

**ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ**

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**М. Ю. Барна**, д. е. н.,  
професор,  
**Ю. Б. Миронов**, к. е. н.

**M. Y. Barna**, Doctor of Economic Sciences,  
Professor,  
**Yu. B. Myronov**, Candidate of Economic  
Sciences

**ЕКОНОМЕТРИЧНЕ МОДЕЛЮВАННЯ  
ДИНАМІКИ ТУРИСТИЧНИХ ПОТОКІВ****ECONOMETRIC MODELLING  
OF TOURIST FLOWS DYNAMICS**

**Актуальність теми дослідження.** Туризм є одним з перспективних напрямів економічного розвитку України. Важливість дослідження діяльності сфери туризму, зокрема динаміки туристичних потоків на основі економетричного аналізу, обумовлюється міжнародним науковим досвідом та отриманням статистично вірогідних результатів за стохастичних умов господарювання.

**Постановка проблеми.** Більшість наукових досліджень, які вивчають діяльність суб'єктів туристичної діяльності, мають описовий характер, тому оцінка динаміки показників туристичної діяльності на основі економетричних моделей є доцільною за сучасних умов.

**Аналіз останніх досліджень і публікацій.** Економіко-математичному аналізу та моделюванню діяльності туристичного сектору, присвячені наукові праці таких зарубіжних та вітчизняних вчених як N. Dritsakis, S. Athanasiadis, L. Botti, B. Solonandrasana, Г. Кармелюк, О. Кальченко, Р. Балашова, Л. Івченко та ін.

**Виділення не досліджених частин загальної проблеми.** Наукові дослідження стану та динаміки сфери туризму в Україні характеризуються недостатнім застосуванням економетричних методів та моделей. Тому доцільним є вивчення міжнародних наукових напрацювань у дослідженні туристичної галузі засобами економетричного моделювання.

**Постановка завдання.** Стаття покликана дослідити динаміку туристичних потоків України та виявити фактори впливу на їх зміну з використанням економетричних методів і моделей.

**Виклад основного матеріалу.** Проаналізовано динаміку показників туристичних потоків України за допомогою лінійних моделей тренду. Досліджено вплив фінансово-економічних та соціально-економічних чинників на розвиток туристичних потоків на основі кореляційно-регресійного аналізу.

**Висновки.** Отримані моделі динаміки туристичних потоків можуть мати практичне застосування з метою прогнозування при визначенні напрямків розвитку підприємств туристичної галузі та прогнозуванні туристичних потоків.

**Ключові слова:** туризм; туристичні потоки; економетричне моделювання; кореляційно-регресійний аналіз; модель тренду.

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**Urgency of the research.** Tourism is one of perspective economic development directions of Ukraine. The importance of studying the tourism activities, in particular the dynamics of tourist flows, based on econometric analysis, is determined by international scientific experience and obtaining statistically reliable results in stochastic economic conditions.

**Target setting.** The majority of scientific studies, which examine the tourism subjects' activities, have a descriptive character therefore the evaluation of the dynamic indicators of tourism activity on the basis of econometric models is appropriate at the current development stage.

**Relevant scientific research and issues analysis.** Scientific works of such foreign and Ukrainian scientists such as N. Dritsakis, S. Athanasiadis, L. Botti, B. Solonandrasana, H. Karmelyuk, O. Kalchenko, R. Balashova, L. Ivchenko and others are dedicated to the economic and mathematical analysis and modelling of the activities of tourism sector.

**Uninvestigated parts of general matters defining.** Scientific researches on tourism industry status and dynamics in Ukraine are characterized by insufficient use of econometric methods and models. Therefore, it is feasible to study international scientific advances in tourism industry by the econometric modelling means.

**Research objective.** This article aims to explore the tourist flows dynamics in Ukraine and to identify the factors influencing their change using econometric methods and models.

**Statement of basic materials.** The dynamics of tourist flows indicators in Ukraine is analysed. The influence of financial and economic and also social and economic factors on the development of tourist flows based on correlation and regression analysis is investigated.

**Conclusions.** The models of tourist flows dynamics obtained can have practical applications for prediction the directions for development of the tourism industry enterprises, as well as tourist flows forecasting.

