Influence of tourist flows intensity on market of passenger air carriages

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Abstract. This research deals with the impact of intensity of inbound and outbound tourism on the sphere of passenger air carriages, based on the dataset that covers the indicators across different economic regions over the period of 2015-2017. The results based on building a correlation-regression model have shown that there is a close connection between tourism development and passenger carriages intensity. Verification of the model by the criteria of Fisher and Student (F-test and t-test) have proved the hypothesis about its statistical significance only after excluding five countries, for which no direct connection is observed between the chosen indictors. Further research has shown that the level of the country economic development does not influence the passenger air carriages industry. Specific attention is paid to the state and main tendencies of passenger air carriages industry in Ukraine. Impact of tourism on this kind of activity is analysed. The basic measures to increase its efficiency are highlighted.

1 Introduction

Attractiveness of the country tourist industry depends greatly on the quality of transport services provided. The central place in tourism is taken by the sphere of passenger air carriages. The more branched and intensified passenger air carriages are, the bigger potential of tourism development in the country is (on condition of logistic approach to management and increasing economic efficiency of air companies activities).

The level of air carriages industry development is characterised by number of passengers carried, number of internal and international flights, number of city-pair routes. In 2018, airlines continued to increase the number of city-pair routes globally. Almost 22,000 city pairs are now regularly serviced by airlines. The real, inflation-adjusted cost of air transport was halved in the past 20 years and declined further in 2018 [1]. Though according to the statistical data of International Civil Aviation Organisation, the number of air carriages in the world has increased (in 2017 in comparison with 2010 by 51,4 %) and constitutes 3,979 billion passengers. Naturally, the intensity of tourist flows has increased quite dynamically as well. In comparison with 2010, in 2017 the outbound flow of tourists in the world increased by 40,3 % and constituted 1,341 billion tourists.

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2 Theoretical development and hypotheses formulation

Tourism development affects the development of a range of transport infrastructure (especially air transport). Inbound and outbound tourism has bidirectional causality with air transportation [2]. Air transport and tourism are highly connected. The research shows that tourist-oriented airports may achieve higher efficiency levels than non-touristic ones [3].

Air transport development is a key driver for growth in national and international scale. The air transport has both a direct positive impact on key economic indicators and business sectors at a regional or national scale, and indirect impact in the form of side effects for tourism industry to the local or national economy [4].

Traffic flows decrease despite significant fare reductions. However, these data vary substantially based on the flight origin and ticket-type purchased [5]. The air passenger duty modifies the budget allocations of UK outbound tourists by increasing the relative share of transportation expenditure, while correspondingly decreasing the at-destination expenditures on items such as accommodation and food [6].

Air transport is highly connected with other modes of transport such as high speed trains and car travels for short time trips. Researchers compare development of travel time to show how the evolution of the air transport network has influenced reduction in travel time [7].

Regulatory systems of the air transport policy have an impact on passenger traffic and tourist flows. Restrictions on the air transport sector also have a substantial negative impact on bilateral tourist flows. Further liberalisation in this sector could help build up a stronger tourism industry [8].

The analysis of the mentioned resources has allowed hypothesising the following:

Hypothesis 1. There is mutual influence of industry development of passenger air carriages and intensity of inbound and outbound tourist flow of the country.

Hypothesis 2. Development of passenger air carriages is influenced by the development level of the country economy.

3 Research methodology

It is suggested to apply correlation methods of regression analysis to verify the hypotheses. In particular, a matrix of pair correlation coefficients has been constructed to detect the linear connection between factors. The Method of Ordinary Least Squares has been used to evaluate the parameters of linear equations of regression. The statistical criteria of Fisher and Student (F-test and t-test), Glejser test have been used to test hypotheses about statistical significance of regression models.

Dummy-variables have been used, that are variables with a discrete set of values that describe qualitative characteristics in a quantitative way, have been used to verify structural changes in number of air carriages for countries with different level of income. Dummy variables of the binary type «0-1» are usually used in econometric models.

