International Journal of Aviation, Aeronautics, and Aerospace

Volume 8 | Issue 1 Article 4

2021

# The Determination of the Factors Affecting Air Transportation Passenger Numbers

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## Cover Page Footnote

Title of the Article: The Determination of the Factors Affecting Air Transportation Passenger Numbers Corresponding Author Name and Surname: Tüzün Tolga İNAN Title: Asst. Prof. Dr. PhD Area: Civil Aviation Management Institution: Bahcesehir University, School of Applied Disciplines, Pilotage Department Address (Home): Ismail Pasa Street, Kosuyolu Distinct, Kosuyolu, Kadıkoy, İstanbul, 34718 E-Mail: tuzuntolga.inan@sad.bau.edu.tr Telephone Number: 0554 426 06 04 ORCİD İD: https://orcid.org/0000-0002-5937-9217 Second Author Name and Surname: Neslihan GÖKMEN Title: Res. Asst. PhD Area: Statistics Institution: Istanbul Technical University, Maritime Faculty, Basic Sciences Department Address (Home): Sahil Street, Postane District, Istanbul Technical University Maritime Faculty, Tuzla, Istanbul, 34940 E-Mail: ngokmen@itu.edu.tr Telephone Number: 0536 501 62 00 ORCİD İD: https://orcid.org/0000-0002-7855-1297

The progress in the civil aviation industry is one of the most distinguished improvements of the 21st century and establishes one of the most significant factors of the rapid and dependable transport of advanced life nowadays which are specifically taking caution. Although solely more than a hundred years have passed since the first engine flight was flown by Wright Brothers on 17 December 1903, thousands of aircraft, thousands of airports with aviation businesses, and billions of passengers have flown with saving time in an assured and comfortable technique. Because of all this information, this dramatic progress has enhanced the distinction between the other transport selections of civil aviation which can be an alternative every passing day. Similar to the fast improvements in civil aviation worldwide, the countries that have close connections to the other countries reached a significant position in civil aviation at the international level. Furthermore, the civil aviation industry has developed in the examination of crash investigation reports, passenger and freight traffic, exemplary airport investments, improvements in national and international flight destinations with the regulations about flight safety, and civil aviation security (Aksoy & Dursun, 2018). In modern society, the civil aviation industry has become a necessary module of public transportation because of its simplicity and efficiency. Furthermore, this industry could lightly be affected by diverse historical, political, economical, and geographical factors. Besides these factors with the progression of the Airline Deregulation Act in 1978, the concept of deregulation in the civil aviation sector has been examined on a worldwide level. Furthermore, the application of airline liberalization in 2002 was related to ease unfavorable effects induced by the rivalry between airlines during the deregulation period. Although the rising of the airline liberalization period, developed countries' civil aviation system has improved by its individual operation and construction. In this situation, searching out the statistics and spatial signification of geographical location in the civil aviation system is one of the significant issues on account of researchers. It is usually mentioned that the construction of the airline system could be directly affected by state-owned strategies. As the primary countries have ventured deregulation period in civil aviation, a lot of route options have been broadly debated with the United States' knowledge more than decades (Bowen, 2002; Chou, 1993; Goetz & Vowles, 2009).

In addition to the deregulation period of the airline sector and the development progress of low-cost airlines have developed in numerous European countries (Dobruszkes, 2006; Ison, Francis, Humphreys & Page, 2011). Therefore, adjusting the destination point construction has a serious effect on airlines to keep alive (Bowen, 2002; Fleming & Hayuth, 1994; O'Connor, 2003). Aside from European countries, the development and efficiency of airline networks in numerous Southeast Asian countries have withal been examined by geographers related to their location and diverse models of progress (Bowen, 2000; Bowen & Leinbach, 1995; O'Connor, 1995). However, China's striking development in the

airline sector has achieved a lot of caution from researchers. China has evaluated its geographical location more than Asian Countries except for the United Arab Emirates (Wang 2005; Wang & Jin, 2007). So, the all-innovative period about geographical location has a relationship with state-owned decisions that are related to countries' decisions. With this decision-making, it is important to provide a profit-based industry by separating working areas into sub-stages (Shaw et al., 2009; Shen, 1992; Zhang, 1998; Zhang & Chen, 2003; Zhang & Round, 2008). The aim of the study is to map the similarities of the countries in terms of air transportation passenger number and the parameters having an impact on air transportation passenger number via geographical location importance of the countries. The selected parameters are classified as: Air transportation passenger numbers, gross domestic product (GDP), total population, and human development index (HDI). Air transportation passenger numbers, and total population parameters are related to the quantity and/or volume when comparing the countries. Gross domestic product (GDP), and human development index (HDI) parameters are shown the economical welfare of countries. In this study, literature review, the selected parameters for the analysis, research method with the methodology and results part is examined. The study is ended with the conclusion and discussion remarks. This study has a difference from previous studies related to analyzing the selected four parameters under the multidimensional scaling to find the importance of geographical location.

