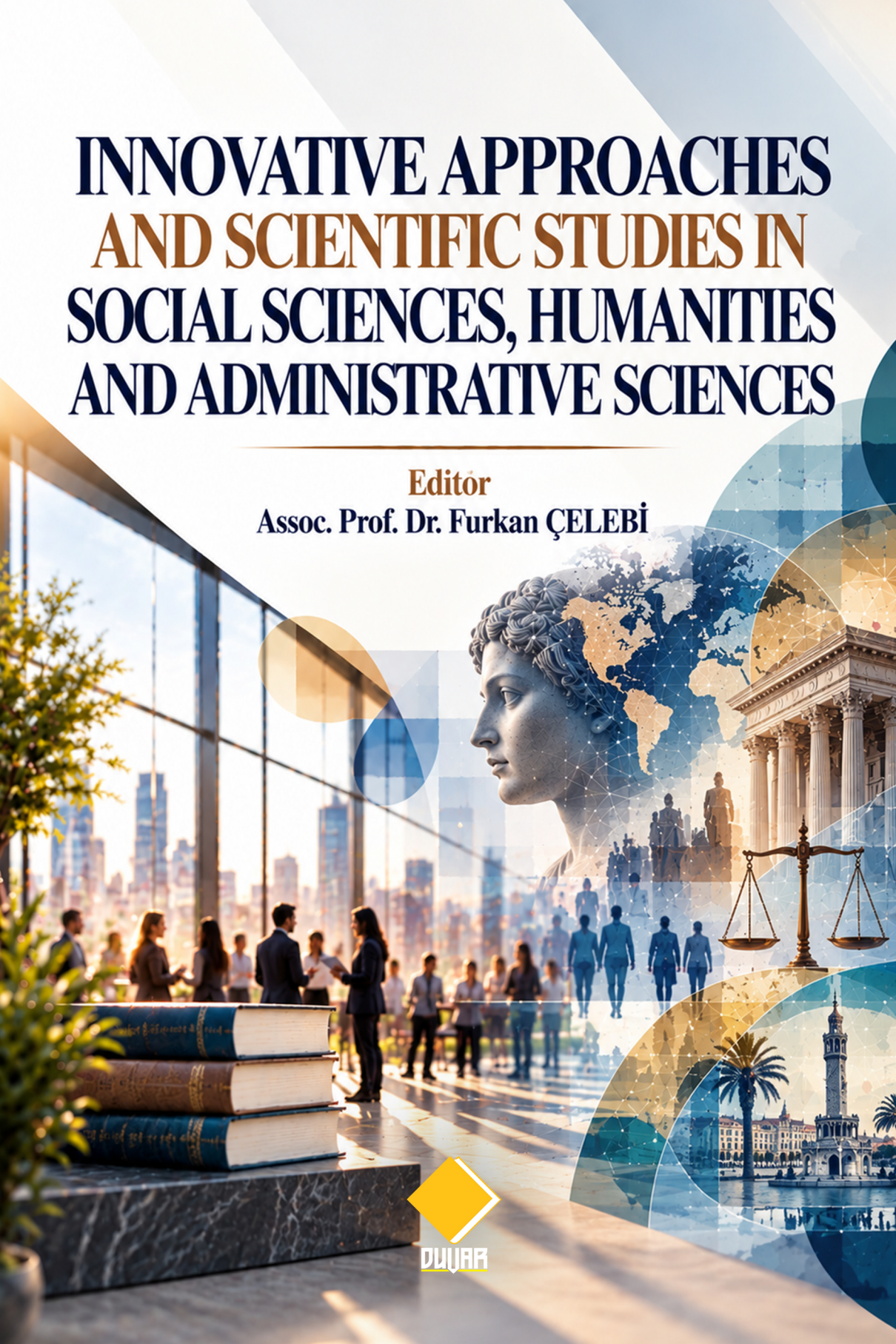
INNOVATIVE APPROACHES AND SCIENTIFIC STUDIES IN SOCIAL SCIENCES, HUMANITIES AND ADMINISTRATIVE SCIENCES

Editor
Assoc. Prof. Dr. Furkan ÇELEBİ



DUVAR

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Editor

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Chapter 1

A Study on The Impact of Consumer Trends on Entertainment, Leısure, Sports, and Culture Prices in Türkiye

Alp POLAT[1], Tuba SEVİL[2]

Abstract

This study aims to analyze the impact of selected consumer trends on the prices of goods and services in the fields of entertainment, leisure, sports, and culture. The ARDL method was employed to determine the relationships between the variables. In the study, the likelihood of purchasing or building a house was found to have a negative impact which indicates that consumers shift towards spending on recreation when their likelihood of housing expenditures decreases, thus influencing prices. Furthermore, shifts towards durable goods negatively impact the prices. The study also revealed an impact from the household's current financial position. Improvements in current financial position can lead to increased spending and raise prices. Finally, the household's financial situation variable was found to have a negative impact. This finding can be interpreted as supporting the Linder effect, a theory in the literature suggesting that recreational spending may be inversely proportional to income, as individuals tend to dedicate less time and interest to such activities as their income increases.

Anahtar Kelimeler: *Economics of Leisure and Recreation, Household Consumption, Consumer Price Inflation*

JEL Sınıflandırması: *E2, E3, G5*

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1. Introduction

Price changes in entertainment, leisure, sports, and cultural goods and services included in household spending budgets constitute the focus of this study. In recent years, the rate of price increase in this area has accelerated. Demand, income, and price relationships are among the fundamental issues of economics. Factors such as household income and consumer expectations can influence price movements. Studies focusing specifically on entertainment, leisure, sports, and culture are limited. Evaluating the specific economic relationships of these areas and revealing the expected relationships between price movements and consumer trends is important. Considering the research in the literature, it is understood that studies on entertainment, leisure, sports, and culture are mostly conducted on demand and focus on income elasticity and price elasticity of demand. A literature review will provide a brief summary of similar academic studies on the subject:

Løyland and Ringstad (2009) examined household consumption in the field of sports in their study. The study considered household demand for both individual sports activities and participation in sporting events. In this context, the price and income sensitivity of sports-related consumption was analyzed. The findings showed that the income elasticity of sports demand is high, and sports expenditures increase relatively faster as income increases. Although sports and leisure activities are generally considered income-elastic consumption areas, the time allocated to these activities can lead to income deprivation. Therefore, for high-income individuals, income-dependent inelastic demand can arise when the preference is based on income. This relationship is known in the literature as the "Linder effect". Taylor and Gratton (2002), in their study, consider spending on entertainment, leisure, sports, and culture as non-durable consumption. Watching most sporting events falls into this category of consumer demand. For example, the aesthetic pleasure and enjoyment of watching gymnastics or ice skating, or the tension and excitement of watching a football match, are perceived. Each consumer will evaluate the potential satisfaction or benefit of consuming the product and decide whether it is worth more or less than the asking price. If it is more, they will be willing to pay. Most spending in this area is a type of non-durable consumption. People participate for the purpose of enjoyment. Downward (2004), on the other hand, aimed to analyze recreation and sports participation in terms of socio-economic factors, and age, gender, income, ethnicity, occupation and education were evaluated in this category. Income has been found to be an important variable affecting this area. When looked at from the perspective of neoclassical economic models, it is understood that despite the

significant effects of income in this area, the effect of prices is lower than basic microeconomic analysis suggests.

Şengül et al. (2018) analyzed participation in entertainment and cultural activities in their study. They argued that economic and socio-demographic variables influence household purchasing decisions in the entertainment and cultural sector. In Türkiye, income was found to be the most important determining factor. They highlighted the importance of increased income for boosting entertainment and cultural spending. Lera-López and Rapún-Gárate (2007) examined sports spending and the factors influencing consumption in this area. Their findings indicated that even changes in personal income did not significantly affect this area, but changes in the amount of time people had available played a crucial role. Fort (2004) stated that findings regarding sports activities and related goods and services were made by considering both price-elastic and price-inelastic products in terms of demand. Melstrom and Vasarhelyi (2019), examining national park entrance fees in the USA as a sample, found that demand showed no elasticity despite price changes. Coates and Humphreys (2007) measured the elasticity of participation fees and additional expenses incurred by participants in various sports activities. They found that the vast majority of expenses showed an inelastic structure in relation to price. This suggests that, particularly for these events, pricing may be driven by a profit-maximizing approach, similar to a monopoly.

In the international literature, the price-demand relationship and household consumption behavior have been primarily addressed within the framework of income elasticity. Ali (1985), analyzing household consumption and saving behavior in Pakistan, revealed that income elasticity was low in areas such as recreation, travel, furniture, and housing rentals. The same study found that increases in the prices of food and basic goods suppressed other expenditure items, leading to a decrease in spending on recreation and especially education; it was determined that demand in these sectors was sensitive to their own price changes.

Gratton and Taylor (1995) emphasized that the price-demand relationship is one of the fundamental issues of economics, but that this relationship may differ in terms of recreation prices. The authors demonstrated how sector managers can interpret market data within the framework of price-demand relationships and how they can shape their final pricing decisions accordingly. Similarly, Berrett et al. (1993) argued that sports and entertainment facilities and services both serve the public interest and exhibit positive externalities; therefore, they stated that market pricing mechanisms can influence the extent to which society benefits from these facilities and services.

Beznoska (2014) utilized cross-sectional data in her analysis of energy, transportation, and recreation expenditures in Germany. The study's findings indicate that elasticities differ significantly among household groups and that leisure

expenditures are sensitive to price and income elasticities. It was emphasized that increases in energy and transportation prices constitute a significant share of household budgets and negatively affect household well-being. Kopytov et al. (2023) examined the relationships between recreation prices and working hours and wages; supported by US household data, they found that as individuals' working hours and wages decrease, recreation prices tend to fall. The researchers suggested that falling prices may reduce household incentives for capital accumulation and employment.

Studies on the Turkish sample have examined the factors determining household entertainment and cultural expenditures using different data sets and methods. Üçdoğruk et al. (2001) analyzed survey data on household income distribution and consumption expenditures through the subcategories of entertainment and cultural expenditures. In the study, households that owned their homes were compared with households that rented; it was observed that homeowners spent relatively less on entertainment and culture, but it was stated that this finding was not statistically significant.

Gümüşsoy and Doğrul (2018), in their study examining the entertainment and culture expenditures of households in Türkiye, found that retirement status, education level and total expenditure amount are determinants of these expenditures. According to the findings, the retired population spends more on entertainment and culture than the population close to retirement. The fact that the population close to retirement has non-wage income also increases such expenses. Tecirli and Köksel (2025) analyzed consumption expenditures in Türkiye within the framework of permanent income and lifetime income hypotheses. They revealed that long-term consumption dynamics are shaped by both permanent income and permanent income expectations.

Selim (2020) examined the determinants of entertainment and cultural expenditures in Türkiye and listed them as the educational level and gender of the head of the household, household size and disposable income of the household. According to the findings, education and household income stand out as the variables with the highest impact; it has been concluded that high-income households allocate a relatively larger share to entertainment and cultural expenditures; therefore, the income elasticity of this expenditure item is high. Dikmen (2021) conducted a micro-level analysis of culture and sports expenditures using survey data collected at the household level in Türkiye. According to the study findings, individuals with high income and education levels, car owners, those who have the habit of eating out, women, those who live with their relatives, relatively large families, credit card users and individuals who have the habit of reading newspapers and magazines constitute the groups with the highest tendency to spend on culture and sports.

This research aims to determine the impact of consumer trends in Türkiye on the prices of entertainment, leisure, sports, and culture. The data and methods section

will present information on the research variables and the methodology used. The findings section will present evidence related to the research objective obtained from the analysis. The conclusion section will conclude the study with an interpretation of the findings, inferences, and evaluations related to the topic

2. Aim and Methodology

The aim of this research is to evaluate the factors affecting the prices of goods and services in the fields of entertainment, leisure, sports, and culture in Türkiye, based on consumer trends. In this context, the following consumer trends that may influence price changes were selected and included in the analysis: Likelihood of Purchasing or Building a House, Suitability of the Current Period for Purchasing Durable Goods, Household Financial Situation (compared to 12 months prior), and Household's Current Financial Position. The research period covers monthly data from the first month of 2020 to the last month of 2025. This period is selected due to data availability. Monthly percentage change values were used for each variable. Information on the variables and data sources of the research is presented in Table 1.

Table 1. Research Variables

Variables	Data Provider	Source	Observation
Prices in Entertainment, Leisure, Sports, and Culture	TÜİK	TCMB Electronic Data Distribution System	Annual Percentage Change (monthly basis)
Likelihood of Purchasing or Building a House	TÜİK	TCMB Electronic Data Distribution System	Annual Percentage Change (monthly basis)
Suitability of the Current Period for Purchasing Durable Goods	TÜİK	TCMB Electronic Data Distribution System	Annual Percentage Change (monthly basis)
Household Financial Situation (compared to 12 months prior)	TÜİK	TCMB Electronic Data Distribution System	Annual Percentage Change (monthly basis)
Household's Current Financial Position	TÜİK	TCMB Electronic Data Distribution System	Annual Percentage Change (monthly basis)

The aim was to select a forecasting model for the study that aligns with the unit root test results of the variables. In this context, the ARDL model was chosen as the method for analyzing the research data. Pesaran and Shin (1995) noted that, in econometric modeling, the standard procedure involves stationarizing series that

exhibit unit root problems. They provided strong evidence supporting the use of an improved version of the traditional ARDL method to address the complexities that arise when dealing with variables of differing orders of integration. Developed by Pesaran, Shin, and Smith (2001), the Autoregressive Distributed Lag (ARDL) model is based on the bounds testing approach and is widely used in time-series econometrics. This model is particularly suitable when working with variables that have mixed orders of integration.

The ARDL method is considered suitable for series exhibiting different orders of stationarity. A key advantage of this method is its ability to analyze variables that are stationary either at the level or after first-differencing. The ARDL method also allows for the identification of long-run relationships (cointegration). In this approach, the cointegration relationship is assessed using the Bounds F-statistic; if the calculated test statistic exceeds the critical bound, a long-run cointegration relationship is deemed to exist. An error correction term is employed in the ARDL model to explain the long-run relationship. Through this error correction term, the model is reformulated, enabling the determination of both long-run and short-run effects of the variables (Nkoro and Uko, 2016).

Table 2. Descriptive Statistics

Variables	Number of Observations	Mean	Median	Maximum	Minimum	Standard Deviation
Prices in Entertainment, Leisure, Sports, and Culture	72	37.90347	39.21000	73.34000	4.120000	23.03507
Likelihood of Purchasing or Building a House	72	16.13139	21.46500	66.77000	-39.50000	25.70840
Suitability of the Current Period for Purchasing Durable Goods	72	5.200139	4.685000	71.79000	-33.38000	24.50570
Household Financial Situation (compared to 12 months prior)	72	0.615139	2.125000	54.31000	-27.82000	15.35998
Household's Current Financial Position	72	1.933333	1.470000	17.94000	-10.85000	5.684822

Table 2 presents the basic descriptive statistics for the five variables used in the analysis; these include the number of observations, mean, median, maximum, minimum, and standard deviation. Each series, derived from time-series data, consists of 72 observations. For the variable treated as the dependent variable—Prices in Entertainment, Leisure, Sports, and Culture—the mean is 37.90% and the median is 39.21%, while the maximum and minimum values are 73.34% and 4.12%, respectively.

Table 3 presents the ADF unit root test results at both the level and first-difference stages. Automatic lag selection and the Schwarz Information Criterion were employed in the testing process. The results indicate that the variables "Prices in Entertainment, Leisure, Sports, and Culture" and "Household Financial Situation" contain a unit root at the level—meaning they are non-stationary—but become stationary when their first differences are taken. Conversely, the other three independent variables—"Likelihood of Purchasing or Building a House", "Suitability of the Current Period for Purchasing Durable Goods," and "Household's Current Financial Position" were found to be stationary at the level. These findings reveal a mixed stationarity structure; the fact that some variables are I(0) while others are I(1) constitutes the primary rationale for selecting the ARDL model. The ARDL bounds test yields reliable results and is appropriate for such mixed structures.

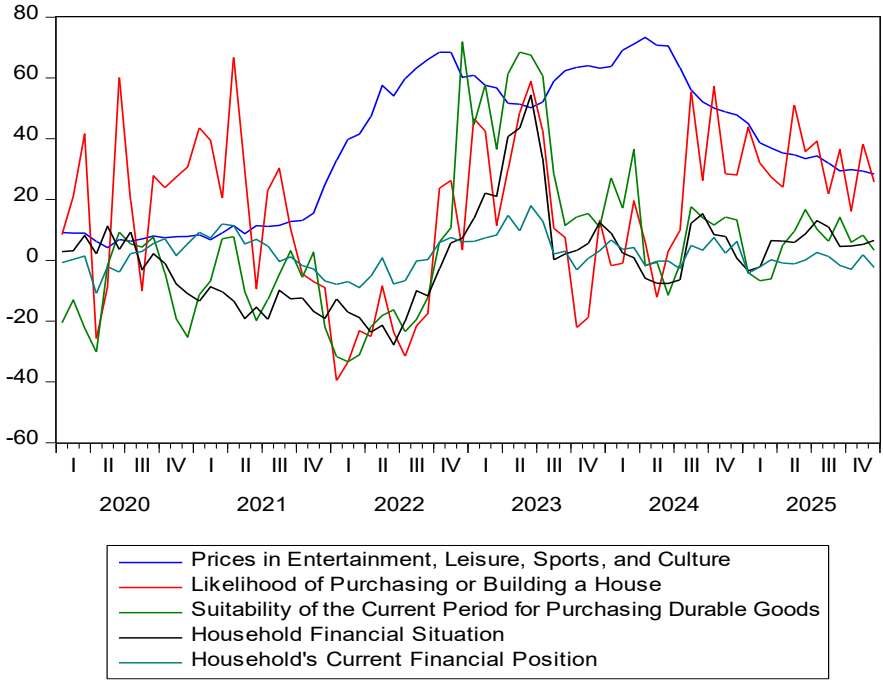
Table 3. Unit Root Tests

Test Results	**Level**			**First Difference**		
Variables	**t-statistic**	**p-value**	**Unit Root**	**t-statistic**	**p-value**	**Unit Root**
Prices in Entertainment, Leisure, Sports, and Culture	-1.597403	0.4785	Yes	-5.166900	0.0000***	NO
Likelihood of Purchasing or Building a House	-4.416943	0.0006***	NO	-4.962637	0.0001***	NO
Suitability of the Current Period for Purchasing Durable Goods	-2.677242	0.0830*	NO	-5.803272	0.0000***	NO
Household Financial Situation (compared to 12 months prior)	-2.113094	0.2403	Yes	-7.598582	0.0000***	NO
Household's Current Financial Position	-3.470873	0.0117**	NO	-11.55995	0.0001***	NO

Augmented Dickey-Fuller test
Schwarz Information Criterion, Constant Term, Maximum Lag: 11, Automatic Lag

The percentage changes of the variables included in the analysis over the research period are illustrated in Graph 1. An examination of the graph reveals that recreation prices and independent variables show similar and different movements over time. Therefore, it can be argued that revealing the cointegration relationship between short-term shocks and long-term equilibrium in the modeling would be beneficial.

Graph 1. Changes in Analysis Variables



3. Findings

The analysis in this study will present findings regarding short-run lag relationships using the ARDL model, as well as long-run form, bounds test and ECM results. Basic diagnostic tests for heteroskedasticity and autocorrelation will be included to assess the reliability of the research findings. CUSUM tests will also be provided in order to explain the stability of the results regarding structural break conditions.

The findings indicate that "Prices in Entertainment, Leisure, Sports, and Culture" are positively and significantly affected by their own lagged values. The factor representing the "Likelihood of Purchasing or Building a House" affects the dependent variable negatively and significantly through both its current and lagged values. The factor regarding the "Suitability of the Current Period for Purchasing

Durable Goods" was also found to be significant; while this variable exerts a negative effect, its lagged value produces a positive effect. The "Household Financial Situation" factor was observed to have a negative and significant impact on the dependent variable, whereas its lagged value was found to have a positive effect, albeit at a lower level of significance. Finally, the effect of the "Household's Current Financial Position" variable was determined to be positive and significant, though its lagged value was found not to exert a significant effect.

Table 4 presents the short-run coefficient estimation results for the investigated ARDL model in which "Prices in Entertainment, Leisure, Sports, and Culture" serves as the dependent variable of the analysis. Automatic lag selection was performed during the analysis; when models with a maximum lag of 1 were tested, the model incorporating a one-period lag for all variables was identified as the most suitable according to the Akaike Information Criterion. A total of 16 models were tested.

Table 4. **Short-Term Form Results**

Test Results Independent Variables	**Factor Coefficient**	**t-statistic**	**p-value**	**Factor (-1) Coefficient**	**t-statistic**	**p-value**
Prices in Entertainment, Leisure, Sports, and Culture	-	-	-	0.951718	55.43019	0.0000***
Likelihood of Purchasing or Building a House	-0.036146	-2.160227	0.0347**	-0.067544	-3.967084	0.0002***
Suitability of the Current Period for Purchasing Durable Goods	-0.075604	-2.577186	0.0124**	0.128264	4.735874	0.0000***
Household Financial Situation (compared to 12 months prior)	-0.142172	-2.619525	0.0111**	0.087773	1.672395	0.0996*
Household's Current Financial Position	0.222426	2.337088	0.0227**	-0.157943	-1.490428	0.1413
C	3.438144	4.156462	0.0001	-	-	-
R-Square: 0.989531		Adjusted R- Square: 0.987987		F-Statistics: 640.6515 p-value: 0.000000***		

Dependent Variable: Prices in Entertainment, Leisure, Sports, and Culture
ARDL Automatic Lag Selection, Maximum Lag:1, Akaike Information Criterion
Number of Models Tested: 16, Selected Model: ARDL (1, 1, 1, 1, 1)
Sample: 2020-2025, Constant Term: C

Table 5 presents the long-run coefficient estimates based on the ARDL model. Among the long-run coefficient estimates for the independent variables, the factor found to be highly statistically significant was the "Likelihood of Purchasing or Building a House", which exhibited a negative effect. Although the "Suitability of the Current Period for Purchasing Durable Goods" was another significant factor, its positive coefficient showed a lower level of significance. The other factors examined were not found to be individually significant in the long run.