The algorithm of the research involves the following steps:

1) choosing the period of the research;
2) forming the space of indicators;
3) choosing the form of correlation between factors;
4) parameterising the model;
5) verifying the model;
6) applying the model.

4 Results

The research period from 2015 to 2017 is chosen in the process of realisation of the first step of the proposed algorithm. The quantity of the world countries, which have out-coming data for each year by the chosen indices of Air transport, passengers carried (AT) and Number of arrivals (NA) equals 135. The data are taken from the site of the World Bank [9].

The second step presupposed outlining factors which characterise intensity of passenger air flow as well as intensity of inbound and outbound tourist flows: Air transport, passengers carried (AT), Number of arrivals (NA), Number of departures (ND). Hypothesis 1 presupposes a significant correlation between these indicators. The matrix of even correlation coefficients between the researched indicators for the given period looks as follows (Fig. 1).

	AT_15	AT_16	AT_17	NA_15	NA_16	NA_17	ND_2015	ND_2016	ND_2017
AT_2015	1,000	0,999	0,997	0,718	0,708	0,687	0,741	0,744	0,759
AT_2016	0,999	1,000	0,999	0,719	0,710	0,689	0,749	0,752	0,767
AT_2017	0,997	0,999	1,000	0,718	0,709	0,688	0,756	0,760	0,775
NA_2015	0,718	0,719	0,718	1,000	0,996	0,994	0,735	0,733	0,738
NA_2016	0,708	0,710	0,709	0,996	1,000	0,998	0,731	0,731	0,734
NA_2017	0,687	0,689	0,688	0,994	0,998	1,000	0,712	0,711	0,714
ND_2015	0,741	0,749	0,756	0,735	0,731	0,712	1,000	0,999	0,998
ND_2016	0,744	0,752	0,760	0,733	0,731	0,711	0,999	1,000	0,999
ND_2017	0,759	0,767	0,775	0,738	0,734	0,714	0,998	0,999	1,000

Fig. 1. Matrix of even correlation coefficients
Source: Own research

Let us pay attention to the highlighted diagonal matrix sectors given in Fig. 1. The values of the highlighted coefficients indicate a high level of auto-correlation connection between consequent values for each index that almost does not lessen in the course of time. It proves the essential inertness of the processes. Besides, the elements of the presented matrix indicate a close linear correlation connection between current values AT and NA and ND, as well as between lag variables. Influence of ND on Air transport, passengers carried (AT) is even bigger than influence of NA on Air transport, passengers carried (AT). However, absence of data by index ND for many countries has stipulated the choice of NA as an exogenous variable.

During realisation of the third step, the linear form of connection was chosen through high values of even correlation coefficients between the researched indices.

The following model has been built to test the first hypothesis:

$$AT_t = a_0 + a_1 NA_t, \quad (1)$$

where a_0 and a_1 – are unknown mdel parametres, estimated at the fourth step of the research with the help of the Method of Ordinary Least Squares, both for the whole sample frame in general (405 observations – data for 135 countries for three years), and each year t separately:

Verification of the built models was realised at the fifth step. All four models have turned out to be statistically significant on the whole upon Fisher criterion (F-test). However the values of determination coefficient R^2 for these models range within 0,39 – 0,43, that indicates not high enough quality of the model. Verification of the statistical significance of certain model parameters with the help of Student criterion (t-test) has revealed that the parameter a_0 is statistically insignificant for all four models. Thus the models of the following type have been built:

$$AT_t = a_1 NA_t \tag{2}$$

Models of the kind (2) have turned out to be more adequate and statistically significant. Let us consider in more detail the results of building the summarised model by 405 observations. The model is of the following type:

$$\widehat{AT} = 3{,}556 \cdot NA \tag{3}$$

The correlation coefficient $R = 0.682$; the determination coefficient $R^2 = 0.465$; $F(1; 404) = 351.2$; $t_{a_1}(404) = 18.74$. Thus, the model is adequate and statistically significant both in general and by certain parameters. However, there is heteroscedasticity of surpluses that is proved by non-parametric and parametric tests *Goldfeld – Quandt*. The reason of dispersion of random errors is data non-homogeneity that can be noticed in the graph of factual and theoretical (predicted) values Air transport, passengers carried (Fig. 2).