## Literature Review

This part of the study is related to the network structure and the selected countries for the analysis which includes the data of air transportation passenger numbers, gross domestic product (GDP), total population, and human development index (HDI).

### The Network Structure

An organized and connected transportation system could develop countries' air transportation numbers as more attainable, so these systems could support the domestic progress of civil aviation by bringing international passengers. Because of this, the connected transportation system acts a significant role in nowadays air transportation (Lew & McKercher, 2002). For example, civil aviation systems comprise a set of connections such as destinations with different time planning, transit-transfer connections, and comfortable terminals. Geographic location related to these destinations, facilities about destination airports, and arrangement of schedules. So, the collection of transit and transfer traffic from airports exemplifies a significant system for civil aviation countries. For instance, Singapore and Dubai have handled to divert an important number of passengers related to long-distance destinations among Europe, Asia, and the Southwest Pacific. Planning this process is a source of income for national economies. Instead

of; routes are related to benefit facilities and provide support for the connection of traffic to stop for little hours or all night at the airport. This situation is related to the connection of airports to other destinations (Dennis, 1994). Exclude long-haul flights, geographical location with the geographical characteristics of transportation are also related to the urban network (Derudder & Witlox, 2008; Malecki, 2002; Murayama, 1994).

The region about air transportation geographies has designed the urban network where these geographies were accommodated. For instance, Japan has a developed country with its GDP, total population, and human development index, but Japan's air transportation numbers have in the low level because of using urban transportation such as fast trains (in Japanese name Shinkansen) (O'Connor, 2003; O'Connor & Fuellhart, 2012; Tranos, 2012). The development of air transportation networks has got a particular evaluation related to other transport modules. Transporting between countries worldwide is applied as macro-level factors, besides micro-level factors embrace the entire macro-level factors with the connections inside the country that included cities. Because of this situation, in the global world national and international transportation systems connect on the macro-level (Liu et al., 2013). The merger of air transportation and tourism could be examined as physical (for instance; short and long-distance flights) and economic (for instance; business and leisure purposes) factors inside the countries' geographic characteristics. The route planning between countries could be complicated and subsume considerable plans like selecting the origin, midpoint, designated destinations such as transit, transfer flights with the planning of factors such as comfort, price flexibility, and saving time (Fleming & Hayuth, 1994). The relationship between cities (micro-level factors) and environmental factors such as tourist characteristics have created the demand that is named hospitality. Besides, air transportation for tourism purposes (the other name leisure) is designated with the seasonal schedule (planning the time of flights) because of climatic, holiday, festive, and other travel options. Planning the network of air transportation guarantees passenger safety with the help of rules and regulations and provides the order of facilities inside civil aviation, technical procedures, and implementation of international security standards. Since the final period of World War II, air transportation actions have been arranged by multilateral and bilateral worldwide contracts and tight national and international standards. That industrial perimeter is still viable in almost every developed country in civil aviation all over the world. As the cause of this situation, it is shown that the liberalization period has begun in civil aviation transportation in the late 1970s. Nowadays, this system has continued for more than 40 years (especially, put into practice in the year 1978). This process has prepared and increased the significance of geographical location on a worldwide level. The United States is the best country as using the liberalization

period for increasing its number of air transportation at the national and international levels (Papatheodorou, 2002).

The traffic of air passengers is a significant sign evaluating the growth level of a country's civil aviation industry. It is significant to figure out which factors identify the development of air traffic. In addition to the air transportation strategy, the modules such as full-service carriers and the existence of low-cost airlines (LCCs) have been respected as key factors. Numerous research on the factors of air traffic volume have focalized on the metropolitan regions in the USA and Europe (Zhang & Zhang, 2016). For instance, Liu et al. (2006) gratified that the probability of a grand air passenger market is principally specified by the metropolitan population size and the businesses of employment in professional/scientific/technical services and management strategies. Discazeaux and Polese (2007) analyzed the factors of the 89 largest urban areas in the USA and Canada related to air traffic volume. They approved that urban size and local industry construction remain the prime factors. Dobruszkes et al. (2011) informed that gross domestic product (GDP), the economical level of decision-power, functions of tourism, and distance from a grand air market are the most significant issues for air traffic flows in Europe.

