The Relationship between Globalization and Air Transport in Turkey: A Cointegration Analysis

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Abstract

The purpose of the study is to examine the relationship between globalization and air transport in Turkey for the period between 1970 and 2018. The KOF Globalization Index as a globalization variable and the number of air passengers carried as an air transport variable are used in the analysis for this purpose. Firstly, Harvey et al. (2008) and Harvey and Leybourne (2007) tests are applied to test the linearity of the variables. Secondly, the unit root hypothesis is tested by applying the Augmented Dickey-Fuller (ADF), Kapetanios et al. (2003), Sollis (2009), and Kruse (2011). Finally, Kapetanios et al. (2006) cointegration test created based upon threshold autoregressive models, also known as KSS (2006), is run to test the cointegration relation. Results report that there is a cointegration relation between globalization, which covers the economic, social, and political dimension, and air transport in Turkey. In other words, results support that there is a long run relationship between the variables.

Keywords: KOF Globalization Index, Globalization, Air Transport, Cointegration Analysis


1 This study is created from Gülşah Sedefoğlu's ongoing PhD thesis supervised by Prof. Dr. Burak Güriş.
Introduction

The term globalization has been used in different meanings changes from people to people or society to society. The most common definition is that it is the degree of communication and interaction between people, society, and countries within the framework of the concept of mutual dependency. It mostly refers to a dynamic meaning rather than static. Globalization does not cover only a single indicator such as openness to trade or capital flows; it has a multidimensional concept that includes people of different countries exchange ideas, information in a mutual way or governments coming together to overcome the faced global problems. In order to see the causes and consequences of globalization and to make an analysis to understand the relation between globalization and other indicators, globalization needs to be in a measurable form (Gygli et al., 2019). In applied econometrics, for instance, it is necessary to have data to examine the causes and consequences of globalization. KOF Globalization Index introduced by Dreher (2006) and published by the KOF Swiss Economic Institute allows combining different variables to measure different aspects of globalization along the economic, social, and political dimensions for almost all countries (Gygli et al., 2019). Those dimensions are seen as essential for contemporary societies (Dreher et al., 2010). The influence of globalization can be positive or negative depends on the indicator compared and on the country or country group although the term globalization is generally detected positively. In the literature, most of the studies, such as Hasan (2019), Samimi and Jenatabadi (2014), Ying et al. (2014), Gurgul and Lach (2014), Chang and Lee (2010) analyse the linkage of globalization and economic growth and results mostly find out that globalization’s effect on economic growth is positive. However, various studies remark that globalization is linked to inequality but mostly with an inverse relationship. Giri et al. (2021) confirm that financial globalization leads to inequality in a direct and indirect way in India. Jaumotte et al. (2013) report that financial globalization enhances inequality while trade globalization reduces inequality in developing and high-income countries. Dreher and Gaston (2008) point out that globalization causes an increase in inequality in OECD countries. The given examples from the literature can be extended but in this study, we examine the relationship between globalization and air transport in Turkey applying a cointegration approach suggested in the literature of econometrics. Air transport has become one of the most important industries in the world by showing great development over the years with technological developments. It has crucial importance on the development of a country directly or indirectly by creating job areas, contributing to trade and tourism and facilitating economic integration (Küçükörenal and Sedefoğlu, 2017). Moreover, the air transport sector also plays a major role in the Turkish economy by providing connections between countries. These virtual bridges in the air provide economic flows of goods, investments and allow people to interact and share knowledge and solutions. It is estimated that air transport supports around 1 million jobs included tourists arriving by air (IATA, 2019). Thus, air transport can be seen as one of the major contributors to the economy, and lack of it, as with any other contributor to the economy, can lead to preventing efficient growth (Ion, 2011). It is obvious that the effect of globalization has been profound for air transport both on the demand side and supply side. In the literature of air transport, the variables of economic growth and tourism are widely used to see their effects on air transport such as Altuntas and Kılıç (2021), Kiraci and Battal (2018), Küçükörenal and Sedefoğlu (2017), Hakim and Merkert (2016), Hu et al. (2015), Button and Yuan (2013), Fernandes and Pacheco (2010), Bieger and Wittmer (2006). However, not many studies are found that considered the approaches in econometrics to put forth the linkage between globalization and air transport although some remarkable researches, reports, and papers are detected which are mostly created based on a discussion or descriptive statistics. Furthermore, as far as our knowledge, there is not any paper examine the cointegration relation between globalization and air transport in Turkey.

