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The Relationship between Transportation Infrastructure Investments and Economic Growth in Turkey

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Abstract

This study investigates the short run and long-run relationship between highway and railway transportation infrastructure investment and economic growth in Turkey from 1970 to 2017 by ARDL bound test estimation. The reason of choosing Autoregressive Distributed Lag Boundary Test (ARDL) approach is that some of the variables are stationary at level and some of them are stationary at first differences. According to ARDL test results, it is concluded that there is a strong and significant relationship between highway and railway infrastructure investment and economic growth in the short and long term in Turkey.

Keywords: economic growth, transportation infrastructure investment, highway, railway, ARDL model

1. Introduction

Transportation infrastructure, which is considered within the scope of highway, railway, airline and maritime, is an important determinant of productivity and economic growth. The lack of adequate transportation infrastructure may adversely affect economic performance by limiting market expansion, material transportation, and labor migration. Theoretically, the development of transportation infrastructure and services reduces input costs by reducing transportation costs and increasing accessibility and creates employment by increasing private investment and promoting trade. This has a positive impact on overall economic performance (Deng, 2013).

The impact of transportion infrastructure on economic performance can be attributed to the decrease in production costs and the increase in revenues and investments. While infrastructure investments are seen as a way of influencing public policies for long-term growth and efficiency, many studies have been conducted to determine the effects of infrastructure investments on national and regional economic development. In Turkey, highways and railways constitute the majority of the realized investments in transportation infrastructure.

2. Literature Review

When the studies examining the relationship between transportation infrastructure investments and economic growth are examined, it is seen that there is a predominantly positive relationship between transportation infrastructure investments and economic growth. Besides, there are studies which find a negative relationship between transportation infrastructure investments and economic growth. In the literature, the reason for the existence of a negative relationship is shown to be the inefficiency of the transportation infrastructure services provided by the public sector and the exclusion of the private sector from the financing of these investments due to the borrowing of the public sector to perform these services.

When the empirical studies are examined in the literature, Cobb-Douglas production function and vector autoregression (VAR) analysis are predominantly used to estimate the relationship between transportation infrastructure investments and economic growth. In the literature, the first empirical analysis of the relationship between transportation infrastructure investment and

economic growth was made by Antle (1983). In this study, 49 developed countries and 19 developing countries are taken as a sample. As a result, a positive relationship was found between transportation infrastructure investment and economic growth. In other words, it is determined that productivity increases in transportation infrastructure activities have an increasing effect on economic growth (Antle, 1983).

One of the ongoing studies Flored de Frutos et al. (1998), investigated the relationship for Spain by VAR method for the period 1964-1992. As a result of the VAR analysis, it is concluded that transportation infrastructure investment positively affects economic growth (Flored de Frutos et al., 1998). Similarly, Sturm et al. (1999) examined the impact of transportation infrastructure on economic growth in the Netherlands for the period 1853-1913 by VAR analysis. According to the results of the analysts, the effect of transportation infrastructure on economic growth is positive (Sturm et al., 1999). In another study, Percoco (2004) examined the relationship between transportation infrastructure and economic growth for Italy for the period of 19701994 with panel data analysis. According to the estimation results, while investments in highways have a negative impact on economic growth, investments in maritime and railways have a positive impact on economic growth (Percoco, 2004). Pereira and Andraz (2006) investigated the impact of Portuguese public transport infrastructure investments at the regional level. A vector autoregression model is used in the review of the five administrative regions of the country. The results indicate that the economic contribution of infrastructure investment expenditures depends on the long term but varies from region to region (Pereira & Andraz, 2006).

In recent studies, Agbelie et al. (2017) investigated the effect of transportation infrastructure investment on output in 237 cities in China with the data of 2000-2012 period by using the random parameters logit method considering the variability in cities. According to the results of the research, the relationship between infrastructure investment and output varies according throughout the cities. General results of the study show that the effect of highway and railway investments and transportation on output is positive (Agbelie et al., 2017). In another study, Kabaklarlı et al. (2018) investigated the relationship between transportation infrastructure investment and economic growth for 17 OECD countries and Russia employing panel cointegration test and joint effects model. According to the results of the analysis conducted

between 1995 and 2015, a positive and significant relationship is found between transportation infrastructure expenditures and economic growth (Kabaklarlı et al., 2018). In a study for Turkey by Eruygur et al. (2012) investigated the relationship between transportation infrastructure investment and economic growth with Vector Error Correction Model (VECM) based on the 1963-2006 period. They found a positive and strong relationship between transportation infrastructure investment and economic growth in the long run (Eruygur et al., 2012).