The present COVID-19 crisis has strained the civil aviation industry to regulate rapidly to implement regulations that comply with the state. More than half of the aircraft grounded because of the substantial decline in passenger demand. The airlines operate to detect alternative, rapid and influential dimensions for keeping alive as the crisis proceeds at a global level. In response to the prevailing state, a press release has published by the International Air Transport Association (IATA). Besides IATA, the states which are a member of the International Civil Aviation Organization (ICAO) have a significant mission to promote civil aviation particularly in the financial sector like direct assistance for financial decisions, credits, and tax reprieve. IATA also specifies that recently more than 2.7 million airline business is in risky level because of the COVID-19 effect (International Air Transport Association, 2020).

***The Selected Countries for the Analysis***

In this analysis, the top 50 countries were listed according to the total number of commercial passengers, gross domestic product (GDP), total population, and human development index (HDI) with the values compared to the year with the highest value in 2018 and/or 2019. A total of 28 countries took place in common at least three categories, so these countries were included in the analysis. These countries were located in the continents of America (including North and South), Europe, Asia, and Africa. 6 of the selected countries are located in America, 8 in Europe, 11 in Asia, and 3 in Africa Continents. In order to have an equal distribution, countries located in America with Europe and Asia with Africa were compared separately. So, two different distributions are created consisted of 14

countries. All data exclude human development index (HDI) took into consideration in the analysis were taken from the World Bank Data website (The World Bank, 2020a/2020b/2020c).

The selected countries that were examined in this analysis are classified as: The United States, Brazil, Canada, Mexico, Colombia, and Argentina are from America Continent. The United Kingdom, Turkey, Germany, Russian Federation, Spain, France, Italy, and Poland are from Europe Continent. China, India, Japan, Indonesia, Korea Republic, Thailand, Malaysia, Vietnam, Philippines, Saudi Arabia, and the Iran Islamic Republic are from Asia Continent. South Africa, Egypt Arab Republic, and Nigeria are from Africa's Continent. America and European Continents' countries are examined together. Also, Asia and African Continents' countries are examined together to obtain an even distribution.

**Air Transportation Passenger Numbers**

This data is related to the number of passengers used for commercial air transportation in the most recent year (2018). According to ICAO's primary compilation of annual global statistics, and the total number of passengers transported with scheduled services increased to 4.3 billion in 2018 that is 6.4 percent higher than the prior year, while the number of departures attained 37.8 million in 2018 with a 3.5 percent increment (International Civil Aviation Organization, 2018).

**Gross Domestic Product (GDP)**

GDP is the overall financial or market amount of whole the finished goods and services produced inside a country's boundaries in a particular period. As an extensive evaluation of total domestic production, it works as an exhaustive scorecard of an established country's economic welfare. GDP is generally measured on an annual basis; however, it is sometimes calculated on a quarterly base therewithal. In this research, the data were taken from the most recent year (2019) (Investopedia, 2020).

**Total Population**

This data is related to the number of human beings who lived in the selected country in the most recent year (2019). The total population is a parameter which shows the country's economic wellbeing if gross development product (GDP), and human development index (HDI) is at a high level. The variables of HDI are taken form human development reports document for the year 2019 (United Nations Development Programme, 2020b).

**Human Development Index (HDI)**

HDI is an outline measurement of average success in key extents of human improvement. HDI is related to an extended and healthful life, being knowledgeable, and have an esteemed standard of living. The HDI is the geometric description of standardized indications for each of the three dimensions. These are

classified as: An extended and healthful life, having knowledge, and an esteemed standard of living (United Nations Development Programme, 2020a).

## Research Method

This study includes Air Transport Passengers Carried, Total GDP Most Recent Value (Current US$), Total Population Most Recent Value, and HDI Most Recent Value from 28 countries. The descriptive statistics of the data which are examined by multidimensional scaling are shown in Table 1.