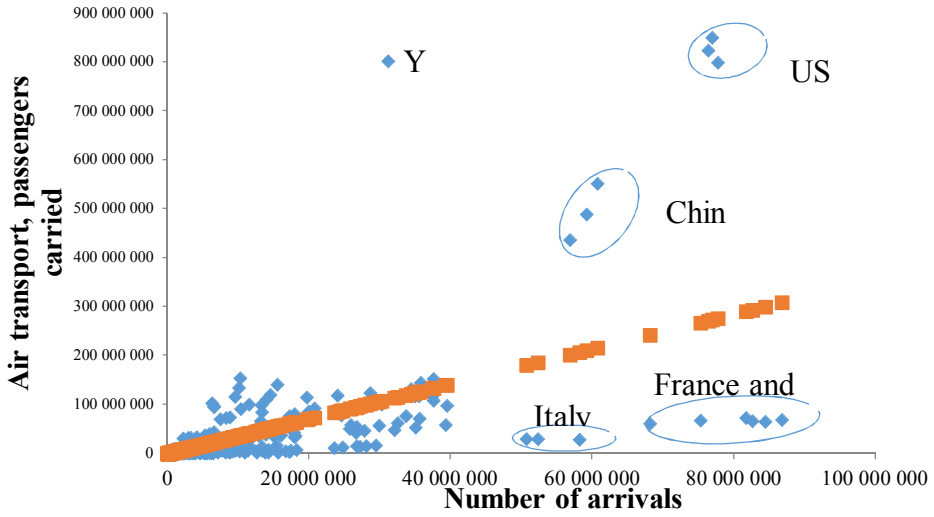

Fig. 2. Line Fit Plot
Source: Own research

As the diffusion diagram shows, the leading countries in the rating by indicators of tourists' incomes are outliers in the correlation-regression model. So, The USA and China are the largest countries in size of Air transport, passengers carried (AT) with a significant amount of inner carriages. The essential deviation upward in factual values of AT form the

regression line indicates a significant amount of aviation passenger carriages, which are not connected with inbound and outbound tourist flows. It is resulted by the fact that the US passenger market has remained the largest in the world. The US domestic market, with almost 590 million passenger journeys in 2018, is still the world's largest single market. China is on the second place, with 515 million, although China's domestic market added the most passenger journeys in 2018 [1]. Such growth of international tourist aviation will make it possible for China to outrun the USA soon, and to become the largest market of air carriages by 2022 [2]. Chinese air companies propose low prices at the market of passenger air carriages. At the same time they increase quality of their services by investing and implementing international standards. It has become possible due to the policy of the state that subsidises the sphere of passenger air carriages and allows aviation companies to seize the world markets, often without getting profit from their activity. Moreover, China is facing a steady increase in the net of international airports. The nation well-being is increasing as well, that allows intensifying tourist activity of the most densely populated country in the world.

On the other hand, such countries as Spain, France and Italy are characterised by significant shift downwards in comparison with the regression line. It indicates that these countries are the most attractive for tourists, but an insignificant number of these tourists get to the countries not by air, but by traffic, railways and sea. Intensity of traffic flow into these countries promotes free transportation within Schengen zone to which these countries belong.

As the model with heteroscedasticity of surpluses could not be applied for analysis and forecast, then at the next step the enumerated countries were excluded from the model and a new model of the type (2) was constructed by the sample frame of 390 observations.

The diffusion diagram of the model after extraction of outliers is presented in Fig. 3.

