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MODELING THE RELATIONSHIP BETWEEN THE COUNTRY'S ECONOMIC DEVELOPMENT AND NATIONAL TOURISM

Abstract. *Tourism occupies an important place in the socio-economic development of any country and the improvement of its competitive position on the world stage. Effectively working tourism sectors contribute to the creation of new jobs, fill budgets at all levels, attract investments in infrastructure, help preserve or restore cultural and historical monuments, and also stimulate the involvement of the population in traditional arts and innovative crafts. In this case, a thorough study of the functioning of the tourist sector of the economy, as well as determining its contribution to the macroeconomic development of the country, is of particular importance. Analyzing trends or relationships between a country's macroeconomic development and tourism flows can help better understand how tourism affects a country's economy.*

To solve the problems of our research, we analyzed such indicators as: seasonality indices of outbound and domestic tourists; gross domestic product per person; the number of tourists served by tour operators and travel agents, etc. In the process of analysis, we used production function modeling methods, regression and correlation analyses, and separate built-in statistical functions in the "Statistica" software resource.

Based on the simulation results, we obtained numerical production functions, regression equations, and models that allowed us to determine the dependence and influence of tourist flows on the main macroeconomic indicator of the country. The specified method of analyzing the dependence of the gross domestic product on tourist flows is the basis for further forecasting of the outlined trends.

The interdependence of the index of seasonality and the gross domestic product per person using economic and mathematical methods and models proves the ambiguity in the conclusions and descriptions of the resulting modeling. After all, the flow of tourists during the calendar year depends on many factors and tourist preferences, can affect both the overall production of the gross domestic product and other macro indicators of the national economy.

Keywords: *tourist activity, tourist flows, tour operators, travel agents, gross domestic product, production functions, seasonality index.*



1. Introduction

The country's macroeconomic development and tourism have a deep relationship, since tourism can affect the main indicators of macroeconomic activity, such as gross domestic product, employment, investments, and others. Tourism can become an important component of filling the country's gross domestic product due to direct and indirect costs of tourists. An increase in the tourist flow can lead to an increase in socio-economic development, an increase in the attractiveness of the country and an increase in the welfare of the population. The development of the tourism industry can create new jobs in the service sector, construction and other areas related to tourism. This can have a positive effect on the level of employment in the country. Tourism can improve the country's foreign economic relations by increasing the international exchange of goods and services, as well as by attracting foreign investment. In general, tourism can play an important role in the macroeconomic development of a country, but it is important to ensure the sustainability of development and its balance with other sectors of the economy to avoid negative consequences such as overpopulation, environmental degradation and cultural degradation. In the context of the above, the study of the relationship between the macroeconomic development of the country and tourism is of great importance. Irtischeva *et al.*, [1], identified the problems of macroeconomic aspects of the development of the tourism industry in Ukraine and the peculiarities of their regulation. The researchers rightly noted that our country has all the prerequisites for the intensive development of various areas of tourist activity, and the territorial concentration of tourist enterprises reflects the structure of demand and depends on the well-being of the population of the region. Ostapyuk, [2], investigated the impact of the macroeconomic situation on the development of tourism in Ukraine and specified the specifics of its functioning. Lendel and Morohovych, [3], determined the impact of the macroeconomic situation on the development of the tourism industry of the Transcarpathian region. Lebedeva, [4], analyzed the impact of the macroeconomic situation on the development of the tourism sector of Ukraine. Nakonechnyi *et al.*, [5], Tsyganchuk, [6], proposed mathematical and statistical modeling tools that can be used within our scientific research. Of particular interest to us are the scientific studies of Zhang *et al.*, [7], which focus on the issues of balanced consumption, resource conservation, and the efficiency of using mineral resources, human capital, and tourism. Portella-Carby *et al.*, [8], described in detail the cause-and-effect relationships between economic growth and tourism using the example of business cycles in Europe for the period 1995–2021. Interesting are the scientific findings of Calero and Turner, [9], Dogan and Zhang, [10], which analyzed the effects of tourism on sustainable development

and changes in macroeconomic indicators of the country. A research paper by Wickramasinghe and Naranpanawa, [11], identifies how the pandemic has affected hospitality and tourism. Nag and Sarkar, [12], proposed tools for forecasting tourism demand and transport infrastructure. The noted scientific studies undoubtedly have a significant contribution to the theory and practice of macroeconomic development and the analysis of complex socio-economic processes, namely tourist flows. However, the problem of analyzing the country's macroeconomic development and tourist flows, taking into account the present, needs a more thorough analysis.