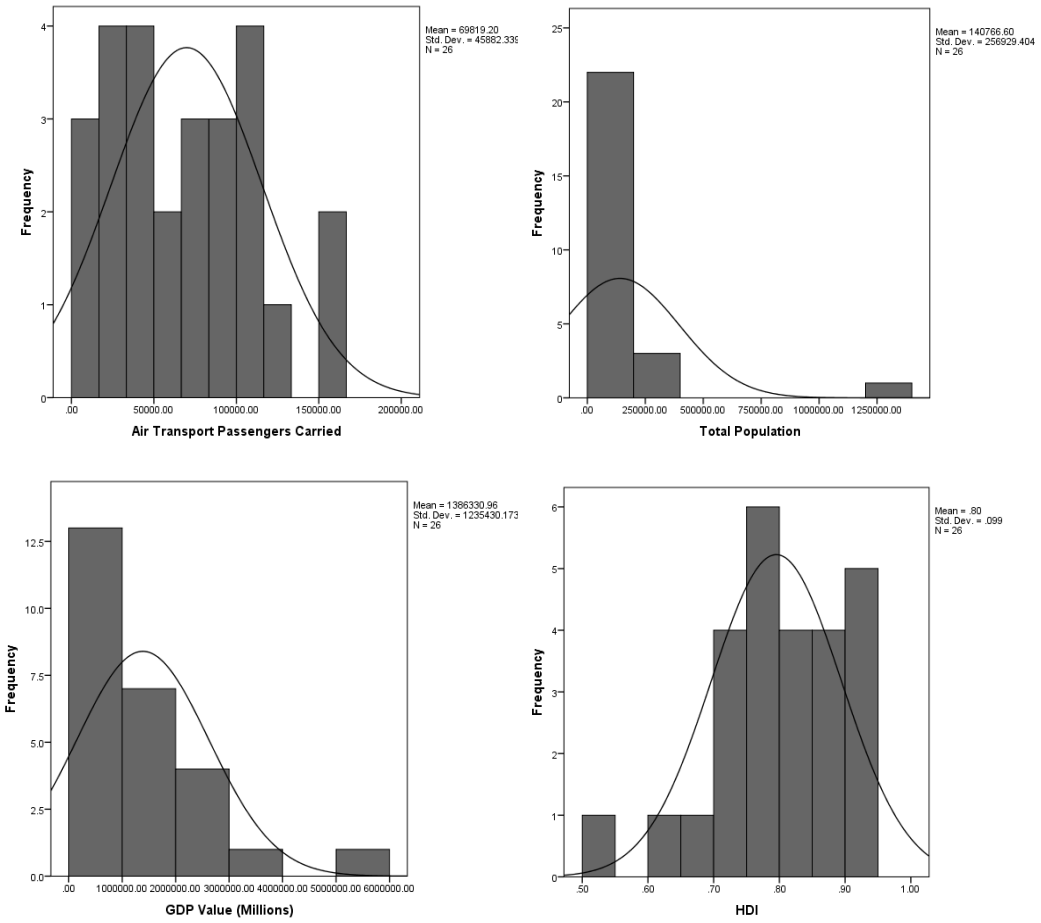
**Table 1**

*Descriptive Statistics of the Variables*

| | | Mean±SD | Med (Min-Max) |
|---|---|---|---|
| Air Transport Passengers Carried | | 118420.03±187669.8 | 73120.53 (8169.1-889022) |
| Total GDP Most Recent Value (Current US$) | | 2564828.8±4589837.5 | 1188738.75 (261921.2-21427700.0) |
| Total Population Most Recent Value | | 192353.07±343773.76 | 83023.36 (31949.78-1397715) |
| Human Development Index (HDI) | | 0.803±0.099 | 0.805 (0.53-0.94) |
| | | N | % |
| Region | America-Europe | 14 | 50.0 |
| | Africa-Asia | 14 | 50.0 |

In Table 1, it is shown that the average of air transport passengers carried is 118420.03±187669.8, the average total GDP most recent value (Current US$) is 2564828.8±4589837.5. and the average total population most recent value is 192353.07±343773.76, and the standard deviations are seemed very high excluding the human development index (HDI) because of the variation of the countries. So, these parameters are evaluated by separating the regions as America-Europe, and Africa-Asia considering as geographical location parameter.

**Figure 1**
*Histogram of the Continuous Variables*




The histograms of the continuous variables are shown in Figure 1. According to Figure 1, it is seen that the variation is high in terms of all the variables. The high variance may be due to the diversity of the countries included in the study. The study also includes data from China, USA and India. In the methodology section, the min-max normalization used by scaling the variables is explained in order to provide the assumptions of the analysis.

