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EFFECTS OF TRANSPORTATION INFRASTRUCTURE ON ECONOMIC GROWTH IN TURKEY: ARDL BOUNDS TESTING APPROACH[1]

TÜRKİYE'DEKİ ULAŞTIRMA ALTYAPILARININ EKONOMİK BÜYÜMEYE ETKİSİ: ARDL SINIR TESTİ YAKLAŞIMI

Res. Asst. Anıl LÖGÜN

Atatürk University, Faculty of Economics and Administrative Sciences, Department of Econometrics, Erzurum/Turkey

Res. Asst. Abdullah TÜZEMEN

Atatürk University, Faculty of Economics and Administrative Sciences, Department of International Trade and Logistics, Erzurum/Turkey

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ABSTRACT

Transport has an important role in the development of countries and the functioning of economic activities. Transportation is very important in the production and distribution of goods. In a growth-oriented economy, determining the relationship between transportation infrastructure and economic growth will be of great importance in the design and implementation of transport policies. The development of transportation infrastructure is thought to help economic growth.

In this study, the impact on economic growth logistics development in Turkey is examined. Economic growth rate(growth) as indicator of economic growth, road and rail lengths(road and rail), the sum of road and rail lengths(railroad) and gross fixed capital formation(gfcf) value are used. The data in the study are obtained from the OECD and TURKSTAT database. Annual data are used as the data range in the period of 1984-2016. In this context, the stationary of series to be used in this analysis is examined by unit root tests. As a result of analysis of unit root tests, growth variable is found to be stationary I(0) (level); road, rail, railroad and gfcf are found to be stationary in I(1) (first difference).

In study, ARDL bounds testing approach is used which allows to examine the cointegration relationship between variables which are stationary. The selection of the appropriate for ARDL model is important and the AIC(Akaike Information Criterion) has been used for this purpose. As a result of ARDL model estimation, it is concluded that there is cointegration between variables. Autocorrelation, heteroscedasticity, idendification error and normality assumptions are exmined. As a result of the tests performed, it is seen that there was no autocorrelation and heteroscedasticity problems in the model. In addition, the functional form of the model is defined correctly and the normality assumption has been obtained as a result of the tests. Error correction model is established to see whether there are short-term relationship between variables. The error correction coefficient in this model is found to be negative and statistically significant. In other words, those who have long-term equilibrium will reach their former balance after any shock.

Keywords: Transportation, Economic Growth, ARDL Bounds Test

ÖZ

Ulaştırma, ülkelerin gelişiminde ve ekonomik faaliyetlerin işleyişinde önemli bir role sahiptir. Ulaştırma, malların üretiminde ve dağıtımında oldukça önemlidir. Ulaştırma altyapısı ve ekonomik büyüme arasındaki ilişkinin belirlenmesi, büyüme odaklı bir ekonomide, ulaştırma politikalarının etkili tasarımı ve uygulanmasında büyük bir öneme sahip olacaktır. Ulaştırma altyapısının geliştirilmesi ekonomik büyümeye yardımcı olacağı düşünülmektedir.

Bu çalışmada, Türkiye'deki lojistikteki gelişimin ekonomik büyüme üzerindeki etkisi incelenmiştir. Ekonomik büyümenin göstergesi olarak ekonomik büyüme oranı(growth); lojistik gelişimin göstergeleri olarak ise kara(road) ve demir yolu(rail) uzunlukları, toplam ulaştırma(railroad) ile gayrisafi sabit sermaye oluşumu(gfcf) değeri kullanılmıştır. Çalışmadaki veriler OECD ve TÜİK veri

[1] This study was presented at 4.UMTEB Congress between December 7-9 2018.

tabanından elde edilmiştir. Veri aralığı olarak 1984-2016 dönemi aralığında yıllık veriler kullanılmıştır. Bu kapsamda analizde kullanılacak serilerin durağanlıkları birim kök testleriyle incelenmiştir. Birim kök testleri analizi sonucunda, growth değişkeni I(0) (düzeyde) durağan; road, rail ve gfcf değişkenleri ise I(1) (birinci farkta) durağan olarak bulunmuştur.