2. Materials and Methods

Production functions play a conceptual role in determining efficiency, optimal use of resources, and forecasting cash and human flows in tourism. Forecasting using production functions allows predicting the amount of tourism services that can be provided using available resources for a certain area. This helps business entities in the tourism sector and infrastructure organizations to plan their activities according to their own potential and effectively manage resources. Modeling production functions helps to determine the directions of optimal use of labor, capital and other assets (location of hotels, transport logistics, size and composition of management teams, etc.). Production functions play an important role in determining the effectiveness of investments in tourism infrastructure, the relationship between service costs and profit. Economic-statistical modeling of production functions shows regularities or dynamics of dependence between target indicators of the tourism industry, production of products, gross industrial product of the country, and so on. Therefore, we can state the great epistemological, methodological and practical importance of modeling production functions, since their mathematical expression contains the result of the interrelationship of factors and results of the tourism market, which can be interpreted at the macro-, meso- and microeconomic levels. In order to study tourist flows using production functions, we used data from the statistical reporting of Ukraine for 2015–2021. Linear and non-linear production functions will help to investigate the dependence of gross domestic product per person on the seasonality index of outbound and domestic tourists for the period under analysis. Taking into account these factors and the macroeconomic indicator, we believe that the seasonality of tourist activity, among other factors, directly affects the gross domestic product. Precisely, these judgments led us to a deeper study, analysis and modeling of the impact of tourist flows on the gross domestic product.

We briefly justify the choice and properties of research factors — indices of seasonality of outbound and domestic tourists. In statistics, the most widespread method of calculating the seasonality

Table 1

Dynamics of the index of seasonality of outbound and domestic tourists and the effective indicator of gross domestic product per person, 2015–2021.

Years	Index of seasonality of outbound tourists	Index of seasonality of domestic tourists	Gross domestic product per person, UAH
2015	2,13	1,90	46413,00
2017	1,90	1,80	70170,00
2018	1,46	1,88	84228,00
2019	1,21	1,74	94633,00
2020	2,05	2,35	101138,00
2021	1,87	2,24	131734,00

Source: supplemented by the author taking into account the source <https://www.ukrstat.gov.ua/>

index is the determination of the average level of the indicator for months, years, which is taken to compare temporal data with the average level as a whole. This index is calculated as a percentage. The material for the study will be the dynamic series of the main factors of the index of seasonality of outbound and domestic tourists and the effective indicator of the gross domestic product per person for the last 2015–2021 (Table 1).

In our study, the main purpose of regression modeling and calculation of the obtained coefficients is to determine the production function. Such a function indicates the connection between the performance indicator and the factors, which will allow modeling of complex socio-economic phenomena in the future. We will define production regression models that we will use in our research for statistical processing.

Thus, the classic linear production regression is generally represented by the equation (Nakonechnyi *et al.*, [5]):

$$Y = a_1 X + a_0 \quad (2)$$

Non-linear production regressions are expressed as (Nakonechnyi *et al.*, [5]):

$$Y = a_1 / X + a_0 \quad (3)$$

$$Y = a_1 \ln X + a_0 \quad (4)$$

$$Y = a_1 / \ln X + a_0 \quad (5)$$

$$Y = a_1 e^X + a_0 \quad (6)$$

$$Y = a_1 / \sqrt{X} + a_0 \quad (7)$$

$$Y = a_1 \sqrt{X} + a_0 \quad (8)$$

$$Y = a_1 / X^2 + a_0 \quad (9)$$

$$Y = a_1 X^2 + a_0 \quad (10)$$

$$Y = a_1 / X^3 + a_0 \quad (11)$$

$$Y = a_1 X^3 + a_0 \quad (12)$$

$$Y = \frac{1}{a_1 X + a_0} \quad (13)$$

$$Y = a_1 \sqrt[3]{X} + a_0 \quad (14)$$

$$Y = a_1 / \sqrt[3]{X} + a_0 \quad (15)$$

$$Y = a_1^X a_0 \quad (16)$$

$$Y = X^{a_1} a_0 \quad (17)$$

To calculate and process data on the dependence of the gross domestic product per person on the declared factors for the analysis of the tourism sector, we use the “Statistica” software resource and built-in statistical functions.