## Methodology

The normality test is done with the Shapiro-Wilk test. Non-parametric statistical methods are used for values with skewed (non-normally distributed, Shapiro-Wilk $p>0.05$) distribution. Descriptive statistics are presented using mean, standard deviation, median (and minimum-maximum) for the continuous variables.

For comparison of two non-normally distributed independent groups Mann Whitney U test is used and Spearman's correlation analysis is performed to determine the significant correlation between Air Transport Passengers Carried and Total GDP Most Recent Value (Current US$), Total Population Most Recent Value, and HDI Most Recent Value. To investigate the effect of parameters on Air Transport Passengers Carried, the Multivariate Regression model is used and the statistical significance is accepted when the two-sided p-value is lower than 0.05 for 95% confidence level and 0.10 for 90% confidence level. To avoid the scaling differences Min-Max Normalization is performed for continuous variables in regression analysis. The Min-Max Normalization formula is given below for the variable:

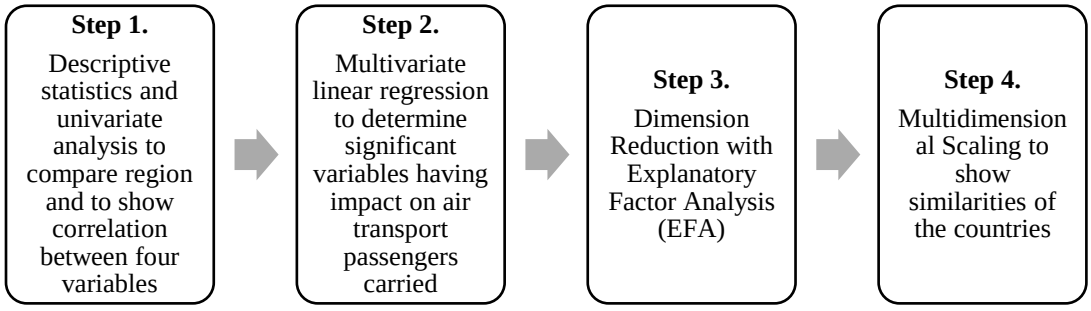
Min-Max Normalization: $\boldsymbol{x_i^* = \frac{x_i - min(x_i)}{max(x_i) - min(x_i)},\ i = 1, 2, \dots, 28}$

To show the similarities between countries, explanatory factor analysis (EFA) and multidimensional scaling (MDS) is used. EFA is a statistical method used to uncover the underlying structure of a set of variables to reducing dimensions and MDS is a visual representation of distances or dissimilarities between sets of countries (Kruskal & Wish, 1978). Countries that are more alike (or have shorter distances) are closer together on the graph than objects which are lesser alike (or have longer distances).

As well as evaluating diversities as distances on a graph, MDS could withal serve as a dimension decline process for high-dimensional data (Buja et al., 2008). In this study, the factors are calculated by using VARIMAX rotation in EFA, and the similarities are calculated by using Euclidean Distance in MDS. The overall methodology of the study is shown in Figure 2. Statistical analysis is performed by using the MedCalc Statistical Software version 12.7.7 (MedCalc, 2013), and R (smacof package).

**Figure 2**

Flowchart of the Methodology



## Results

To investigate the differences between regions in terms of the variables, univariate analysis is utilized (Table 2).

**Table 2**

*Comparisons According to Regions*

| | America-Europe Mean+SD Med (Min-Max) | Africa-Asia Mean+SD Med (Min-Max) | p |
|---|---|---|---|
| Air Transport Passengers Carried | 133910.24±221581.88 85026.05-(9277.54-889022) | 102929.83±153407.29 53765.72-(8169.19-611439.83) | .487 |
| Total GDP Most Recent Value (Current US$) | 3061836.54±5378748.31 1718151.11-(323802.81-21427700) | 2067821.16±3780311.51 495885.21-(261921.24-14342902.84) | .077 |
| Total Population Most Recent Value | 99279.09±82045.63 66947.14-(37589.26-328239.52) | 285427.06±469107.5 98425.09-(31949.78-1397715) | .352 |
| Human Development Index (HDI) | 0.834±0.095 0.858 (0.65-0.94) | 0.772±0.098 0.782 (0.53-0.89) | .069 |

*Note:* Mann-Whitney U test.