**Keywords:** tourism; tourist flows; econometric modelling; regression analysis; trend model.

**Urgency of the research.** Tourism is one of the perspective economic development directions of Ukraine. Tourism sector involves a wide range of economic and social activities in the domestic and international level, goods and services across sectors and covers all social classes. The importance of studying the tourism activities, in particular the dynamics of tourist flows, based on econometric analysis

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sis, is determined by international scientific experience and obtaining statistically reliable results in stochastic economic conditions. Relevant econometric modelling apparatus allows to find the solutions of the constructed models and is an important tool in solving economic development problems of different levels and directions, including the study of tourist flows' dynamics.

**Target setting.** The majority of scientific studies, which examine the tourism subjects' activities, have a descriptive nature or not sufficiently disclosed the quantitative factors' influence on the tourism sector development. Therefore, the evaluation of the dynamic indicators of tourism activity and the study of the major factors influence on its development based on econometric models is appropriate at the current development stage of Ukraine's national economy.

**Relevant scientific research and issues analysis.** Scientific works of many foreign and domestic scientists are devoted to the economic and mathematical analysis and econometric modelling of the tourism sector.

In particular, N. Dritsakis and S. Athanasiadis in their study developed an econometric model of tourist demand in the developed tourist market in order to improve the tourism product of Greece [1]. In the work by T. Garin-Munoz and T. Perez Amaral a study was conducted to assess the economic determinants of international demand for tourism services in Spain on the basis of econometric models, taking into account factors such as real per capita income, exchange rates and real prices for Spanish travel services [2]. An applied study of tourism demand in France with the help of an econometric model (L. Botti, N. Peypoch, R. Randriamboarison, B. Solonandrasana) shows a positive link between tourism spending and GDP production in the country as well as a negative correlation between travel costs and prices [3]. Researchers S. F. Witt and C. A. Martin developed econometric models of tourism demand based on the data of tourist flows in Western Europe and proposed the prediction models [4]. The spatial econometric approach to the tourist flows modelling is presented by scientists Y. Yang and K. F. Wong [5]. The study of the tourism industry with the use of economics and mathematical modelling was carried out by such Ukrainian scientists as O. Kalchenko [6], R. Balashova, L. Ivchenko [7], H. Karmelyuk [8] and others. In particular, they identify the main factors that affect the tourism enterprises activities. Using correlation-regression analysis, the influence of the proposed factors on the functioning and development of tourist enterprises was evaluated and the most important factors were selected. Also a number of econometric models reflecting these dependencies were proposed and analyzed in their scientific publications.

**Uninvestigated parts of general matters defining.** Scientific research of the Ukrainian tourism sphere's dynamics is characterized by insufficient application of econometric methods and models in the study of the tourist flows dynamics. Therefore, it is expedient to research international scientific development in the study of tourism industry by means of econometric modelling. The development of econometric models of tourism activity indicators and their application in practice is also demanded.

**Research objective.** This article aims to explore the tourist flows dynamics in Ukraine and to identify the factors influencing their change using econometric methods and models.

**Statement of basic materials.** The activity of tourist enterprises and organizations is preliminary estimated by the number of tourists served. The current situation of indicators system of the Ukrainian tourist sector, particularly tourist flows, is characterized by uneven rates of development.

The statistical analysis of the tourist flows dynamics in Ukraine, based on the average growth or decline (Table 1), shows that for the years 2000-2016 the average number of Ukrainian citizens, who travelled abroad, grew by 3.9%, the number of foreign citizens, who visited Ukraine - by 4.7%, the number of tourists serviced by the Ukrainian tourism industry enterprises - by 1.5%, the number of Ukrainian tourists travelling abroad, serviced by the Ukrainian tourism industry enterprises - by 13.2%. During the studied period only the number of foreign tourists serviced by the Ukrainian tourism industry enterprises decreased by 13.8% and the number of domestic tourists serviced by the Ukrainian tourism industry enterprises - by 6.6%.

