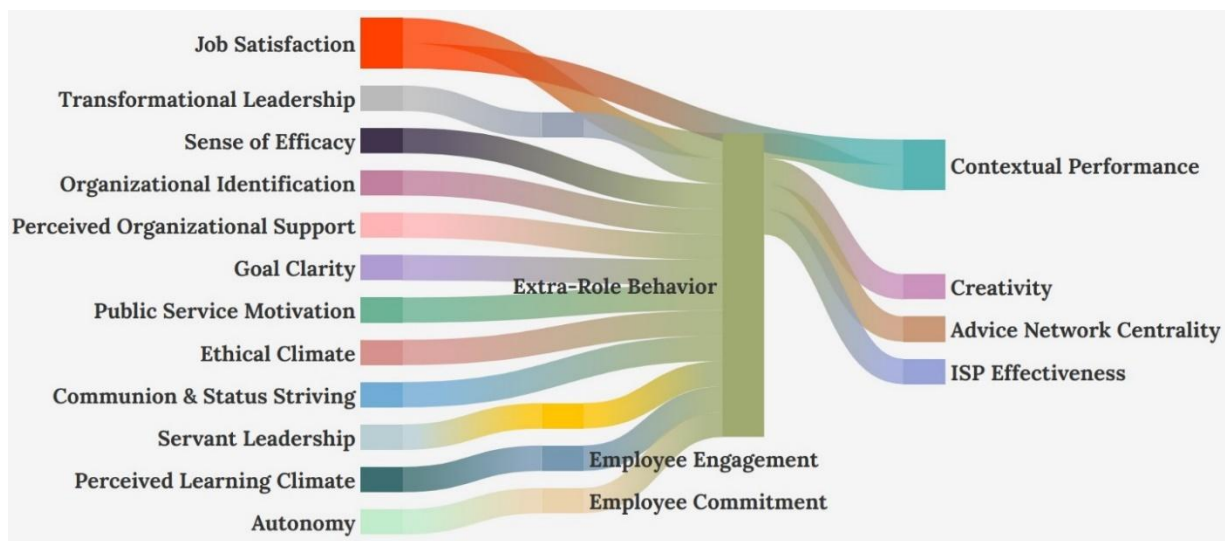
Climate and support: A perceived learning climate boosts ERB via employee engagement (Eldor & Harpaz, 2016), while perceived organizational support has a direct positive impact (Alnaimi & Rjoub, 2021). Similarly, higher levels of an ethical climate (caring and law-and-code, indicating a strong relational contract) foster positive ERB, whereas lower levels (instrumentality and independence) correlate with negative outcomes (Leung, 2008).

Goal setting: The relationship between goals and ERB is highly nuanced. While general goal clarity is positively associated with ERB (Caillier, 2016b), assigning difficult goals coupled with pay-for-attainment actually results in the lowest levels of ERB.

The positive antecedents and outcomes associated with extra-role behavior are outlined in Figure 8.

Figure 8

Positive Antecedents and Outcomes of Extra-Role Behavior



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Negative Dynamics

Several findings illuminate the detrimental elements that stifle voluntary behaviors or transform them into negative outcomes.

Knowledge hiding behavior: When employees actively hide knowledge from colleagues, it negatively impacts extra-role behavior. This hiding often stems from a sense of psychological entitlement (Alnaimi & Rjoub, 2021).

Compulsory citizenship behavior: When extra-role behavior loses its voluntary nature and becomes "compulsory," it leads to distinctly negative outcomes. Compulsory Citizenship Behavior is negatively related to actual organizational citizenship behavior, employee innovation, job satisfaction, and formal in-role performance (Vigoda-Gadot, 2007).

Strict goal attainment and role formalization: Assigning difficult goals and paying employees purely based on goal attainment results in the lowest levels of extra-role behavior. For highly committed individuals, strict goals can actually be negatively related to extra-role efforts (Wright et al., 1993). Highly formalized roles and strict procedural boundaries reduce the likelihood of extra-role behavior.

Customer incivility: Hostile or rude behavior from customers creates a highly stressful environment for front-line employees. This incivility negatively affects extra-role behaviors indirectly by causing emotional exhaustion and burnout (Bani-Melhem, 2020).

Negative antecedents of extra-role behavior are presented in Figure 9.

