INVESTIGATION OF RELATIONSHIP BETWEEN AIR TRANSPORT AND ECONOMIC GROWTH

Arş. Gör. Anıl LÖGÜN
Atatürk Üniversitesi İktisadi ve İdari Bilimler Fakültesi
anil.logun@atauni.edu.tr

Arş. Gör. Abdullah TÜZEMEN
Atatürk Üniversitesi İktisadi ve İdari Bilimler Fakültesi
abdullah.tuzemen@atauni.edu.tr

Arş. Gör. Ebubekir KARABACAK
Atatürk Üniversitesi İktisadi ve İdari Bilimler Fakültesi
ebubekir.karabacak@atauni.edu.tr

Abstract

Air transport is a means of integrating countries within the world economy. At the same time, it contributes to the tourism sector, and employment in this particular field as well. In this study, the relationship between air transport and economic growth is examined. The number of passengers and the amount of freight carried by countries are used as indicators of air transport; gross domestic product values are used as indicator of economic growth. The first 20 countries with the highest number of passengers in both international and domestic flights are included in the analysis. The US, China, The United Kingdom, Ireland, Germany, India, Japan, Turkey, Indonesia, Brazil, Canada, Russia, Korea, Australia, Spain, France, Thailand, Malaysia, Mexico are included and The UAE has been removed from the list because its data hasn't been available in the world Bank database. The data is obtained from the World Bank database and this study covers the period of 1993-2016. Natural logarithms of all of the series are taken. Stationary of the series is examined by different panel unit root tests. The panel causality approach is used to determine whether there is any causal relationship among stationary variables. According to the results, economic growth is found to be cause of both the number of passengers and the amount of freight carried. In other words, economic growth has an impact on air transport.

Keywords: *Air transport, Economic Growth, Panel causality*

HAVAYOLU TAŞIMACILIĞI VE EKONOMİK BÜYÜME ARASINDAKİ İLİŞKİNİN İNCELENMESİ

Özet

Havayolu taşımacılığı, ülkelerin dünya ekonomisi içinde bütünleşmesini sağlayan bir araçtır. Aynı zamanda, havayolu taşımacılığı turizm sektörüne ve bu alanda çalışanlara istihdam sağlamaktadır. Bu çalışmada, hava yolu taşımacılığı ve ekonomik büyüme arasındaki ilişki incelenmiştir. Hava yolu taşımacılığının göstergeleri olarak ülkelerin yolcu sayıları ile taşınan yük miktarı; ekonomik büyümenin göstergesi olarak gayri safi yurtiçi hâsıla değerleri kullanılmıştır. Ülkelerin hem iç hem de dış uçak yolcu sayıları kapsamında en çok yolcu taşıyan ilk 20 ülke analize dâhil edilmiştir. ABD, Çin, İngiltere, İrlanda, Almanya, Hindistan, Japonya, Türkiye, Endonezya, Brezilya, Kanada, Rusya, Kore, Avustralya, İspanya, Fransa, Tayland, Malezya, Meksika ülkeleri çalışmada yer alırken Birleşik Arap Emirlikleri'nin verileri Dünya Bankası veri tabanında mevcut olmadığı için çıkarılmıştır. Veriler Dünya Bankası veri tabanından elde edilmiş ve çalışma 1993-2016 dönem aralığını kapsamaktadır. Serilerin tümünün doğal logaritmaları alınmıştır. Serilerin durağanlıkları farklı panel birim kök testleriyle incelenmiştir. Durağan değişkenler arasında herhangi bir nedensellik ilişkisinin olup olmadığını tespit etmek için panel nedensellik yaklaşımı kullanılmıştır. Sonuçlara göre, ekonomik büyümenin hem yolcu sayılarının hem de taşınan yük miktarlarının nedeni olduğu görülmüştür. Diğer ifadeyle, ekonomik büyüme havayolu taşımacılığı üzerinde etkilidir.