3. Results and Discussion

For further analysis of tourist flows, the influence of each factor on the value of gross domestic product per person was calculated using linear and non-linear functions for 2015–2021. In the course of mathematical transformations and static calculations, linear production regression and non-linear production regressions of gross domestic product were obtained per person, which are presented in Table 2.

Therefore, the obtained production regression models of the gross domestic product per person for the last six years help to determine the quality and their adequacy, which will allow modeling and forecasting in the future. The equation functions a_1 and a_0 were calculated by the method of least squares. Since, in the selected production regression models, $F_{dis} > F_{tab}$ ($F_{tab} = 0.0045$), then with a reliability of $P = 0.95$ the selected econometric models of the dependence of the effective indicator of the gross domestic product per person on the factors of the seasonality indices of outbound and domestic tourists can be considered as adequate initial data, so it is possible to carry out modeling and in the subsequent post-war period of forecasting this indicator. Next, we analyze the correlation coefficients of selected production models of gross domestic product per person. They vary from a weak connection to a close one and indicate that different factors affect the performance indicator differently (Table 2). The coefficients of determination of the investigated and selected production models in the table 2 are also different, and testify to the different

Table 2

Results of data processing to determine the production function of gross domestic product per person, 2015–2021

Impact factor: index of seasonality of outbound tourists					
Production function in general form	Regression parameters		Coefficient of determination "R ² "	Correlation coefficient "r"	Estimated value of Fisher's "F test", "F calculated"
	a_1	a_0			
$Y = a_1 X + a_0$	-18597,16	120977,78	0,85	0,77	1,02
$Y = a_1 / X + a_0$	37769,05	65842,48	0,83	0,68	0,94
$Y = a_1 \ln X + a_0$	-26839,63	102870,64	0,74	0,80	0,87
$Y = a_1 e^X + a_0$	2590,95	82132,23	0,92	0,93	0,97
$Y = a_1 / \ln X + a_0$	-4162,42	113743,00	0,78	0,22	1,05
$Y = a_1 \sqrt{X} + a_0$	-44838,65	147437,13	0,55	0,58	0,70
$Y = a_1 / \sqrt{X} + a_0$	63859,70	39345,93	0,64	0,59	0,75
$Y = a_1 X^2 + a_0$	-6256,34	108332,99	0,62	0,44	0,84
$Y = a_1 / X^2 + a_0$	26051,51	78625,17	0,63	0,56	0,71
$Y = a_1 X^3 + a_0$	-2718,65	104627,55	0,62	0,51	0,91
$Y = a_1 / X^3 + a_0$	23630,07	82533,90	0,82	0,65	0,89
$Y = \frac{1}{a_1 X + a_0}$	37768,65	65842,08	0,43	0,58	0,54
$Y = a_1 \sqrt[3]{X} + a_0$	-55793,09	120977,78	0,85	0,77	1,02
$Y = a_1 / \sqrt[3]{X} + a_0$	113305,56	65842,48	0,83	0,88	0,94
$Y = a_1^X a_0$	-1957397866,25	132942,78	0,70	-0,84	9,24
$Y = X^{a_1} a_0$	1,11	29734,80	0,65	0,81	7,48
Impact factor: index of seasonality of domestic tourists					
Production function in general form	Regression parameters		Coefficient of determination "R ² "	Correlation coefficient "r"	Estimated value of Fisher's "F test", "F calculated"
	a_1	a_0			
$Y = a_1 X + a_0$	69418,43	-49717,80	0,36	0,60	2,23
$Y = a_1 / X + a_0$	-277947,42	229853,67	0,34	-0,58	2,02
$Y = a_1 \ln X + a_0$	139660,08	-6789,64	0,35	0,59	2,13
$Y = a_1 / \ln X + a_0$	-63015,80	183221,14	0,30	-0,55	1,73
$Y = a_1 / \ln X + a_0$	8917,68	21390,67	0,37	0,61	2,34
$Y = a_1 \sqrt{X} + a_0$	197189,76	-189297,40	0,85	0,59	2,68
$Y = a_1 / \sqrt{X} + a_0$	-394587,57	369469,53	0,94	-0,58	2,68
$Y = a_1 X^2 + a_0$	17072,70	19924,27	0,92	0,60	2,85