Table 5. Long-Term Form Results

Independent Variables	Coefficient	t-statistic	p-value	Independent Variables	Coefficient	t-statistic	p-value
Likelihood of Purchasing or Building a House	-2.147568	-2.971491	0.0042***	Household Financial Situation (compared to 12 months prior)	-1.126694	-1.275236	0.2071
Suitability of the Current Period for Purchasing Durable Goods	1.090671	1.870717	0.0662*	Household's Current Financial Position	1.335558	0.631516	0.5301
C	71.20953	5.354882	0.0000***				

Dependent Variable: Prices in Entertainment, Leisure, Sports, and Culture
Sample: 2020-2025, Constant Term: C, Selected Model: ARDL (1, 1, 1, 1, 1)

Table 6 demonstrates the F-bounds test results in the existence of a long-run cointegration relationship among the variables included in the model. These results also highlight the importance of considering long-term coefficients. The presence of a significant long-term relationship indicates that the analysis results from the ARDL ECM form should also be examined.

Table 6. Bounds Test

Significance	Lower Bound	Upper Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

F-Bounds test statistic: 7.754501
Null Hypothesis (H0) = No cointegration.
Decision: Reject Null Hypothesis
(Long-run relationship – cointegration exists)

Table 7. ARDL ECM Form

Independent Variables	Coefficient	t-statistic	p-value	Independent Variables	Coefficient	t-statistic	p-value
Likelihood of Purchasing or Building a House	-0.036146	-2.470297	0.0163***	Household Financial Situation (compared to 12 months prior)	-0.142172	-3.071698	0.0032***
Suitability of the Current Period for Purchasing Durable Goods	-0.075604	-3.375814	0.0013***	Household's Current Financial Position	0.222426	2.671958	0.0097***
CointEq(-1)*	-0.048282	-7.095118	0.0000***				

ARDL ECM Regression
Dependent Variable: Prices in Entertainment, Leisure, Sports, and Culture
Sample: 2020-2025, Restricted Constant and No Trend, Selected Model: ARDL (1, 1, 1, 1, 1)

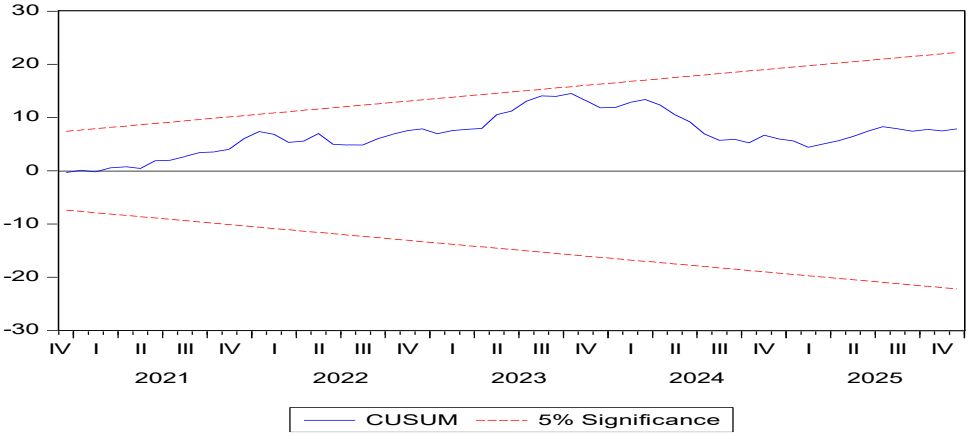
Table 7 presents the results of the ARDL ECM model, including the error correction coefficient. The negative and significant correction coefficient confirms the ARDL ECM model. According to the model, shocks experienced in the long term are balanced. Examining the coefficients and significance of the independent variables reveals highly significant effects. The results support previous findings regarding the independent variables.

Table 8. Basic Diagnostic Tests

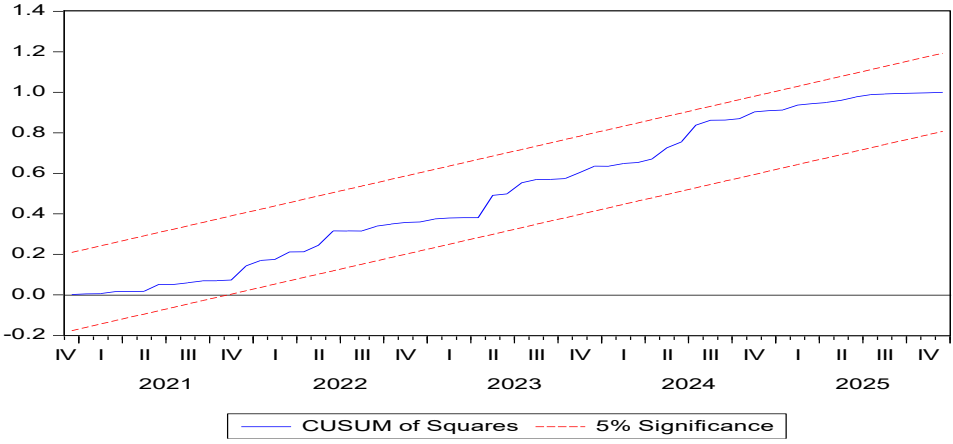
Basic Diagnostic Tests		
Heteroskedasticity Test: Breusch-Pagan-Godfrey	F-Statistic	p-value (F)
	1.230432	0.2937
	Obs*R-square	p-value (Chi-square)
	10.90889	0.2820
Breusch-Godfrey Serial Correlation LM Test	F-Statistic	p-value (F)
	1.109892	0.3364
	Obs*R-square	p-value (Chi-square)
	2.574407	0.2760

Table 8 presents the results of two key diagnostic tests used to assess the reliability of the research model. The Breusch-Pagan-Godfrey Heteroskedasticity Test examines the issue of heteroskedasticity; the results indicate that there is no heteroskedasticity problem. The Breusch-Godfrey Serial Correlation LM Test aims to check for autocorrelation within the model; no autocorrelation issue was detected. The findings demonstrate that the estimated ARDL model satisfies the fundamental econometric assumptions and that the resulting coefficients are reliable.

Graph 2. CUSUM Test



Graph 3. CUSUM of Squares Test



The CUSUM tests, which are important for the reliability of the results obtained from the model, are shown in Graphs 2 and 3. Examination of the graphs reveals that both the CUSUM and CUSUM of Squares tests stay within the confidence interval. This can be interpreted as indicating that stability has been achieved. It shows that the effect of structural breaks is absent in the model and that stable results have been obtained.

4. Conclusion

The Turkish economy has faced a chronic inflation problem in recent years; persistent increases in the prices of goods and services have highlighted the need to identify the determinants of this instability. In a high-inflation environment, the erosion of real purchasing power compels households to restructure their consumption baskets and revise their spending priorities. In this context, the question of whether transformations in households' financial conditions and their preferences regarding consumption expenditures significantly impact price levels requires empirical investigation. The issue of whether changes in households' financial situations and their choices regarding budget allocations influence the prices of goods and services is a subject of debate. High inflation diminishes real purchasing power, forcing households to redefine their spending priorities; consequently, when households shift their priorities—thereby reallocating budget resources from one group of goods and services to another—this shift is expected to be reflected in prices. This study focuses on the prices of entertainment, recreation, sports, and culture in Türkiye. Existing literature contains few studies addressing price dynamics in this sector; thus, this research is significant for understanding the sector's price dynamics, demand structure, and consumer

behaviors. Furthermore, studies examining the impact of consumer confidence indices on this specific sector remain extremely limited. This research aims to fill this gap by analyzing the impact of consumer trends on the prices of entertainment, recreation, sports, and culture in Türkiye within the framework of an ARDL model.

The most prominent finding of the study is that the "Likelihood of Purchasing or Building a House" variable exerts a statistically significant negative effect on the prices of Entertainment, Leisure, Sports, and Culture. This relationship was found to be consistently significant regarding both level and lagged values. Long-term model estimates confirmed a significant relationship in the same direction. Viewed within the framework of the demand-price relationship, this finding can be interpreted as follows: It can be argued that during periods when households lose the expectation of making housing investments, budget resources freed up from this item are redirected toward spending on Entertainment, Leisure, Sports, and Culture, and the resulting increase in demand is ultimately reflected in price levels. Indeed, Ali (1985) demonstrated that when major expenditure items—which account for a significant share of the household budget—are present, cutbacks are made in discretionary consumption areas such as recreation and education.

The variable representing the "Suitability of the Current Period for Purchasing Durable Goods" also exerts a negative short-term effect on the dependent variable; however, the relationship was found to turn positive when considering lagged values and a long-term perspective. This finding suggests that the pressure exerted by durable consumer goods purchases on household budgets is relatively limited compared to housing investments, and that, consequently, their role in determining spending on recreation, leisure, sports, and culture is less significant.

Løyland and Ringstad (2009) discussed a phenomenon known in the literature as the Linder Effect. According to the Linder Effect, individuals with high incomes may allocate less time to recreational activities. In this regard, the indicator examined in the study was "Household Financial Situation" which mainly explains household income compared to the previous year. The analysis revealed that the "Household Financial Situation" variable had a negative effect which supports the Linder effect. This finding can also be interpreted in two ways. The decline in a household's financial status triggers a surge in demand significant enough to influence prices in the entertainment, leisure, sports, and culture sectors. Substantial budget allocations—typically reserved for major expenditures like durable goods and housing—are redirected toward entertainment, leisure, sports, and culture. Conversely, the "Household's Current Financial Position" variable showed a positive relationship. Interpreting this

finding, it can be said that when financial status is considered—accounting for the household's past and future standing as well as borrowing potential—an income-elastic demand structure emerges, consistent with fundamental economic theories. In other words, improvements in financial status can be expected to drive spending toward entertainment, leisure, sports, and culture, thereby raising prices. It contradicts the literature suggesting that recreation spending depends primarily on leisure time and exhibits income-inelastic demand; instead, it supports the role of the classical economic income elasticity.

In conclusion, the findings of this study empirically demonstrate the relationship between prices in the entertainment, leisure, sports, and culture sectors and consumer sentiment indicators, thereby contributing to the literature on price dynamics specific to this sector. While existing studies largely base their assessments on expenditure levels, the use of price indices as the dependent variable constitutes the methodological originality of this research. Furthermore, the use of consumer sentiment indicators as independent variables represents another unique aspect of the study. It is anticipated that the results obtained could make significant contributions to public and private sector decision-making regarding sectoral demand management, particularly concerning price stability policies. Future research is encouraged to analyze the relationship between demand and prices using more comprehensive quantitative methods and to expand the set of independent variables to include both consumer sentiment indices and other macroeconomic factors.

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Chapter 2

Understanding Problematic Digital Use Through A Family Lens: Parenting, Attachment, And Prevention

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Abstract

Behavioral addictions have become an increasingly important issue in mental health and public health as digital technologies have assumed a greater role in the daily lives of children and adolescents. Problematic use of the internet, digital games, social media, and smartphones cannot be explained solely by individual characteristics; family systems, the quality of parent–child relationships, attachment patterns, parenting styles, and digital media use habits within the family are also important in terms of risk and protective factors. This review aims to examine parental attitudes and family dynamics associated with behavioral addictions among children and adolescents and to evaluate protective parenting approaches. Within this scope, family climate and parenting styles, attachment and emotional neglect, psychological control, parental modeling, and digital parenting practices are addressed. The literature indicates that supportive, warm, consistent, and communication-based parenting may be protective against problematic digital use, whereas rejecting, punitive, overly controlling, neglectful, and inconsistent parental attitudes may be associated with increased risk. However, the relationship between parenting and problematic digital behaviors is not unidirectional; problematic use among children and adolescents may also trigger more reactive and restrictive attitudes among parents. Consequently, focusing solely on limiting screen time is insufficient for preventing behavioral addictions. Strengthening the parent–child relationship, fostering open communication, developing emotion regulation skills, establishing consistent boundaries, promoting healthy parental modeling, and developing balanced digital media use habits within the family should be considered fundamental components of a comprehensive protective approach.

Keywords: behavioral addiction, parental attitudes, problematic internet use, gaming disorder, digital parenting

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1. Introduction

Although the concept of addiction has long been addressed predominantly in relation to alcohol, tobacco, and psychoactive substances, it is recognized that certain behaviors may also exhibit addiction-like characteristics, such as loss of control, the behavior taking precedence over other areas of life, and its continuation despite negative consequences. Gambling and gaming behaviors, in particular, are central to this discussion, while problematic use of the internet, social media, and smartphones constitutes an important part of the expanding research literature.

An important terminological limitation should be emphasized here. Not all intensive digital use constitutes an "addiction," and internet, smartphone, or social media use is not universally recognized as an independent addiction diagnosis in existing classification systems. Therefore, particularly in studies involving children and adolescents, it is more cautious to use terms such as "problematic internet use," "problematic social media use," or "problematic smartphone use." Recent systematic reviews also show that problematic behaviors associated with the internet, gaming, social media, smartphones, and gambling among adolescents should be understood through the interaction of biological, psychological, social, and familial variables (Simón Márquez et al., 2025).

Adolescence is of particular importance in this regard. During this period, when the pursuit of autonomy intensifies, peer relationships gain importance, identity development accelerates, and self-regulation capacities continue to develop, digital environments may serve many functions, such as socialization, entertainment, obtaining information, experiencing achievement, and distancing oneself from negative emotions. Therefore, it is insufficient to evaluate problematic digital behaviors solely on the basis of the device used or the time spent using it. Indeed, scoping reviews examining factors associated with internet and gaming addiction show that family and parental factors should be evaluated alongside numerous variables, including individual psychopathology, personality, school, peer relationships, stress, and access to technology (Juthamanee & Gunawan, 2021).

At this point, the family is not merely an external monitoring mechanism in understanding behavioral addictions. The family is also the child's first relational context, the environment in which emotion regulation is learned, the system in which the repertoire of coping with stress develops, and the social environment in which the first norms regarding technology use are acquired. Therefore, the central question is not simply, "How much does the parent restrict the child's screen use?" The more comprehensive question is: From what family climate, with which emotional needs, and with which self-regulation skills does the child turn to the digital world?

This review aims to examine the possible role of parental attitudes in the development and maintenance of behavioral addictions along four main dimensions:

(1) family climate and parenting styles, (2) attachment, emotional neglect, and control, (3) parenting in the digital age, and (4) protective family approaches based on healthy boundaries, communication, and psychoeducation.

2. Family Climate and Parenting Styles in the Development of Behavioral Addictions

The development of behavioral addictions is related not only to individual and psychological characteristics but also to the family environment in which the individual lives and to parenting practices. The quality of relationships within the family, parents' attitudes toward their children, the level of emotional support, and patterns of family communication may influence the risk of children and adolescents developing problematic behaviors. In this context, family climate and parenting styles are regarded as important environmental factors that may play a role in the emergence and maintenance of behavioral addictions (Sugaya et al., 2019).

2.1. Why Is Family Climate Important?

The behaviors of children and adolescents are not independent of the relational system in which they live. Levels of warmth, conflict, trust, communication, consistency, and support within the family may shape both a child's interpersonal relationships and their repertoire of coping with stress.

A systematic review examining biopsychosocial research on children and adolescents with internet gaming disorder demonstrated that the quality of the parent–child relationship is one of the important social factors (Sugaya et al., 2019). In a more recent study, familial variables were categorized as parental mediation, positive parenting, negative parenting, family dysfunction, and socioeconomic factors. Positive parenting and parents' knowledge of their children's lives were reported to be protective factors, whereas poor parenting and family dysfunction were identified as risk factors (Petrescu et al., 2025). These findings show that the relationship between the family environment and behavioral addiction is more complex than a simple dichotomy of the "presence or absence of parental control."

2.2. Parenting Styles

The parenting literature commonly describes authoritative/democratic, authoritarian, permissive, and neglectful parenting patterns. The main characteristics distinguishing these styles are parental warmth, responsiveness, expectations, and the level of behavioral control.

Meta-analytic findings regarding problematic internet use are noteworthy. In a three-level meta-analysis involving a total of 40,587 participants, Niu et al. (2023) found that positive parenting styles were negatively associated with

problematic internet use, whereas negative parenting styles were positively associated with it. Moreover, the association between problematic internet use and negative parenting was reported to be stronger than the association with positive parenting. Similarly, one study found that authoritarian parenting was a significant predictor of problematic internet use, whereas problematic internet use was lower among adolescents who perceived their parents as authoritative (Yaffe & Seroussi, 2019). The important point here is that setting boundaries is not itself risky. The principal distinction lies in the balance between boundaries and relationships. In authoritative parenting, boundaries can be explained, are predictable, and are implemented within a warm relationship; in authoritarian patterns, obedience-based, punitive, and one-sided control may be more pronounced. Therefore, "increasing control" alone is not a sufficient goal for preventing behavioral addictions. The aim should be to establish consistent behavioral boundaries that preserve the relationship.

2.3. Family Conflict and Emotion Regulation

One of the important mechanisms that may explain the effects of family conflict on digital behaviors is emotion regulation. In a study conducted with adolescents, Qi (2019) reported that the relationship between interparental conflict and problematic internet use could be explained by adolescents' emotional dysregulation. For some young people, the digital environment may be more than a space for entertainment; it may also become a tool for emotion regulation that provides relief from family tension, loneliness, failure, or negative emotions. In this situation, removing the device does not eliminate the function underlying the behavior. If a child uses the screen to find relief, escape, or feel a sense of belonging, the intervention must answer the question of "what we will replace the screen with" as much as that of "reducing screen use."

3. Attachment, Emotional Neglect, and Control

Attachment patterns, emotional neglect, and parental control play an important role in understanding the connection between family relationships and behavioral addictions. Emotional closeness, attention, and support experienced during childhood, together with parents' forms of control, may be associated with how individuals meet their emotional needs and cope with stress. Within this framework, it is important to consider together the relationships of attachment, emotional neglect, and parental control with behavioral addictions.

3.1. Attachment and Behavioral Addictions

From the perspective of attachment theory, early relationships with caregivers play a fundamental role in the development of children's mental representations of themselves and others. Secure relationships may support the capacity to seek help in stressful situations and regulate emotions within interpersonal relationships. A study conducted in the context of online addictions reported that secure attachment was negatively associated with internet, social media, and online gaming addiction, whereas insecure attachment patterns were positively associated with these problematic behaviors (Salehi et al., 2022). Similarly, a study examining loneliness and problematic internet use found that detachment from parents mediated the relationship between parent-related loneliness and problematic internet use (Musetti et al., 2020). These findings are consistent with the hypothesis that digital environments may compensate for needs that remain unmet in interpersonal relationships for some young people. However, existing correlational studies do not, on their own, demonstrate causality. While insecure relationships may increase problematic use, increasingly intensive problematic use may also damage family relationships.

3.2. Emotional Neglect and Rejection

Emotional neglect, the failure to meet a child's physical needs, and the persistent failure to recognize, understand, or validate a child's feelings or to respond adequately to their emotional needs are also important for relational development. Studies examining parenting styles and problematic internet use have particularly highlighted rejection and low emotional warmth. In a study conducted with a large sample of adolescents, Ying et al. (2024) showed that emotion regulation strategies played a role in the relationship between maternal and paternal parenting behaviors and problematic internet use. Expressive suppression was found to be a significant mechanism in the relationship between maternal rejection and problematic internet use, while cognitive reappraisal was a significant mechanism in the relationship between maternal and paternal emotional warmth and problematic use.

3.3. Overcontrol and Psychological Control

Treating parental control as a single construct may be misleading. Age-appropriate, consistent behavioral control that ensures a child's safety should be distinguished from psychological control that suppresses the child's thoughts, feelings, and autonomy. Research on harsh parenting supports the importance of this distinction. Kong et al. (2024) reported that harsh parenting was associated with problematic internet use and that basic psychological need satisfaction and

self-concept clarity played mediating roles in this relationship. When adolescents' needs for autonomy, competence, and belonging are persistently frustrated in the family environment, digital environments may become alternative spaces that provide a sense of control, achievement, social acceptance, or escape. Therefore, the aim of protective parenting is not unlimited freedom. The healthy approach should be to “provide structure” rather than “control” and to “develop self-regulation” rather than “demand obedience.”

4. Parenting in the Digital Age

Parenting in the digital age is not a phenomenon entirely separate from traditional parenting. A parent who cannot establish a warm, consistent, and supportive relationship with a child in the offline world cannot be expected to promote healthy digital behavior merely by using advanced technical filters. Strategies such as active mediation, restrictive mediation, co-use, and monitoring are discussed in the digital parenting literature.

4.1. Active Mediation

Active mediation does not mean that parents merely set rules; it involves discussing online experiences, risks, content, and reasons for use with the child. Liu et al. (2023) found that active parental mediation was associated with lower problematic internet use, while the quality of the parent–child relationship and the adolescent's concealment of online behaviors from their parents were among the mechanisms explaining this association.

4.2. The Effect of Restriction

When parents notice problematic use, they often tend to reduce the duration of use, take away the device, or prohibit applications. However, research findings show that the effects of restrictive mediation are not the same in every situation. In their systematic review, Nielsen et al. (2019) reported that active mediation had the potential to reduce problematic internet use, whereas findings concerning restrictive mediation ranged from positive to negative. Family cohesion was found to be associated with lower problematic use, while family conflict was associated with higher problematic use. Research on social media also suggests a need to distinguish between “a clear rule established in advance” and “a reactive restriction imposed in anger when a problem arises.” Positive parenting and explicit rules regarding internet use appear to be protective, while reactive restrictions may occur alongside problematic social media use (Geurts et al., 2022).