Figure 9

Inhibitors of Extra-Role Behavior



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Discussion

The aim of this systematic review was to map the intellectual structure of extra-role behavior by identifying and synthesizing the most influential variables addressed in the highly cited literature. By integrating fragmented findings across diverse theoretical perspectives, this review provides a comprehensive understanding of the antecedents and consequences of extra-role behavior. The findings demonstrate that extra-role behavior is a complex and multidimensional construct shaped by the interaction of leadership practices, individual psychological characteristics, organizational conditions, and negative workplace dynamics (Liu et al., 2026). Rather than functioning independently, these dimensions collectively explain the emergence, sustainability, and organizational outcomes of extra-role behavior.

One of the most prominent themes emerging from the reviewed studies is the decisive role of leadership in fostering voluntary employee behaviors. The literature consistently indicates that constructive leadership approaches, including transformational, servant, authentic, and ethical leadership, positively influence extra-role behavior (Islam et al., 2021). However, these leadership styles rarely exert a direct effect on employee behaviors. Instead, their influence is generally mediated through psychological mechanisms such as work engagement, psychological capital, organizational commitment, and mission valence (Usman et al., 2024; Raub & Robert, 2010). This finding supports the evidence from a systematic review examining nurses' extra-role behaviors. Conducted by Sleman et al., (2026) this study suggests that managers' transformational leadership traits positively influence nurses' job satisfaction, organizational commitment, and motivation, thereby increasing their tendency towards extra-role behaviors.

In contrast, destructive leadership styles, particularly authoritarian leadership, negatively affect extra-role behavior by increasing role conflict, emotional exhaustion, and role overload (Zhang & Xie, 2017). Collectively, these findings suggest that leadership functions as a critical contextual factor that shapes employees' psychological safety, motivation, and willingness to engage in behaviors beyond formal role requirements.

The findings further reveal that extra-role behavior is strongly associated with positive psychological states and intrinsic motivation. Individual-level variables such as

conscientiousness, self-efficacy, job satisfaction, and organizational identification appear to serve as important antecedents of extra-role behavior (Van Dick et al., 2008; Bowling, 2010; Sulea et al., 2012). Nevertheless, these psychological drivers are not independent of organizational context. Organizational climate and job design play a substantial role in strengthening or weakening these internal motivations. In particular, job autonomy, perceived organizational support, and ethical organizational climates create conditions that encourage employees to voluntarily contribute beyond their formal job duties (Knies & Leisink, 2014; Alnaimi & Rjoub, 2021). These findings reinforce the argument that extra-role behavior should not be viewed solely as an individual characteristic, but rather as the outcome of reciprocal interactions between employees' personal dispositions and supportive organizational environments (Kao et al., 2023). This finding is consistent with the result of a systematic review (Miarni & Ibrahim, 2025) that examines employees' extra role behavior in the public sector in Indonesia and concluded that the notion is affected by contextual factors such as the reward system and organizational climate as well as personal motivation.

Another significant issue highlighted in the literature concerns the relationship between goal setting, formalization, and extra-role behavior. Although goal clarity generally contributes positively to extra-role behaviors (Caillier, 2016b), highly formalized systems characterized by difficult performance targets and pay-for-performance mechanisms may undermine employees' willingness to engage in discretionary behaviors (Wright et al., 1993). This finding points to a critical paradox within organizational management. While organizations seek to improve performance through strict monitoring and transactional reward systems, excessive formalization may weaken intrinsic motivation and reduce employees' tendency to engage in voluntary and prosocial actions. In this sense, extra-role behavior appears to flourish more effectively in environments that balance organizational expectations with employee autonomy and psychological empowerment.

The reviewed literature also emphasizes the "dark side" of extra-role behavior, which has become an increasingly important topic in contemporary organizational research. The concept of compulsory citizenship behavior (Vigoda-Gadot, 2007) demonstrates that when organizations implicitly or explicitly pressure employees to perform voluntary behaviors, the discretionary nature of extra-role behavior is fundamentally undermined. Such pressures may lead to reduced job satisfaction, emotional exhaustion, and lower in-role performance. Similarly, external stressors such as customer incivility and toxic workplace interactions consume employees' emotional resources, increasing the likelihood of burnout and decreasing their capacity to engage in extra-role activities (Bani-Melhem, 2020). These findings suggest that extra-role behavior is a fragile organizational resource that can easily deteriorate under conditions characterized by excessive pressure, psychological strain, and unhealthy organizational climates.