In the literature, it is mainly found a positive relationship between transportation infrastructure investment and economic growth. However some studies finds a negative relationship. Kustepeli, Gulcan and Akgungor (2012) have analyzed the effect of highway infrastructure investment expenditures on foreign trade and economic growth in Turkey by time series analysis using the data from 1970 to 2005. According to the results of the study, while there is no relationship between transportation infrastructure expenditures and economic growth and foreign trade, it states that there is a weak causality only between exports and highway infrastructure expenditures in the short term (Kustepeli et al., 2012). Amadi and Nyenke (2013) examined the relationship between transportation infrastructure investment and economic growth with the data of the period of 1981-2010 by least squares (OLS) method for Nigeria. According to the results, an insignificant and negative relationship was found between transportation infrastructure expenditures and economic growth (Amadi & Nyenke, 2013). In another study, Musaba et al. (2013) showed that transportation infrastructure investment expenditures negatively affect economic growth (Musaba et al., 2013).

3. Data Set And Econometric Method

In this study long and short-term relationship between economic growth and transportation infrastructure investments in Turkey are investigated by auto regressive distributed lag (ARDL) bounds testing approach. In this context, per capita income (GDPPC) is considered as the dependent variable, while independent variables consist of highway length (Highway), railway length (Railway), labor force participation rate (Labor) and fixed capital stock (Capital) data in the model. The variables used in the model were included by taking the logarithm. Descriptive and statistical information about the variables is shown respectively in Table 1 and Table 2.

Table 1: Explanatory Information on Variables

Variables	**Definition of Variables**	**Source**
GDPPC	Real GDP Per Capita 2010 (Euro)	World Bank
Highway	Highway Lenght	Turkstat Statistical (Turkish Institute)
Railway	Railway Lenght	Turkstat Statistical (Turkish Institute)
Capital	Fixed Capital Stock to GDP	World Bank
Labor	Labor Participation Rate	World Bank

Gross domestic product per capita, fixed capital stock, and labor force participation rate used in the model were obtained from the World Bank, while the length of highways and railways were obtained from Turkish Statistical Institute (TURKSTAT).

Table 2: Statistical Information on Variables

	LNGDPPC	LNCAPITAL	LNLABOR	LNRAIL	LNHİGHWAY
Mean	8.901977	3.047503	16.75187	9.058671	11.01459
Median	8.870829	3.128356	16.75805	9.056311	11.00446
Maximum	9.607146	3.401099	17.27000	9.230829	11.08156
Minimum	8.347864	2.531895	16.33145	8.900276	10.97767
Std. Dev.	0.351566	0.257008	0.246446	0.078279	0.027485
Skewness	0.344413	-0.347373	0.259413	0.471203	0.796915
Kurtosis	2.061216	1.743639	2.282413	3.224625	2.640417
Jarque-Bera	2.711593	4.122225	1.568222	1.877168	5.339185
Probability	0.257742	0.127312	0.456525	0.391181	0.069280
Sum	427.2949	146.2801	804.0897	434.8162	528.7003
Sum Sq. Dev.	5.809122	3.104504	2.854581	0.288000	0.035506
Observations	48	48	48	48	48

From Table 2, comments can be made on the central tendency and central distribution of the data. As can be seen from the table, the mean and median values of the data are very close to each other. This can be seen as a sign of normal distribution of the datas. In addition, the JargueBera statistical values indicate that the datas are normally distributed. Central scattering of the datas is also very low. The coefficient of variation is small because the difference between the maximum and minimum values of the variables is small means. Therefore, it can be said that the central distribution of variables is not much. This is also understood from the standard deviation values of the variables.

In this study, the mathematical model used to explain the relationship between transportation infrastructure investment and economic growth is as follows.

$$Y = f(K, L, Rd, Rl)$$

The mathematical relationship stated above is modeled as equality 1.

$$Y_t = \theta_t Capital + \beta_t Labor + \delta_t Road + \alpha_t Rail + \mu_t \quad (1)$$

3.1. Empirical Findings

Firstly, stationary analysis of the datas used in the study is investigated by Augmented Dickey Fuller (ADF) test. Results of ADF test are shown in Table 3.