4.3. Inconsistent Digital Parenting

In a study evaluating 1,095 parent–adolescent pairs, Kammerl and Wartberg (2018) reported significant associations between inconsistent media-related parenting and problematic internet use. When parents apply rules regarding digital media use inconsistently at different times, it may become more difficult for children and adolescents to understand and comply with boundaries. For example, allowing three hours of gaming on one day without any response but severely punishing the same behavior the following day may reduce the predictability of rules. In this context, predictability, consistency, and explainability come to the forefront in healthy boundary-setting. Predictability means that the child knows which behaviors are acceptable; consistency means that established rules are applied in the same way in similar situations; and explainability means that the reasons for rules are communicated in a manner appropriate to the child's developmental level. Therefore, establishing clear, understandable, and consistent boundaries for digital media use may be important for supporting self-control skills among children and adolescents and reducing the risk of problematic digital use.

4.4. Parents as Digital Role Models

Although digital parenting concerns what the child does, parents' own behaviors also shape norms regarding technology use within the family. In a study involving more than 4,500 parent–adolescent pairs, Milkovich et al. (2024) reported a strong association between parents' problematic internet use and adolescents' problematic internet use. Furthermore, the quality of parent–child communication about the internet was found to be lower among adolescents experiencing problematic use. Therefore, in parental psychoeducation, instead of saying only, “Reduce your child's phone time,” it may be more useful to say, “Evaluate your family's relationship with technology together.”

5. The Relationship Between Parenting and Behavioral Addiction

One of the most important methodological issues in this field is causality. The prospective study by Koning et al. (2018) showed that bidirectional relationships may exist between internet-specific parenting practices and gaming and social media problems. A more recent three-wave longitudinal study also reported that an increase in problematic social media use was associated with a subsequent decrease in parental rule-setting and an increase in reactive restrictions; by contrast, changes in parental restrictions did not significantly predict subsequent problematic social media use (Geurts et al., 2024). A similar reciprocity may apply to emotional communication within the family. One study reported

reciprocal relationships between not sharing negative emotions with parents and problematic digital behaviors (Su et al., 2025). Therefore, language that blames families is both scientifically inadequate and clinically unhelpful.

6. Protective Family Approaches: Healthy Boundaries, Communication, and Psychoeducation

In preventing behavioral addictions, protective parenting should not mean "keeping the child completely away from the digital world." Today, digital technologies are part of education, socialization, entertainment, and identity development. Therefore, the realistic goal is not to eliminate digital life but to develop self-regulated and functional use.

6.1. Boundaries That Preserve Relationships

In establishing boundaries for digital media use among children and adolescents, not only the restriction of use time but also the ways in which these boundaries are established and implemented are important. Effective boundaries should be based on rules that are appropriate to the child's age and developmental stage, discussed in advance, accompanied by explanations of their rationale, and applied as consistently as possible by parents. Moreover, it is important that boundary-setting not be based solely on punishment, that the child's views be taken into account, and that rules be reassessed in accordance with changing developmental needs. Research findings indicating that active parental mediation may be more effective in a supportive parenting environment also support this approach (Ren & Zhu, 2022). From this perspective, boundaries concerning digital media use should be considered not as a monitoring mechanism independent of the parent–child relationship but within a framework of trust, communication, and mutual understanding.

6.2. Shifting from Screen Time to Functioning

One of the questions parents ask most frequently regarding the digital media use of children and adolescents concerns how much daily screen time is appropriate. However, focusing only on the time spent in front of screens is insufficient when evaluating problematic digital use. The extent to which use affects the child's daily life, responsibilities, and interpersonal relationships should also be considered. In this context, the child's ability to stop using digital media when necessary, maintain sleep patterns, fulfill academic responsibilities, and preserve relationships with family members and friends are important areas of assessment. In addition, withdrawal from previously enjoyed activities, continued digital media use despite negative consequences, and using digital

environments as a primary means of emotional escape or emotion regulation are indicators that warrant attention in relation to problematic use. The clinical literature on problematic interactive media use also emphasizes the importance of assessing academic difficulties, social withdrawal, family conflicts, and co-occurring mental health problems (Pluhar et al., 2019). Therefore, when evaluating digital media use, the primary criterion should be not only the duration of use but also the degree of control over use and the extent to which functioning in the individual's daily life is affected.

6.3. Developing Emotion Regulation Skills

Emotion regulation skills play an important role in enabling children and adolescents to cope with negative emotional experiences and appropriately guide their behavior. Difficulties in emotion regulation have been shown to be an important variable in problematic social media and online gaming use. A study conducted with adolescents reported that low emotion regulation capacity was associated with the severity of both social media addiction and internet gaming disorder symptoms (Giordano et al., 2022).

Within this scope, skills such as recognizing and appropriately expressing emotions, developing tolerance for distressing emotions, problem-solving, impulse control, and creating alternative activities that can provide satisfaction outside digital environments should be supported. Particularly when digital media use is preferred as a means of distancing oneself from stress, loneliness, or negative emotions, it is important to help children and adolescents develop different coping strategies. Thus, preventive approaches should aim not only to reduce the problematic behavior but also to understand the emotional needs that may be associated with this behavior and develop more functional coping skills.

6.4. Parental Psychoeducation

In preventing behavioral addictions, parental psychoeducation aims to increase families' awareness of digital media use and support them in evaluating their children's digital behaviors in a healthier manner. In this process, merely informing parents about the potential harms of excessive screen use is insufficient. The circumstances under which digital media use may become problematic, its effects on daily life, and how parents can adopt a supportive role in this process should also be addressed.

Within the scope of psychoeducation, it should first be emphasized that not all intensive digital media use constitutes addiction and that the purpose, function, and consequences of use are as important as its duration. It is important for parents to approach their children's digital world not only for monitoring purposes

but also with interest and curiosity, in order to develop open communication. Furthermore, rather than establishing rules concerning digital media use during crises or conflicts, it may be recommended that such rules be discussed in advance and developed with the child's developmental characteristics in mind. Parents' review of their own digital media habits and their provision of a consistent model for their children are also important components of the psychoeducation process.

Protecting areas of daily life such as sleep, physical activity, face-to-face social relationships, and academic responsibilities should also be among the main objectives in regulating digital media use. Adopting approaches based on collaborative problem-solving between parent and child, rather than sudden and punitive prohibitions, may help make rules more understandable and practicable. Clinical discussions of problematic smartphone use also highlight practical strategies such as establishing cooperation between parents and adolescents, reducing notifications, and creating device-free periods agreed upon by family members (Kalk et al., 2024).

Nevertheless, parents should be informed about the importance of seeking professional assessment in situations where digital media use causes significant impairment in the child's academic, social, or family functioning, control over use becomes difficult, and the behavior continues despite negative consequences.

7. Conclusion

The development of behavioral addictions among children and adolescents is a multidimensional process that cannot be explained solely by individual characteristics, screen time, or access to digital technologies. The studies discussed in this chapter show that family climate, the quality of the parent–child relationship, attachment patterns, emotional support, and parenting practices are associated with problematic digital behaviors. The literature generally reports that warm, supportive, and consistent parenting attitudes are associated with lower levels of problematic use, whereas rejecting, excessively controlling, inconsistent, and conflictual family relationships are associated with higher levels of problematic use (Schneider et al., 2017; Vossen et al., 2024). Nevertheless, these relationships should not be interpreted as unidirectional or within a framework of definitive causality; individual, developmental, and environmental factors should be considered together.

The relationship between family climate, parenting attitudes, and problematic digital use can be explained particularly through relational processes, emotion regulation skills, and parents' modeling of digital behaviors. While secure and supportive family relationships may make it easier for children and adolescents

to meet their emotional needs and cope with difficulties, family conflict and a lack of emotional support may create conditions in which digital environments are used for relief or escape. In addition, parents' own technology use habits and approaches to digital media use have also been found to be associated with children's behaviors (Philippi et al., 2024). Therefore, when evaluating problematic digital use, it is important to focus not only on the child's behaviors but also on the family environment and relational processes in which these behaviors emerge.

The primary goal in preventing behavioral addictions should be to strengthen the quality of parenting practices rather than increase parental supervision. Accordingly, healthy digital parenting requires a comprehensive approach that includes open communication, emotional support, developmentally appropriate boundaries, consistent rules, and support for the child's self-regulation skills. It is also important to evaluate digital media use not only in terms of its duration but also together with its purpose, the level of control over the behavior, and its effects on daily functioning. Parents' interest in their children's digital world, their efforts to establish rules together whenever possible, and their reflection on their own digital habits may be considered important components of preventive approaches (Nielsen et al., 2019; Morawska et al., 2025).

In conclusion, the prevention of problematic digital use among children and adolescents should be addressed not only by restricting access to technological devices but also by supporting healthy family relationships and developmental skills. In this process, parents' fundamental responsibility is not to prohibit digital technologies altogether but to guide their children, recognize their emotional needs, and help them develop healthy use habits. Therefore, the main focus in preventing behavioral addictions should go beyond controlling the amount of time the child spends in front of a screen and should instead be on creating a supportive family environment in which children can regulate their emotions, establish secure relationships, and develop a sense of autonomy and competence.

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Chapter 3

The Sibling Subsystem and Changing Care Dynamics in the Context of Disability: An Evaluation from a Social Work Perspective

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ABSTRACT

The sibling bond represents one of the most fundamental, enduring systemic connections in an individual's life course. The presence of disability within the family system profoundly reshapes traditional sibling dynamics and structural equilibriums. Literature indicates that growing up alongside a sibling with a disability fosters early maturity, deep empathy, compassion, and an innate sense of responsibility. However, behind this developmental maturity often lies an unspoken toll: parentification, role overload, emotional alienation within the family, courtesy stigma, and chronic anxiety regarding future caregiving demands. This study investigates the internal experiences of individuals with siblings with disabilities, analyzing the asymmetric transformation of sibling roles and the cumulative burden of caregiving. Furthermore, it examines social work interventions across micro, mezzo, and macro levels, contrasting international sibling-oriented programs in the United States, the United Kingdom, Australia, and Canada with the existing policy landscape in Türkiye. The evaluation indicates that social welfare policies in Türkiye primarily center on the individual with a disability and the mother, leaving siblings as invisible and unacknowledged backup caregivers. The chapter concludes with concrete social work policy and practice recommendations recognizing siblings as independent service recipients and rights-holders.

Keywords: Disability, Sibling Relationships, Parentification, Caregiver Burden, Social Work Interventions.

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1. INTRODUCTION

The sibling relationship is one of the most enduring and transformative bonds a human being can establish in their life. Unlike the vertical relationship between parent and child, it is not hierarchical; it is fundamentally based on equality, a shared history of childhood, and natural rivalry. From infancy onward, siblings are a powerful source of social interaction that accelerates observational learning through imitation and enriches the world of play (Barr & Hayne, 2003; Berk, 2013). These early reciprocal exchanges facilitate the child's connection with the external world and emotional regulation. During adolescence, this bond is reshaped according to internal and external familial conditions; siblings at times become confidants to one another, and at other times serve as a protective emotional haven against storms in the outside world (Tucker et al., 2001).

However, this natural flow shifts completely with the arrival of a child with a disability into the family. As emphasized by Family Systems Theory, the family is an interconnected structure; the slightest tremor in one link reverberates throughout the entire system (Seligman & Darling, 2007; as cited in Sanıyaman, 2023). Disability is a major turning point that affects not only the parents but also the entire life of the typically developing sibling from top to bottom.

Research in the literature (Dyson, 2010; Nalevska et al., 2022; Schuntermann, 2007; Seligman, 1987; Singh, 2014) reveals that this situation exerts both challenging impacts on siblings and endows them with valuable qualities such as precocious maturity, compassion, and responsibility at an early age. However, the extent of these effects varies depending on the type of disability and the socioeconomic resources of the family. While it sometimes intensifies contact between siblings, it may at other times weaken the warmth of the relationship and introduce emotional distance (Doody et al., 2010). Having a sibling with a disability is a multidimensional life experience where love and sorrow, intimacy and helplessness intertwine.

In this study, the changing structure of the sibling subsystem and caregiving relationships within the context of disability are addressed from a social work perspective. First, the position of sibling relationships within the family system is evaluated; subsequently, parentification, caregiving responsibilities, caregiver burden, and the psychosocial gains brought about by the sibling experience are discussed. Based on these evaluations, a three-dimensional social work intervention model that considers siblings' needs and strengths is highlighted. Finally, international best practice examples and legal regulations in Türkiye are critically examined to evaluate the status of siblings of individuals with disabilities in caregiving processes, opportunities for support, and the requirements for developing social work practices.

2. TRANSFORMATION OF ROLES AND PARENTIFICATION

A natural balance based on mutual sharing exists among typically developing siblings. However, when there is a child with a disability in the family, this equality dissipates; over time, the sibling bond evolves into a 'caregiver and care-recipient' relationship. Apalaça's (1996) study conducted with children who have siblings on the autism spectrum demonstrates this asymmetry in a very concrete manner. In that study, children with siblings with disabilities perceived their relationships as less warm, conflict rates did not differ, yet their 'Relative Status and Power' scores were found to be remarkably high. This situation serves as clear evidence that the horizontal equilibrium of the sibling relationship is lost and that it acquires a hierarchical structure. In Zoylan's (2005) study, ordinary sibling rivalry and conflict were found to decrease among individuals with siblings with disabilities. This occurs because competing against a sibling with special needs loses its legitimacy in the eyes of the typically developing child, rapidly giving way to an early-emerging protective instinct.

Precisely at this juncture, the role conflict and role ambiguity explained by role theory emerge (Aykara, 2015). Despite their childhood age, the typically developing sibling is compelled to undertake adult roles such as chaperone, advocate, interpreter, and caregiver (Aykara, 2015; Levante et al., 2025; Sanıyaman, 2023).

In social work literature, this condition is conceptualized as 'parentification.' Especially when older sisters and female siblings are concerned, domestic chores and caregiving burdens are placed directly on the shoulders of these children under the influence of societal expectations (Apalaça, 1996; Aykara, 2015). Forced to shape their own childhood, education, or future aspirations around the care of their sibling, the individual finds themselves in the midst of a profound moral dilemma (Leane, 2019). As caregiving responsibilities transform into an obligation, uncertainties and anxieties regarding the future intensify (Levante et al., 2024); in carrying this heavy burden, only sibling affection and faith-based coping mechanisms can serve as a refuge (Aykara, 2015; Sanıyaman, 2023).

3. EMOTIONAL GAINS AND THE INVISIBLE CAREGIVER BURDEN

Sharing the same home and life with a sibling with a disability can never be summarized by a single emotion. On one hand, there are enriching experiences that impart extraordinary maturity to the individual; on the other hand, there are

invisible burdens that silently deplete the soul (Meyer & Vadasy, 2003; as cited in Çınar et al., 2017).

Examining the literature reveals undeniable positive contributions of this experience (Dyson, 2010; Schuntermann, 2007; Singh, 2014). These children learn to empathize much earlier than their peers; they become patient, compassionate, and tolerant. They do not mock others' shortcomings and stay away from peer bullying (Özdemir, 2023). Moreover, adversities braved collectively within the family strengthen interpersonal bonds. Indeed, Seligman (1987) notes that due to these early experiences, such siblings frequently choose human-oriented professions in adulthood, such as social work, psychology, or medicine. Experienced crises pave the way for individuals to discover their inner strength and look at life with far greater depth (Aksoy & Yıldırım, 2008).

On the flip side of the coin, however, lies a profound loneliness that is often shared with no one. These internal conflicts experienced by siblings and their empirical foundations are clearly presented in Table 1.

Table 1. Primary Psychosocial Risks and Reflections Experienced by Individuals with Siblings with Disabilities

Risk Area	Experienced Psychosocial Dynamic	Literature Grounding
Division of Parental Attention	Feelings of exclusion and silent resentment caused by parents devoting all their time and attention to the child with special needs.	Dyson, 2010; Shojaee & Alizadeh, 2019
High Achievement Pressure	Excessive perfectionism and rush for success undertaken to dispel sorrow in the family or to prove one's own existence.	Dyson, 2010; Meyer & Vadasy, 2003
Courtesy Stigma	Embarrassment, guilt, and distancing from friends due to society's pitying or exclusionary gazes.	Dyson, 2010; Levante et al., 2025
Adjustment and Behavioral Problems	Withdrawal, sudden anger outbursts, and physical complaints as external manifestations of heavy responsibilities carried at a young age.	Murphy, 1982; Stallard et al., 1997
Future and Care Anxiety	Chronic future anxiety and helplessness created by the worry of 'Who will take care of my sibling if something happens to my parents?'	Leane, 2019; Saban, 2010

Shojaee and Alizadeh (2019) state that children with siblings with disabilities experience much more intense levels of anxiety, helplessness, shame, and guilt compared to their peers. Especially toward late adolescence, anxiety levels among young women rise noticeably (Saban, 2010). Caregiving burdens that a child cannot bear exhaust them physically and emotionally over time; this picture is further exacerbated by the family's financial limitations and the inadequacy of external support (O'Brien et al., 2009). As the emotional burden increases, the young person's resilience decreases (İnanç et al., 2023). Nevertheless, unconditional love and attachment to the sibling remain the most fundamental anchor enabling them to persevere through this challenging life (Aykara, 2015).

4. SOCIAL WORK PERSPECTIVE: A THREE-DIMENSIONAL INTERVENTION MODEL

Evaluating sibling relationships in a family with an individual with a disability from a social work perspective requires considering not only care needs, but also the distribution of responsibility among family members, power dynamics, and individual rights. Siblings may be individuals who provide emotional support within the family, undertake caregiving responsibilities, or are expected to take part in future care arrangements. However, it cannot be said that these roles are experienced in the same way by all siblings. Lee and Burke (2018) point out that the caregiving experiences of adult siblings have both positive and challenging dimensions; Redquest et al. (2020) emphasize that support needs differ according to age and life stage. Therefore, it is essential that social work interventions are addressed at micro, mezzo, and macro levels in a mutually complementary manner.

4.1. Micro-Level Interventions: Empowering Sibling Autonomy

In micro-level interventions, the sibling's position in the family, the responsibilities they undertake, and their thoughts regarding these responsibilities must first be evaluated. It is particularly important to focus on the parentification experience in siblings who had to assume caregiving tasks incompatible with their developmental characteristics during childhood. However, not every caregiving behavior should be evaluated as parentification; the nature, continuity, and age-appropriateness of the undertaken responsibility, as well as its effects on the sibling's education, social life, and personal development opportunities, must be examined together.

The social worker must create an interview environment where siblings can express their anxiety, guilt, anger, or uncertainties regarding the future, while also considering the positive aspects of the sibling relationship. Providing age-appropriate information regarding the disability, strengthening intrafamilial

communication, and discussing caregiving responsibilities openly are key components of interventions at this level. In future care planning, which comes to the fore especially as parents age, the desires and life choices of siblings must be evaluated. Leane (2020) points out that future caregiving responsibilities can be an emotionally difficult negotiation process for families.

The purpose of micro-level intervention is not limited to preparing the sibling to undertake caregiving responsibilities. It is equally important that the sibling can make decisions regarding their own education, profession, relationships, and future, just as the preferences of the individual with a disability regarding care and support arrangements are observed. Therefore, instead of spontaneously and unquestioningly transferring caregiving responsibility to the sibling within the family, a planning process that takes into account the needs and rights of all family members must be established.

4.2. Mezzo-Level Interventions: Sibling Support Groups and Social Support Networks

Mezzo-level interventions are aimed at enabling siblings to establish supportive relationships outside the family and to come together with individuals who undergo similar experiences. Sibling support groups can be utilized for acquiring information about the disability, discussing roles within the family, sharing feelings, and developing coping skills. In Granat et al.'s (2012) group intervention study, an increase in participants' knowledge level regarding disability was determined. The systematic review by Wolff et al. (2022) also demonstrates that psychosocial interventions targeting siblings can provide various positive outcomes, though the effects are not at the same level across all studies.

It is not sufficient for these groups to focus solely on alleviating the caregiving burden. It is also important that siblings can discuss their place in the family, expectations regarding caregiving responsibilities, positive aspects of their relationships with their disabled siblings, and their own future plans. The ages, developmental stages, and caregiving experiences of participants must be considered in group work; it should not be assumed that all siblings experience similar difficulties or desire to provide care.

Another dimension of mezzo-level intervention is developing collaboration among family, school, rehabilitation centers, and social service organizations. Supporting the educational life and social relations of child and adolescent siblings, and ensuring that adult siblings can access information and support resources regarding future care planning, are of great importance. This collaboration can prevent siblings' needs from being viewed merely as matters to be resolved within the family.

4.3. Macro-Level Interventions: Rights-Based Policies and Advocacy

The difficulties encountered by siblings in the care process cannot be explained solely by intrafamilial dynamics. The insufficiency of accessible care services, the economic conditions of families, and the abandonment of long-term care largely to family members directly affect the responsibilities undertaken by siblings. Therefore, social work interventions must not remain confined to individual support, but must also address the societal and institutional dimensions of care.

At the macro level, the responsibility of the social worker is to support the access of individuals with disabilities and their families to rights and services, to render visible how caregiving responsibility is distributed among family members, and to carry out advocacy work toward developing services. In this context, the accessibility of services such as day care, respite care, family counseling, social support, and future care planning gains prominence. Furthermore, siblings should not be defined solely as the caregivers of the future; their choices regarding pursuing their own lives and whether or not to assume a caregiving role must also be respected.

In a rights-based social work approach, the right to self-determination of the individual with a disability and the autonomy of the sibling should not be seen as opposites. Sacrificing the life choices of siblings to ensure the sustainability of care, or leaving decisions regarding the disabled individual's own life solely to family members, is incompatible with rights-based practice. Therefore, rather than basing caregiving responsibility on the sacrifices of families, social policies must develop support systems that concurrently uphold the needs of individuals with disabilities and the rights of family members.

5. INTERNATIONAL BENCHMARKS AND CRITICAL EVALUATION OF LEGISLATION IN TÜRKİYE

When examining contemporary social work models around the world, well-established structures where siblings are directly targeted and supported as independent individuals are evident:

- **Sibshops (USA):** Initiated in 1978 under the leadership of Don Meyer, this model completely dismantles the gloomy atmosphere of traditional therapy settings. Utilizing the language of play, it brings together siblings in similar situations through fun activities and paves the way for them to express their feelings in a healthy manner (Sibling Support Project, 1990).
- **Sibs UK (United Kingdom):** A national organization dedicated exclusively to serving siblings of disabled individuals. While offering guidance to the 7–17 age group through 'YoungSibs,' it provides counseling to adult siblings on

future care planning. Through 'Sibs Talk' modules in schools, it brings support directly into the education system (Sibs, 2001).