Taken together, the four thematic dimensions identified in this review provide and integrated conceptual framework for understanding extra-role behavior. By consolidating previously fragmented evidence, this study extends existing knowledge beyond isolated antecedents and consequences, illustrating how leadership, individual psychological resources, organizational context, and negative workplace dynamics interact to influence discretionary employee behavior.

Conclusion and Implications

The study demonstrates that extra-role behavior thrives in organizational environments characterized by ethical and supportive leadership, psychological empowerment, job autonomy, and positive organizational climates (Raub & Robert, 2010). Conversely, authoritarian management practices, excessive formalization, compulsory expectations, and workplace stressors significantly weaken employees' willingness and capacity to engage in voluntary behaviors. Therefore, sustaining extra-role behavior requires organizations to create work environments that support intrinsic motivation, psychological well-being, and employee autonomy rather than relying solely on external controls or performance pressures.

The findings of this review offer several important implications for organizational leaders, human resource professionals, and policymakers seeking to cultivate sustainable extra-role behavior. First, organizations should avoid treating extra-role behaviors as implicit or explicit performance requirements. Although such behaviors contribute to organizational effectiveness, institutionalizing them through rigid performance evaluation systems, mandatory expectations, or financial incentives may undermine their voluntary nature (O'Brien et al., 2025). As the reviewed literature demonstrates, compulsory citizenship behavior often generates unintended consequences, including emotional exhaustion, citizenship fatigue, decreased intrinsic motivation, and lower in-role performance (Suhail et al., 2024). Therefore, managers should recognize extra-role behavior as an outcome of supportive organizational conditions rather than as an obligation that employees are expected to fulfill.

Second, leadership development should be considered a strategic investment for promoting extra-role behavior. The reviewed studies consistently indicate that transformational, servant, authentic, and ethical leadership foster discretionary employee behaviors by enhancing trust, psychological safety, work engagement, and organizational commitment (Giancaspro et al., 2022; Javed & Shafique, 2025). Organizations should therefore invest in leadership development programs that emphasize coaching, empowerment, transparent communication, ethical decision-making, and individualized consideration rather than command-and-control management styles. Leadership evaluation systems should also incorporate relational competencies, such as supporting employee development and fostering collaboration, instead of focusing exclusively on operational performance indicators.

Third, organizations should design work systems that strengthen employees' intrinsic motivation and psychological resources. Human resource practices should prioritize job autonomy, meaningful work, participation in decision-making, and opportunities for skill development. Providing employees with discretion over how they accomplish their tasks enables them to perceive extra-role behavior as self-initiated rather than externally imposed (Nguyen & Tuan, 2022). Likewise, strengthening psychological resources—including self-efficacy, resilience, organizational identification, and psychological capital—through mentoring, developmental feedback, and well-being initiatives may increase employees' willingness to contribute beyond formal job requirements (Sidorenkov et al., 2023).

Fourth, organizational climate should be deliberately cultivated to encourage reciprocity and trust. The findings suggest that employees are more likely to engage in extra-role behaviors when they perceive fairness, organizational support, ethical practices, and respectful interpersonal relationships (Ayele et al., 2024; Nuchpramool et al., 2025). Consequently, organizations should strengthen procedural and interactional justice, encourage open communication, and create psychologically safe environments where employees feel comfortable sharing ideas, assisting colleagues, and taking initiative without fear of negative

consequences. Such climates not only promote extra-role behavior but also reinforce organizational commitment and long-term employee engagement.

Finally, organizations should actively manage the risks associated with the dark side of extra-role behavior. Managers should monitor indicators of role overload, emotional exhaustion, work-family conflict, and citizenship fatigue, particularly among highly committed employees who frequently engage in discretionary activities. Employee assistance programs, workload assessments, flexible work arrangements, and regular well-being evaluations can help prevent excessive behavioral expectations from evolving into chronic stress and burnout (Bartram et al, 2023, Bellini et al., 2025). Organizations should also ensure that helping behaviors are distributed fairly among employees to avoid concentrating additional responsibilities on a limited number of high performers.