Çalışmada farklı dereceden durağan olan değişkenler arasındaki eşbütünleşme ilişkisinin incelenmesine olanak sağlayan ARDL sınır testi yaklaşımı kullanılmıştır. Uygun ARDL modeli seçimi önemlidir ve bu amaçla AIC(Akaike Information Criterion) bilgi kriterinden yararlanılmıştır. ARDL modeli tahmini sonucunda değişkenler arasında eşbütünleşme olduğu sonucuna ulaşılmıştır. Modelin otokorelasyon, değişen varyans, tanımlama hatası ve normallik varsayımlarına bakılmıştır. Yapılan testler sonucunda modelde otokorelasyon ve değişen varyans sorunlarının olmadığı görülmüştür. Ayrıca, modelin fonksiyonel biçiminin doğru şekilde tanımlandığı ve normallik varsayımını sağladığı yapılan sınamalar sonucunda elde edilmiştir. Değişkenler arasındaki kısa dönemli ilişkilerin olup olmadığını görmek için hata düzeltme modeli kurulmuştur. Bu modelde yer alan hata düzeltme katsayısı negatif ve istatistiksel olarak anlamlı olarak bulunmuştur. Diğer ifadeyle, uzun dönem dengesi bulunun değişenler, herhangi bir şokun ardından eski dengesine ulaşacaktır.

Anahtar Kelimeler: Ulaştırma, Ekonomik Büyüme, ARDL Sınır Testi

1.INTRODUCTION

Transport can be defined as movement of people and goods from one place to another. Transport has an important role in development of countries and functioning of economic activities. Transport is very important for production and distribution of goods. It is accepted in the studies that there is a close relationship between quality of transport infrastructure and economic growth of a country (Docherty and MacKinnon, 2013:2). Transport will have a vital role in determining the relationship between infrastructure of transport and economic growth and in growth based economy and effective implementation and design of transport policies. It is also thought that improvement of transport infrastructure will boost economic growth (Pradhan and Bahchi, 2013:140).

Economic growth and transport are interrelated. Namely, development of countries increases demand in transport. Transport contributes to economic development of countries by enabling commercial and economic specialization. The importance of transport and transport infrastructure has increased with the developments of industrialization and specialization because of a need for providing more goods (Riberto et all. 2007:327-328).

The relationship between transport infrastructure and economic growth was investigated via Autoregressive Distributed Lag (ARDL) bound testing in the study. For this purpose, firstly, stationarity of series was examined through unit root tests. And then cointegration relationship among variables was examined via ARDL bound testing. And also it was determined whether there was a relationship among variables both in the short and long run.

2. LITERATURE REVIEW

Although Panel data analyses are mostly used in studies in which transport infrastructure and economic growth are examined different time series analyses are also preferred. Granger causality and Johansen cointegration approaches are used in Studies in which the relationship between infrastructure and economic growth for Turkey is investigated.

ARDL bound testing approach by which statistic variables can be analyzed in different lags was used in the study. Kuştepeli Gülcan and Akgüngör (2012) investigated the relationship between investments in transport infrastructure and economic growth and export and import. The analysis which was done for Turkey covered the period of 1970-2005. According to Granger causality analysis it was found that economic growth is the cause of rate of export to GDP. And it was also determined that there was a positive relationship between highway length and economic growth. Kuzu and Önder (2014) investigated the relationship between logistics development in Turkey and economic growth and they used Engle-Granger cointegration and Granger causality approaches. According to the results of Engle-Granger cointegration analysis there was a relationship between logistics development and economic growth in the long term. According to the result of Granger causality analysis there is a one-way causality relationship from economic growth to logistics development. Kara and Ciğerlioğlu (2018) deployed Johansen cointegration approach to examine the relationship between transport infrastructure and economic growth. According to their study which covered the period of 1988-2015 there was a relationship between transport infrastructure and economic growth in the long run.