- **The Sibling Project and SibWorks (Australia):** The Sibling Project, led by Dr. Emma Glasson within The Kids Research Institute, collects academic data by recognizing siblings as 'co-researchers' (Utah Parent Center, 1980). The 7-session 'SibWorks' program developed by Siblings Australia is an evidence-based model that strengthens children's mental resilience (Siblings Australia, 2015).
- **Holland Bloorview Sibling Program (Canada):** Established within a rehabilitation hospital, this service bridges hospital care with community support through 'SibKits' educational sets and publicly accessible safe sharing spaces (Holland Bloorview Kids Rehabilitation Hospital, n.d.).

5.1. Legal Legislation in Türkiye and Field Gaps

When supports in our country are examined in line with data from the Republic of Türkiye Ministry of Family and Social Services (2026), valuable steps taken for the individual with a disability and the household are evident. These supports are presented in Table 2.

Table 2. Fundamental Services and Rights Provided to Individuals with Disabilities and Families in Türkiye

Service Area	Legislation and Granted Rights (Ministry, 2026)
Care Services	Official residential care centers, Hope Homes (Umut Evleri), day care centers, and temporary guest care opportunities provided up to 30 days per year.
Economic Assistances	Pensions under Law No. 2022, Home Care Assistance increased to 13,878 TL at the beginning of 2026, Disabled Relative Pension, and income tax reductions.
Working Life Rights	EKPSS quotas, 10-day excuse leave per year for employees with disabled children, companion leave up to 3 months, night shift exemption, and early retirement rights for mothers with severely disabled children.
Social Rights and Exemptions	Disability ID card, free municipal and railway transportation, SCT (ÖTV)/MTV exemption, property tax exemption, water tariff discounts, and the AİLEM Barrier-Free Communication Center (Alo 183 / Alo 144).

The services included in the table certainly lighten the burden of the household; however, when examined through the eyes of a social worker, very serious structural deficiencies are observed in the system:

1. **Mother-Centric Design of Policies:** Almost all rights in the legislation are organized almost entirely around the mother. In cases where parents pass away or become unable to provide care, the caregiving burden undertaken by the adult sibling has no legal counterpart.
2. **Viewing the Sibling as a Natural and Unpaid Caregiver:** The system accepts siblings almost as 'unpaid care backups' who exist spontaneously within the family and from whom every sacrifice is expected. The sibling's own developmental needs and mental health are completely disregarded.
3. **Absence of Sustainable Public Policy:** The TÜBİTAK project titled 'Psychoeducational Program for Middle and High School Students with Siblings with Disabilities' conducted by Avcu et al. (2017) between 2017 and 2020 is one of the most valuable steps in the field. However, such studies remain at the project level and cannot be transformed into widespread and continuous public services within the ministry.

6. CONCLUSION AND POLICY RECOMMENDATIONS: INTEGRATING INVISIBLE SUBJECTS INTO THE SYSTEM

The effects of growing up with an individual with a disability on siblings vary depending on intrafamilial relationships, the distribution of caregiving responsibilities, and available support opportunities. While the sibling relationship can contain positive experiences such as developing solidarity, empathy, and responsibility, leaving the caregiving burden to siblings from early ages can create various difficulties in terms of education, social life, and future plans. Particularly as parents age, the question of who will take over caregiving responsibility becomes more prominent. Therefore, siblings must be evaluated not merely as family members who contribute to the care of the individual with a disability, but as individuals with their own needs, rights, and life choices.

The fundamental responsibility in terms of social work is to make siblings' roles in the caregiving process visible, while preventing this responsibility from turning into an obligatory and unilateral liability. In this direction, the following recommendations come to the fore for developing services aimed at supporting siblings in Türkiye:

Sibling-focused support services should be developed in Social Service Centers. In social investigation and service planning for the individual with a

disability, siblings' needs should also be taken into account; independent counseling and psychosocial support should be provided to siblings when necessary. Peer support groups similar to Sibshops can be implemented for child and adolescent siblings in accordance with their age and developmental periods. Participation of siblings in these services must be based on voluntariness.

Accessibility of day care and temporary respite services should be increased. The expectation that caregiving responsibility be met solely by family members can limit siblings' opportunities for education, employment, and participation in social life. For this reason, day care and short-term respite care services suitable for the needs of families should be developed; regional distribution, accessibility, and economic affordability of services should be observed.

Social protection regulations should be evaluated for adult siblings who undertake caregiving responsibilities. In cases where parents cannot provide care, difficulties encountered in working life by adult siblings who assume responsibility should be considered. In this context, evaluating options such as caregiving leave, flexible working arrangements, and social security support from a legislative perspective is recommended. However, these regulations should not be based on the assumption that caregiving responsibility naturally belongs to the sibling; they must consider the choices of both the individual with a disability and their sibling together.

Efforts aimed at supporting siblings should be developed within the scope of school social work. Responsibilities within the family, school experiences, and psychosocial support needs of children with disabled siblings should be evaluated. Collaboration to be developed between the Ministry of National Education and the Ministry of Family and Social Services can strengthen referral and support processes between schools, families, and social service organizations. These efforts must be based on determining individual needs, not on the assumption that all siblings experience psychosocial problems.

In conclusion, evaluating the sibling subsystem in the context of disability requires going beyond the question of who undertakes caregiving responsibilities. A rights-based social work approach must protect the disabled individual's needs and right to self-determination, while also respecting siblings' rights to plan their own lives and decide at what level they will participate in the care process. Therefore, supporting siblings should be addressed not only by strengthening intrafamilial solidarity, but together with developing accessible services and social policies that share the caregiving responsibility.

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Chapter 4

Border Control and Operational Preparations in Serbia-Hungary Railway Cooperation (Belgrade-Budapest Line, 2024-2026)

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Abstract

This book chapter examines the legal and operational dimensions of cross-border railway cooperation between Serbia and Hungary on the Belgrade-Budapest line in the January 2024-July 2026 period. In the research focusing on the Kelebia-Subotica border crossing, the provisions of the 2025 bilateral border control agreement, institutional responsibilities, and documented operational preparations are addressed. Through the qualitative document analysis method, bilateral agreements, national legislation, official statements, records of railway operators, and the draft railway traffic agreement dated 2026 were compared. The findings show that border control, railway safety and technical authorization, and actual transport services are subject to different legal and institutional procedures. The 2025 border control agreement entered into force at the international level on March 14, 2026, while the Serbian and Hungarian authorities reported that international freight transport had begun on February 27, 2026. As of the research's information cutoff date of July 31, 2026, due to the existence of statements indicating that technical preparations were continuing and the scope of the documents examined, it is not possible to say that all final technical authorizations had been completed or that regular and direct international passenger service via Kelebia had begun. The comparison also reveals the differences between Hungary's obligations arising from European Union law and Serbia's national regulatory framework. Here, it was concluded that cross-border railway coordination cannot be evaluated through a single legal procedure or operational date. The contribution of the research should be sought in its distinction between documented legal regulations, institutional preparations, and operational statuses while preserving the evidentiary limits of the available sources.

Keywords: Belgrade-Budapest Railway, Serbia-Hungary Relations, Border Control, Cross-Border Railway Cooperation, Kelebia-Subotica, Railway Interoperability..

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1. Introduction

The Belgrade-Budapest railway can be evaluated as an area requiring interstate coordination beyond investment decisions in terms of the development of the transport connection between Serbia and Hungary. On the same corridor, the preparation of railway infrastructure, the assessment of the technical conditions of trains, the organization of commercial services, and border crossings are subject to the areas of authority of different institutions and legal regulations. For this reason, a statement regarding the completion of a certain section of the line is not sufficient on its own to reach the conclusion that all the conditions of international passenger operation have been met. Studies examining the railway project through political economy and regulatory standards draw attention to the role of different actors and institutions (Szabó & Jelinek, 2023; Pinna & Neuman Stanivukovic, 2026). This study, however, unlike the aforementioned broad examinations, focuses on the position of operational preparations documented through border control arrangements on the Serbia-Hungary line.

It is seen that the road, railway, and waterway border control agreement signed between the governments of Serbia and Hungary on October 22, 2025, contains regulations regarding mutual border crossings between the two countries. Article 20 of the agreement includes general procedures regarding railway controls, Article 21 includes the Kelebia-Subotica railway border crossing, and Article 22 includes Röszke-Horgoš, which is a separate crossing (Magyarország, 2025, Annex 2, Art. 20-22). It is difficult to say that their inclusion in the same document constitutes, on its own, a sufficient basis for evaluating these two crossings as a single operating route. In this study, the Kelebia-Subotica border crossing has been accepted as the focal point of the examination of the Serbia-Hungary line. It can be stated that the provisions regarding Röszke-Horgoš have been used for the purpose of explaining the integrity of the agreement and the route distinction between the two crossings.

The agreement entered into force at the international level on March 14, 2026 (Külgazdasági és Külügyminisztérium, 2026). In contrast, in the statement of the Serbian government dated February 27, 2026, it was reported that freight traffic on the Belgrade-Budapest railway began on the same day (Government of the Republic of Serbia, 2026b). The fact that the official statement regarding the beginning of freight traffic was made before the entry into force of the agreement may provide a basis for the interpretation that legal entry into force and actual transport status should not be evaluated as the same event. Based on the dates in question, it is difficult to reach a definite conclusion as to whether the new agreement caused the beginning of freight traffic or within the

framework of which previous procedures the operation was carried out. In this research, however, the comparative examination of under which duties and statuses the legal and operational records in question appear in the documents of the Serbian and Hungarian authorities has been determined as the main problem.

This problem also encompasses the possibility that institutions in the two countries may not always mean the same procedure despite using similar concepts regarding the same railway corridor. Granting legal permission for border crossing, granting technical permission for the train, and actually providing the transport service can be evaluated as different situations that need to be verified through separate documents. In the examination, this distinction has been adopted as a comparison criterion to be tested through source types rather than a previously accepted assumption.

The main period of the research has been limited to the time interval between January 1, 2024, and July 31, 2026. The starting date has been selected as the beginning of the research period in which new targets and institutional records regarding the operation of the line can be traced, rather than the date on which an independent legal event occurred. In the statement of the Serbian government dated June 7, 2024, it was stated that the commencement of service between Belgrade and Subotica by December of the same year was targeted. This statement documents the official target of the period rather than a service that had actually begun (Government of the Republic of Serbia, 2024a). When necessary, older investment decisions and border agreements may be used as contextual sources. The examination of these sources, however, should not be evaluated as a backward extension of the main period of the research.

In the study, the Serbian and Hungarian sides are compared within the scope of a single case. The relevant border authorities, railway administrations, infrastructure managers, and operators of the two countries are evaluated in terms of the duties they undertake in official documents. Chinese financing and the regulatory framework of the European Union (EU) are addressed in terms of the aspects considered necessary for explaining the case. The study focuses on examining the legal and institutional coordination between the two countries through documents rather than measuring the economic effects of an international infrastructure investment or establishing a definite causal model regarding operational delays.

The main research question has been expressed as follows. In the January 2024-July 2026 period, under which different statuses do the railway provisions of the 2025 border control agreement, the duties of institutions, and documented operational preparations appear in Serbian and Hungarian official documents

regarding the Belgrade-Budapest line, and how can they be compared in terms of cross-border coordination? This question is evaluated through five areas of examination: the legal scope of the railway provisions of the border control agreement, the verifiable statuses of operational preparations and the institutional statements regarding them, the regulatory conditions of the two countries, the preparation status of the separate railway traffic arrangement, and the historical context of financing. Financing documents, however, are used only for the purpose of explaining the historical background of the research.

In the examination, rather than treating the two sides of the border as independent cases, the common border crossing is evaluated as an area of relations subject to simultaneous regulations by different institutions. Accordingly, the documents have been classified according to the issuing authorities and the line sections they cover.

In academic studies regarding the Belgrade-Budapest line, the political nature of the investment, state-capital relations, foreign policy identity, technical standards, and the stages of the infrastructure project progressing at different times have been examined (Rogers, 2019; Szabó & Jelinek, 2023; Peragovics & Szunomár, 2024; Neuman Stanivukovic, 2025; Pinna & Neuman Stanivukovic, 2026). For this reason, it is not claimed in the study that the geopolitical importance of Chinese financing or the regulatory differences between the two states are presented for the first time. The contribution of the research tested within a narrower scope, however, may be sought in the comparison of the railway provisions of the 2025 border control agreement with legal procedures extending into 2026 and documented operational statuses within the same cross-border case, while preserving different thresholds of evidence.

In this comparison, three separate levels of explanation are taken as the basis. At the first level, the matters regulated by agreements and legislation are examined, at the second level, the statements of authorized institutions regarding targets, preparations, permissions, and operation are examined, and at the third level, documents directly supporting the occurrence of a particular activity are examined. The distinction between these levels will be used as the main criterion in evaluating the strength of evidence of the conclusions reached in the research. Although the government decision and draft law regarding the separate railway traffic agreement dated 2026 have been obtained, it should be stated that the legal process regarding final signature, legislative approval, and entry into force at the international level is continuing (Magyarország Kormánya, 2026; Government of Hungary, 2026). It is seen that the statements

dated May and July 2026 include information regarding preparations before passenger service (MÁV, 2026; RTS, 2026).

In the following sections, first, the literature positioning the research problem and the document analysis method used will be explained. Subsequently, the historical background of the corridor necessary for the research, the provisions of the 2025 border control agreement, the operational preparations in the 2024-2026 period, and the institutional arrangements of the Serbian and Hungarian sides will be examined. In the discussion section, the findings obtained from official documents will be compared with the explanations of previous academic studies. Through this examination, it is aimed to determine within which limits normative and operational relations can be explained through the available documents rather than to confirm a predetermined judgment of success or failure.

In the research, no claim of originality is put forward that the same legal text is examined for the first time in a particular period. In evaluating the original contribution, however, the basis will be which new explanations the joint examination of normative regulations and official operational records can provide a basis for. Accordingly, in the conclusion section, attention will be paid to preserving the distinction between documented facts and the interpretations derived from them.

2. Literature Review

In a significant part of the literature regarding the Belgrade-Budapest railway, the infrastructure investment has been addressed within the framework of economic and political relations between China and Central and Southeastern Europe. Rogers (2019) drew attention to the increasingly political nature of economic decisions in explaining China-linked investments directed toward Hungary. This assessment can be associated with the view that explaining the railway investment solely through project cost or transport demand may not be sufficient. Szabó and Jelinek (2023), on the other hand, examined state-capital relations together at global, national, and local scales and discussed how financing, governance, and infrastructure development processes were shaped together with different state actors. Although both studies addressed the same project, a clear analytical distinction can be made between Rogers's emphasis on Hungary's political economy and the multiscalar relational approach of Szabó and Jelinek.

Mohan et al. (2024) focused on central and local state relations while comparing Chinese-supported transport projects in Europe. They addressed the Hungarian case for the purpose of examining the role of relations at different

state levels alongside national political preferences in project decisions. Peragovics and Szunomár (2024), on the other hand, focused on the symbolic function undertaken by the same line in Hungary's foreign policy identity. Within the framework of this literature, financing is evaluated as part of the verified investment framework explaining the emergence of the cross-border line rather than as an independent causal variable. Based on the existence of credit arrangements, no direct conclusion is reached regarding the concrete causes of the operational process.

These approaches may contribute to understanding the connection between infrastructure investments and bilateral diplomacy. Analyses regarding the political meaning of the investment, however, do not replace sources directly documenting the control procedures at the railway border station. Taking this distinction into account, it has been preferred in the research to address financing as an explanatory background element.

In the literature directly addressing the technical and institutional conditions of the railway, the study by Pinna and Neuman Stanivukovic (2026) can be evaluated as one of the sources offering the closest possibility of comparison with the present research. The authors argued that evaluations regarding the success or failure of infrastructure projects do not emerge on their own, and that technical, financial, environmental, social, and governance standards constitute evaluation frameworks used by different actors. In the two-level design of the research, EU- and China-related standards regimes were examined together with concrete practices in Hungary and Serbia. In this approach, standards were addressed as criteria referred to in the evaluation of the project and the discussion of responsibilities rather than as the direct cause of delays or technical malfunctions (Pinna & Neuman Stanivukovic, 2026).

The research in question requires two matters to be taken into account in terms of the present examination. First, it is seen that interoperability, technical certification, and regulatory differences related to EU membership have previously been addressed in the same case. Second, the documentation of a permission condition may not be sufficient on its own to explain why operation could not begin on a particular date. For this reason, it would be more appropriate to avoid equating border control with technical safety and drawing conclusions regarding the definite cause of delay based on the existence of different norms.

Neuman Stanivukovic (2025), in the study titled *Rhythms of growth*, discussed acceleration, delay, and project processes that did not progress simultaneously in the same railway corridor within the framework of the temporal politics of infrastructure. In the research based on ethnographic

fieldwork and document examination, how narratives of growth and modernization encountered different rhythms of progress of events was addressed (Neuman Stanivuković, 2025, pp. 695-698, 701-702).

One of the important contributions of studies on standardization and temporal politics may be sought in their drawing attention to the fact that the project cannot be reduced to independent technical parts. In the present research, however, it is aimed to examine the statuses of documents regarding border control authorities and operation within a more specific comparison framework in a particular historical period rather than to expand the explanations in question. Accordingly, care will be taken to preserve the different questions answered by both groups of evidence by avoiding the replacement of the explanations in the literature with legal provisions.

In this examination, regulatory difference and legal applicability are kept separate from each other. Academic evaluations regarding a standard should not be considered equivalent to provisions in force in the national law of the relevant country on a particular date or to concrete permissions granted by the competent authority. In particular, the expansion of discussions regarding technical certification by basing them on an assumption of a final authorization date that cannot be verified through official documents will be avoided. Similarly, it should not be accepted in advance that the occurrence of procedures in the two countries on different dates proves the failure of political coordination.

The Serbia-Hungary border can be evaluated as an area of governance connected not only with relations between the two countries but also with the external border regulations of the European Union (EU). Korte (2022) examined the physical barrier constructed by Hungary on its border with Serbia within the framework of political conditions in the two countries, re-bordering practices, and mutual relations. In the research based on qualitative interviews and document examination, the functions undertaken by the border in terms of domestic politics and international relations were addressed together. However, the research in question does not directly address the operational controls at the border stations of the Belgrade-Budapest railway or the implementation of the provisions of the 2025 bilateral agreement. For this reason, it is difficult to reach the conclusion that a particular railway control was actually carried out based on findings regarding general border governance.

In the bilateral agreement dated 2025, matters regarding the cooperation of the competent authorities responsible for border control and the use of crossing points have been regulated (Magyarország, 2025, Annex 2, Art. 1-3, 20-22). However, it has not been accepted in advance that border control, the technical

safety of railway infrastructure, and the service decision of the train operator are under the responsibility of the same institution. In this research, the concept of border governance refers to the legal and institutional regulation of persons and relevant border crossing procedures, while the areas of customs, railway safety, and commercial tariffs are examined within the framework of their own legal regulations. This distinction may provide a basis for addressing coordination between institutions in the two countries as a researchable problem.

Political discourses regarding the control of the border and texts regulating the procedures that authorized personnel at crossing points must follow should be evaluated as different types of evidence. While the bilateral agreement is a normative source explaining the legal framework of border control, it is also necessary to refer to official procedural records to determine how daily implementation is carried out. For this reason, care will be taken not to extend evaluations regarding border governance beyond the matters directly supported by the available documents.

In some of the previous studies, the Belgrade-Budapest railway project was examined through Chinese financing and state capitalism, in some through foreign policy identity, and in others through the politics of technical standards and the temporal dimension of delays. It would not be very accurate to evaluate these approaches, which proceed from different research questions, as direct opposites of one another. The distinguishing aspect of the present research may be sought in the joint examination of the provisions of the 2025 border control agreement and the documentable operational stages relating to 2026 within the same comparative document corpus. However, this approach should not be evaluated as a claim of originality that no other equivalent research exists in the literature. In particular, because not all subscription-based academic databases have been searched and only the abstracts of some studies could be accessed, the evaluation regarding the original contribution is kept within the framework of a criteria-based comparison with the publications examined.

Within this scope, the verification of legal norms and actual operational situations through different source types is the main analytical approach adopted in the research. Which statuses can be verified through the available documents and which have not yet been clarified will be examined in the following sections.

The limitation of the research in this way should not be evaluated as an attempt to invalidate the findings of previous studies. Explanations regarding the political economy of the investment, foreign policy identity, standardization, and temporal politics constitute the broader academic context of the examination. The question of how legal regulations regarding border control

can be evaluated together with different document types and actual operational statuses is developed through comparison with the approaches in question in the literature examined.

3. Method

In the research, the Belgrade-Budapest railway was accepted as a single case, while Serbia and Hungary were compared through qualitative document analysis as the two institutional sides of the same corridor. Bowen (2009) addressed the methodological possibilities and limitations regarding the use of documents as data sources in qualitative research. This approach was applied through the systematic examination of relevant agreements, legislation, official statements, tariffs, and operational records, without claiming that data were collected through interviews or field observation. The main level of analysis consists of the institutional and legal relations of the two states regarding the cross-border railway connection. China and the European Union (EU), however, were addressed within the framework of the relevant investment and regulatory contexts rather than as independent cases of comparison.

The procedures complementing qualitative document analysis include the examination of the legal nature of agreement provisions, the comparison of statements by official authorities within a specific scope, and the matching of operational statuses with dated documentary records. The chronological ordering of events should not be interpreted as the application of the causal process tracing method. Similarly, the comparison of official discourses was not designed as a comprehensive critical discourse analysis aimed at determining the intentions of states that were not explicitly expressed. The research question was limited in a way that allows an answer to be sought regarding the statuses under which border control regulations and operational preparations appear.