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Table 1

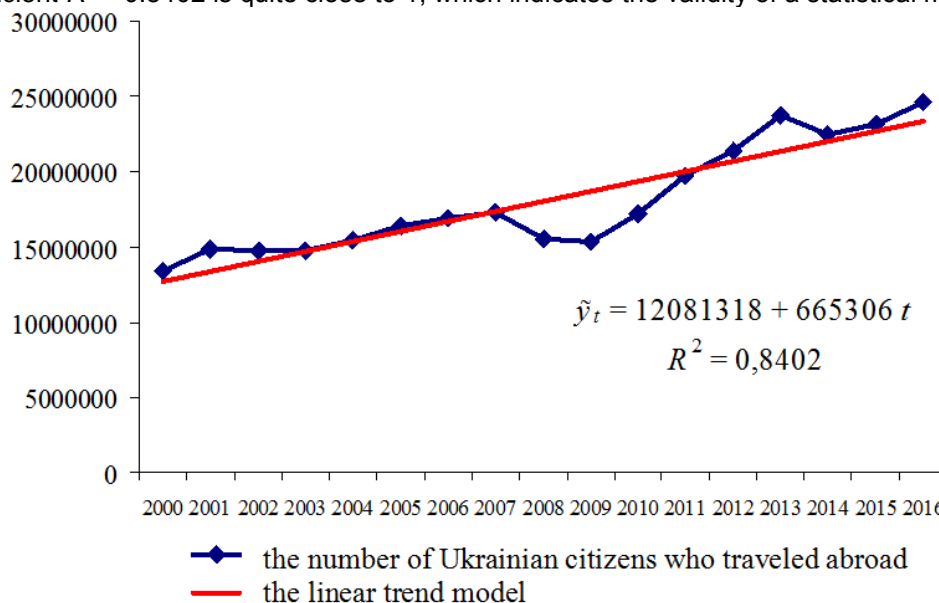
**Average rates of growth / decrease of tourist flows in Ukraine (2000-2016)**

Indicator	Average growth rate
Number of the Ukrainian citizens who travelled abroad	1,039
Number of foreign citizens who visited Ukraine	1,047
Number of tourists serviced by the Ukrainian tourism industry enterprises	1,015
Number of foreign tourists serviced by the Ukrainian tourism industry enterprises	0,862
Number of Ukrainian tourists-citizens who travelled abroad, serviced by the Ukrainian tourism industry enterprises	1,132
The number of domestic tourists, served by the Ukrainian tourism industry enterprises	0,934

Calculated by the authors according to [9]

In order to provide deeper and more reliable analysis of the tourist flows dynamics in Ukraine we conducted an econometric analysis based on linear trend models on statistical data for 2000-2016 [9]. The reliability of the obtained main trend development equations is estimated by the value of determination coefficient  $R^2$  and Fisher criteria (model adequacy estimation to empirical data), Student's  $t$ -test (equation coefficients reliability) and Durbin-Watson statistic (autocorrelation of residues) [10, p. 213-216].

The linear trend equation coefficient  $\tilde{y}_t = 12081319 + 665306 t$  (Figure 1) shows that the number of Ukrainian citizens travelling abroad increases by 665,306 people annually. The value of the determination coefficient  $R^2 = 0.8402$  is quite close to 1, which indicates the validity of a statistical model.



**Fig. 1. Linear trend model of the number of Ukrainian citizens who travelled abroad (2000-2016)**

The main development trend equation is statistically reliable with a probability  $p = 0.99$  for such tourist flows as the number of foreign citizens who visited Ukraine in general; the number of foreign tourists serviced by the Ukrainian tourism industry enterprises; the number of Ukrainian tourists who travelled abroad, serviced by the Ukrainian tourism industry enterprises and also the number of domestic tourists serviced by the Ukrainian tourism industry enterprises (Tab. 2).