Boopen (2006) investigated the effect of transport capitals on economic growth by using both cross-section and panel data estimations. According to the analyses which were done for African countries transport capitals were deemed to be important for development of countries.

Hong, Chu and Wang (2011) investigated the relationship between local economic development and transport infrastructure in China. And the study covered the period of 1998-2007. According to panel analyses transportation of road, railway and seaway had more effect on economic growth compared to airway. According to the analyses it was also suggested that economic inequality among Chinese regions were caused by unbalanced distribution of transport infrastructure development in the regions.

Saatçioğlu and Karaca (2011) investigated the relationship between transport infrastructure and economic growth. The study in which 51 countries examined covered the period of 1990-2009. In the study panel data analysis was utilized and according to the results it was found that transport infrastructure had a positive effect on economic growth as expected.

Badalyan, Herzfeld and Rajcaniova (2014) examined the relationship between transport infrastructure and economic growth in the scope of Turkey, Armenia and Georgia. Panel cointegration and panel causality approaches were used. And the study covered the period of 1982-2010. According to the results of the analysis it was observed that variables of gross capital formation and road and rail way lengths had a positive effect on economic growth in a statistical sense on the short term.

Farhadi (2016) investigated the relationship between economic growth and transport infrastructure for 18 OECD countries in his study. Panel data analysis was used in the study which covered the period of 1870-2009. And according to the study it was concluded a 10% increase in infrastructure expenses would led to an increase in manpower efficiency.

3. DATA AND METHODOLOGY

The effect of logistics development on economic growth in Turkey was investigated in this study. Economic growth rate was used as an indicator of economic growth. And length (Km) of road and railway and total transport and gross fixed capital formation were used as indicators for logistics development. Data in the study were obtained from Turkish Statistical Institute (TSI) and OECD data bases. The study covers the period of 1984-2016. Rate of investments in logistics infrastructure in total GDP was given in Table 1.

It is seen that Rate of investments in road transport infrastructure in total GDP is higher compared to railway. While share of Infrastructure investments in railway in total GDP was about 0.03% this rate rose up to 0.22% in 2016. While share of Infrastructure investments in road in total GDP was 0.45% in 2005 this rate rose up to 1.17% within 10 years.

Table 1: Share (%) of Investments in Transport Infrastructure in GDP for Turkey

Years	Rail	Road
1995	0.035	0.528
2000	0.029	0.337
2005	0.061	0.453
2010	0.259	0.884
2015	0.140	1.170
2016	0.220	0.939

Source: https://stats.oecd.org/

Descriptive statistics were given in Table 2. According to the table, mean of Growth variable is 4.76 in the period of 1984-2016. Variance in economic growth is high in the period. The variable which is expressed as Total signifies aggregation of road and railway lengths. Total variable is 366651.5 on average.

Table 2: Descriptive Statistics

Statistics	GROWTH	ROAD	RAIL	TOTAL	GFCF
Mean	4.76	357804.7	8846.79	366651.5	159832.9
Median	6.09	367956.00	8671.00	376594.00	38066.60
Maximum	11.11	428415.00	10131.00	437112.00	764661.7
Minimum	-5.96	236794.00	8400.00	246881.00	5.47
Std. Deviation	4.49	48341.65	557.68	48076.73	221249.8
Skewness	-1.06	-1.08	1.34	-1.06	1.38
Kurtosis	3.29	4.07	3.29	4.01	3.83

Stationarity of variables in the study was examined via unit root tests of Augmented Dickey Fuller (ADF) and Phillips and Perron (PP). Distribution theory in Dickey-Fuller test suggests that errors are statistically

independent and also they have a constant variance. There is a possibility that this situation is not valid. Alternatively, Philip and Perron test which allows distribution of error terms to be dependent are used (Aggarwal and Kyaw, 2015:397).