In the document analysis, first, the legal nature and subjects of regulation of the sources were determined, and then comparable event and procedural records were matched. Through this comparison, it can be evaluated whether a common target exists in the official statements of the states. However, it will not be accepted that the targets in question were implemented simultaneously on both sides unless additional evidence confirming this is available. The scope of the conclusions obtained from the research will be limited to the case and period examined.

The primary document corpus consists of the 2025 border control agreement and national entry-into-force procedures, the draft of the separate railway traffic arrangement dated 2026 and the relevant preparatory decisions, and applicable EU and national legal documents. The dated construction, technical testing,

freight and passenger operation statements of Serbian and Hungarian institutions, the MÁV operator announcement dated May 7, 2026, and the necessary financing and investment records were also included in this document group. The academic literature, however, was used as a separate source group for the purpose of comparing previous interpretations. RTS (2026) was evaluated as a news record conveying the ministerial statement dated July 22 and was not used in place of an official technical authorization or operator document. In document selection, verification of the institutional identity of the sources, their relevance to the main research period or the necessary historical background, their concrete connection with the research questions, and the traceability of the relevant text sections were taken as the basis.

In the records included in the examination, the document date, event date, national publication date, and international entry-into-force date were kept in separate fields. The agreement published by Hungary through Act No. CVII of 2025 was evaluated through the original English annex, while its entry into force at the international level on March 14, 2026, was evaluated through a separate KKM notification (Magyarország, 2025, Annex 2, Art. 32; Külgazdasági és Külügyminisztérium, 2026). The separate railway traffic agreement submitted by the Hungarian government for public consultation on February 2, 2026, was classified as a draft because the signature and entry-into-force dates were absent from the version examined and the final entry-into-force document could not be verified either (Government of Hungary, 2026). From sources whose full texts could not be accessed, only information supported by the accessible sections was used. Accounts whose dates and relevant institutions could not be determined were not accepted on their own as primary evidence of events.

While constructing the document corpus, the republication of the same press statement on different websites was not evaluated as independent verification. Procedures recorded by national authorities on different dates regarding the same process were not reduced to a single date, and the distinction regarding document, event, and entry-into-force dates was preserved. In the event that a difference in interpretation arises between the version of a text in its authentic language and its translation, it will be preferred to take the authentic text as the basis.

The units of analysis were classified as international agreement provisions, national approval or entry-into-force procedures, official statements, operational records, authorization documents, historical events, financing documents, and academic opinions. Since Articles 20, 21, and 22 of the same agreement regulate different legal and geographical matters, they were examined in

separate rows. The Kelebia-Subotica main border crossing was indicated by the code KS, while Röszke-Horgoš was indicated by the code RH as a separate border crossing. The passenger timetables of lines 150 and 136 in Hungary were also evaluated separately, and records regarding one were not used in place of the other.

In the classification of operational and event statuses, target was indicated by code S0, construction by S1, testing by S2, final technical authorization by S3, international freight transport by S4, direct international passenger service by S5, actual border control by S6, legal entry into force by S7, and insufficient or contradictory evidence by SX. The code P-DOM was additionally used for domestic passenger service. The levels of examination of the sources were evaluated as A/B/C/D, while the support they provided for a particular claim was evaluated separately under the categories of direct, interpretation, contradiction, or insufficiency (D/Y/Ç/X). For example, a minister's statement can directly verify that the relevant statement was made. However, it cannot be said that the same statement is sufficient to independently prove that the final technical authorization document was issued. Through this distinction, care was taken to address legal regulations, announced targets, activities reported to have occurred, and final official authorizations at different levels of evidence.

The codes were not designed as stages that necessarily follow one another. For example, while an official statement regarding the commencement of freight transport may exist, a record verifying with the same strength of evidence that direct international passenger service has begun may not be accessible. In this case, the combination of codes S4 and S5 into a single general opening category will be avoided, and the authorized source on which each claim is based will be specified separately.

The date of the research has been limited to July 31, 2026. In the document corpus examined, documents showing that the final signature and entry-into-force procedures of the separate railway traffic agreement dated 2026, the final authorization procedures regarding the ETCS system on the Hungarian section, and the additionally requested TÜV assessment had been completed could not be accessed because the process was continuing. It should also be stated that the definitive operator record showing that regular and direct international passenger service via Kelebia has begun and all the actual implementation procedures of joint railway border control have not been confirmed through the available sources. In contrast, it is seen that the MÁV announcement dated May 7 and the ministerial statement reported on July 22 include information regarding passenger operation preparations during the period (MÁV, 2026; RTS, 2026). However, the fact that the records in question have not been

verified should be evaluated as evidence that the relevant activities never took place.

The dating of institutional statements and the verification of the stated activities through independent observations should be addressed at different levels of evidence. For academic studies with limited access, only information supported by the abstracts was used, and references to methods or findings going beyond these were avoided. Considering that documents belonging to the two countries are published and updated on different dates, it would not be appropriate to reach the conclusion that the relevant event did not occur based on the inability to access a record. For this reason, no claim is put forward in the research that the lack of technical approval, EU regulations, or Chinese financing directly caused operational delays. The scope of the findings, however, has been limited to verifiable document contents and the comparisons supported by these documents.

It would not be accurate to evaluate the inability to access all the documents as a situation invalidating all the conclusions obtained from the comparison. Nevertheless, it should be taken into account that these deficiencies may constitute a significant limitation of evidence in answering questions requiring a definite positive or negative conclusion regarding operation. In the research, explicitly stating these deficiencies rather than ignoring them, determining the scope of the relevant claims according to the available evidence, and the possibility of re-examining the records if new primary documents are accessed have been taken as the basis.

4. Investment and Institutional Background

In order to evaluate the cross-border operational preparations of the Belgrade-Budapest railway in the 2024-2026 period, it is first necessary to take into account that the investment and border regime have different legal bases. The agreement signed in Suzhou on November 24, 2015, between the governments of Hungary and the People's Republic of China, containing provisions regarding the development, construction, and financing of the Hungarian section, was published in Hungary through Act No. XXIV of 2016. It is seen in the Act that the entry into force of the agreement at the international level and the national publication procedure took place on different dates. Article 6 of the agreement includes regulations regarding the contractor partnership and project organization, while Article 7 includes regulations regarding financing, procurement, and relevant technical standards (Magyarország, 2016, agreement Art. 6-7). This document can be evaluated as a source explaining the institutional and financial establishment of the railway

investment in terms of the research. However, it would not be appropriate to use it as a document directly verifying the provisions of the 2025 border control agreement or actual train movements at the border.

In paragraphs (1) and (2) of Article 7 of the investment agreement, the framework regarding the credit facility envisaged between China Exim Bank and the representative of the Hungarian side and the possibility of using this facility up to 85 percent of the construction contract value was regulated. However, based on the expression "up to 85 percent," it would not be accurate to conclude that the entire loan amount was actually used, expenditures were made at the same proportion, or financing determined the opening schedule of the line. In paragraph (7) of the same article, it was envisaged that the equipment, materials, and technologies to be brought to Hungary within the scope of the project would meet EU and Hungarian standards. For this reason, the existence of provisions regarding technical compliance in the financing and investment agreement should not be interpreted as meaning that technical operating permits were also granted within the scope of the same document (Magyarország, 2016, agreement Art. 7(1-2), 7(7)).

Hungary's Act No. XXIX of 2020 constitutes another part of the national legal framework regarding the preparation, development, construction, and financing of the Budapest-Ferencváros-Kelebia section. The Act includes provisions aimed at the acceptance of the investment as a priority state task for Hungary and the regulation of the relevant administrative procedures (Magyarország, 2020, §1 and introductory provisions). However, it would not be appropriate to conclude, based on this national regulation giving priority to the investment, that passenger controls at the border have been completed or that the train operator has put the international timetable into effect. In the research, Chinese financing is addressed through the documentable aspects of the political-economic background, and it is not accepted in advance that there is a direct causal relationship between interstate border control and national railway investment management.

The regulation dated 2025 at the Serbia-Hungary border did not emerge in an area where legal cooperation had not previously existed. The road, railway, and waterway border control agreement signed between the parties on January 24, 2012, and the amendment arrangements dated February 9, 2018, and July 4, 2022, were among the legal bases of the previous border crossing framework. Records regarding these arrangements can be traced in Hungarian legislation and in the termination provisions of the 2025 agreement (Magyarország, 2012; Magyarország, 2025, Annex 2, Art. 32(7)). Considering this legal background,

it would not be appropriate to interpret the 2025 agreement as a text establishing all border institutions for the first time.

It is necessary to make a distinction between the termination of previous agreements and the continuity of implementation procedures. Article 32(7) of the new agreement envisages the termination of the specified previous interstate agreements upon the entry into force of the new arrangement. In contrast, Article 29(2) states that the joint border crossing operating procedures determined according to the 2012 agreement will remain in force to the extent that they do not conflict with the new agreement (Magyarország, 2025, Annex 2, Art. 29(2), 32(7)). When these provisions are evaluated together, it would not be accurate to conclude that the termination of the previous agreements automatically invalidated all the relevant implementation documents on the same date. However, the continuity provision in question does not mean that the full text of the current implementation procedures specific to Kelebia-Subotica has been accessed either.

This distinction may provide a basis for examining at which points legal continuity and new institutional obligations differ. The previous arrangements, however, are addressed within the necessary historical context for the purpose of explaining the provisions of the 2025 agreement regarding the joint committee, border crossing points, and implementation procedures, rather than being transformed into a comprehensive legal history examination.

In the announcement of the Serbian Railway Directorate dated July 4, 2023, it was reported that the Serbian and Hungarian railway safety authorities held a meeting on June 21, 2023. The statement indicated that differences between EU railway regulations and Serbia's level of compliance with these regulations could require special solutions in terms of cross-border cooperation and that work on a new institutional cooperation text had come onto the agenda (Direkcija za železnice, 2023). This statement can be evaluated as an official declaration that the parties discussed regulatory differences in the field of technical safety in 2023. However, the fact that the meeting in question was held does not, on its own, verify that all authorizations were granted or that the special agreement entered into force in the subsequent process.

In the statement of the Serbian government dated June 7, 2024, it was stated that the operation of Soko high-speed trains between Belgrade and Subotica from December 1, 2024, was targeted (Government of the Republic of Serbia, 2024a). This statement was classified as an announced target under code S0. In the statement dated December 20 of the same year, the publication of official documents regarding the Belgrade-Subotica-Kelebija project that were accessible up to that date was addressed (Government of the Republic of Serbia,

2024b). Another announcement dated February 2025 also concerns the presentation of project documents to the public (Ministry of Construction, Transport and Infrastructure, 2025). Considering these records, it can be said that the ongoing document and administrative announcement process at the end of 2024 and the transport target announced in June should be evaluated separately.

5. Legal Framework and Entry into Force of the 2025 Border Control Agreement

The agreement signed between the governments of Serbia and Hungary on October 22, 2025, should not be evaluated solely as an operating contract specific to the Belgrade-Budapest railway project. The official title of the agreement covers road, railway, and waterway border control, while its authentic Hungarian and English texts were published in the annexes of Hungary's Act No. CVII of 2025. Articles 1 and 2 of the agreement include provisions regarding the border crossing arrangements between the two states and basic concepts. In particular, it can be evaluated that the legal definitions regarding joint border crossing, personnel on duty, and types of crossing have decisive importance in the interpretation of the subsequent railway provisions (Magyarország, 2025, Annex 2, Art. 1-2).

Article 3 of the agreement includes principles regarding cooperation between border control authorities, exchange of information about waiting times and situations restricting crossing, informing the other party about modernization activities that may affect border crossing, and determination of common working languages. Although these provisions explain the normative content of bilateral coordination, it is difficult to say that they are sufficient on their own to prove that a particular delay resulted from a lack of coordination or that information sharing was carried out effectively in every case (Magyarország, 2025, Annex 2, Art. 3(1-4)). For this reason, in the research, it has been preferred to evaluate the concept of "cooperation" through the concrete duties specified in the agreement rather than through general political discourse of friendship.

It is seen that Articles 4-6 regarding joint border crossing regulate the legal framework to which the officials of the parties are subject, the order of controls, and the special procedures that may be applied if the joint crossing place is located in the territory of one of the two countries. Article 4(3) of the agreement envisages that officials conduct border controls in accordance with their own national laws, while Article 4(4) envisages that entry control should not begin before exit control is completed. In addition, Article 6(1) states that Hungary's customs and certain health controls will be carried out on Hungarian territory in

accordance with EU law (Magyarország, 2025, Annex 2, Art. 4(3-4), 6(1)). When these provisions are evaluated together, an assessment can be made that co-located border control does not mean that all control powers have been transferred to a single state authority.

In the legal history of the agreement, three separate stages need to be taken into account, namely the signing of the text by the states, the completion of national procedures, and its entry into force under international law. In the announcement of the Serbian government dated October 22, 2025, it was reported that the relevant ministers of the two countries signed the border control agreement. Hungary's Act No. CVII of 2025, however, was published on December 19, 2025 (Government of the Republic of Serbia, 2025b; Magyarország, 2025). For this reason, the signing of the agreement, its publication in Hungary, and its entry into force at the international level should be addressed as different legal procedures, and the relevant dates should be evaluated separately.

The National Assembly of Serbia adopted the relevant law on January 28, 2026. The ratification text was published in issue 1/2026 of the official gazette devoted to international agreements, with a record dated February 2, 2026. In the records of the Serbian parliament and the official legal system, it is seen that the national adoption and publication procedures were completed after Hungary's procedure dated December 2025 (Narodna skupština Republike Srbije, 2026; Pravno-informacioni sistem Republike Srbije, 2026). However, it should not be assumed that these procedures alone were sufficient for the agreement to enter into force at the international level. The dates regarding the domestic legal procedures of both parties need to be evaluated together with the diplomatic notification mechanism envisaged in Article 32(2) of the agreement.

Article 32(2) of the agreement envisages that the parties inform each other in writing through diplomatic channels after completing the necessary national procedures and that the agreement enters into force on the thirtieth day following the receipt of the later notification. In notification No. 1/2026 (III. 5.) of the Hungarian Ministry of Foreign Affairs and Trade, it was explicitly stated that the necessary condition was fulfilled on February 12, 2026, and that the agreement entered into force on March 14, 2026 (Magyarország, 2025, Annex 2, Art. 32(2); Külgazdasági és Külügyminisztérium, 2026). Accordingly, status S7 was used for March 14, 2026, the date on which the agreement entered into force at the international level. However, it would not be correct to interpret the date in question as meaning that all the provisions of the law published in Hungary had the same legal function on the same day or that all commercial services on the railway began on that date.

This legal distinction also needs to be taken into account in terms of the operational chronology. In the statement of the Serbian government dated February 27, 2026, it was reported that freight transport on the Belgrade-Budapest route began on the same day. In the statement of the Hungarian Ministry of Construction and Transport dated March 30, 2026, it was also stated that freight transport began on February 27 (Government of the Republic of Serbia, 2026b; Építési és Közlekedési Minisztérium, 2026). In the official statements of both states, the beginning of freight transport is dated before the entry into force of the border control agreement at the international level. Considering this chronology, it would not be appropriate to evaluate the entry into force of the new agreement as a necessary condition for the commencement of freight transport. However, the statements in question do not, on their own, provide sufficient information to determine within the framework of which previous border control procedures freight transport was carried out.

Article 32(5) of the agreement explicitly states that Hungary's obligations arising from its EU membership, particularly the regulations regarding the Schengen Borders Code, cannot be changed by the bilateral agreement (Magyarország, 2025, Annex 2, Art. 32(5)). Within the framework of this provision, the entry into force of the agreement at the international level should not be interpreted as a legal authority that eliminates Hungary's existing EU obligations or allows it to act outside these obligations. For this reason, it would be more appropriate to examine the legal positions of the two countries together, but also to take into account separately the different regulatory obligations to which they are subject.

Article 20, located in Section III of the agreement, includes four separate rules regarding railway border crossings. In the first paragraph, it is envisaged that border control will be carried out while the train is stopped at the border station. This provision may provide a basis for evaluating border control as a process carried out separately from the train's operating schedule but capable of affecting the operation of services. However, it is difficult to say that the legal regulation of where and under which conditions the control will be carried out is sufficient to reach the conclusion that all technical authorizations regarding the operation of the train have been granted (Magyarország, 2025, Annex 2, Art. 20(1)).

In the second paragraph of Article 20 of the agreement, railway passenger controls are linked to the joint border control rules regulated in Articles 4, 5, and 6. Considering this connection, it cannot be said that the planning of passenger transport by railway automatically eliminates the person checks to be carried out by the border police. In the conduct of border control, authority,

place of control, order of procedures, and relevant national legal provisions need to be evaluated separately. Based on the railway provisions regarding the establishment of the joint control point on Hungarian territory, making an interpretation that the personnel on duty have completely relinquished their powers arising from the laws of their own states would also not be compatible with the existing legal framework (Magyarország, 2025, Annex 2, Art. 4-6, 20(2)).

In the third paragraph of Article 20 of the agreement, it is envisaged that cargo controls will be carried out separately by the officials of the two parties on the territories of their own states. This regulation is important in terms of understanding the distinction between the joint control point that may be envisaged for passenger controls and the legal procedures regarding cargo controls. Considering the use of the expression "cargo (goods) control" in the agreement, it would not be correct to conclude that all customs and railway safety procedures will be carried out by the same personnel and at the same place. Customs procedures, the control of persons at the border, and technical authorizations regarding train operation may fall within the areas of authority of different authorities within the framework of the relevant legislation (Magyarország, 2025, Annex 2, Art. 20(3), 6(1)).

In the fourth paragraph of the same article, a special regulation is included regarding the separate carrying out of border controls at the railway crossing points on the parties' own territories for certain direct international passenger trains operating without stopping between the departure and arrival points of the two parties. The relevant paragraph is a normative regulation determining the border control procedure that may be applied in the event that such a form of operation takes place (Magyarország, 2025, Annex 2, Art. 20(4)). For this reason, it should be taken into account that evaluating the different control procedures included in the four paragraphs under a single concept of "joint train control" may obscure legal distinctions.

The importance of these differences in terms of bilateral institutional analysis may be sought in the fact that procedures regarding border crossing cannot be reduced to the authority of a single institution or a single technical condition. The place where person controls will be carried out and the applicable law, the territorial distribution of cargo controls, the order of controls, and technical authorizations regarding train movement require examination through different document types. For this reason, Article 20 was used in the analysis as a primary source showing the legal framework of the duties in question rather than as evidence explaining the cause of actual delays.

In Article 21 of the agreement dated 2025, provisions regarding the Kelebia-Subotica railway border crossing, and in Article 22, provisions regarding the Röszke-Horgoš railway border crossing were regulated separately. Both articles include regulations regarding international passenger and goods traffic, unlimited working hours, trains carrying dangerous goods, and the carrying out of passenger controls at the joint control point to be established on Hungarian territory. However, the existence of similar normative provisions requires approaching with skepticism the interpretation that these two separate border crossings belong to the same railway line or the same scheduled service (Magyarország, 2025, Annex 2, Art. 21(1-4), 22(1-4)).

The border crossing on which this research focuses in the main Belgrade-Budapest corridor has been determined as Kelebia-Subotica. Article 21(3) of the agreement envisages that passenger controls at the joint control point will be carried out by the officials of both parties on Hungarian territory. However, the location of the joint control point on Hungarian territory should not be interpreted as meaning that all of Serbia's border control powers have been transferred to the Hungarian authorities. The legal basis of the controls in question consists of the joint control regime envisaged in the agreement and the relevant legislation of each state. Operator records showing that passenger service has actually begun, detailed implementation documents regarding joint control procedures, and technical operating authorizations are evaluated as matters that need to be verified through separate sources (Magyarország, 2025, Annex 2, Art. 4(3), 21(3), 29).

Article 22 of the agreement regulates provisions regarding international passenger and freight transport at the Röszke-Horgoš border crossing. However, it is difficult to say that announcements regarding line 136 related to the Szeged-Röszke-Horgoš-Subotica connection or passenger routes involving transfers constitute evidence that direct Budapest-Belgrade services are operated on line 150 via Kelebia. Ignoring this geographical distinction may cause passenger service existing at another border crossing to be incorrectly transferred to the S5 status of the main corridor. For this reason, Articles 21 and 22 were addressed comparatively, but operational data regarding the two border crossings were kept separate from each other.

It is seen that Articles 21 and 22 of the agreement regulate the conditions regarding the carrying out of health and phytosanitary controls in different ways. While Article 21(5) of the agreement envisages reaching an agreement through diplomatic channels if the necessary conditions are met and compliance with EU law is determined, Article 22(5) includes the condition that the competent authorities agree in advance (Magyarország, 2025, Annex 2, Art.

21(5), 22(5)). This difference indicates that evaluating the two articles as regulations having the same legal content may overlook certain procedural distinctions. However, based on the normative difference in question, additional implementation records will be needed to reach the conclusion that certain health controls were actually carried out at Kelebia or Röszke.

Article 28 of the agreement envisages that the Hungarian-Serbian Joint Border Traffic Committee, established through the arrangement dated 2012, will continue its activities. Provisions are also included regarding the committee, consisting of representatives of the competent authorities, meeting through consultations when necessary and alternately on the territories of the two states. This regulation can be interpreted as meaning that the continuity of the previous institutional structure was taken into account in the new agreement. However, it is difficult to say that there is sufficient evidence to claim, based on the legal existence of the committee, that meetings were held for every concrete railway problem in 2026 or that the decisions taken produced particular operational results (Magyarország, 2025, Annex 2, Art. 28(1-3)).

Article 29 of the agreement envisages that the details regarding the operation of joint border crossing points and border control duties will be determined by the competent authorities within the framework of joint operating procedures. The second paragraph of the same article states that the previous procedures determined according to the 2012 agreement and not contrary to the new arrangement will remain in force. When these provisions are evaluated together, it can be said that the general agreement does not regulate all the details of duties and functioning regarding border control on its own, and that secondary and institutional documents at the implementation level should also be taken into account. However, it should be stated here that the full texts of the implementation protocols specific to the Kelebia-Subotica border crossing for 2026 have not been accessed (Magyarország, 2025, Annex 2, Art. 29(1-2)).