It is found that there is no difference according to regions in terms of Air Transport Passengers Carried, Total GDP Most Recent Value (Current US$), Total Population Most Recent Value, and HDI Most Recent Value (Mann-Whitney U test $p>0,05$). In the light of the findings above, full data is used to apply multiple linear regression analysis to show impacting factors on air transport passengers carried. To choose independent variables and investigate the pairwise relationships, correlation analysis is utilized. According to correlation analysis results, there is statistically significant positive and moderate relationship between Air Transport Passengers Carried, Total GDP Most Recent Value (Current US$), and Total Population Most Recent Value, in 95% significance level ($r=0.470$, $p=0.012$ [for population], $r=0.762$, $p<0.001$ [for GDP]). There is statistically significant positive

and weak relationship between Air Transport Passengers Carried and HDI in 90% significance level (r=0.332, p=0.085).

**Table 3**

*Regression Analysis Results*

| | | $R^2$ | Adjusted $R^2$ | Durbin-Watson | p | F |
|---|---|---|---|---|---|---|
| Model | | 0.966 | 0.963 | 1.978 | <0.001 | 351.665 |
| | Unstandardized $\beta$ | Standard Error | Standardized $\beta$ | t | p | VIF |
| Constant | 0.057 | 0.023 | | 2.489 | 0.020 | |
| Total GDP Most Recent Value (Current US$) (normalized) | 0.981 | 0.038 | 0.999 | 25.947 | <0.001 | 1.079 |
| HDI (normalized) | -0.057 | 0.033 | -0.066 | -1.726 | 0.097 | 1.079 |

Normalized Total GDP Most Recent Value (Current US$), and HDI are considered as independent variables that can be affected Air Transport Passengers Carried. Total Population Most Recent Value is excluded due to having an outlier effect in the USA and China. Since the Durbin-Watson value is 1.978, there is no autocorrelation. The Variance Inflation Factor (VIF) measures the impact of collinearity among the variables in a regression model. Since VIF values are less than 10, there is no multicollinearity. The model is statistically significant ($p<0.001$) and can be interpreted. Total GDP Most Recent Value (Current US$) is found statistically significant at 95% confidence level and HDI is found statistically significant at 90% confidence level. It can be said that a change of 1 unit in a Total GDP Most Recent Value (Current US$) increases Air Transport Passengers Carried by 0.981. It can be said that a change of 1 unit in HDI decreases Air Transport Passengers Carried by 0.057. To show similar countries in terms of 5 variables (Air Transport Passengers Carried, GDP, Population, HDI, and Region), EFA is used to reduce dimensions. In this way, EFA helps us to map the countries by using MDS. Moreover, the number of dimensions is determined by EFA results. The variables are used in original forms in both EFA and MDS. According to EFA results, 5 variables are reduced in 2 dimensions shown in Table 4. The assumptions of EFA are provided (KMO test value=0.581, Bartlett's test $p<0.001$). Two dimensions are explained 82.9% of the total variance.

**Table 4**

*Rotated Component Matrix with Varimax Rotation*

| Factor loadings | Component | |
|---|---|---|
| | 1 | 2 |
| Air Transport Passengers Carried | 0.970 | -0.123 |
| Total GDP Most Recent Value (Current US$) | 0.961 | -0.180 |
| Total Population Most Recent Value | 0.693 | 0.524 |
| HDI | 0.134 | -0.879 |
| Region | -0.015 | 0.830 |

According to Table 4, the first component is consisting of Air Transport Passengers Carried, Total GDP Most Recent Value (Current US$), and Total Population Most Recent Value. The second component is consisting of HDI, and the regions that are shown in the scree plot based on the factor loadings.