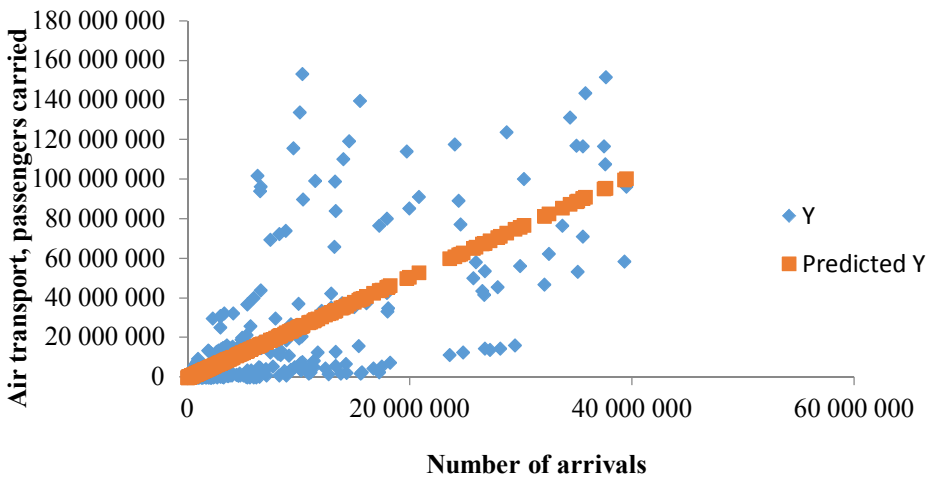

Fig. 3. Line Fit Plot after extraction of outliers.
Source: Own research

The model on data without anomalous observations looks as follows:

$$\widehat{AT} = 2{,}5473 \cdot NA\,. \qquad (4)$$

Characteristics of quality of the model (4) compared to the model (3) are better: the correlation coefficient $R = 0.779$; the determination coefficient $R^2 = 0.606$; $F(1; 389) = 598{,}8$; $t_{a_1}(389) = 24{,}47$. The decrease in parameter a1 to 1 indicates that for two inbound

tourists the quantity of air carriages has reduced by 2 people. So, hypothesis 1 can be accepted.

To verify hypothesis 2 the model of the following type has been tested:

$$AT_t = a_1 NA_t + a_2 d_1 + a_3 d_2 + a_4 d_3, \quad (5)$$

де d_1, d_2, d_3 – dummy-variables, that indicate the group to which a country belongs: with High income, Upper middle income and Lower middle income correspondingly. Adding dummy-variables to the model allows researching the extent to which the corresponding group of the country increases AT level in comparison with Low income countries.

Evaluation of the model parameters by the Method of Ordinary Least Squares has given the following result:

$$AT = 2{,}515 NA_t + 1\,771\,330 d_1 - 194\,7176 d_2 + 1\,956\,443 d_3 \quad (6)$$

The quality of the proved model is acceptable: the coefficient of the multivariable correlation $R = 0.780$; the coefficient of determination $R^2 = 0.609$; $R^2_{adj} = 0.603$; $F(4; 386) = 150{,}04$; $t_{a_1}(386) = 18{,}28$; $t_{a_2}(386) = 0{,}765$; $t_{a_3}(386) = -0{,}828$; $t_{a_4}(386) = 0{,}844$. The coefficient of regression near dummy-variables is statistically insignificant. That is why the effect of such a factor as a group of the country with a corresponding income level on the number of passenger air carriages is not significant. So, hypothesis 2 cannot be accepted as intensity of passenger air carriages does not depend on the level of the country economic development.

In 2018 the number of passengers carried constituted 12,529 mln., that is 98,8% more than in 2015. Besides, this index is practically not influenced by inbound tourist flow that after 2014 has become 6 times less [10]. Increase in intensity of outbound tourist flows influences the level of passenger air carriages, but it is not a critically important factor (fig. 4). Moreover, according to the data of Airports Council International only 4-5% of Ukrainians use services of air companies [11].