The border control agreement dated 2025 and the draft of the separate railway traffic agreement submitted by the Hungarian government for public consultation on February 2, 2026, concern different areas of legal regulation (Government of Hungary, 2026). In the Hungarian government's Decision No. 1024/2026 (II. 3.), authorization was granted for the finalization of the agreement text regarding cross-border railway traffic, and provisions were subsequently included regarding the legislative procedures to be submitted to parliament. In the 23-page draft law and agreement published by the government, it is seen that the law number for 2026 and the place and date of signature were left blank (Magyarország Kormánya, 2026, decision points 1-4; Government of Hungary, 2026, draft PDF pp. 1, 23). These documents can be

evaluated as official records of the preparation process regarding the regulation. However, the government's granting of authorization for the finalization of the agreement text is not, on its own, a sufficient basis for reaching the conclusion that the signature, parliamentary approval, and international entry-into-force procedures have been completed, and it should also be stated that the process is continuing**.**

The draft railway traffic agreement includes regulations regarding infrastructure managers, operators, railway vehicles, and the organization of cross-border traffic. While Article 14 of the draft links border controls to a separate bilateral border control agreement, Article 20 envisages the entry-into-force procedure to be applied following the completion of the necessary national procedures (Government of Hungary, 2026, draft Art. 14, 20). Although these provisions explain the normative design of the agreement at the preparation stage, they should not be evaluated as evidence that the parties had put the regulations in question into effect as of the research cutoff date. Taking this distinction into account, the duties of border control authorities and the powers and responsibilities regarding railway traffic management are addressed separately.

6. 2024-2026 Official Operational and Technical Preparation Records

When examining the operational chronology of the Serbian section, official targets and activities reported to have taken place need to be distinguished from each other. In the statement of the Serbian government dated June 7, 2024, it was stated that the operation of Soko trains between Belgrade and Subotica from December 1, 2024, was targeted (Government of the Republic of Serbia, 2024a). However, it is difficult to say that the announcement in question constitutes evidence that commercial transport actually began on the targeted date. For this reason, the statement was classified as an announced target under code S0. It can be said that this source alone does not provide a sufficient basis for making a causal evaluation regarding the possibilities that the plan announced in June may have changed on subsequent dates or that other conditions may have been required for the commencement of operation.

The statement of the Serbian government dated December 20, 2024, concerns the presentation of certain construction and authorization documents regarding the Belgrade-Subotica-Kelebija railway project to the public through the central electronic system. In the statement, it was indicated that the documents available in the relevant system as of December 12 had been published (Government of the Republic of Serbia, 2024b). Although this record verifies that some of the project documents were opened to public scrutiny, it

does not mean that each document was examined separately in terms of its validity, technical reliability, and usability. The announcement of the Serbian government dated February 2, 2025, also addressed the sharing of documents regarding railway construction with the public (Ministry of Construction, Transport and Infrastructure, 2025). For this reason, document publication processes should not be considered equivalent to final operational records verifying that physical works within the scope of S1 have been completed.

In the statement of the Serbian government dated October 3, 2025, it was reported that the Novi Sad-Subotica high-speed railway section was opened, tests were carried out before the opening, and a ceremonial train movement took place (Government of the Republic of Serbia, 2025a). This statement differs from the target announced in June 2024 in terms of both date and type of evidence. The opening in question can be evaluated as an official statement that progress was made toward putting a particular infrastructure section on the Serbian side into use. However, based on this record, there is no sufficient basis to conclude that regular and direct passenger services between the two countries via Kelebia have begun or that all technical authorizations on the Hungarian section have been completed.

When these three groups of records are evaluated together, it is seen that the Serbian authorities included targets, document publication procedures, tests, and the opening of the line section on different dates in their official statements regarding the railway project. Which legal or technical stages the records in question correspond to was classified on the basis of the operational codes defined in the method. In this evaluation, no single cause of delay unsupported by the sources was put forward, and where necessary, the difference in evidence between official statements and independent technical completion reports was also specified.

In comparing railway operation between the two countries, the geographical scope of passenger transport needs to be taken into account. In Srbijavoz's 2025/2026 timetable announcement dated December 12, 2025, information regarding domestic passenger service on the Belgrade-Subotica route was included. Although this record verifies the existence of train service on the Serbian side, it is not very likely to evaluate it as evidence showing that the trains continued to Budapest via Kelebia, since the final station is Subotica (Srbijavoz, 2025b). For this reason, the service in question was classified as P-DOM in the operational coding defined in the method. Considering domestic passenger service equivalent to the S5 status representing direct international passenger transport would be an interpretation going beyond the scope supported by the available route and operator records.

In another announcement by Srbijavoz regarding the 2025/2026 timetable, a travel option to Budapest with transfers via Subotica and Szeged was included. It is understood from the accessible timetable records that the use of more than one train and making transfers were envisaged on this route (Srbijavoz, 2025a). However, the existence of the possibility of international travel with transfers does not mean that a direct and uninterrupted train service is operated between Budapest and Belgrade. In addition, the Röszke-Horgoš railway border crossing used by the Szeged connection is different from the main Kelebia-Subotica crossing. Considering this geographical and operational distinction, it can be said that the fact that both border crossings have been legally regulated as open to international passenger traffic is not sufficient to reach the conclusion that a passenger service of the same nature is actually provided.

The scope of access to operator sources should also be taken into account separately. The accessible statements of Srbijavoz regarding the 2025/2026 timetable were used only in terms of the relevant routes and announced service types (Srbijavoz, 2025a, 2025b). However, it would not be appropriate to conclude, based on these sources, that all service numbers and times remained valid without change as of July 31, 2026. In addition, domestic passenger service and the possibility of transport with transfers via Szeged were not evaluated as evidence verifying that regular and direct international passenger service via Kelebia had begun.

In the statement of the Hungarian Ministry of Construction and Transport dated March 30, 2026, it was reported that the physical infrastructure elements on line section 150 in Hungary of the Belgrade-Budapest railway project had been completed. In the same statement, while information regarding the railway track, signalling, and station infrastructure was included, it was stated that the European Train Control System (ETCS) tests required for passenger operation at the level of 160 km/h were continuing (Építési és Közlekedési Minisztérium, 2026). This statement shows that the ministry addressed the completion of physical infrastructure and the fulfillment of the technical conditions required for passenger operation as different stages. Therefore, the official statement regarding physical completion should not be considered equivalent to an authorization document verifying that all technical permissions have been obtained.

In the same statement, it was also stated that the German TÜV examination was continuing. The ministry defined the examination in question as a safety verification additionally requested by the relevant minister before the commencement of passenger operation, rather than as a condition required by general legislation in every case. Considering this distinction, it would not be

appropriate to evaluate the request for an independent examination and the official technical authorization process envisaged in EU railway legislation within the same legal category. Although the fact that the TÜV examination was requested can be verified from the official statement, as of the information cutoff date of July 31, 2026, the definitive result document showing that the examination in question had been completed and all the necessary final authorization records regarding the ETCS system could not be accessed in the sources examined. For this reason, claiming that both processes have been completed would be an evaluation going beyond the level of evidence supported by the available documents (Építési és Közlekedési Minisztérium, 2026).

In MÁV's operator announcement dated May 7, 2026, it was explicitly stated that there was no passenger traffic yet on the Hungarian section of the Belgrade-Budapest line as of that date, while freight trains were being operated (MÁV, 2026). This announcement documents the situation stated by the operator on a particular date, unlike the service change page that can be updated. However, it would not be correct to use the record in question as a document verifying the current status of international passenger service or the completion of final technical authorizations as of July 2026. Accordingly, records regarding freight operation and evidence that could verify the commencement of direct international passenger service were evaluated separately.

February 27, 2026, can be evaluated as an important operational threshold in terms of comparing the commencement of freight transport in the official statements of the two states. In the economy-focused statement published by the Serbian government on the same day, it was reported that freight traffic had begun on the Belgrade-Budapest railway (Government of the Republic of Serbia, 2026b). The development in question was also included in another government announcement dated the same day (Government of the Republic of Serbia, 2026a). Although these announcements are dated institutional statements, their publication through the same news system does not allow each of them to be evaluated as an independent train movement or transport document. In the operational classification defined in the method, these official statements reporting the commencement of international commercial freight transport were coded under S4.

In the statement of the Hungarian Ministry of Construction and Transport dated March 30, 2026, it was also stated that freight traffic had begun on February 27. In the same statement, it was reported that the number of freight trains entering and leaving via Kelebia had reached 150 after the first month (Építési és Közlekedési Minisztérium, 2026). This numerical data is based on the ministry's official statement and was not recalculated in the research through

independent train records, customs statistics, or operator data. Therefore, although the volume of services reported by the ministry can be conveyed at the level of an official statement, reaching a direct conclusion regarding the commercial efficiency or financial success of the line based solely on this number would be an evaluation exceeding the scope of the available evidence.

In the statement of ÖBB Rail Cargo Group dated June 24, 2026, it was stated that the Budapest-Kelebia-Belgrade connection had been reopened to freight transport from the end of February 2026 and that freight trains used the Kelebia-Subotica border crossing instead of the alternative Röszke-Horgoš route used during the construction period (Rail Cargo Group, 2026). This statement can be evaluated as a dated operator statement regarding the route used in freight transport. However, it cannot be said that the record in question is sufficient on its own to verify the concrete legal basis of the procedures applied in border controls or that the separate railway traffic agreement dated 2026 entered into force.

The difference in dates between the official statements reporting that freight transport began on February 27, 2026, and the entry into force of the 2025 border control agreement at the international level on March 14, 2026, is important in terms of operational chronology. Based on the official statements, it is understood that freight transport began before the entry into force of the new border control agreement. Considering this chronology, it is difficult to say that the causal interpretation directly linking the commencement of freight transport to the entry into force of the new agreement has a sufficient basis. However, within the framework of which previous control procedures freight trains crossed the border, how long the controls lasted, and how detailed customs procedures were carried out cannot be determined solely through these dates. Article 29(2) of the 2025 agreement includes provisions regarding the continuity of the implementation procedures determined according to the arrangement dated 2012. This regulation may provide a basis for evaluating the legal position of previous border control procedures. However, it would not be correct to use it in place of operational records verifying the procedures applied on a particular date (Magyarország, 2025, Annex 2, Art. 29(2); Külgazdasági és Külügyminisztérium, 2026).

Although this observation does not explain in all aspects the conditions under which the transport activity took place, it can be evaluated as a concrete example of the distinction between legal entry into force and actual operation. For this reason, the S4 status representing freight transport should not be considered equivalent to S5 regarding direct international passenger service or S6 expressing actual border control. It would also not be appropriate to consider

the uncertainty regarding passenger service as resolved based on the commencement date of freight transport.

As of the information cutoff date of July 31, 2026, no definitive operator timetable or decision to commence service verifying that regular and direct Budapest-Belgrade international passenger service via Kelebia-Subotica had begun could be accessed in the sources examined. In MÁV's announcement dated May 7, 2026, it was stated that passenger operation did not yet exist on the Hungarian section. In contrast, in the statement of the Serbian Minister of Transport reported in the RTS news dated July 22, it was stated that the final ETCS Level 2 checks in Hungary were continuing and that the definite commencement date depended on a joint decision by the two parties (MÁV, 2026; RTS, 2026). However, it is difficult to say that these two dated statements mean that all actual operational records had been examined as of July 31, 2026. For this reason, the S5 status was evaluated in the research as an operational stage that had not yet been definitively verified within the framework of the accessible documents. Domestic trains in Serbia and travel options with transfers via Szeged were addressed under different operational categories (Srbijavoz, 2025a, 2025b).

In the statement of the Hungarian Ministry of Construction and Transport dated March 30, 2026, it was stated that the ETCS tests required for passenger operation at the level of 160 km/h and the additionally requested TÜV examination were continuing, and that no political deadline had been set for the commencement of service (Építési és Közlekedési Minisztérium, 2026). In the statement of the Serbian Minister of Transport reported by RTS on July 22, 2026, attention was drawn to the continuation of the final ETCS Level 2 checks in Hungary and to the fact that the commencement date of direct passenger service depended on a joint decision by the two parties (RTS, 2026). These statements can be evaluated as official declarations indicating that technical preparations and discussions regarding the operating schedule were continuing. However, claiming that the statements in question independently verify that the final ETCS authorization or TÜV assessment had been completed or that regular and direct international passenger service had begun would exceed the scope of the available evidence.

In MÁV's statement dated May 7, 2026, it was stated that there was no passenger operation yet on the Hungarian section at that date, while freight trains were operating (MÁV, 2026). However, reaching the conclusion based on this statement that the same operational situation continued on all subsequent dates would not be a very realistic approach. For this reason, in the analysis, determining which type of service was documented on which date and by which

competent source was taken as the basis, rather than making a general judgment independent of date regarding whether the service had begun. Considering this distinction, the regulation of the border crossing point regarding international passenger traffic in Article 21 of the 2025 agreement should not be considered equivalent to an operator record verifying that direct scheduled international services had actually begun.

7. Regulatory Comparison of Countries and Institutions

Since Hungary is a member of the EU and part of the Schengen system, it will not be sufficient to evaluate the control procedures at its common border with Serbia solely within the framework of rules arising from bilateral agreements. The Schengen Borders Code No. 2016/399 includes general provisions regarding the crossing of external borders by persons and special regulations regarding controls in railway traffic in Section 1.2 of Annex VI (European Parliament and Council of the European Union, 2016c, Art. 2, 8, Annex VI 1.2). The provisions in question concern border controls of persons travelling by train. Decisions regarding the technical safety of railway vehicles, ETCS tests, and the commercial timetables of operators should not be addressed within the scope of the same legal regulation.

Article 32(5) of the bilateral agreement dated 2025 explicitly states that Hungary's rights and obligations arising from its EU membership, particularly the provisions of the Schengen Borders Code, cannot be changed by the agreement in question. In addition, Article 6(1) envisages that Hungary's customs, health, and phytosanitary controls will be carried out on Hungarian territory in accordance with EU law (Magyarország, 2025, Annex 2, Art. 6(1), 32(5)). When these provisions are evaluated together, it can be said that a distinction needs to be made between the regulation of passenger controls at the joint border crossing point and subjecting all public powers to the same procedures. Therefore, it would not be appropriate to interpret bilateral arrangements aimed at accelerating border crossings as eliminating the scope of the relevant control duties subject to EU law.

In the legal framework regarding railway operation, the Interoperability Directive No. 2016/797 and the Railway Safety Directive No. 2016/798 regulate a different normative area. While the first directive covers the technical interoperability of the EU railway system and the relevant conformity and authorization processes, the second directive concerns the institutional and certification framework of railway safety (European Parliament and Council of the European Union, 2016a, 2016b). However, it cannot be said that there is a sufficient basis to reach the conclusion that all technical and institutional

authorizations specific to the Kelebia line have been granted based on the existence of these regulations. In particular, the statements published in Hungary regarding ETCS and TÜV processes need to be evaluated separately in terms of the legal nature of the relevant documents and the functions they fulfill.

Accordingly, Hungary's legal framework was addressed at three separate levels: border control of persons, railway technical safety, and operation and timetable regulations. The fact that the areas in question fall within the obligations of the same state should not be interpreted as meaning that all procedures can be completed by a single institution or through the same document.

It would not be appropriate to examine Serbia's railway law by directly taking as the basis the regulations applicable to EU member states. The Law on Interoperability of the Railway System No. 62/2023, published by the Serbian Railway Directorate, regulates the national legal framework regarding design, construction, renewal, commissioning, operation, and maintenance processes. Article 1 of the law includes matters regarding the scope of the regulation, while Article 67 includes matters regarding entry into force and the time of application of certain provisions. The fact that the application of certain provisions has been linked to Serbia's EU membership indicates that the alignment of national legislation with EU law and legal applicability in EU member states should not be evaluated at the same level (Republic of Serbia, 2023, Art. 1, 67).

Serbia's national railway safety legislation also needs to be examined separately in terms of the competent authorities responsible for technical operation. Which provisions of EU directives have been transposed into national laws and whether they were in force on the relevant dates should be verified for each regulation individually. For this reason, the research avoided both the generalizing approach that Serbia is completely outside EU railway law and the view that it automatically directly applies all EU regulations. Although the available primary sources allow the comparison of selected national regulations, claiming that all secondary regulations and authorizations have been examined completely as of July 31, 2026, would exceed the evidentiary scope of the research.

In the version of Serbia's Border Control Regulation No. 104/2018 published in 2018 by the Serbian Ministry of Internal Affairs, Articles 13-16 include national procedures regarding railway border control (Ministarstvo unutrašnjih poslova Republike Srbije, 2018, Art. 13-16). However, the fact that the version in question has been examined does not mean that the current text of these provisions, including all amendments as of July 31, 2026, has also been

verified. In addition, it would be more appropriate not to consider these national regulations equivalent to the joint implementation procedures envisaged for the Kelebia-Subotica border crossing in the bilateral agreement dated 2025. In accordance with this distinction, national person controls and border procedures, and the international agreement and possible joint implementation protocols were addressed within the framework of different document types and levels of evidence.

In the statement of the Serbian railway authority dated 2023, it was reported that discussions were held with the Hungarian authorities on railway safety and technical regulations (Direkcija za železnice, 2023). This statement can be evaluated as an official declaration that the regulatory differences between the two countries were made a subject of discussion at the institutional level. However, original procedural records from the subsequent period will be needed to claim that the discussions in question resulted in the granting of a particular operating authorization in 2026. For this reason, the comparison of national legislation was limited to the examination of institutional responsibilities and legal positions that can be verified through documents.

The institutional scope of coordination between the two states should not be addressed as limited to the responsibilities of border control officials. Articles 28 and 29 of the 2025 agreement include provisions regarding the continuation of the activities of the joint border traffic committee and the joint operating procedures through which duties at crossing points will be detailed. In contrast, the responsibilities of railway infrastructure managers, train operators, and technical safety authorities are different from the duties of the border police. The determination of commercial timetables, the use of railway infrastructure, the authorization of vehicles, and the fulfillment of personnel and safety conditions may require different decision-making processes. For this reason, institutional coordination was addressed in the research through the powers and responsibilities specified in the relevant documents rather than combining the duties of the institutions in question within the scope of a general "two-government decision."

It is seen that the draft of the separate railway traffic agreement dated 2026 also includes regulations regarding this institutional distinction. While the draft addresses infrastructure managers, operators, border stations, railway vehicles, and authorization obligations, it refers to a separate bilateral agreement regarding border control (Government of Hungary, 2026, draft Art. 14). These provisions indicate that, in the normative design at the preparation stage, the areas of responsibility of border control authorities and institutions responsible for railway activities were addressed separately. However, because the place

and date of signature were left blank in the draft version presented to the public and the final signature and entry-into-force procedures could not be verified in the records examined, there is insufficient evidence to conclude, based on this document, that a new interstate railway traffic regime was being applied as of July 31, 2026.

The comparison of the official statements of Serbian and Hungarian authorities may also provide a basis for evaluating the differences between institutional duties. While targets, the opening of certain railway sections, and the commencement of freight transport come to the forefront in Serbian statements, the statement of the Hungarian Ministry of Construction and Transport dated March 2026 includes conditions regarding tests before passenger service and the additional safety examination. This difference can be evaluated as indicating that the statements focus on different subjects and institutional responsibilities rather than being interpreted as meaning that the parties have conflicting hidden objectives (Government of the Republic of Serbia, 2025a, 2026b; Építési és Közlekedési Minisztérium, 2026). In addition, the statement of the Serbian Minister of Transport reported by RTS on July 22, 2026, also included the ETCS checks on the Hungarian section and the expectation of a joint decision by the two parties regarding the commencement date of direct passenger service (RTS, 2026). In the research, no prior assumption was adopted that both parties must be at the same operational stage on the same date.

When Hungary's EU and Schengen obligations and Serbia's national railway and border legislation are addressed together, it is seen that the two states are involved in regulations regarding the common railway corridor despite their different legal positions. These legal differences need to be taken into account in terms of understanding the coordination of the concrete duties envisaged in the bilateral agreement. However, the existence of different legal obligations alone will not be sufficient to make an evaluation that coordination has failed or that the delay in train operation resulted from these differences. In order to put forward such a causal relationship, it will be necessary to examine separately the correspondence between competent authorities, decision records, or direct procedural documents.

The joint passenger control provisions included in the 2025 agreement, the separate carrying out of freight controls by the parties on their own territories, and the possibility of previous implementation procedures continuing under certain conditions indicate that the normative distribution of duties is regulated at different levels. However, since all the details of the implementation protocols could not be accessed, how this distribution of duties was actually

implemented in concrete cases cannot be fully evaluated through the available documents. Similarly, the statements dated May and July 2026 were not accepted as evidence that all final technical authorizations within the scope of S3 had been granted or that direct international passenger service within the scope of S5 had actually begun (MÁV, 2026; RTS, 2026).

This comparison may provide a basis for the evaluation that investment, border control, railway technical safety, and transport service are regulated through different normative and institutional instruments in the same cross-border corridor. Although the legal nature of the instruments in question and the operational statuses included in official statements can be compared, it is difficult to say that the available documents provide a sufficient basis for making a definite evaluation regarding how all the processes affect one another or which result a particular cause produces. For this reason, in terms of the main research question, regulatory asymmetry was used as an explanatory context and comparison criterion and was not transformed into a general theory of delay.

8. Discussion

The findings obtained in the previous sections indicate that explaining Serbia-Hungary railway cooperation through a single completion or opening date may not be sufficient. The main distinction here is that the legal regulation of border crossing, the technical evaluation of infrastructure and railway vehicles, and the actual operation of a particular transport service are based on different document types and institutional authorities. Indeed, while Articles 20-22 of the 2025 border control agreement regulate procedures regarding railway passenger and freight controls and the Kelebia-Subotica and Röszke-Horgoš border crossings, Articles 28 and 29 include the institutional framework regarding the joint committee and implementation procedures (Magyarország, 2025, Annex 2, Art. 20-22, 28-29). However, it would not be appropriate to interpret these normative regulations as automatically covering procedures regarding the technical certification of trains or operators' scheduled service decisions. For this reason, the distinction between legal authority and actual implementation was adopted as the main analytical criterion for not combining different activities and operational situations on the same railway line under a single status within the scope of codes S4-S7.