Anahtar Kelimeler: *Havayolu Taşımacılığı, Ekonomik Büyüme, Panel Nedensellik*

1. Introduction

Air transport is one of the most important sectors in the world. Air transport makes a huge contribution to advancement of modern society (ATAG, 2005:4). Advancement of transport and logistics sector contributes to economic growth via its effect on production, consumption and trade (Nguyen and Tongzon, 2010:135). Air transport is one of factors that have an effect on advancement of economic growth. It also links fields of trade, tourism and employment within the scope of national, local and international (www.worldbank.org). Air transport which is a driving power for countries' economic development offers many options to consumers in terms of saving time and continuous connection (IATA-WATS 2017, World Air Transport Statistics). Many firms watch advancement of air transport services in order to provide their customers with quality services and ensure just in time production management (Button and Taylor, 2000:209).

Effect of air transport on economic activities differs from other modes of transportation because of its features such as speed, cost and safety (Ishutkina and Hansman, 2008:2). Factors such as increase in disposable income, increase in quality of life, decrease in air transport and effect of globalization contribute to rapid growth of air transport (ATAG, 2005:4).

According to the studies in the literature, there is a relationship between air transport and economic growth. But what important here is the direction of causal relationship between air transport and economic growth. Not knowing the direction of causal relationship might cause politicians, air transport business managers and logistics and tourism firms to have wrong information (Hakim and Merkert, 2006:120). Better knowledge about causal relationship between air transport and economic growth is an important helper in policy creation process within the scope of factors that affect economic growth (Button and Yuan, 2013:338).

20 countries which carry the most passengers both domestically and internationally were analyzed via panel data analysis in the study. Results are considered to be significant in terms of revealing the effect of air transport sector on economic growth.

2.Literature Review

Because air transport data are not in long time intervals panel data analysis is usually deployed in studies in which relationship between air transport and economic growth is examined.

A positive relation was found in the studies which were about the effect of air transport on regional economic growth (Kirsi and Hannu, 2013; Profillidis and Botzoris, 2015; Van de Vijyer, Derudder and Witlox, 2016; Hakim and Merkert, 2017). In their study which included several regions in Europe Mukkala and Tervo (2012) reached a conclusion that air transport played an important role especially for development of remote regions. Different cointegration approaches and causality tests were used in the studies in which airports of Chinese cities were analyzed territorially. Yao and Yang determined that, economic growth had a positive and significant effect on air transport. Hu et al (2015) found that there was a relationship between domestic air passenger and economic growth in the long run. And also, according to their study there was a causal relationship between domestic air passenger traffic and GDP in the short term.

In some studies, relationship between air transport and economic growth in the short and long run was researched on the basis of countries (Brida, Lanzilotta, Brindis and Rodrigez, 2014; Brida, Bukstein and Zapata-Aguirre, 2016). Marazzo, Scherre, Fernandes (2010) examined the relationship between air transport demand in Brazil and economic growth in period of 1966-2006. And in their study there was a relationship between variables in the long term according to

Johansen-Juselius approach. And also according to the Granger causality test economic growth was a cause of air transport. In the study conducted by Mehmood, Feliceo, Shahid (2014) the relationship between air transport's demand and economic growth in Romania was investigated. According to the study which included periods of 1970-2013 different approaches were deployed to investigate a long term relationship between variables. According to results of the study, there are both long term and short term relation between variables. When Chi and Baek (2013) investigated the relation between economic growth and air transport they also attempted to find out whether factors such as 9/11 terrorist attacks, Iraq War, sever acute respiratory syndrome (SARS) and financial crisis had an effect on economic growth and air transport. By analyzing the factors mentioned above. In this context, 9/11 terrorist attacks and sever acute respiratory syndrome (SARS) had a negative effect on air transport both in the short term and the long term.

3. Data and Methodology

The relationship between air transport and economic growth was investigated via penal data analysis. In this context, the number of passengers and volume of freight carried by air were used as indicators of air transport while GDP was deployed as an indicator of economic growth in the analysis of the study. Data that contained period of 1993-2016 were obtained from World Bank for the study.