In the cointegration analysis, when we look at the basic level economic variable pairs, these pairs of variables are expected to converge at least in the long run. Divergence in the short run can be observed in the economic variables but divergences that are continued in the long run tend to create economic problems. In this case, it is expected that economic forces, such as a market mechanism or state intervention, intervene in the situation to make pairs of variables act together in the long run. In the study of Granger (1986), in which the foundations of cointegration analysis were laid, the validity of beliefs about the relationship between variables in the long run was handled as an empirical question. Based on this information, we can say that the main idea in the cointegration analysis is to create models that capture some of these beliefs, especially for the variables encountered in macroeconomic theory (Granger, 1986). In the literature, remarkable contribution has been made in the linear cointegration analysis such as Engle and Granger (1987), Sargan and Bhargava (1983), Banerjee et al. (1986), Johansen (1988), Johansen (1995) and Johansen and Juselius (1990), Leybourne and McCabe (1993), Banerjee et al. (1998), Pesaran and Shin (1995) and Pesaran et al. (2001). Following to mentioned cointegration tests, nonlinear cointegration tests have been remarkable attention thanks to technological development and the remarkable progress in science. Nonlinear cointegration tests, also unit root tests, have seen as an alternative way to linear tests, especially for the variables with the nonlinear aspect. The work of Balke and Fomby (1997), Li and Lee (2010), Hansen and Seo (2002), Seo (2006), Enders and Siklos (2001) and Kapetanios, Shin, and Snell (KSS) (2006) are well known in the nonlinear tests based on the threshold autoregressive regression. In this study, we aim to contribute to the literature on air transport and globalization by considering the lack of literature and we apply the KSS (2006) cointegration test
developed based on the smooth transition autoregressive (STAR) methodology. The data of air transport is conducted from the World Bank database as the number of domestic and international aircraft passengers and the KOF globalization index is used for the globalization variable between the years 1970 and 2018.

The rest of the paper is organized as follows: The method of cointegration and related tests are examined in the second section. Data and results are presented in the third section and finally, final remarks are given in the conclusion section.

Method

In the cointegration analysis, considered variables in the analysis have to be integrated at the same level which mostly required to be at the first difference (Murray, 1994). In order to test whether the variables are stationary at level or at the first difference, we first follow the Augmented Dickey-Fuller (ADF) test which is an extended version of the Dickey (1979, 1981) test and the origin of the most suggested tests in the literature.

In the nonlinear unit root tests, Kapetanios et al. (KSS) (2003), Sollis (2009), and Kruse (2011) are the most popular tests used in applied econometrics. KSS (2003) unit root test is the first nonlinear unit root test which considers the Taylor series approximation in the testing procedures and the test is known as a nonlinear form of the ADF unit root test. The exponential transition function is used as a transition function to define the nonlinearity in the model following the literature on STAR models.

The model can be written as follows:

\[ y_t = \beta y_{t-1} + \phi y_{t-2} G(\theta; y_{t-2}) + \epsilon_t \]  

where the transition function \( G(\theta; y_{t-2}) = 1 - e^{-\theta y_{t-2}} \). In the function, \( c = 0, \theta \geq 0 \) and \( d \geq 1 \) (Kapetanios et al., 2003). The model can be reorganized by assuming that \( c = 0, \theta \geq 0 \) and \( d = 1 \) as follows:

\[ \Delta y_t = \phi y_{t-1} + \gamma y_{t-2} \left[ 1 - e^{-\theta y_{t-2}} \right] + \epsilon_t \]  

where \( \phi = \beta - 1 \) (Kapetanios et al., 2003). Under the assumption of \( \phi = 0 \), the model can be formed as follows:

\[ \Delta y_t = \gamma y_{t-1} \left[ 1 - e^{-\theta y_{t-2}} \right] + \epsilon_t \]  