The concrete counterpart of this distinction is seen in the chronological sequence between the statements of the Serbian government on February 27, 2026, regarding the commencement of international freight transport and the entry into force of the 2025 border control agreement at the international level

on March 14, 2026 (Government of the Republic of Serbia, 2026b; Külgazdasági és Külügyminisztérium, 2026). In the statement of the Hungarian Ministry of Construction and Transport dated March 30, it was also stated that freight transport began on February 27 (Építési és Közlekedési Minisztérium, 2026). When these records are evaluated together, it is understood that, according to the official statements, freight transport began before the new agreement entered into force at the international level. Therefore, evaluating the commencement of freight transport directly as a result of the entry-into-force procedure dated March 14 would not be compatible with the chronological sequence in question. However, it cannot be understood from the available statements within the framework of which detailed border control procedures freight trains were processed on February 27. The provision in Article 29(2) of the agreement allowing the continuation of previous implementation procedures under certain conditions may provide a basis for examining legal continuity. However, it would not be very realistic to evaluate this provision as a record directly verifying the border control procedures actually applied on February 27 (Magyarország, 2025, Annex 2, Art. 29(2), 32(7)).

It is possible to say that, in this situation, evaluating bilateral border coordination solely through the entry into force of an agreement may not be sufficient. When the legal duties of border control authorities, the technical preparations of infrastructure managers, and the services provided by train operators are not examined through different document types, the existence of legal regulations and the completion of all stages of operation may be confused with each other. In the statement of the Hungarian Ministry of Construction and Transport dated March 2026, the treatment of ETCS tests and the additionally requested TÜV examination as different technical conditions before passenger operation can be evaluated as another example of this distinction (Építési és Közlekedési Minisztérium, 2026). MÁV's announcement dated May 7 and the official statement reported by RTS on July 22 provide dated information regarding the status of passenger operation and ongoing preparations. However, in the document corpus examined, definitive records verifying that all final technical authorizations had been completed or that regular and direct international passenger service via Kelebia had begun could not be accessed. For this reason, making an evaluation that the service had actually begun or definitely had not begun as of July 31, 2026, would exceed the scope of the available evidence (MÁV, 2026; RTS, 2026). The main contribution of the comparison, however, may be sought in revealing through which documents and to what extent each operational status can be verified, rather than eliminating the uncertainty in question.

The relationship of these findings with the existing literature becomes apparent primarily at the different levels of examination of the studies. Rogers (2019) addressed China-linked investment decisions in Hungary within the framework of the influence of political actors on economic development. Szabó and Jelinek (2023), on the other hand, examined the same project in terms of multiscalar state-capital relations. Mohan and others (2024) compared Hungary with Germany and Italy and drew attention to central and local state relations in Chinese-supported transport infrastructure projects. When these studies are evaluated together, it can be said that explaining large-scale infrastructure investments solely through market conditions or financing relations between two governments may not be sufficient. The documents examined in the present research also provide a basis for taking into account the duties of different public authorities in the process. However, it is not claimed that there is a direct causal relationship between financing decisions and the daily implementation of border controls (Rogers, 2019; Szabó & Jelinek, 2023; Mohan vd., 2024).

Peragovics and Szunomár (2024) argued that the Belgrade-Budapest railway line was associated with the idea of establishing a connection between East and West in Hungary's foreign policy identity. This approach may contribute to the evaluation of the political meaning of official infrastructure statements. However, it would not be appropriate to use it as a source directly documenting which procedures the joint border committee carried out on a particular date or which timetable the train operator put into effect. For this reason, the comparison of the connectivity target in official discourse with legal practices and operational records is directed toward the examination of a more specific documentary question that the approach in question does not directly answer, rather than rejecting the previous foreign policy identity explanation.

The closest overlap with the existing literature can be seen in the study by Pinna and Neuman Stanivukovic (2026), which examined how technical, financial, environmental, social, and governance standards shape evaluations regarding the success or failure of infrastructure projects. The different standards regimes and the distribution of responsibilities among institutions addressed by the authors can be evaluated together with Serbia and Hungary's regulation of the same railway corridor within the framework of different legal systems. However, in the present research, no new conclusion regarding the failure of the project is put forward based on the institutional differences in question. In particular, the EU's railway safety and interoperability regulations, the border control of persons within the scope of Schengen, and the provisions of the 2025 bilateral agreement regarding freight control correspond to different legal areas. For this reason, evaluating every regulatory difference as direct

evidence of the same standards conflict may be an interpretation going beyond the scope supported by the available documents. Within this framework, the contribution of the research may be sought in presenting a more specific comparison that prevents particular legal and operational statuses from being used in place of one another, rather than re-explaining the geopolitical meaning of standardization.

Neuman Stanivuković (2025), in the published article, associated the different rhythms of progress of infrastructure projects over time with growth and geopolitical politics. Considering this study, it would not be very realistic to evaluate the temporal difference between the target announced in 2024 and the subsequent section opening and technical preparation statements as an original theoretical finding on its own. In the present research, however, the dates in question were used to distinguish different evidentiary statuses, such as S0 target, S2 testing, S4 freight transport, and S5 direct international passenger service that has not yet been verified, rather than to prove the political causes of delays. This comparison can be associated with the author's temporal politics approach. However, it is seen that the examined text of the article does not include a direct legal analysis regarding Articles 20-22 of the bilateral border control agreement dated 2025 (Neuman Stanivuković, 2025, pp. 695-711).

Linking the differences observed between legal regulations, technical preparations, and actual services to a single cause of delay would not be a sufficient explanation in terms of the available evidence. The physical condition of infrastructure construction, ETCS tests, authorizations of competent authorities, commercial preferences of operators, border control procedures, and financing conditions can be evaluated as possible areas of explanation that need to be examined separately in terms of delays. For example, in the statement of the Hungarian Ministry of Construction and Transport dated March 2026, the commencement of passenger operation was linked to the condition of completing the tests and the additionally requested independent examination. However, it would not be appropriate to interpret this institutional statement as revealing the single and definite cause of delays along the entire route (Építési és Közlekedési Minisztérium, 2026). In order to attribute a direct causal role to Chinese financing or obligations arising from EU membership, additional evidence supported by relevant procedural, decision, and implementation records will be needed.

The types of documents that may require the reevaluation of the interpretations reached in the research have also been identified. In the event that a signed and published railway traffic agreement dated 2026, dated final technical authorizations, a timetable verifying direct international passenger

service via Kelebia, or a concrete implementation protocol of the border committee is accessed, the relevant legal and operational statuses will need to be reclassified. In contrast, the absence of a document from the document corpus examined should not be evaluated as a sufficient basis for concluding that the relevant activity never took place. Within the framework of the available sources, it can be stated that the different normative, institutional, and operational levels of cross-border railway cooperation can be traced through separate document types. This evaluation can be addressed as a more specific comparison focusing on border control and operational records in the 2025-2026 period, rather than as a comprehensive explanation replacing the literature on financing and standardization.

9. Conclusion

The main research question can be answered in the direction that explaining cross-border coordination on the Belgrade-Budapest line through a single legal procedure or operational date would not be sufficient. In Serbian and Hungarian official documents regarding the January 2024-July 2026 period, the legal framework of border control, the duties of the relevant institutions, and the different preparation and operational statuses of transport activities can be traced through separate records. However, this distinction should not be interpreted as meaning that the processes in question were carried out independently of one another or that there is no relationship between them. Within the framework of the available documents, it can be concluded that each status needs to be evaluated separately in terms of different competent authorities, types of procedures, and verification conditions.

In the first area of examination, Article 20 of the border control agreement signed on October 22, 2025, includes provisions regarding the general rules of railway controls, Article 21 regarding the Kelebia-Subotica border crossing, and Article 22 regarding Röszke-Horgoš, which is a separate crossing. The joint committee and implementation procedures are regulated in Articles 28 and 29, while the entry-into-force process through diplomatic notification is regulated in Article 32 (Magyarország, 2025, Annex 2, Art. 20-22, 28-29, 32). Following the publication procedure in Hungary and the national approval procedures in Serbia, the agreement entered into force at the international level on March 14, 2026 (Külgazdasági és Külügyminisztérium, 2026). However, it would not be appropriate to conclude that the legal regulations in question directly document all stages regarding the actual implementation of joint border controls.

In the second area of examination, it was determined that the target announced in 2024, the statement regarding the opening of the Novi Sad-

Subotica section dated October 3, 2025, domestic passenger timetables, and technical testing records represent different operational statuses (Government of the Republic of Serbia, 2024a, 2025a; Srbijavoz, 2025b). In the statement of the Serbian government dated February 27, 2026, it was reported that international freight transport had begun, and the announcement of the Hungarian Ministry of Construction and Transport dated March 30 also included the same commencement date (Government of the Republic of Serbia, 2026b; Építési és Közlekedési Minisztérium, 2026). This date on which freight transport was reported to have begun falls before the entry into force of the new border control agreement at the international level. However, the chronological distinction in question does not, on its own, explain within the framework of which concrete border control protocols freight trains were processed. In MÁV's statement dated May 7, 2026, it was stated that passenger service did not yet exist on the Hungarian section, while in the statement of the Serbian Minister of Transport reported by RTS on July 22, it was stated that the final ETCS checks in Hungary were continuing (MÁV, 2026; RTS, 2026). Although these records provide information regarding the operational and preparation situations on the relevant dates, they should not be evaluated as definitive documents verifying that all final technical authorizations had been completed or that regular and direct international passenger service via Kelebia had begun as of the end of July 2026.

In the third area of examination, while Hungary's Schengen obligations constitute the legal framework regarding external border controls of persons, railway safety and interoperability regulations were addressed as separate areas of law (European Parliament and Council of the European Union, 2016a, 2016b, 2016c). In Serbia's national Law No. 62/2023, however, it is seen that the application of certain provisions is linked to EU membership (Republic of Serbia, 2023, Art. 1, 67). Considering these differences, the common railway corridor needs to be evaluated within the framework of the non-identical legal positions of the two states. In the fourth area, operational targets and technical preparations were examined through official statements. In addition, although official authorization was granted for the finalization of the text of the separate railway traffic agreement dated 2026, it was determined that the accessible version of the agreement was in draft form and that the examined document corpus did not contain records of final signature and entry into force at the international level (Magyarország Kormánya, 2026; Government of Hungary, 2026). For this reason, claiming on the basis of these documents that a new traffic regime had been put into effect with all its legal procedures completed or

that the states had undisclosed intentions would exceed the scope of the available evidence.

In the fifth area of examination, Chinese financing and investment regulations were evaluated as documents explaining the historical and economic background of the railway line (Magyarország, 2016, 2020). However, it is difficult to say that the documents in question alone provide a sufficient basis for directly explaining the causes of particular border control procedures or developments regarding passenger operation. When the five areas of examination are addressed together, it should be taken into account that the processes regarding financing, border control, technical safety, and transport service are based on different legal and institutional conditions. For this reason, combining the processes in question under a single "transition to operation" evaluation may lead to overlooking the different statuses that can be determined through the available documents.

The limitations of the research arise from the fact that different source types in qualitative document analysis are not suitable for drawing conclusions at the same level. Although official statements verify which operational or preparation status the relevant authorities reported on particular dates, they do not replace independent train movement records or final authorization documents. As of the information cutoff date of July 31, 2026, in the document corpus examined, the final signature and entry-into-force procedures of the separate 2026 railway traffic agreement, all the necessary final technical authorizations regarding the ETCS system, and the definitive result of the additionally requested TÜV examination could not be determined because the process was continuing. The definitive operator record showing that regular and direct international passenger service via Kelebia had begun and all the actual implementation details of joint border control could not be accessed either. In contrast, MÁV's statement dated May 7 and the ministerial statement reported by RTS on July 22 provide more concrete institutional information regarding the status of passenger operation and technical preparations on the relevant dates (MÁV, 2026; RTS, 2026). However, the absence of these documents should not be evaluated as evidence that the activities in question definitely did not take place. Developments after July 2026, however, were kept outside the information to be determined by the research**.**

The original contribution of the research may be sought in its focus on a different area of examination rather than reproducing explanations regarding financing, state-capital relations, foreign policy identity, standardization, and temporal politics related to the Belgrade-Budapest railway. The subjects in question have been addressed from different aspects in previous academic

studies (Rogers, 2019; Szabó & Jelinek, 2023; Peragovics & Szunomár, 2024; Mohan vd., 2024; Neuman Stanivukovic, 2025; Pinna & Neuman Stanivukovic, 2026). In this research, however, the railway-specific provisions of the 2025 border control agreement and the operational statuses documented in 2026 were examined within a more specific comparison framework while preserving the source-claim relationship.

As a result, examining normative authorities, institutional preparations, and transport activities through different types of evidence may contribute to determining which conclusions regarding railway cooperation between the two countries can be supported by the available documents and which matters have not yet been clarified. The signed railway traffic agreement, final technical authorizations, operator timetables, or joint implementation records that may be accessed later may require the reevaluation of the statuses after July 31, 2026. For this reason, the conclusions reached were limited to explaining the documented legal and operational differences in the 2024-2026 period rather than making a definite judgment regarding the success or failure of coordination.

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Chapter 5

Sectoral Dynamics of Financial Distress Risk on Borsa Istanbul: An Altman Z-Score Analysis (2007-2025)

Tuğba KAYHAN*

Abstract

This study tracks the financial distress risk of 410 non-financial companies listed on Borsa Istanbul over 2007-2025, sector by sector, using the Altman Z model for manufacturing firms and the Z'' model for the rest. Scores are split into their five components, and changes are traced back to the macroeconomic and accounting developments of the period. Among manufacturing companies listed continuously since 2007, the share in the distress zone rose from 16% to 48% in 2025. The 2008 decline was driven by market value; the 2025 deterioration comes from falling operating profitability and asset turnover. The median Z-score of 17 long-listed food companies fell from 2.99 to 1.46, and the sector average stays higher mainly because recent IPOs score well on the market-value-based X4 component. In non-manufacturing sectors the distress share fell from 42% in 2019 to 17%, with electricity improving most. Part of this improvement is a mechanical effect of the move to IAS 29 (TMS 29) inflation accounting on equity items. In Türkiye the Z-score responds to market valuations, changes in accounting standards and sectoral business models, and it needs to be read with these in mind.

Keywords: Altman Z-score, financial distress, Borsa Istanbul, sectoral analysis, inflation accounting, IAS 29 (TMS 29)

JEL classification: G33, M41, L66

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1. Introduction

This chapter looks at how the financial distress risk of non-financial companies listed on Borsa Istanbul (BIST) changed by sector over 2007-2025, using Altman Z-score models. The analysis starts with the food sector, then applies the same method to the other real-sector industries on BIST and links changes in scores to the macroeconomic and regulatory developments of the period.

Beaver (1966) and Altman (1968) established the idea of using accounting ratios to predict whether firms will run into payment difficulty. More than half a century later, the Z-score that Altman (1968) derived through multiple discriminant analysis is still one of the most widely used measures of financial distress in credit analysis, academic research and investor screening (Altman et al., 2017).

Türkiye is a good setting for such a long-horizon analysis because the 2007-2025 period contains shocks of very different kinds: the global financial crisis and the 4.8% contraction in 2009 (Ministry of Treasury and Finance [HMB], 2023), the 2018 currency shock and the restructuring of the concordat (composition with creditors) regime in the same year, the 2020 pandemic, the high inflation of 2021-2023 (annual CPI of 85.51% in October 2022), and the move to IAS 29 (TMS 29) inflation accounting from 31 December 2023. Each shock moved the five ratios behind the Z-score (liquidity, accumulated profitability, operating profitability, market value and asset turnover) in its own direction and with its own intensity.

Most Z-score studies on Türkiye cover a single sector over three to five years (e.g., Erol Fidan, 2021; Yücel et al., 2024); this study covers nineteen years and all non-financial sectors at once. It uses the original Z model for manufacturing firms and the Z" model for non-manufacturing firms, and applies Z" to manufacturing firms as well as a robustness test. It also separates the mechanical effect of the move to inflation accounting on Z-score components from economically driven change.

Section 2 reviews the literature and Section 3 describes the method and data. Section 4 sets out the macroeconomic background, Sections 5 and 6 report the findings for the food sector and the other sectors, and the final section discusses the findings and concludes.

2. Literature

2.1. Development of Z-score models

Beaver's (1966) univariate analysis was the first systematic attempt to predict failure with financial ratios. Comparing failed and non-failed firms over the years before failure, Beaver showed that some ratios already separated the two groups years in advance. Altman (1968) took the approach to a multivariate setting and, using multiple discriminant analysis on a matched sample of US manufacturing firms, estimated the following function:

$$Z = 1.2 \cdot X1 + 1.4 \cdot X2 + 3.3 \cdot X3 + 0.6 \cdot X4 + 1.0 \cdot X5$$

Here X1 is working capital/total assets, X2 retained earnings/total assets, X3 earnings before interest and taxes/total assets, X4 market value of equity/book value of total liabilities, and X5 net sales/total assets. Altman (1968) classed scores above 2.99 as the “safe” zone and scores below 1.81 as the “distress” zone; the range in between is a “grey zone” where most classification errors fall.

The original model has two structural limitations: privately held firms have no market value for X4, and X5 (asset turnover) varies widely across industries. Altman addressed these with two adaptations. The Z' model uses the book value of equity in X4 instead of market value. The Z" model drops X5 altogether to reduce the industry effect, which makes it usable for non-manufacturing firms and emerging-market issuers (Altman, 2005; Altman et al., 2019):

$$Z'' = 3.25 + 6.56 \cdot X1 + 3.26 \cdot X2 + 6.72 \cdot X3 + 1.05 \cdot X4$$

In this model X4 is book value of equity/total liabilities. The constant of 3.25 was added so that scores line up with US bond-rating equivalents (Altman, 2005). Altman (2017) treats Z" with the constant as safe above 5.85, grey between 4.35 and 5.85, and distressed below 4.35. Subtracting 3.25 gives the thresholds of 2.60 and 1.10 often used in the literature for Z" without the constant.

2.2. Criticisms and alternative models

The Z-score has drawn three main criticisms. Its coefficients come from a sample of one period and one country, so its classification accuracy falls in other periods and industries (Grice & Ingram, 2001). As a single-period (static) model, it also ignores the firm's trajectory over time: Ohlson (1980) proposed a probability-based alternative using logistic regression, and Shumway (2001) showed that single-period models give inconsistent estimates and that discrete-time hazard models with market-driven variables predict better. And because the model runs on accounting data, a change in accounting standards can move scores with no change in economic reality, which matters for IAS 29, applied in Türkiye since year-end 2023.

Even so, Altman et al. (2017), testing the model on non-financial firms from 34 countries (31 of them European), report classification accuracy of about 0.75 in general, rising above 0.90 with country-specific re-estimation and additional variables. On this evidence the Z-score works better as a consistent measure of

financial health for comparing sectors and periods than as a definitive bankruptcy predictor, and that is how this chapter uses it.

2.3. Applications in Türkiye

Z-score research on Türkiye has mostly looked at one sector over a short period. Terzi (2011) used discriminant analysis on 2009-2010 food sector data to explain the success status assigned by the Z-score and found return on assets and the debt-to-equity ratio to be decisive. Erol Fidan (2021) showed that most of the 22 firms in BIST's textile, apparel and leather sector were in the distress zone in 2017-2019. Akdeniz and Güven (2023) compared the Z and Springate models for the cement sector over 2017-2021. Yücel et al. (2024) applied the Altman Z, Springate and Fulmer models to 183 BIST manufacturing firms over 2018-2022 and found that the Z-score signalled more failures than the other two. That result suggests the original model may classify conservatively (pessimistically) in Turkish conditions, which is one reason this study uses Z" as a robustness test. The chapter differs from these studies in following all of BIST's non-financial sectors together over the whole 2007-2025 period.

3. Method and Data

3.1. Sample

The sample covers non-financial companies listed on BIST over 2007-2025 with at least one year-end financial statement. Banks, insurance and pension companies, holding and investment companies, real estate investment trusts, leasing and factoring companies and brokerage houses are excluded. In these firms much of the liabilities side is the business itself and working capital has little meaning, so Z-score models were never designed for them (Altman et al., 2017). Sectors follow BIST definitions.

Financial statement items and year-end market values come from the Finnet database, annually (December) and consolidated where available. Finnet also holds financial statements for years before a firm's IPO, but there is no market value for those years. These observations are therefore left out of the original Z calculation and used only for Z", which needs no market value.

3.2. Mapping the variables to Turkish financial statement items

Variable	Altman's definition	Counterpart in this study	Model
X1	Working capital / Total assets	(Current assets − Short-term liabilities) / Total assets	Z, Z"
X2	Retained earnings / Total assets	(Restricted reserves appropriated from profit + Retained earnings/accumulated losses) / Total assets	Z, Z"
X3	EBIT / Total assets	Operating profit / Total assets	Z, Z"
X4 (Z)	Market value of equity / Total liabilities	Year-end market capitalisation / (Short-term + Long-term liabilities)	Z
X4 (Z")	Book value of equity / Total liabilities	Total equity / (Short-term + Long-term liabilities)	Z"
X5	Net sales / Total assets	Annual net sales revenue / Total assets	Z

Turkish financial statements do not report “retained earnings” as a single line, so X2 is defined as reserves appropriated from profit plus retained earnings/accumulated losses. As a robustness test, net profit for the period is also added to X2. X3 uses operating profit. Because operating profit includes other income and expenses from main operations (such as foreign exchange differences on trade transactions), an alternative calculation based on profit from main operations is also reported for currency-shock years.

3.3. Model selection and classification

The original Z model was estimated on manufacturing firms, so it is used here for manufacturing and Z" for the other real sectors (trade, services, energy, transportation, construction, information technology, etc.). Z" is also applied to the whole sample so that sectors can be compared directly. In the findings Z" is reported without the 3.25 constant; the constant only shifts the level, so the classification is the same as with the thresholds for the version that includes it (Altman, 2017).