In Autoregressive Distributed lag (ARDL) approach cointegration relationsip among variables can be examined without considering whether variables are I(0) or I(1) (Pesaran, Shin and Smith, 2001:290). This approach contrary to standard cointegration approaches can be applied when variables are stationary in different lags (Duasa, 2007: 91-91). And also this approach enables estimators to be asymptotically effective in small samples (Sakvi, 2011: 150). ARDL bound testing has fewer constraints compared to other cointegration approaches.

Error correction model is established to investigate short term dynamics among variables which have cointegration relationship. When conditional error correction form is used with variables of the study in ARDL cointegration introduced by Pearsan et all (2001) this can formula can be expressed as follows;

$$\Delta growth_t = \alpha_0 + \sum_{i=1}^{p} \emptyset_i \Delta growth_{t-i} + \sum_{i=0}^{p} \delta_i \Delta total_{t-i} + \sum_{i=0}^{p} \theta_i \Delta gfcf_{t-i} + \beta_1 growth_{t-1} + \beta_2 total_{t-1} + \beta_3 gfcf_{t-1} + u_t \quad (1)$$

According to formula (1), p signifies optimal lag length, Δ operator signifies that first difference of variables is deployed. When cointegration relationship among variables is examined f- distribution is deployed in ARDL bound testing. In this test null hypothesis suggests that there is no cointegration among variables while alternative hypothesis states that cointegration exists among variables (Odhiambo, 2009: 619). Conditional error correction model in Equation (1) is estimated via least squares method. And information criterion is utilized in proper lag length (Morley, 2006:89-90).

4. FINDINGS

Firstly, it was investigated that whether or not variables are stationary via ADF and PP unit root tests in the study. Results of series' unit root tests are presented in Table 3. Null hypothesis asserts that series have unit roots in ADF and PP unit root tests. It was determined that Growth variable was stationary at I (0) level according to ADF and PP unit root tests. Variables of road, rail and total became stationary after conducting their first differences. As to Gfcf, it became stationary after deploying its first difference according to ADF unit root test.

Table 3: Results of Unit Root Tests

Valuables	ADF	PP	Variables	ADF	PP
GROWTH	-5.95(0.00)*	-6.43(0.00)*	DGROWTH	-9.74(0.00)*	-19.27(0.00)*
ROAD	-1.46(0.82)	-1.43(0.83)	DROAD	-5.45(0.00)*	-5.44(0.00)*
RAIL	-0.19(0.99)	-0.71(0.96)	DRAIL	-3.28(0.00)*	-3.39(0.00)*
TOTAL	-1.47(0.82)	-1.44(0.82)	DTOTAL	-5.45(0.00)*	-5.45(0.00)*
GFCF	1.95(1.00)	3.56(1.00)	DGFCF	-1.79(0.06)**	-1.48(0.12)

Values in brackets mean prob values. *,** signifies at the of %5 ve %10 significance level.

It was concluded that growth variable I(0) and variables of total and gfcg were stationary at I(1). ARDL bound testing was conducted for cointegration analysis whose sationarities are at different levels. Proper lag length was determined as 2 for ARDL bound cointegration analysis according to AIC information criterion.

Table 4: Results of ARDL Cointegration Analysis

k	F Test statistics	Lower Bound	Upper Bound
2	8.75	3.10	3.87

F statistics was examined at the 5% significance level.

According to the result of ARDL cointegration analysis shown in Table 4 null hypothesis was rejected because F test statistics was bigger than upper bound. Consequently, it was determined that there was a cointegration relationship among variables.

ARDL model was estimated via least squares method after it was determined that there was a cointegrated relationship among variables. Estimation results of ARDL model are presented in Table 5. Diagnostic test results were examined after model was estimated.