In the KSS (2003) unit root test, the null hypothesis of unit root process \( H_0: \theta = 0 \) is tested against the alternative of stationary exponential smooth autoregressive (ESTAR) process \( H_1: \theta > 0 \). However, it is not feasible to directly test the null hypothesis since the parameter \( \gamma \) is not identified under the null hypothesis. Taylor series approximation is suggested to overcome the problem, also called as Davies (1987) problem, in the literature (Kapetanios et al., 2003). The suggested model for the stationary test is created based on the Taylor series approximation as follows:

\[ \Delta y_t = \delta y_{t-2}^2 + \sum_{j=1}^{p} \rho_j \Delta y_{t-j} + \epsilon_t \]  

The null and alternative hypotheses are formed as \( H_0: \delta = 0 \) and \( H_a: \delta < 0 \). Critical values are tabulated in the KSS (2003) for the cases for row, demeaned and detrended data.

In the Sollis (2009) test, a new unit root test is proposed to test the unit root null hypothesis against the alternative hypothesis that allows symmetric or asymmetric ESTAR nonlinearity (Sollis, 2009), unlike KSS (2003). The suggested model is also known as asymmetric ESTAR (AESTAR) written as follows:

\[ \Delta y_t = \phi_1 y_{t-1}^2 + \phi_2 y_{t-2}^2 + \sum_{j=1}^{k} \kappa_j \Delta y_{t-j} + \epsilon_t \]  

The rejection of the null hypothesis of unit root \( H_0: \phi_1 = \phi_2 = 0 \) may address to test the null of symmetric ESTAR nonlinearity \( H_0: \phi_2 = 0 \) against the alternative of asymmetric ESTAR nonlinearity \( H_a: \phi_2 \neq 0 \) using a standard F test statistics. Critical values of F tests are tabulated in Sollis (2009) for three cases as KSS (2003) since a standard F test cannot be used to test the unit root null hypothesis (Sollis, 2009).

In the Kruse (2011) unit root test, the ESTAR specification is concerned with the assumption of \( c \neq 0 \). Thus, the model is written based on the Taylor approximation as follows:

\[ \Delta y_t = \phi_1 y_{t-1}^2 + \phi_2 y_{t-2}^2 + \sum_{j=1}^{k} \rho_j \Delta y_{t-j} + u_t \]  

where unit root null hypothesis \( H_0: \phi_1 = \phi_2 = 0 \) is tested against the alternative of globally stationary ESTAR process \( H_1: \phi_1 < 0, \phi_2 \neq 0 \) (Kruse, 2011).

In the KSS (2006) cointegration test, there are first suggested two different cointegration tests using the ESTAR process in error correction model (ECM) and second, a nonlinear form of the residual-based test is proposed.
following to Engle-Granger (1987) residual based study to test the null hypothesis of no cointegration against the alternative of globally stationary ESTAR cointegration (Kapetanos et al., 2006). The ECM can be written as follows:

$$\Delta z_t = \phi u_{t-1} + g(.) + \sum_{i=1}^{p} \psi_i \Delta z_{t-i} + e_t$$

where $$u_t = y_t - \beta' x_t$$, $$y_t$$ is the scalar variable, $$k$$-vector $$(x'_t = x_{t1} \cdots x_{tk})$$ for $$k = n - 1$$ and $$z_t = (y_t, x'_t)^{2}$$. In the model, $$g(.)$$ is the nonlinear function which allows the presence of nonlinear adjustment in ECM and it can be in different functional forms such as logistic or exponential forms. In the KSS (2006) test, it is considered as an exponential function and the function can be written as follows:

$$g(.) = -\phi u_{t-1} e^{-\theta(u_{t-1}-c)^2}$$

where $$c$$ is a transition variable and $$\theta$$ is the smoothness parameter assumed as $$\theta \geq 0$$. The ECM is rewritten to make it more suitable for applying cointegration tests as follows:

$$\Delta y_t = \phi u_{t-1} + \gamma u_{t-1} \left(1 - e^{-\theta(u_{t-1}-c)^2}\right) + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i \Delta z_{t-i} + e_t$$

$$\Delta x_t = \sum_{i=1}^{p} \Gamma_i \Delta z_{t-i} + \eta_{xt}$$

For the model, the null hypothesis of no cointegration $$H_0: \theta = 0$$ is tested against the alternative of nonlinear ESTAR cointegration $$H_1: \theta > 0$$. However, testing the null hypothesis directly is found problematic as mentioned in KSS (2003) unit root test since $$\gamma$$ is not identified under the null hypothesis. Thus, Taylor series approximation is suggested to overcome the problem following KSS (2003) and Luukkonen et al. (1988). Testing regression is written as follows while considering $$\phi \neq 0$$ under the null hypothesis:

$$\Delta y_t = \delta_1 \Delta u_{t-1} + \delta_2 \Delta u_{t-1}^2 + \delta_3 \Delta u_{t-1}^3 + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i \Delta z_{t-i} + e_t$$