20 countries which carry the most passengers both domestically and internationally were included in the analysis. The USA, China, U.K, Ireland, Germany, India, Japan, Turkey, Indonesia, Brazil, Canada, Russia, Korea, Australia, Spain, France, Thailand, Malaysia, Mexico were included in the study. Data belonged to The UAE (The United Arab Emirates) were removed from the study. Because, the data from The UAE didn't exist in data bank of World Bank.

Cross sectional dependence might have many effects on estimators. Ignoring cross sectional dependence will affect characteristics of estimators (Hoyos and Sarafidis, 2006:2). Cross sectional dependence can be defined as correlation among individuals (Moscone and Tosetti, 2009:258). Peseran (2004:6) suggests a test based on pairwise correlation coefficients. According to his suggestion;

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

Here, N signifies panels' unit dimension whereas T signifies panel's time dimension. While Test statistics in (1) is formed for balanced panels, test statistics for unbalanced panels as follows;

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

Panel unit root tests which could be termed as second generation tests are suggested if correlation exists between individuals (Hurlin and Mignon, 2006:3-8).

It could be expressed that ADF root test has limited power against alternative hypotheses in finite samples. In this test H_0 signifies that individuals contain unite root and alternative hypothesis suggests that unit are stationary (Levin, Lin and Chu, 2002:2). A more powerful panel unit root test is suggested with LLC instead of unit root for each cross sectional data. H_0 suggests that time series of each individual contain unit root. And alternative hypothesis suggests that that time series

of each individual is stationary (p.240). LLC draws upon extended Dickey-Fuller (ADF) regression:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{L=1}^{p_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad (3)$$

Here d_{mt} signifies deterministic variable, ρ_i signifies autoregressive parameter, L signifies optimal lag length. And also m which is utilized to examine stationarity gains respectively values of 1, 2, 3 in defining three different models (Baltagi, 2008:240).

Im, Pesaran and Shin (IPS) (2003) suggests a unit root test for dynamic heterogeneous panels which hinge on mean of unit root tests (Im, Pesaran and Shin, 2003:53). When error terms contain autocorrelation, this test hinges on calculation of ADF's mean by individuals. When Formula (3) is taken into consideration, H_0:ρ_i=0 and alternative hypothesis could be expressed as Formula (4) (Baltagi, 2008:242).

$$H_1: \begin{cases} \rho_i < 0, & i = 1,2,\dots,N_1 \\ \rho_i = 0, & i = N_1+1,\dots.N \end{cases} \quad (4)$$

When serial correlation doesn't exist, IPS test yields quite good results in finite samples (Im, Pesaran and Shin, 2003:73).

Dumitrescu and Hurlin (2012), suggests a nonlinear approach for heterogeneous panel models on the basis of causality test which is put forward by Granger. Here, test statistics is put forth based on Wald test statistics.

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{it-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{it-k} + \varepsilon_{it} \quad (5)$$

As in Equation (5), i=1, 2……..N number of units and t=1,…….., in a T time dimension panel model, H_0 expresses that there isn't a causality relationship in any cross section unit. Alternative hypothesis of (6) shows that there is a causality relationship for at least one sub group in the panel model. And also alternative hypothesis suggests model is heterogeneous (Dumitrescu and Hurlin, 2012:1453).

$$H_0: \beta_i = 0, \quad i = 1,\dots N \quad (6)$$

$$H_1: \begin{matrix} \beta_i = 0, & i = 1,\dots N_1 \\ \beta_i \neq 0, & i = N_1+1,\dots.N \end{matrix} \quad (7)$$

Test statistics in Dumitrescu and Hurlin (2012) approach which is based on Wald statistics is expressed in Equation (8).

$$W_{N,T} = \frac{1}{N} \sum_{L=1}^{p_i} W_{i,T} \quad (8)$$

Here,$W_{N,T}$, is Walt test which is in (6) and used to test H_0 (Dumitrescu and Hurlin, 2012:1453).