Limitations and Future Research Directions

Despite offering a comprehensive overview of the extra-role behavior literature, this study has certain limitations due to its methodological choices. First, limiting the final search to the title field creates a selection bias, thus relevant studies that examine the concept using alternative terminology may have been ignored. Another selection bias in the research is evident in limiting the number of citations to 50. This approach inherently favors earlier publications that have had the time to accrue citations, while potentially omitting recent publications that have not yet reached this metric. Therefore, while this study does offer insights into the most cited studies in this field, it does not claim to encompass the entire field of extra-role behavior or recent research trends in the field. Another limitation is that the research covers only the WoS Core Collection Database and the specific time period in which the research was conducted. Therefore, conducting similar research in another database might yield different results. Additionally, since the citation index is constantly changing, a similar study in the future might present different findings. Finally, the impact of technological changes and transformations on extra-role behavior could also be an important research area. In particular, the relationship between flexible and remote working conditions, which have become popular today, and the innovations brought about by artificial intelligence could be explored.

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- Vigoda-Gadot, E. (2007). Redrawing the boundaries of OCB? An empirical examination of compulsory extra-role behavior in the workplace. *Journal of Business and Psychology*, 21(3), 377-405. <https://doi.org/10.1007/s10869-006-9034-5>
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Appendix

Appendix 1: Overview of the Most Cited Publications on Extra-Role Behavior

No	Publication	Total WoS citations	Citations per year
1	Van Dyne, L., & Le Pine, J. A. (1998). Helping and voice extra-role behaviors: Evidence of construct and predictive validity. <i>Academy of Management Journal</i> , 41(1), 108-119. https://doi.org/10.5465/256902	2,217	82
2	Van Dyne, L., Cummings, L. L., & Parks, J. M. (1995). Extra-role behaviors-in pursuit of construct and definitional clarity (a bridge over muddied waters). <i>Research in Organizational Behavior: An Annual Series of Analytical Essays and Critical Reviews</i> , (17), 215-285.	885	30
3	MacKenzie, S. B., Podsakoff, P. M., & Ahearne, M. (1998). Some possible antecedents and consequences of in-role and extra-role salesperson performance. <i>Journal of Marketing</i> , 62(3), 87-98. https://doi.org/10.5465/256902	465	17
4	Demerouti, E., Bakker, A. B., & Gevers, J. M. (2015). Job crafting and extra-role behavior: The role of work engagement and flourishing. <i>Journal of Vocational Behavior</i> , (91), 87-96. https://doi.org/10.1016/j.jvb.2015.09.001	344	34
5	Hui, C., Law, K. S., & Chen, Z. X. (1999). A structural equation model of the effects of negative affectivity, leader-member exchange, and perceived job mobility on in-role and extra-role performance: A Chinese case. <i>Organizational Behavior and Human Decision Processes</i> , 77(1), 3-21.	274	10
6	Somech, A., & Drach-Zahavy, A. (2000). Understanding extra-role behavior in schools: The relationships between job satisfaction, sense of efficacy, and teachers' extra-role behavior. <i>Teaching and Teacher Education</i> , 16(5-6), 649-659. https://doi.org/10.1016/S0742-051X(00)00012-3	244	10
7	Eldor, L., & Harpaz, I. (2016). A process model of employee engagement: The learning climate and its relationship with extra-role performance behaviors. <i>Journal of Organizational Behavior</i> , 37(2), 213-235. https://doi.org/10.1002/job.2037	201	22
8	Tremblay, M., Cloutier, J., Simard, G., Chênevert, D., & Vandenberghe, C. (2010). The role of HRM practices, procedural justice, organizational support and trust in organizational commitment and in-role and extra-role performance. <i>The International Journal of Human Resource Management</i> , 21(3), 405-433. https://doi.org/10.1080/09585190903549056	192	12
9	Islam, T., Khan, M. M., Ahmed, I., & Mahmood, K. (2021). Promoting in-role and extra-role green behavior through ethical leadership: Mediating role of green HRM and moderating role of individual green values. <i>International Journal of Manpower</i> , 42(6), 1102-1123. https://doi.org/10.1108/IJM-01-2020-0036	191	48
10	Van Dick, R., Van Knippenberg, D., Kerschreiter, R., Hertel, G., & Wieseke, J. (2008). Interactive effects of work group and organizational identification on job satisfaction and extra-role behavior. <i>Journal of Vocational Behavior</i> , 72(3), 388-399. https://doi.org/10.1016/j.jvb.2007.11.009	187	11
11	Miles, D. E., Borman, W. E., Spector, P. E., & Fox, S. (2002). Building an integrative model of extra role work behaviors: A comparison of counterproductive work behavior with organizational citizenship behavior. <i>International Journal of Selection and Assessment</i> , 10(1-2), 51-57. https://doi.org/10.1111/1468-2389.00193	183	8
12	Belschak, F. D., & Den Hartog, D. N. (2009). Consequences of positive and negative feedback: The impact on emotions and extra-role behaviors. <i>Applied Psychology</i> , 58(2), 274-303. https://doi.org/10.1111/j.1464-0597.2008.00336.x	182	11
13	Vigoda-Gadot, E. (2007). Redrawing the boundaries of OCB? An empirical examination of compulsory extra-role behavior in the workplace. <i>Journal of Business and Psychology</i> , 21(3), 377-405. https://doi.org/10.1007/s10869-006-9034-5	180	10