***Figure 3***

*Scree Plot*

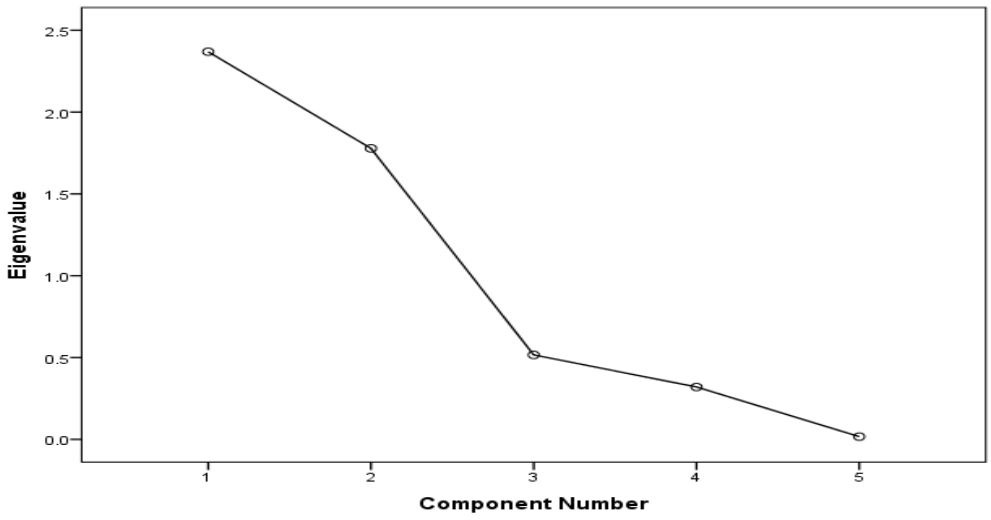
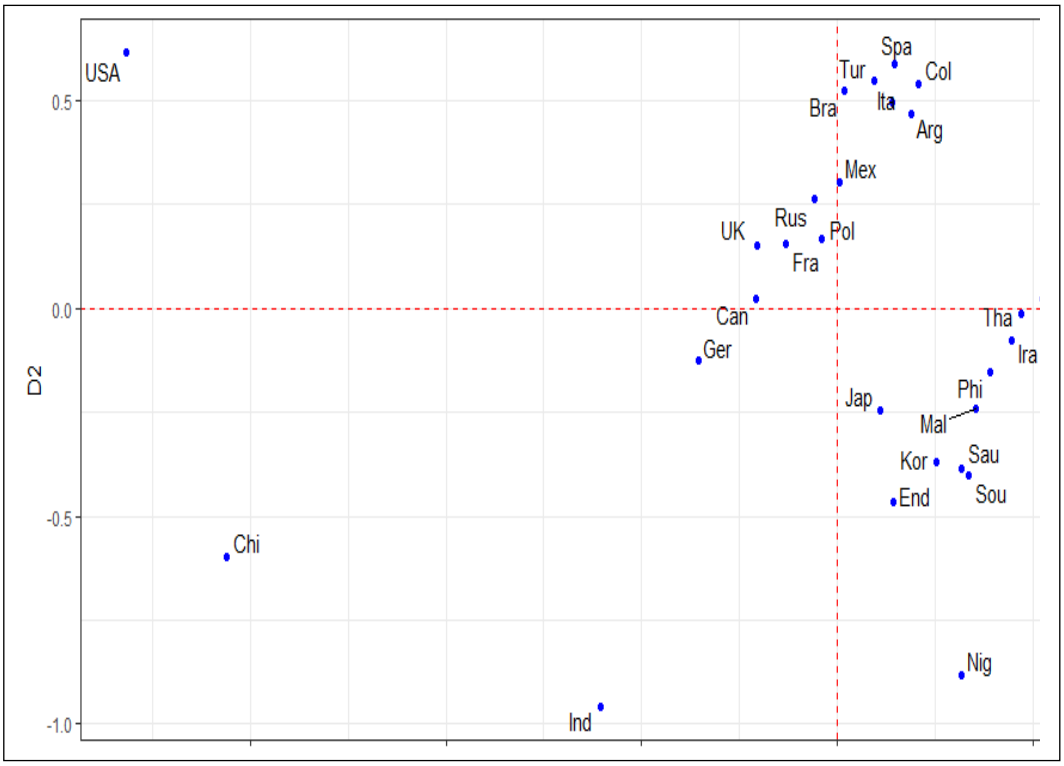



Figure 3 shows the determination of the number of factors. Since there is a very distinct decrease in the transition from the second dimension to the third dimension, so 2 dimensions are determined in multidimensional scaling. These two

components are used in MDS to show the similarities between the selected countries.

**Figure 4**

*MDS Configuration of Countries with Labels*




Multidimensional scaling (MDS) is used to show the similarities between the countries. The stress-1 value equals to 0.121 which is acceptable (0.10-0.05 good fit) (Borg & Groenen, 2005). As can be seen in Figure 4, the United States, India, and China are the most different countries for two dimensions. The similar countries are separated with reference lines and argued in the conclusion and discussion section.