Table 5: ARDL(4,0,0) Model Estimation Results

Variables	Coefficient	t-statistics value
Growth(-1)	-0.2489	-1.5124(0.1447)
Growth(-2)	-0.1129	-0.7129(0.4834)
Growth(-3)	-0.1322	-0.8333(0.4136)
Growth(-4)	-0.3699	-2.2707(0.0333)*
dtotal	-0.0001	-0.5282(0.6027)
dgfcf	0.0006	2.8970(0.0084)*
Sabit	6.7404	3.4629(0.0022)*

Values in brackets mean prob values. *,** signifies at the of %5 and %10 significance level.

F test statistics was used for general significance of the model, LM test was used to test autocorrelation, Jarque-Bera approach was used for normality test. And white test was used to determine whether there was heteroscedasticity or not. According to LM test results which suggest that that there is no autocorrelation in error terms of null hypothesis, null hypothesis wasn't rejected. Consequently, it was determined in the study that there was no autocorrelation in error terms of the model. Likewise, null hypothesis suggests that there is no heteroscedasticity in white heteroscedasticity test. According to the results, null hypothesis was supported and there wasn't heteroscedasticity. As to normality, null hypothesis which suggests that error terms distribute normally was supported.

Table 6: Diagnostic Tests

F Test statistics	2.8597(0.0326)*
Test of Autocorrelation	5.1703(0.5222)*
Test of Normality	2.3633(0.3225)*
Test of Heteroscedasticity	28.1317(0.4042)*

Values in brackets mean prob values. *,** signifies at the of %5 significance level.

Long term estimation results of ARDL model are presented in Table 7 It is seen that there is a positive effect of dgfcf variable -which is used as an indicator for transport infrastructure- on economic growth.

Table 7: Long Term Estimation Results of ARDL

Variables	Coefficent	t-statistics value
dgfcf	0.0003	2.4956(0.0206)*
dtotal	-0.00007	-0.5387(0.5955)
Sabit	3.6162	6.6923(0.0000)*

Values in brackets mean prob values. *,** signifies at the of %5 significance level.

Estimated error correction model was given to determine a short term relationship among variables in Table 8. Coefficient ecm (-1) which signifies error correction term was found to be significant and negative at 5% significance level. It is seen that error correction coefficient is quite high. This coefficient expresses that a potential shock will gain its pervious balance at rate of 186% in the first year.

Table 8: Estimation Results of ARDL Error Correction Model

Variables	Coefficent	t-statistics value
dgrowth(-1)	0.6151	2.5124(0.0198)*
dgrowth(-2)	0.5021	2.5072(0.0200)*
dgrowth(-3)	0.3699	2.6087(0.0160)*
dgfcf	0.00007	2.8970(0.0084)*
dtotal	-0.00001	-0.5282(0.6027)
ecm(-1)	-1.8639	-6.3072(0.0000)*

Values in brackets mean prob values. *,** signifies at the of %5 significance level.

5. CONCLUSION REMARKS

Reza (2013) in his study which is similar to this study utilized Engle-Granger cointegration and Granger causality approaches. According to the results of analyses in his study, it was conducted that logistics industry had an effect on economic growth. In the other study Mohmand, Wang and Saeed (2017) investigated the effect of transport infrastructure on economic growth in Pakistan. According to the result of Granger causality analysis, it was determined that there was no causal relationship between these two variables. But it was determined that economic growth caused an important change on transport investment in the long term.

The relationship between transport infrastructure and economic growth in Turkey was investigated in the period of 1984-2016. Variables of economic growth rate, aggregation of road and railway lengths and gross fixed capital formation were used. ARDL approach was used to determine whether there was a cointegration relationship among variables after examining stationarity of variables. According to the analysis it was concluded that there was a cointegration relationship among variables. Error correction coefficient was found to be -0,186 meaning relationship among variables would gain its pervious balance very fast caused by a potential shock.

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