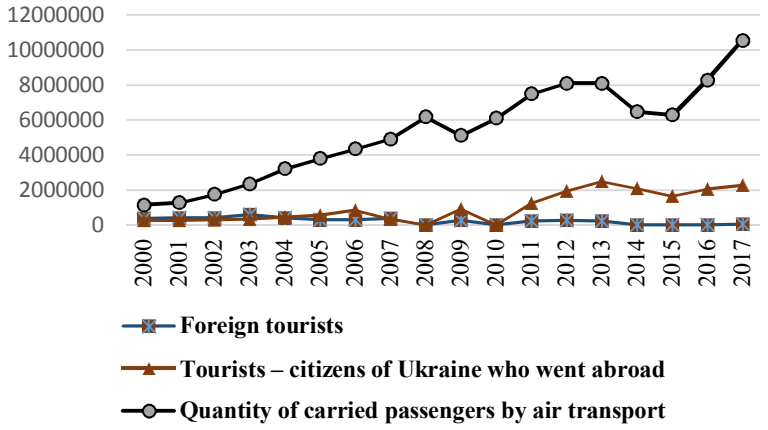

Fig. 4. Dynamics of passenger air carriages, thousand people.
Source: compiled by the authors based on [11]

The reasons of the market recovery of passenger air carriages are as follows:

– accumulation of postponed demand of the population resulted from the fact that in 2014-2016 many Ukrainians restrained from rest abroad;

– gaining the status of visa-free regime in 2017 between Ukraine and European Union;

– efficient activity of foreign and local air companies at the Ukrainian market of passenger air carriages;

– high performance of low-cost companies at the Ukrainian market of passenger air carriages: Wizz Air (Hungary), Ryanair (Ireland), Vueling Airlines (Spain), Ernest Airlines (Italy), which offer tickets to passengers at quite a low price; it is a motivating development factor, especially in conditions of low solvent demand;

– response to market demands and launching new regular routes by Ukrainian air carriers (17 such routes were launched in 2018), besides, foreign air companies have enlarged significantly the net of their carriages as well;

– stimulating transit carriages by the strategy of forming an international hub on the basis of Boryspil airport.

So, despite quite a dynamic development of air carriages in Ukraine in recent years, the air industry has not reached a desired position yet. It requires a clear vision and determined policy of the country concerning development of aviation and airports. Development of transport air infrastructure requires:

– orientation of the state policy at strategic integrated development of the sphere of air carriages and infrastructure of airports system in Ukraine;

– adjusting Ukrainian laws about air carriages to European standards (including Customs office rules, rules of carrying passengers and luggage);

– renewal of aircraft fleet of Ukrainian air companies, signing Agreement about common air space with EU;

– creating European common air space that can establish mutual security standards and liberalise market relations in the aviation sphere between EU and Ukraine;

– formation of integrated approach to reducing tariffs for air carriages;

– harmonisation of development in the system of regional airports, as by now 61 % [12] of common passenger flows has been concentrated in the international airport «Boryspil»;

– creating a favourable economic environment for development of this trend of the economic activity (tax reductions, credit rates);

– increase of collaboration between tourist companies and air carriers.

Realisation of the proposed events will allow increasing efficiency in the field of passenger air carriages.

5 Conclusions

Using empirical data from the tourism and travel industry as well as air carriages industry in 135 countries over the period of 2015-2017, this study reveals the effect of intensity of inbound and outbound tourism on market development of passenger air carriages. This statement was given as a hypothesis at the beginning of the research and has been verified with the help of the matrix of correlation paired coefficients. They allowed proving a close linear connection between the indicators and applying methods of the correlation-regression analysis. As in the built correlation model there was heteroscedasticity of outliers, it required data exclusion by such countries as the USA, China, Spain, France and Italy. These countries had significant shifts upwards and downwards compared to the regression line that is connected with especially intensive development of industry in passenger air carriages or tourism. The gained result does not contradict to the results of the previous research and proves that air transport and tourism are closely interconnected.

For further research the country groups have been considered by the level of their economic development (classified by the World Bank) with High income, Upper middle income and Lower middle income. The hypothesis about impact of economic development on air carriages has not been proved.

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