For this model, the null hypothesis $$H_0: \delta_1 = \delta_2 = \delta_3 = 0$$ is tested against the alternative hypothesis $$H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq 0$$ and $$F_{REC}$$ statistics is calculated based on the restricted regression defined under the null.

For the second suggested test $$F_{REC}$$ assumed that $$c = 0$$, the regression is written as follows:

$$\Delta y_t = \delta_1 \Delta u_{t-1} + \delta_2 \Delta u_{t-1}^2 + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i \Delta z_{t-i} + e_t$$

The test statistics is calculated based on the null hypothesis of $$H_0: \delta_1 = \delta_2 = 0$$. The other suggested tests in the KSS (2006) are defined as t-types assumed that $$\phi = 0$$. For the first suggested t-types test $$t_{REC}$$, the regression is written as follows:

$$\Delta y_t = \delta_1 \Delta u_{t-1} + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i \Delta z_{t-i} + e_t$$

For the second suggested t-types test $$t_{REC}$$ is calculated based on the following regression:

$$\Delta \hat{u}_t = \delta_1 \Delta u_{t-1} + \sum_{i=1}^{p} \psi_i \Delta \hat{u}_{t-i} + e_t$$

The null hypothesis $$H_0: \delta = 0$$ is tested against the alternative hypothesis $$H_1: \delta < 0$$ for both t-types tests. Test statistics for all suggested tests are tabulated in the KSS (2006).

Data and Results

Data we use for the period 1970-2018 for Turkey are conducted from the KOF Globalization Index published by the KOF Swiss Economic Institute for the variable of globalization and from The World Bank database for the air transport variable. The period of the data is chosen depending on the data availability. The KOF Globalization Index we used here measures the economic, social, and political dimensions of globalization. Equal weights are used for each of the economic, social, and political globalization and the overall globalization index is calculated by the average of the de facto and de jure Globalization Index. The index is created with a scale ranges between 0 and 100. The fact that the index value of a country is approaching 100 indicates that globalization has increased in that country. The air transport variable refers to passengers carried which include both domestic and international aircraft passengers of air carriers registered in the country. The short names used for the variables in the study is “global” for The Globalization Index and “air” for the air transport variable. We redefine the variables as “log global” and “log air” in the analysis and in the below tables since the logarithmic transformation has been made for the variables to prevent the nonstationary in the variance. In Graph 1 and Graph 2, we present the number of

2 Two other cases with a constant and a constant and linear trend may also be defined to compute the residuals as $$u_t = y_t - \mu - \beta' x_t$$ and $$u_t = y_t - \mu - \beta t - \beta' x_t$$, respectively. Choosing the cases is subject to the purpose of the study or characteristic of the variables.
passengers carried and The Globalization Index values for the years between 1970 and 2018 in Turkey. The Graph 1 shows that number of passengers carried tended to increase in 1990s and showed a significant increase after the year of 2003. In Graph 2, The Globalization Index values indicate that globalization has been in a smooth increase almost all years.

Graph 1. Number of Passengers Carried between 1970 and 2018 in Turkey

![Graph 1. Number of Passengers Carried between 1970 and 2018 in Turkey](image1.png)

Graph 2. The Globalization Index Values between 1970 and 2018 in Turkey

![Graph 2. The Globalization Index Values between 1970 and 2018 in Turkey](image2.png)

We first test the linearity of the variables using Harvey et al. (2008) and Harvey and Leybourne (2007) linearity tests. According to Harvey et al. (2008) test results in Table 1, the null hypothesis of linearity is rejected at the 1% significance level for lair but not rejected for lglobal. Harvey and Leybourne (2007) test results indicate that both variables show a nonlinear aspect since the null hypothesis is rejected at the 5% significance level for the lglobal variable and at the 1% significance level for the lair variable.