Table 3: Results of ADF Test

Variables	**Level**		**First Differences**	
	Intercept	**Intercept and Trend**	**Intercept**	**Intercept and Trend**
GDPPC	0.637705 (-2.925169)	-1.724133 (-3.50508)	-6.502782*** (-2.926622)	-6.574040*** (-3.510740)
Capital	-1.686853 (-2.925169)	-2.824275 (-3.508505)	-6.391609*** (-2.926622)	-6.344844*** (-3.510740)
Labor	1.257106 (-2.925169)	-0.345956 (-3.508508)	-6.695084*** (-2.926622)	-6.905283*** (-3.510740)
Rd	1.890538 (-2.926622)	-0.531213 (-3.510740)	-10.22280*** (-2.926622)	-11.18595*** (-3.510740)
Rl	-0.040096 (-2.926622)	-3.560349** (-3.510740)		

Note: The values in parentheses indicate the critical values of the tests at the level of 5%. ** and *** express the significance at the level of 5% and 1%, respectively.

According to the results of ADF test, it is seen from the table that the variables other than R1 are not stationary at level. In other words, while R1 is I(0), the other variables are I (1). In this context, ARDL model is preferred due to the variables I(0) and I(1).

In the model expressed in Equation 1, auto regressive distributed lag method is used to estimate the short and long term relationship between transportation infrastructure investments and economic growth. Table 4 shows the appropriate ARDL model, F statistic, and error correction term (ECT) results. As can be seen from the table, the calculated F statistical value is higher than the lower limit (2.86) and upper limit (4.01) at the level of 5%, indicating that there is a long-term relationship between the variables.

Table 4: Selected ARDL model and F-statistics

Model	ARDL Model	F-Statistical Value	ECT(-1)
KG=f(K, L, Rd, Rl)	ARDL (2.2.3.2.4)	4.706251**	-0.507397***

According to the appropriate ARDL model and F statistics results, estimated short and long term coefficients are shown in Table 5. According to short term results, all variables are statistically significant. The error correction term is also negative and statistically significant. According to long-term estimation results, variables other than the labor force participation rate (Labor) are statistically significant. Accordingly, when the short and long term estimation results are taken into consideration, it can be said that there is a strong and important relationship between transportation infrastructure investment and economic growth. In addition, according to coefficient estimations, it is seen that the infrastructure investments for highways and railways have a positive relationship on economic growth in both long and short term. Besides, it is seen that highway investments are more effective than the railway investments on economic growth.

In the estimated model, Breusch-Pagan Lagrange Multiplier, autoregressive conditional heteroscedasticity (ARCH) and Jarque-Bera tests are used to determine whether the assumptions such as autocorrelation, heteroscedasticity and normal distribution are realized. According to the test results, it is seen that autocorrelation, heteroscedasticity and normal distribution problems are not in the estimated model.

Table 5: ARDL Short and Long Term Estimation Results

Short-Run Coefficients			
Variables	*Coefficients*	*t-statistics*	*Prob.*
C	-36.35124	-5.209049	0.0000
D(LNCAPITAL)	0.353694	9.709394	0.0000
D(LNLABOR)	-0.644892	-3.295804	0.0028
D(LNRAIL)	0.549754	3.511546	0.0016
D(LNHİGHWAY)	1.421988	2.173893	0.0390

ECT(-1)	-0.507397	-5.210705	0.0000
Long-Run Coefficients			
Variables	*Coefficients*	*t-statistics*	*Prob.*
LNCAPITAL	0.617694	7.799268	0.0000
LNLABOR	0.122297	0.490074	0.6282
LNRAIL	0.830327	2.206517	0.0364
LNHİGHWAY	6.280180	7.931053	0.0000
Varsayımlar Testi			
R^2	0.82		
B-G LM Test X^2	3.966 (0.137)		
ARCH Test	0.344 (0.557)		
Jarque-Bera	1.049 (0.591)		

Note: B-G LM test refers to autocorrelation test, ARCH heteroscedasticity and Jarque-Bera normal distribution test. The values in parentheses show probability values of the tests.

4. Conclusion

Although there are many sources of economic growth, one of the most important sources is infrastructure investment such as telecommunication, communication and transportation. It is stated that the effects of highway, railway and maritime transportation infrastructure are effective on economic growth. In other words, transportation infrastructure which is understood in the context of highway, railway and maritime is an important determinant of productivity and economic growth. In this context, the short and long term impacts on economic growth of the transportation infrastructure in Turkey are investigated for the period 1970-2017 by ARDL cointegration test.

According to the results of the study, transportation infrastructure has an important, strong and positive effect on economic growth. This effect is also valid in the short and long term. In other words, highway and railway transportation investments increase economic growth in both short and long term in Turkey. When the effects of highways and railways are examined separately, it is another significant result that the effect of highways on economic growth is higher than that of railways. When these results are all in all evaluated, among other factors, with due regard to transportation infrastructure investments (such as highways and railways) and expenditures

should be expanded and increased in order to increase the stability and significance of economic growth in Turkey.

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