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Table 2

**Linear equations of the trends of tourist flows in Ukraine (2000-2016)**

Indicator	Linear trend model	Ratio Determination $R^2$	F-test	Durbin-Watson statistic
Number of the Ukrainian citizens who travelled abroad	$\hat{y}_t = 12081319 + 665306 t$	0,840	78,9*	0,65
Number of foreign citizens who visited Ukraine	$\hat{y}_t = 12696020 + 478067 t$	0,170	3,1	0,48
Number of tourists serviced by the Ukrainian tourism industry enterprises	$\hat{y}_t = 2162015 + 30100 t$	0,110	1,8	1,61
Number of foreign tourists serviced by the Ukrainian tourism industry enterprises	$\hat{y}_t = 532074 - 26234 t$	0,720	38,5*	1,25
Number of Ukrainian tourists-citizens who travelled abroad, serviced by the Ukrainian tourism industry enterprises	$\hat{y}_t = -128154 + 134682 t$	0,824	70,4*	1,75
The number of domestic tourists, served by the Ukrainian tourism industry enterprises	$\hat{y}_t = 1758095 - 78348 t$	0,560	19,1*	1,65

Note: \* - statistical probability  $p = 0.99$  (significance level  $\alpha = 0.01$ )

All the studied indicators of tourist flows are characterized by positive character of the main development trends. Only such an indicator as the number of domestic tourists serviced by Ukrainian tourism industry enterprises has a negative tendency – from 2000 to 2016 the number of domestic tourists decreased annually.

The study of macro-economic factors influences on tourists' flows on the basis of correlation-regression analysis, which reflects the absence or presence of a correlation connection and its form.

The analysis of paired values of linear correlation coefficients (Table 3) allows identifying the most important influence factors on tourist flows in Ukraine.

Table 3

**Linear paired correlation coefficients of indicators of tourist flows and macro-economic indicators of Ukraine**

Indicator	Factors				
	GDP per 1 Person	GDP	The Average Monthly Wage	Price Index	Capital Investment
Number of the Ukrainian citizens who travelled abroad	0,849	0,848	0,870	0,123	0,532
Number of foreign citizens who visited Ukraine	-0,377	-0,358	-0,360	-0,662	0,222
Number of tourists serviced by the Ukrainian tourism industry enterprises	0,215	0,229	0,265	-0,484	0,496
Number of foreign tourists serviced by the Ukrainian tourism industry enterprises	-0,843	-0,833	-0,832	-0,685	-0,440
Number of Ukrainian tourists-citizens who travelled abroad, serviced by the Ukrainian tourism industry enterprises	0,786	0,792	0,829	-0,057	0,614
The number of domestic tourists, served by the Ukrainian tourism industry enterprises	-0,674	-0,671	-0,687	-0,230	-0,260

Calculated by the authors according to [9]

According to the obtained results the number of Ukrainian citizens who travelled abroad mostly depends on the size of GDP and per capita income. The number of foreign citizens who visited Ukraine does not depend on the macro-economic situation in Ukraine.

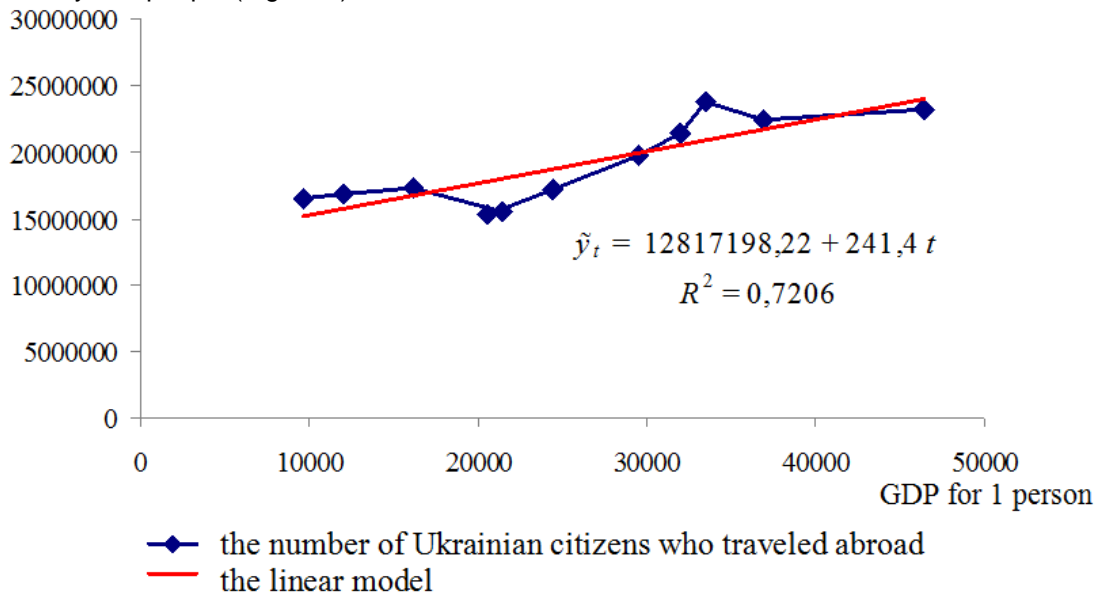
The number of tourists serviced by the Ukrainian tourism industry enterprises depends on the mac-