4. Findings

First of all, it was investigated to find out whether series in the study had a unit correlation. Unit correlation was conducted for each series via Pesaran (2004) CD test. H_0 which suggests that series don't have a unit correlation was rejected. And according to Table 1.1, H_0 was rejected for

all series. Second generation panel root tests were deployed to examine stationarity of series which don't have a unit correlation.

Table 1.1. Results of Cross Sectional Dependence Test

Variables	**lfreight**	**lpassenger**	**lgdp**
Pesaran(2004) CD Test	26.20 (0.00)*	54.14 (0.00)*	61.28 (0.00)*

* Significant at 0.05, Probability values are in brackets

The results of panel unit root tests which include series and their first difference are shown in Table 1.2. Im Pesaran and Shin (IPS) and also Levin, Lin and Chu (LLC) panel unit root test were deployed to investigate stationarity of series. According to both of tests' results, primary differences of series are stationary at the 0.05 significance level.

Table 1.2. Results of Panel Unit Root Tests

Variables	Levin, Lin and Chu(LLC)	Im, Pesaran and Shin(IPS)
lfreight	1.40 (0.92)	3.25 (0.99)
Δlfreight	-17.25 (0.00)*	-15.81 (0.00)*
lpassenger	0.6334 (0.7367)	2.43 (0.99)
Δlpassenger	-13.31 (0.00)*	-12.59 (0.00)*
lgdp	0.32 (0.63)	3.29 (0.99)
Δlgdp	-11.08 (0.00)*	-10.56 (0.00)*

*, Significant at 0.05, Probability values are in brackets. H_0 suggests that panels contain unit root. And alternative hypothesis states that panels are stationary. Lengths of lag in unit root tests are determined based on Akaike criterion. Δ signifies first difference of series.

Causality relationship of series whose stationarity were secured by getting their primary difference was examined via Dumitrecu and Hurlin (2012) approach. For this purpose, two different lags were conducted to find out whether there was a causal relationship among series. According to Dumitrecu and Hurlin (2012) heterogeneous panel causality analysis, it was determined that GDP had an effect on air freight and number of air passenger.

Table 1.3. Results of Dumitrescu and Hurlin (2012) Heterogeneous Panel Causality Analysis

	k=1	**k=2**
dlfreight-dlgdp	0.2846 (0.7759)	0.4411 (0.6592)
dlgdp-dlfreight	2.1285 (0.0333)*	1.7139 (0.0866)**
dlpassenger-dlgdp	1.0065 (0.3142)	0.7735 (0.4392)
dlgdp-dlpassenger	2.4160 (0.0157)*	1.7144 (0.0865)**

Probability values are in brackets. *,** express significance at 0.05 and 0.10 respectively, k signifies lag number.

5. Conclusion

The relationship between air transport and economic growth was investigated via panel approach. In this context, GDP, number of passengers and volume of freight were used in analysis.

Cross sectional dependence of series was examined at first in the study. Stationarity of series was examined via LLC and IPS panel unit root tests. On the basis of Dumitrescu and Hurlin (2012) causality approach it was determined that GDP was cause of number of air passengers and volume of air freight. Dumitrecu and Hurlin (2012).

Study of Marazzo, Scherre and Fernandes (2010) which was conducted in Brazil have similar findings with our study. And similarly, Chi and Baek (2013) determined in their panel data study that economic growth had an effect on number of air freight passengers and air freight. According to results of this study, it could be stated that economic growth plays an important role in number of air passengers and air freight services. These results might help airway mangers to take decision and measures about topics like planning, marketing to enhance air transport and air freight services.

References

Air Transport Action Group(2005). *The Economic and Social Benefits of Air Transport ATAG*. Geneva: ATAG.

Baker, D., Merkert, R. and Kamruzzaman, M. (2015). "Regional aviation and economic growth: cointegration and causality analysis in Australia". *Journal of Transport Geography*. *43*. 140-150.

Baltagi, B. (2008). *Econometric Analysis of Panel Data*. John Wiley & Sons.