14 Hsu, J. S. C., Shih, S. P., Hung, Y. W., & Lowry, P. B. (2015). The role of extra-role behaviors and social controls in information security policy effectiveness. <i>Information Systems Research</i> , 26(2), 282-300. https://doi.org/10.1287/isre.2015.0569	170	17
15 Raub, S., & Robert, C. (2010). Differential effects of empowering leadership on in-role and extra-role employee behaviors: Exploring the role of psychological empowerment and power values. <i>Human Relations</i> , 63(11), 1743-1770. https://doi.org/10.1177/0018726710365092	163	11
16 Becker, T. E., & Kernan, M. C. (2003). Matching commitment to supervisors and organizations to in-role and extra-role performance. <i>Human Performance</i> , 16(4), 327-348. https://doi.org/10.1207/S15327043HUP1604_1	133	8
17 Sulea, C., Virga, D., Maricutoiu, L. P., Schaufeli, W., Zaborila Dumitru, C., & Sava, F. A. (2012). Work engagement as mediator between job characteristics and positive and negative extra-role behaviors. <i>Career Development International</i> , 17(3), 188-207. https://doi.org/10.1108/13620431211241054	131	7
18 Wright, P. M., George, J. M., Farnsworth, S. R., & McMahan, G. C. (1993). Productivity and extra-role behavior: The effects of goals and incentives on spontaneous helping. <i>Journal of Applied Psychology</i> , 78(3), 374-381. https://doi.org/10.1037/0021-9010.78.3.374	126	4
19 Chen, Z., Eisenberger, R., Johnson, K. M., Sucharski, I. L., & Aselage, J. (2009). Perceived organizational support and extra-role performance: Which leads to which? <i>The Journal of Social Psychology</i> , 149(1), 119-124. https://doi.org/10.3200/SOCP.149.1.119-124	124	7
20 Panaccio, A., Henderson, D. J., Liden, R. C., Wayne, S. J., & Cao, X. (2015). Toward an understanding of when and why servant leadership accounts for employee extra-role behaviors. <i>Journal of Business and Psychology</i> , 30(4), 657-675. https://doi.org/10.1007/s10869-014-9388-z	121	12
21 Erdogan, B., Karaeminogullari, A., Bauer, T. N., & Ellis, A. M. (2020). Perceived overqualification at work: Implications for extra-role behaviors and advice network centrality. <i>Journal of Management</i> , 46(4), 583-606. https://doi.org/10.1007/s10869-014-9388-z	116	23
22 Little, L. M., Nelson, D. L., Wallace, J. C., & Johnson, P. D. (2011). Integrating attachment style, vigor at work, and extra-role performance. <i>Journal of Organizational Behavior</i> , 32(3), 464-484. https://doi.org/10.1002/job.709	114	8
23 Leung, A. S. (2008). Matching ethical work climate to in-role and extra-role behaviors in a collectivist work setting. <i>Journal of Business Ethics</i> , 79(1), 43-55. https://doi.org/10.1007/s10551-007-9392-6	113	7
24 Albrecht, S. L. (2012). The influence of job, team and organizational level resources on employee well-being, engagement, commitment and extra-role performance: Test of a model. <i>International Journal of Manpower</i> , 33(7), 840-853. https://doi.org/10.1108/01437721211268357	112	8
25 Karaosmanoglu, E., Altinigne, N., & Isiksal, D. G. (2016). CSR motivation and customer extra-role behavior: Moderation of ethical corporate identity. <i>Journal of Business Research</i> , 69(10), 4161-4167. https://doi.org/10.1016/j.jbusres.2016.03.035	103	11
26 Salanova, M., Lorente, L., Chambel, M. J., & Martínez, I. M. (2011). Linking transformational leadership to nurses' extra-role performance: The mediating role of self-efficacy and work engagement. <i>Journal of Advanced Nursing</i> , 67(10), 2256-2266. https://doi.org/10.1111/j.1365-2648.2011.05652.x	103	7
27 Hall, A. T., & Ferris, G. R. (2011). Accountability and extra-role behavior. <i>Employee Responsibilities and Rights Journal</i> , 23(2), 131-144. https://doi.org/10.1007/s10672-010-9148-9	101	7
28 Bowling, N. A. (2010). Effects of job satisfaction and conscientiousness on extra-role behaviors. <i>Journal of Business and Psychology</i> , 25(1), 119-130. https://doi.org/10.1007/s10869-009-9134-0	97	6