Table 1. Linearity Test Results

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>lglobal</td>
<td>0.19</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>lair</td>
<td>12.45***</td>
<td>37.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.96</td>
</tr>
</tbody>
</table>

Note: Critical values for Harvey et al. (2008) are 9.21, 5.99, and 4.60 at the level of 1%, 5%, and 10%, respectively. Critical values for Harvey and Leybourne (2007) are 13.27, 9.48, and 7.77 at the level of 1%, 5%, and 10%, respectively.

3 In addition to the application of Harvey et al. (2008) and Harvey and Leybourne (2007) tests, we have applied auxiliary tests such as McLeod-Li (1983), Keenan (1985), and Brock et al. (1987). Since the probability results for both series are found less than 0.05 in all tests, nonlinear structure can be suspected in the series.
Linear and nonlinear unit root test results are presented in Table 2 as a second step of the analysis. According to all test results, the null hypothesis of unit root is not rejected for both lglobal and lair variables at the level values of variables. For this reason, first difference of the variables is considered and tested with ADF test in order to evaluate the stationary process. Test results demonstrate that the null hypothesis of unit root is rejected for both variables and thus, variables are stationary at first difference.

Table 2. Linear and nonlinear unit root test results

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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lglobal</td>
<td>-0.971 (0)</td>
<td>-1.108 (6)</td>
<td>0.604 (6)</td>
<td>1.321 (6)</td>
</tr>
<tr>
<td>lair</td>
<td>-1.341 (1)</td>
<td>-1.159 (11)</td>
<td>0.677 (11)</td>
<td>2.032 (11)</td>
</tr>
<tr>
<td>First difference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lglobal</td>
<td>-7.061*** (0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>lair</td>
<td>-8.779*** (0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: The signs *, **, and *** show the significance level at the level of %10, %5, and %1, respectively. Values in parentheses are the chosen lag values. Critical values are tabulated in the main article of the tests.

The results given in Table 3 indicate that the null hypothesis of no cointegration is rejected for \( F_{\text{NEC}} \) and \( t_{\text{NEG}} \) at the 5 % significance level and for \( F'_{\text{NEC}} \) at the 1% significance level. The rejection of the null hypothesis means that there is a cointegration relation between globalization and air transport in Turkey in the long run.

Table 3. KSS (2006) Cointegration Test Results

<table>
<thead>
<tr>
<th></th>
<th>( F_{\text{NEC}} )</th>
<th>( F'_{\text{NEC}} )</th>
<th>( t_{\text{NEC}} )</th>
<th>( t_{\text{NEG}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>15.597*** (9)</td>
<td>24.811*** (12)</td>
<td>-2.501 (9)</td>
<td>-3.742** (11)</td>
</tr>
</tbody>
</table>

Note: The signs *, **, and *** show the significance level at the level of %10, %5, and %1, respectively. Values in parentheses are the chosen lag values. Critical values are tabulated in KSS (2006).

Conclusion

The term globalization has a multidimensional concept and the KOF Globalization Index combines the economic, social, and political dimensions based on the multidimensional property of globalization. In Turkey, globalization showed a smooth increase between the period 1970 and 2018, especially as of 1990 and following years, according to data of the KOF Globalization Index. The air transport industry in Turkey and in the world has been growing rapidly although it sometimes declines in certain periods due to economic crises or a crisis that effect the whole world like a pandemic. Air transport, we considered the number of passengers carried as domestic and international for this study, started to increase in the 1990s and continued with a significant increase in the 2000s according to data of the World Bank. In this study, we consider the globalization in multidimensional concept and air transport to test the cointegration relation in Turkey. We have applied the KSS (2006) cointegration test after testing the linearity of the variables and unit root hypothesis. Findings show that there is a cointegration relation between globalization and air transport in Turkey for the period between 1970 and 2018 which means that both variables have a long run relation and any changes in a variable will have an effect on the other variable. The social, economic, and political developments in Turkey under the globalization concept will be linked to developments in air transport and vice versa. It can be interpreted that any divergence between both variables is temporary and variables are expected to move together in the long run with government intervention in the divergence situation.
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