Model	Safe zone	Grey zone	Distress zone
Z (Altman, 1968)	$Z > 2.99$	$1.81 \leq Z \leq 2.99$	$Z < 1.81$
Z" (Altman, 2005, 2017)	$Z" > 2.60$ (with constant: > 5.85)	$1.10 \leq Z" \leq 2.60$	$Z" < 1.10$ (with constant: < 4.35)

For each sector and year two measures are reported: the median score and the distribution of firms across the three zones. The median is used instead of the mean because ratios can take extreme values in firms with small asset bases or negative equity, and ratios are also winsorised each year at the 1st and 99th percentiles. The number of firms changes every year, so a fixed sub-sample of firms listed continuously since 2007 is tracked as well, to separate the effect of new IPOs on sector medians.

3.4. Effect of inflation accounting (IAS 29)

After the announcement of the Public Oversight, Accounting and Auditing Standards Authority (KGK) of 23 November 2023 and the Capital Markets Board's decision, BIST companies began reporting inflation-adjusted financial statements under IAS 29 (TMS 29) for annual periods ending on or after 31 December 2023 (Capital Markets Board of Türkiye [SPK], 2023). Scores for 2023-2025 are therefore not directly comparable with earlier years. IAS 29 restates non-monetary items (property, plant and equipment, inventories, equity items) with a general price index and leaves monetary items unchanged. This can move Z-score components with no economic change behind it. Restated fixed assets can inflate total assets and shrink ratios, restated cost of sales and depreciation can lower operating profit, and restated equity items can change retained earnings and so X2. To measure this effect, the break between 2022 and 2023 is examined separately at the component level.

4. Macroeconomic Background (2007-2025)

To interpret changes in Z-scores, the period is split into five sub-periods in which corporate balance sheets were hit through different channels. The table below lists the defining shock of each sub-period and its expected effect on the Z-score components; the findings sections test these expectations against the data.

Sub-period	Defining development	Expected effect on Z-score components
2023-2025	Monetary tightening in June 2023 (policy rate from 8.5% to 15%; Central Bank of the Republic of Türkiye [TCMB], 2023); IAS 29 from year-end 2023	Pressure on X3 from high financing costs and slowing demand; mechanical break due to inflation accounting (X1, X2, X3, X5)
2021-2022	High inflation; annual CPI of 85.51% in October 2022 (Presidency of Strategy and Budget [SBB], 2022); FAO Food Price Index at a record 159.3 in March 2022 (FAO, 2022)	Increase in X5 and X3 from nominal sales growth; margin pressure in food due to raw material costs; increase in X4 from share price gains
2020	Pandemic; the economy grew 1.8% for the year, services contracted 4.3% (Turkish Statistical Institute [TÜİK], 2021; first estimate)	Decline in X3 and X5 in service sectors; relative resilience of food firms producing staple goods
2018-2019	August 2018 currency shock; the CBRT USD buying rate rose from TRY 3.77 on 2 January 2018 to TRY 5.28 on 31 December 2018 (TCMB, 2018); the concordat regime was restructured by Law No. 7101 on 15 March 2018 (Law Amending the Enforcement and Bankruptcy Law and Certain Laws, 2018)	Decline in X2 and X3 from FX losses in firms with foreign-currency debt; loss of market value in X4
2007-2009	Global financial crisis; the Turkish economy contracted 4.8% in 2009 (HMB, 2023)	Sharp decline in X4 in 2008 due to the fall in share prices; decline in X3 and X5 as demand contracted

These shocks do not all push the Z-score the same way. High inflation can raise X5 and X3 by inflating nominal sales against assets carried at historical cost, making firms look stronger than they are, and the move to IAS 29 can undo part of this in one step. A strong nominal rise in the stock index lifts scores in the original Z model through X4, but has no such effect in the book-value-based Z" model. For this reason the findings sections break score changes down by component.

Two further channels matter for the food sector. Its raw material costs (grains, vegetable oils, sugar, milk) move with global commodity prices and the exchange rate; in 2022 the spillover of the Russia-Ukraine war into Black Sea grain and vegetable oil markets showed this channel at work (FAO, 2022). And because demand for food is less elastic than in other sectors, sales volumes hold up relatively well in crises while profitability stays exposed to cost shocks.

5. Findings: Food Sector

The median Z-score of the 17 food companies listed since 2007 fell from 2.99 in 2007 to 1.46 in 2025, its lowest level in the period, and the share of these firms in the distress zone rose from 29% to 65%. The sector as a whole looks better (2025 median of 1.96) because firms that went public between 2021 and 2025 joined the sample.

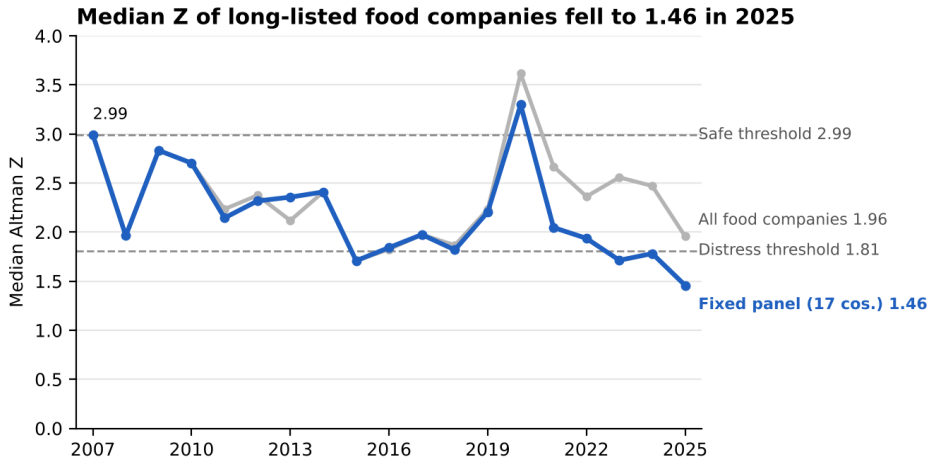


Figure 1. Median Altman Z-score in the food sector, 2007-2025. Source: Author's calculations using Finnet data. Fixed panel: 17 companies with uninterrupted data over 2007-2025. Ratios winsorised each year at the 1%-99% range.

5.1. Trajectory over time and component decomposition

To see where the changes come from, Z is split into its five weighted components. The table below gives the average component contributions of the 17 fixed-panel firms in selected years; the components add up to the average Z.

Year	1.2·X1 (liquidity)	1.4·X2 (retained earnings)	3.3·X3 (operating profit)	0.6·X4 (market value)	1.0·X5 (turnover)	Average Z
2007	0.10	0.08	0.23	1.62	1.05	3.08
2008	0.07	0.09	0.09	0.48	0.96	1.70
2010	0.14	0.11	0.15	2.07	0.92	3.39
2015	0.04	−0.22	0.20	1.20	1.03	2.24
2019	0.12	−0.15	0.30	1.12	0.88	2.26
2020	0.23	−0.01	0.27	2.31	0.75	3.55
2022	0.14	0.01	0.17	1.00	0.84	2.15
2024	0.15	0.03	0.26	1.03	0.82	2.28
2025	0.12	0.09	0.09	0.75	0.62	1.67

The 2008 crisis was followed by a fast recovery, which lasted into 2010. The average Z fell from 3.08 to 1.70 in 2008. About 83% of the 1.38-point drop came from lost market value (X4 contribution from 1.62 to 0.48) and about 10% from lower operating profitability (from 0.23 to 0.09). As share prices recovered in 2010, the X4 contribution rose to 2.07 and the score moved above its pre-crisis level. Despite the 4.8% contraction in 2009 (HMB, 2023), food demand held up, and the shock reached these firms mainly through valuations.

Between 2011 and 2019 the scores eroded slowly. Over these nine years the median Z stayed between 1.71 and 2.41, and the distress share settled at 43-52% in 2015-2018. The liquidity contribution (X1) fell to 0.04-0.07 in 2013 and 2015-2017, and the market value contribution dropped to 0.62 in 2018, its lowest since 2008. Part of the turn to negative X2 values from 2015 onwards reflects a break in the data definition (see Section 6.4), but scores calculated without X2 show the same erosion. At firm level the clearest break is at Anadolu Efes. In March 2012 the company acquired SABMiller's Russian and Ukrainian beer operations in exchange for a 24% stake through a new share issue (Anadolu Efes, 2012), and from 1 January 2013 it fully consolidated Coca-Cola İçecek (Anadolu Efes, 2013). Its balance sheet grew quickly, its Z-score fell from 3.55 in 2012 to 1.70 in 2013, and it has stayed in the 1.0-1.6 range since 2016. A falling Z-score can thus reflect a balance sheet reshaped by acquisitions and consolidation as well as financial weakening.

In the pandemic year of 2020 the score jumped on the back of market prices. The average Z of the fixed panel rose from 2.26 to 3.55. The operating profitability contribution barely moved (from 0.30 to 0.27) and turnover fell (from 0.88 to 0.75), so nearly all of the rise came from the market value contribution, which went from 1.12 to 2.31. The policy rate was cut to 8.25% in May 2020 (TCMB, 2020), and the number of individual shareholders grew from about 1.2 million at the start of 2020 to about 2.4 million in 2021 (Borsa Istanbul, 2022). The 2020 improvement therefore says more about share valuations in a low-rate environment than about firms' solvency.

Costs then took their toll in 2021-2022. The turnover contribution fell to 0.61 in 2021, the lowest of the period, and the operating profitability contribution dropped to 0.17 in 2022. Firms could not pass raw material costs fully on to selling prices at a time when global food commodity prices hit a record in March 2022 (FAO, 2022) and annual CPI reached 85.51% in October 2022 (SBB, 2022).

In 2023-2025 tight monetary policy and inflation accounting shaped the scores. The average Z of the fixed panel fell to 1.67 in 2025, and this time the decline came from the operating side: the operating profitability contribution

fell from 0.26 to 0.09 and the turnover contribution from 0.82 to 0.62. Policy rate increases to 50% in March 2024 (TCMB, 2024) and again to 46% in April 2025 (TCMB, 2025) kept financing costs high. İSO 500 data show operating profitability in manufacturing falling from 12.5% to 6.2% in 2024, with financial expenses reaching 96.6% of operating profit (Istanbul Chamber of Industry [İSO], 2025). In 2025 operating profitability recovered to 7.7%, still below the 2015-2024 average of 10.4%, and financial expenses equalled 84.9% of operating profit (İSO, 2026). The rise in X2 over the same period (from 0.01 in 2022 to 0.09 in 2025) is largely a mechanical result of restating equity items under IAS 29 and inflates the score.

5.2. Distribution as of 2025: The IPO effect

Of the 45 food companies with a Z-score in 2025, 20 are in the distress zone, 13 in the grey zone and 12 in the safe zone. This distribution mixes two different groups. The 17 firms that went public in 2023 or later have a median Z of 3.53 and a distress share of 18%; the 28 firms listed earlier have a median of 1.60 and a distress share of 61%. Almost all of the newcomers' advantage comes from X4: their median market value/liabilities ratio is 3.38 against 0.99 for older firms, while operating profitability (X3) is low in both groups (0.06 vs. 0.04). Because X4 is market-based, the original Z model can overstate the financial strength of small, highly valued firms.

6. Findings: Other Sectors

Data for 410 non-financial companies show that by the end of the period financial distress risk had concentrated in manufacturing and fallen sharply elsewhere. Among the 106 manufacturing companies listed continuously since 2007, the distress share rose from 16% to 48% in 2025. Among non-manufacturing companies it fell from 42% in 2019 to 17% in 2025.

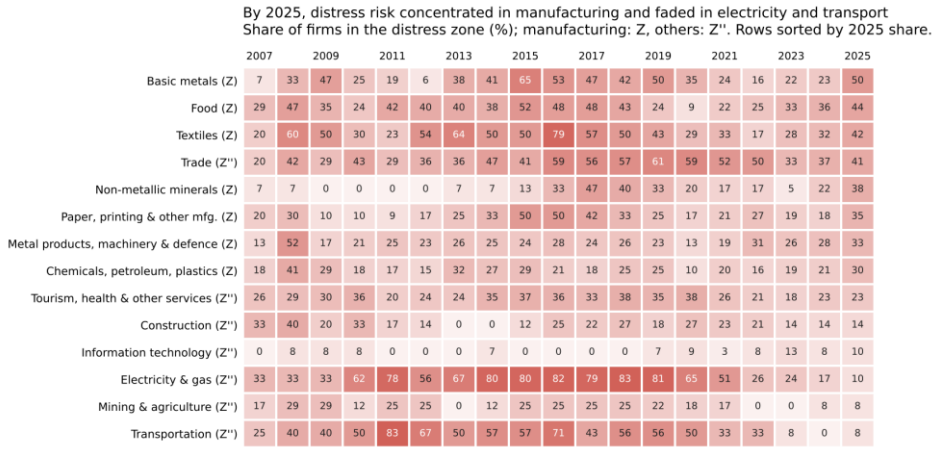


Figure 2. Share of firms in the distress zone by sector group, 2007-2025 (%). Source: Author's calculations using Finnet data. 410 non-financial companies, 4,994 firm-years. Distress zone: Z < 1.81; Z'' (without constant) < 1.10. In small groups (transportation, construction, mining), a single firm can change the share considerably.

6.1. Median scores by sector group

Sectors with few companies were merged, giving 14 sector groups. The original Z is reported for manufacturing groups and Z'' without the constant for the others. The two models are on different scales, so their levels should not be compared directly; each group is read against its own thresholds.

Sector group	Model	Number of firms (2025)	Median 2007	Median 2019	Median 2025
Basic metals	Z	30	3.03	2.08	1.86
Food	Z	45	2.99	2.23	1.96
Textiles	Z	19	2.34	1.88	2.29
Non-metallic minerals	Z	24	5.56	2.89	2.38
Paper, printing and other manufacturing	Z	17	2.81	2.51	2.54
Metal products, machinery and defence	Z	46	3.51	2.76	2.59
Chemicals, petroleum, plastics	Z	44	3.52	2.27	2.66
Trade	Z"	27	3.09	0.45	2.16
Electricity and gas	Z"	42	2.03	0.06	2.77
Transportation	Z"	12	1.74	1.03	3.01
Tourism, health and other services	Z"	39	2.92	3.02	3.67
Information technology	Z"	39	5.38	5.21	3.83
Construction	Z"	14	1.23	1.92	4.79
Mining and agriculture	Z"	12	6.88	3.81	7.04

6.2. Manufacturing sectors: A common deterioration in 2025

In all seven manufacturing sectors the median Z is below its 2007 level. Among the 106 fixed-panel manufacturing firms, the average operating profitability contribution (3.3·X3) fell from 0.40 in 2021 to 0.05 in 2025, and the turnover contribution (X5) from 1.04 in 2022 to 0.69. The market value contribution was 2.15 in 2025, slightly above its 2007-2025 average (1.95). So, unlike in 2008, the 2025 deterioration is operational, which fits the erosion of profitability and the heavy financing burden visible in İSO 500 data (İSO, 2025, 2026).

Basic metals deteriorated most. Their distress share was 7% in 2007, rose to 65% in 2015, fell to 16% in 2022 and climbed back to 50% in 2025. Non-metallic minerals was the strongest manufacturing group in 2007 with a median of 5.56; by 2025 the median had fallen to 2.38 and the distress share had risen from 7% to 38%. Textiles was in chronic distress for much of the period

(distress share of 43-79% in 2012-2019), in line with Erol Fidan's (2021) results for 2017-2019. Chemicals, petroleum and plastics kept the lowest distress share in manufacturing.

All manufacturing groups improved markedly in 2020, and, as in food, the improvement came mostly from market value: the average X4 contribution of the fixed panel rose from 1.62 in 2019 to 3.73 in 2020. A record 52 IPOs in 2021 and the growth in individual shareholders from about 1.2 million at the start of 2020 to 2.4 million in 2021 (Borsa Istanbul, 2022) show how strong the demand behind share valuations was in this period.

6.3. Non-manufacturing sectors: Electricity, transportation and trade

Electricity and gas went through the largest turnaround of the period. Between 2011 and 2019, 56-83% of firms were in the distress zone, and the median Z" was negative in 2011 and in 2015-2018. The components point to two sources: negative working capital (median 6.56·X1 contribution of −0.87 in 2016-2017) and a low equity/liabilities ratio (median 1.05·X4 contribution of 0.29-0.49 in 2014-2019), the profile of a sector that financed its capacity build-up with heavy debt. The sharp rise in electricity prices in 2021-2022 supported operating profitability; in March 2022 the weighted average market clearing price was TRY 1,673.05/MWh, about 5.3 times the TRY 312.99/MWh of a year earlier (Energy Market Regulatory Authority [EPDK], 2022). In 2022-2025 the improvement came mainly from the equity/liabilities ratio (median X4 contribution from 0.99 in 2022 to 1.96 in 2024) and retained earnings (X2 contribution from 0.32 to 0.73), consistent with IAS 29 restatement enlarging equity in power-generation firms whose assets are mostly non-monetary. New IPOs are only part of the story: long-listed firms such as Zorlu Enerji, Ayen Enerji and Odaş have also seen their scores rise markedly since 2021.

In transportation the distress share was 83% in 2011 and 0-8% in 2023-2025. The working capital contribution was negative in most years between 2011 and 2019, and the jump in the equity/liabilities contribution from 0.60 to 1.16 in 2023 coincides with the move to IAS 29. The group has only 12 firms, so these ratios move with changes in individual companies.

In trade the median Z" was very low, at 0.29-0.60, in 2016-2020. This result needs care. A large share of the firms in the distress zone (e.g., Şok Marketler, Migros and CarrefourSA in 2019) are food retailers that run on structurally negative working capital because they collect from customers before paying suppliers. With an X1 coefficient of 6.56, the Z" model reads this business model as financial distress, and retailers' Z" scores have to be interpreted with that in mind.

Information technology is the only large group whose distress share stayed within 0-13% throughout the period; low leverage and positive working capital are typical of the sector. In construction the median rose to 4.79 in 2025, though the group has only 14 firms.

6.4. Robustness tests and the IAS 29 break

X2 has a break in the data. In Finnet the retained earnings/accumulated losses item is only ever zero or positive in 2014 and earlier, but from 2015 onwards it is negative for about one-third of firms. Accumulated losses were probably recorded in a separate item up to 2014, which biases X2 upwards in those years. Scores calculated without X2 show the same trend for fixed-panel manufacturing firms (3.12 in 2007; 2.13 in 2015; 2.95 in 2020; 1.55 in 2025).

Alternative definitions change little. Adding net profit for the period to X2 and using profit from main operations for X3 move the fixed-panel manufacturing medians by at most 0.2 points in any year and leave the trend intact.

Z and Z" agree more on ranking than on zones. For manufacturing firms the Spearman rank correlation between the two models' scores is 0.77, yet they put a firm in the same zone in only 59% of firm-years. Z" is the more optimistic of the two for manufacturing: the 2025 median Z" of manufacturing firms is 3.17, above the safe threshold. The gap arises because Z" leaves out asset turnover and measures equity at book value, and it adds to the IAS 29 effect discussed below.

IAS 29 creates a visible break. Taking the median year-on-year change in each ratio for the same firm, the typical annual change in X2 is 0.002, against 0.013 between 2022 and 2023 and 0.052 between 2023 and 2024. For the equity/liabilities ratio (X4 in Z"), the 2022-2023 change (0.122) is also well above the typical change (0.077). Part of the 2023-2025 improvement in non-manufacturing sectors is therefore an accounting effect. The manufacturing score calculated without X2 falls to 1.55 in 2025, so inflation accounting also partly hides the deterioration in manufacturing through equity items.

7. Discussion and Conclusion

Over 2007-2025 the financial distress risk of non-financial companies on BIST moved in two directions: in manufacturing it reached its highest level at the end of the period, while in non-manufacturing sectors it fell markedly. Four broader points follow from the findings.

The 2025 deterioration in manufacturing is operational. The 2008 decline came mostly from falling share values and reversed quickly once markets

recovered. In 2025 the market value component was above its long-run average, while operating profitability and asset turnover fell to their lowest levels of the period. The distinction matters because a fall in profitability, unlike a fall in valuations, directly weakens firms' ability to service debt. Food is one of the sectors where this is clearest: two-thirds of long-listed food companies were in the distress zone in 2025.

The market-value-based X4 component makes scores more cyclical. The broad improvement in 2020 and the high scores of the 2023-2025 IPOs reflect share prices more than operating performance. This does not contradict the evidence that market value helps predict financial distress (Shumway, 2001), but in shallow markets with strong retail demand X4 can overstate financial strength. For newly listed firms, the Z-score should be read alongside a book-value-based measure such as Z".

Accounting breaks can move scores with no change in economic reality. After the switch to IAS 29, retained earnings and the equity/liabilities ratio rose far more than their usual annual changes. The effect is stronger in the book-value-based Z" model and accounts for part of the improvement in non-manufacturing sectors. It cannot explain the electricity turnaround on its own, though: the price increases of 2021-2022 and the improvement in long-listed firms point to real deleveraging and higher profitability. Altman et al. (2017) found that re-estimating the model for a given country markedly improves classification accuracy, which suggests that Türkiye needs coefficients and thresholds estimated for the inflation-accounting period.

A sector's business model changes what the score means. Food retailers' structurally negative working capital shows up as financial distress in the Z" model, and, as the Anadolu Efes case shows, acquisitions and consolidation can lower the score without any financial weakening. The Z-score is therefore more informative when read against a sector's own history than as an absolute yardstick across sectors.

The study has three main limitations. The sample consists of companies listed on BIST today; firms that went bankrupt or were delisted during the period are missing, so the findings carry survivorship bias and risk in the earlier years is probably understated. The scores have not been checked against actual bankruptcy or concordat filings, so they should be read as indicators of financial health. The data break in the retained earnings/accumulated losses item in 2015 affects X2, although the robustness tests show that the trends do not depend on it. Adding delisted firms and post-2018 concordat filings to the sample would let future work test the model's predictive power in Türkiye directly.

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