29 Alnaimi, A. M. M., & Rjoub, H. (2021). Perceived organizational support, psychological entitlement, and extra-role behavior: The mediating role of knowledge hiding behavior. <i>Journal of Management & Organization</i> , 27(3), 507-522. https://doi.org/10.1017/jmo.2019.1	95	24
30 Tjosvold, D., Hui, C., & Yu, Z. (2003). Conflict management and task reflexivity for team in-role and extra-role performance in China. <i>International Journal of Conflict Management</i> , 14(2), 141-163. https://doi.org/10.1108/eb022895	86	4
31 Zhu, J. N., Lam, L. W., & Lai, J. Y. (2019). Returning good for evil: A study of customer incivility and extra-role customer service. <i>International Journal of Hospitality Management</i> , (81), 65-72. https://doi.org/10.1016/j.ijhm.2019.03.004	85	12
32 Vey, M. A., & Campbell, J. P. (2004). In-role or extra-role organizational citizenship behavior: Which are we measuring? <i>Human Performance</i> , 17(1), 119-135. https://doi.org/10.1207/S15327043HUP1701_6	83	4
33 Knies, E., & Leisink, P. (2014). Linking people management and extra-role behaviour: Results of a longitudinal study. <i>Human Resource Management Journal</i> , 24(1), 57-76. https://doi.org/10.1111/1748-8583.12023	82	7
34 Belogolovsky, E., & Somech, A. (2010). Teachers' organizational citizenship behavior: Examining the boundary between in-role behavior and extra-role behavior from the perspective of teachers, principals and parents. <i>Teaching and Teacher Education</i> , 26(4), 914-923. https://doi.org/10.1016/j.tate.2009.10.032	78	5
35 Hur, W. M., Moon, T. W., & Kim, H. (2020). When does customer CSR perception lead to customer extra-role behaviors? The roles of customer spirituality and emotional brand attachment. <i>Journal of Brand Management</i> , 27(4), 421-437. https://doi.org/10.1057/s41262-020-00190-x	77	15
36 Kim, W. C., & Mauborgne, R. A. (1996). Procedural justice and managers' in-role and extra-role behavior: The case of the multinational. <i>Management Science</i> , (42), 499-515. https://doi.org/10.1287/mnsc.42.4.499	77	3
37 Ahmad, I., Donia, M. B., Khan, A., & Waris, M. (2019). Do as I say and do as I do? The mediating role of psychological contract fulfillment in the relationship between ethical leadership and employee extra-role performance. <i>Personnel Review</i> , 48(1), 98-117. https://doi.org/10.1108/PR-12-2016-0325	75	11
38 Gaither, C. A., Kahaleh, A. A., Doucette, W. R., Mott, D. A., Pederson, C. A., & Schommer, J. C. (2008). A modified model of pharmacists' job stress: The role of organizational, extra-role, and individual factors on work-related outcomes. <i>Research in Social and Administrative Pharmacy</i> , 4(3), 231-243. https://doi.org/10.1016/j.sapharm.2008.04.001	72	4
39 Caillier, J. G. (2016b). Does public service motivation mediate the relationship between goal clarity and both organizational commitment and extra-role behaviours? <i>Public Management Review</i> , 18(2), 300-318. https://doi.org/10.1080/14719037.2014.984625	70	8
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Note. Appendix has been created by the authors, benefiting from WoS database.

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The Ethical Rules for Research and Publication / Araştırma ve Yayın Etiği

The authors declared that the ethical rules for research and publication followed while preparing the article.

Yazarlar makale hazırlanırken araştırma ve yayın etiğine uyulduğunu beyan etmiştir.

Conflict of Interests/ Çıkar Çatışması

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