Continuation of table 2

$Y = a_1 / X^2 + a_0$	-273524,00	160073,52	0,92	-0,57	2,48
$Y = a_1 X^3 + a_0$	5542,35	42981,49	0,91	0,61	2,90
$Y = a_1 / X^3 + a_0$	-354860,63	136788,67	0,30	-0,55	1,74
$Y = \frac{1}{a_1 X + a_0}$	-277947,02	229854,07	0,74	-0,58	2,42
$Y = a_1 \sqrt[3]{X} + a_0$	208255,30	-49717,80	0,36	0,60	2,23
$Y = a_1 / \sqrt[3]{X} + a_0$	-833842,27	229853,67	0,34	0,12	2,02
$Y = a_1^X a_0$	-2913041293,13	159663,98	0,75	-0,87	12,03
$Y = X^{a_1} a_0$	2,18	-8011,04	0,83	0,91	20,09

Source: calculated by the author

quality of the models. Next, we determine the best production regressions of gross domestic product per person taking into account the seasonality index of outbound tourists, 2015–2021 — a non-linear function $Y = 2590.95/\ln X + 2132.23$ and gross domestic product per person taking into account index of seasonality of domestic tourists, 2015–2021 using the nonlinear function $Y = X^{2.18}(-8011.04)$. Using the dynamic series of the index of seasonality of outbound and domestic tourists and the effective indicator of gross domestic product per person and significant coefficients of nonlinear functions $Y = 2590.95/\ln X + 82132.23$ and $Y = X^{2.18}(-8011.04)$ for analytical characteristics and comparison, we determine

the theoretical level of gross domestic product per person (Table 3).

Graphically, the actual and theoretical values of the gross domestic product per person, taking into account the studied factors and the use of non-linear functions for the last period of the study, are presented in Fig. 1.

Also, in the research, analysis and modeling, it is proposed to follow the dynamics of the total number of tourists served by tour operators and travel agents and by types of tourism over the last studied period.

The share of tourists served by tour operators and travel agents by type of tourism was calculated

Table 3

Actual and theoretical values of gross domestic product per person, 2015–2021

Calculation of theoretical values of gross domestic product per person, 2015–2021 using the nonlinear function $Y = 2590.95/\ln X + 82132.23$		
Years	Actual values of gross domestic product per person, UAH., Y	Theoretical values of gross domestic product per person, UAH., Y
2015	46413,00	85556,42
2017	70170,00	86161,68
2018	84228,00	88981,88
2019	94633,00	95610,80
2020	101138,00	85744,25
2021	131734,00	86278,71
Calculation of theoretical values of gross domestic product per person, 2015–2021 using the nonlinear function $Y = X^{2.18}(-8011.04)$		
Years	Actual values of gross domestic product per person, UAH., Y	Theoretical values of gross domestic product per person, UAH., Y
2015	46413,00	82118,89
2017	70170,00	75148,06
2018	84228,00	80612,65
2019	94633,00	71230,47
2020	101138,00	113509,33
2021	131734,00	105696,60