According to the MDS graph, Brazil and Turkey have similarities in terms of the air transport passengers carried, GDP, and total population. It is obvious that the United States is the best country having the highest number of air transport passenges carried. The HDI and the region can be seen clearly on the left-hand side of the MDS graph. In Figure 4, dimension 1 (D1) is more related to the passenger numbers, GDP, and population as it can be seen that the United States and China

are differentiated from other countries. Dimension 2 (D2) is more related to the HDI and region as it can be seen that the United Kingdom, Brazil, and Turkey are differentiated from other countries too.

## Conclusions and Recommendations

In this study, the effects of geographical location on the air transportation of the countries have been examined. In the introduction and literature review part, after writing specific information about civil air transport, the importance of geographical location within air passenger transport was conveyed to the readers. In addition to the specified regions on a country basis; air transport passenger numbers, gross domestic product (GDP), total population, and human development index (HDI) are analyzed with the multidimensional scaling for showing the similarities with the configuration between countries. As seen in the scree plot, the component number of five parameters has been examined with two dimensions since it makes a dramatic decrease after the second component. When it is shown these 28 countries on the map related to the MDS configuration; it is seen that Nigeria, Japan, Turkey, Spain, Brazil, The United Kingdom, India, China, and the United States are different from other countries. It could be explained this difference with the term of geographic location apart from the selected five parameters that are examined.

First of all, the United States is placed at the left-up side of the MDS configuration. The United States' air transport passenger numbers, GDP, total population, and HDI parameters are at a high level. Especially, the total population is below China, and HDI is below with a slight difference lower than Germany, and Canada, the other two parameters are the highest one. Secondly, Nigeria is placed at the right-down side of the MDS configuration. Nigeria's total population is ranked sixth place in the selected 28 countries, but air transport passenger numbers, GDP, and HDI in a low level. Also, Nigeria has no geographical location advantage, so it is placed at the lowest level in selected 28 countries. Japan has the most interesting position country in this analysis. Japan's total air transport passenger numbers, total GDP, total population, and HDI are at a high level. Particularly, GDP and HDI parameters are ranked at top of the five places between the selected 28 countries. However, Japan is a country with a small area, and human-beings in Japan are used fast trains (Japanese name Shinkansen) for domestic transportation. This situation could be expressed as a micro-level factor which is related to the national level. So, a micro-level geographical location has refused the selected parameters that are shown in the development level of a country.

The United Kingdom is a significant country that shows the importance of geographical location. The United Kingdom's air transport passenger number is in third place, the total population is below average (ranked 18th place), GDP is in fifth place, and HDI is in the third place same as the United States. Exclude the total population, the other parameters are close to each other. In the rotated

component matrix with varimax rotation, there has a significant relationship between air transport passenger numbers with GDP and HDI. However, the relationship between air transport passenger numbers with the total population is not significant as GDP and HDI. This is because of the effective use of geographical location at the macro-level by the United Kingdom.

When it is examined the other countries that listed; Turkey in the sixth place, Brazil at the ninth place, and Spain at the thirteenth place in air transport passenger numbers. Turkey's GDP and HDI levels are worse than Brazil's and Spain's. Despite this situation, Turkey's geographical location is a very advantageous position. Therefore, the level of Brazil and Spain has been reached with the use of geographical position. When it is examined the last countries that remained, China's and India's total populations have at a very high level (the most populated two countries in the world). China's total population is 1,397,715,000 and India's total population is 1,366,417,750. After these countries, the United States has come with a total population of 328,239,520. Therefore, China and India are positioned in a different direction. China's position has better than India's due to the fact that the air transport passenger number is approximately four times higher, GDP is approximately five times higher, and HDI is significantly higher.

In conclusion, it could be said that there has a significant relationship between air transport passenger numbers with GDP and HDI. Considering the geographical location, the best countries that are shown in MDS configuration in terms of air transport passenger number is the United States, the United Kingdom, Brazil, and Turkey. It can be easily understood the MDS position of the United States with the aid of selected parameters that are really high. The positions of the United Kingdom, Turkey, and Brazil are having shown the importance of geographical location, although the selected variables of these countries except the number of air transportation passenger are not really high. So, geographical location is a factor which has not a relationship with the numbers like the selected parameters analyzed for multidimensional scaling.

In the following studies, the gravity model which explains the flow of freights and passengers among pairs of regions related to revenue and distance, like other parameters which could enhance or develop the flow of freights and passengers can be included in the MDS configuration.

## Disclosure Statement

The authors declare that there is no conflict of interest related to not have any competing financial, professional, or personal interests from other parties. In this study, all of the data were taken from websites, so there is no need for ethical permission.

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