Brida, G., Lanzilotta, B., Brindis, M. and Rodríguez-Collazo, S. (2014). "Long-run relationship between economic growth and passenger air transport in Mexico". *Serie DT (14/04)*.

Brida, J. G., Bukstein, D. and Zapata-Aguirre, S. (2016). "Dynamic relationship between air transport and economic growth in Italy: a time series analysis". *International Journal of Aviation Management*. *3*(1). 52-67.

Button, K. and Taylor, S. (2000). "International air transportation and economic development". *Journal of air transport management*. *6*(4). 209-222.

Button, K. and Yuan, J. (2013). "Airfreight transport and economic development: an examination of causality". *Urban Studies*. *50*(2). 329-340.

Chi, J. and Baek, J. (2013). "Dynamic relationship between air transport demand and economic growth in the United States: A new look". *Transport Policy*. *29*. 257-260.

Dumitrescu, E. I. and Hurlin, C. (2012). "Testing for Granger non-causality in heterogeneous panels". *Economic Modelling*. *29*(4). 1450-1460.

Hakim, M. M. and Merkert, R. (2016). "The causal relationship between air transport and economic growth: Empirical evidence from South Asia". *Journal of Transport Geography*. *56*. 120-127.

Hakim, M. M. and Merkert, R. (2017). "Econometric evidence on the determinants of air transport in South Asian countries". *Transport Policy*.

Hu, Y., Xiao, J., Deng, Y., Xiao, Y. and Wang, S. (2015). "Domestic air passenger traffic and economic growth in China: Evidence from heterogeneous panel models". *Journal of Air Transport Management*. *42*. 95-100.

Hurlin, C. and Mignon, V. (2007). "Second generation panel unit root tests". THEMA-CNRS. University of Paris X. Mimeo.

Im, K. S., Pesaran, M. H., and Shin, Y. (2003). "Testing for unit roots in heterogeneous panels". *Journal of econometrics*. *115*(1). 53-74.

Ishutkina, M. and Hansman, R. J. (2008). "Analysis of Interaction between Air Transportation and Economic Activity". In *The 26th Congress of ICAS and 8th AIAA ATIO* (p. 8888).

Levin, A., Lin, C. F. and Chu, C. S. J. (2002). "Unit root tests in panel data: asymptotic and finite-sample properties". *Journal of econometrics*. *108*(1). 1-24.

Marazzo, M., Scherre, R. and Fernandes, E. (2010). "Air transport demand and economic growth in Brazil: A time series analysis". *Transportation Research Part E: Logistics and Transportation Review*. *46*(2). 261-269.

Mehmood, B., Feliceo, A. and Shahid, A. (2014). "What causes what? Aviation demand and economic growth in Romania: Cointegration estimation and causality analysis". *Romanian Economic Business Review*. *9*(1). 21-33.

Moscone, F. and Tosetti, E. (2009). "A review and comparison of tests of cross-section independence in panels". *Journal of Economic Surveys*. *23*(3). 528-561.

Mukkala, K. and Tervo, H. (2013). "Air transportation and regional growth: which way does the causality run?". *Environment and Planning A*. *45*(6). 1508-1520.

Nguyen, H. O. and Tongzon, J. (2010). "Causal nexus between the transport and logistics sector and trade: The case of Australia". *Transport policy*. *17*(3). 135-146.

Pesaran, M. H. (2004). "General diagnostic tests for cross section dependence in panels". *Working Paper*. University of Cambridge.

Profillidis, V. and Botzoris, G. (2015). "Air passenger transport and economic activity". *Journal of Air Transport Management*. *49*. 23-27.

Van de Vijver, E., Derudder, B. and Witlox, F. (2016). "Air passenger transport and regional development: Cause and effect in Europe". *Promet-Traffic&Transportation*. *28*(2). 143-154.

Yao, S. and Yang, X. (2012). "Air transport and regional economic growth in China". *Asia-Pacific Journal of Accounting & Economics*. *19*(3). 318-329.

www.worldbank.org