Source: calculated by the author

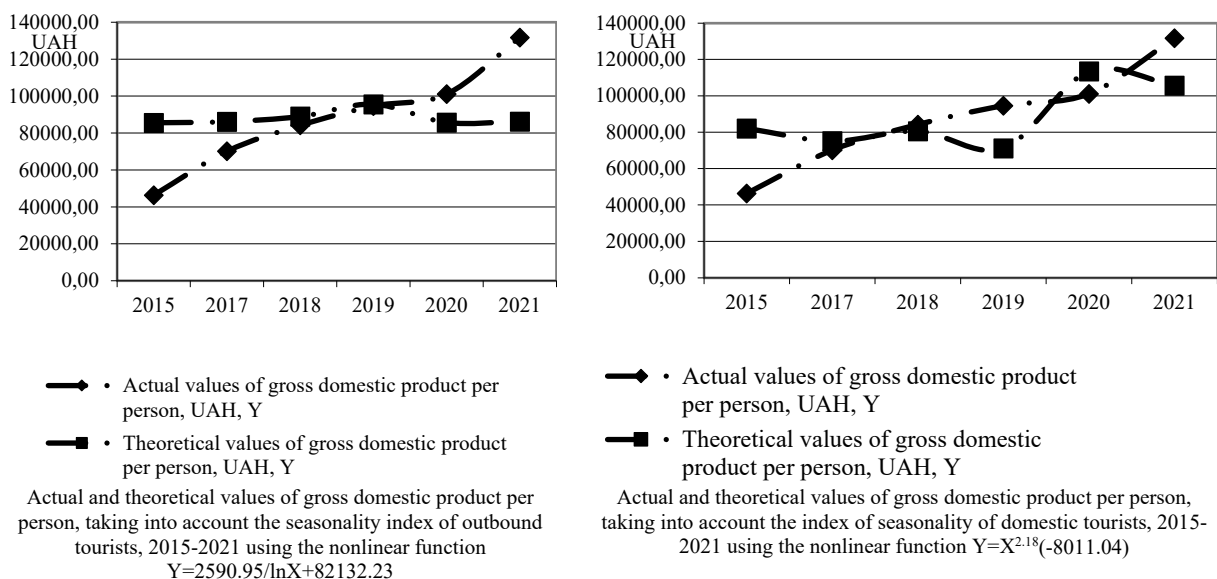


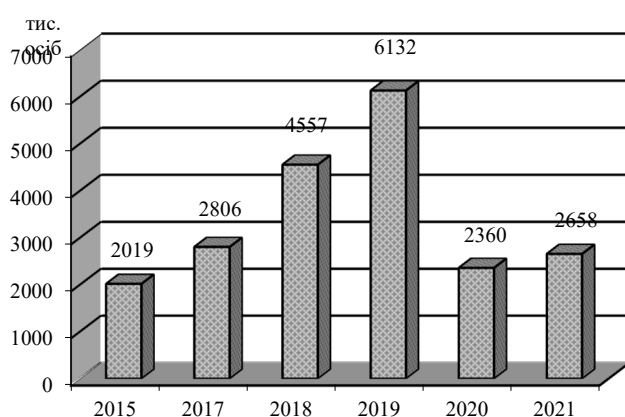
Figure 1. Actual and theoretical values of gross domestic product per person, taking into account the studied factors and using non-linear functions, 2015–2021

Source: development of the author

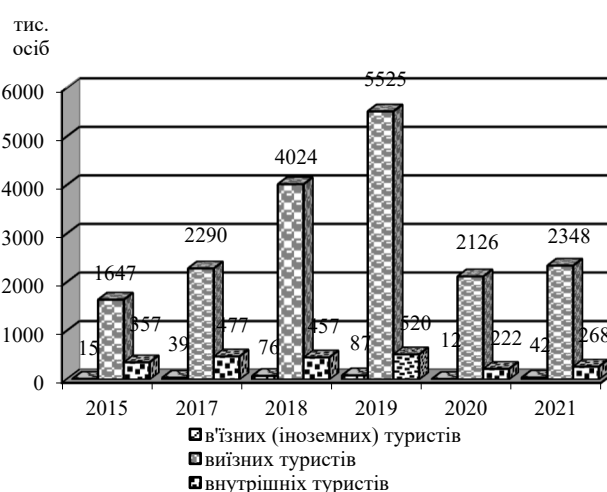
and the dynamics of the share of tourists served by tour operators and travel agents by type of tourism was graphically depicted, 2015–2021 (Table 4 and Fig. 3).

So, the researched topic of the interdependence of the seasonality index and the gross domestic product per person using economic and mathematical methods and models proves the ambiguity in the conclusions and descriptions of the resulting modeling. After all, the flow of tourists during the calendar year depends on many factors and tourist preferences, can affect both the overall production of the gross domestic product and other

macro indicators of the national economy. In this case, hedging risks and reducing uncertainty in the market of the tourism industry requires obtaining timely, broad and reliable information, both at the level of marketing, financial and economic research. That, in combination with statistical and economic-mathematical modeling tools, will allow the tourism business to determine attractive segments for tourism activities and attracting tourists. Our further research will focus on forecasting trends in the development of the tourism sector and determining its impact on the macroeconomic development of the country.



Dynamics of the number of tourists served by tour operators and travel agents, 2015-2021.



Dynamics of the number of tourists served by tour operators and travel agents, by types of tourism, 2015-2021.

Figure 2. Dynamics of the total number of tourists served by tour operators and travel agents and by types of tourism, 2015–2021

Source: built by the author using the source <https://www.ukrstat.gov.ua/>

Table 4

**Dynamics of the share of tourists served by tour operators and travel agents,
by types of tourism, 2015–2021**

Years	2015	2017	2018	2019	2020	2021	On average, 2015–2021
Tourists, everything, %	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
share of incoming (foreign) tourists	0,74%	1,39%	1,67%	1,42%	0,51%	1,56%	1,22%
share of outbound tourists	81,58%	81,61%	88,30%	90,10%	90,08%	88,34%	86,67%
share of domestic tourists	17,68%	17,00%	10,03%	8,48%	9,41%	10,09%	12,11%