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ro-economic situation in Ukraine: the number of Ukrainian citizens who travelled abroad depends on it directly and the number of foreign and domestic tourists has an inverse relationship.

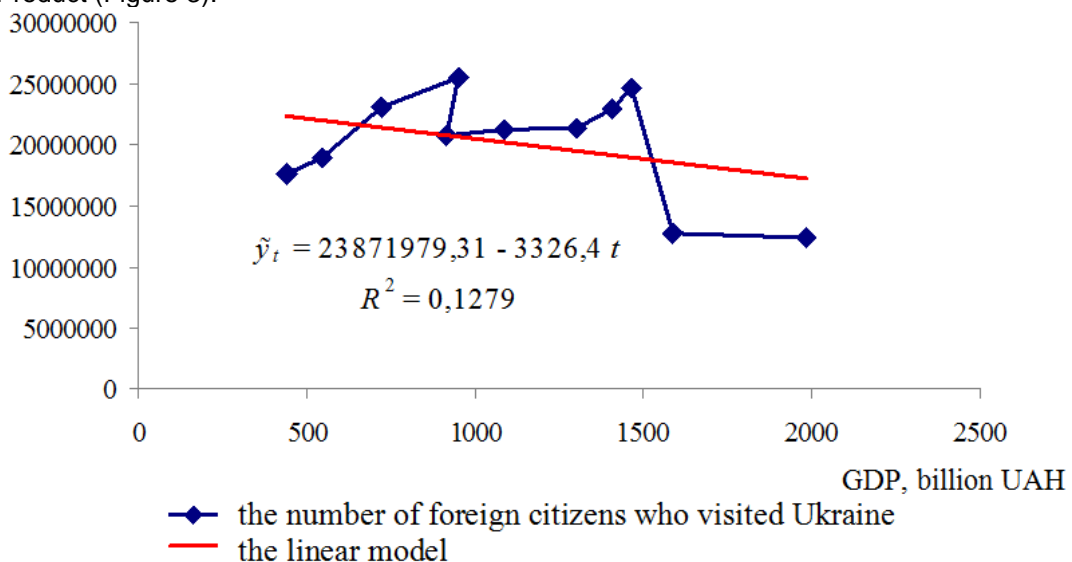
Let the authors analyzes some linear regression equations based on tourist flows in Ukraine from the economic indicators in 2000-2016.

With the growth of GDP per 1 person per 1 UAH the number of Ukrainian citizens who went abroad increased by 241 people (Figure 2).



**Fig. 2. Linear regression model based on the number of Ukrainian citizens who travelled abroad in the GDP per 1 person**

Otherwise, the number of foreign citizens who visited Ukraine does not depend on the Gross Domestic Product (Figure 3).



**Fig. 3. Linear regression model based on the number of foreign citizens who visited Ukraine of Ukraine's GDP**

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The value of the  $R^2$  coefficient confirms a lack of the statistically reliable dependence of foreign citizens who visited Ukraine to GDP.

**Conclusions.** The models obtained based on econometric analysis of the tourist flows dynamics and their dependence on certain economic indicators that have a high level of statistical probability can have practical applications for the prediction of directions for the tourism industry enterprises development as well as tourist flows forecasting depending on external factors.

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