Source: development of the author

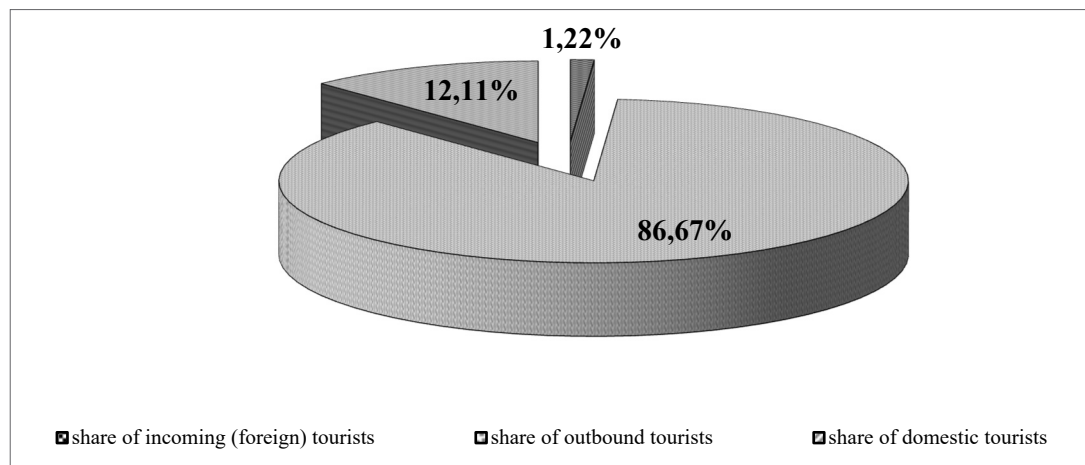


Figure 3. Dynamics of the share of tourists served by tour operators and travel agents,
by types of tourism, 2015–2021

Source: built by the author using the source <https://www.ukrstat.gov.ua/>

4. Conclusions

Gross domestic product and tourism have a deep connection. Tourism is an important component of the economy of many countries, and affects macroeconomic indicators through a variety of financial, social or economic factors. One of the ways to detail the issue of the impact of tourism on macroeconomic indicators is the analysis of direct costs of tourists or tour operators, the dynamics of seasonality of tourist flows, etc. These indicators create a direct economic impact and contribute to an increase or decrease in the socio-economic development of the country. In addition, tourism also stimulates other sectors of the economy such as construction, trade, transport and services. For example, to ensure the

growth of the tourism sector, it may be necessary to build new hotels, develop infrastructure, or implement a number of investment projects. In turn, the growth of the socio-economic development of the country can also contribute to the development of tourism, as there is an increase in the income of the population, which can lead to an increase in spending on travel and recreation. However, it is important to consider that tourism can also have a negative impact on some aspects of the economy and society, such as increased environmental pressure, infrastructure overload and cultural erosion. Therefore, it is important to balance the development of tourism taking into account sustainable development, preservation of natural and cultural resources.

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МОДЕЛЮВАННЯ ВЗАЄМОЗВ'ЯЗКУ ЕКОНОМІЧНОГО РОЗВИТКУ КРАЇНИ ТА НАЦІОНАЛЬНОГО ТУРИЗМУ

Анотація. Туризм посідає важливе місце в соціально-економічному розвитку будь-якої країни та підвищення її конкурентних позицій на світовій арені. Ефективно працюючи туристичні сектори сприяють створенню нових робочих місць, наповнюють бюджети усіх рівнів, привертають інвестиції в інфраструктуру, допомагають зберегти або відновити культурно-історичні пам'ятки, а також стимулюють залучення населення до традиційних мистецтв та інноваційних ремесел. У такому випадку особливе значення має ґрунтовне дослідження особливостей функціонування туристичного сектору економіки, а також визначення його внеску у макроекономічний розвиток країни. Аналіз тенденцій або взаємозв'язків між макроекономічним розвитком країни та туристичними потоками може допомогти краще зрозуміти, яким чином туризм впливає на економіку країни.

Для вирішення проблематики нашого дослідження нами проаналізовано такі показники як: індекси сезонності виїзних та внутрішніх туристів; валовий внутрішній продукт у розрахунку на одну особу; кількість туристів, обслугованих туроператорами та турагентами тощо. В процесі аналізу нами використовувалися методи моделювання виробничих функцій, регресійний та кореляційний аналізи та окремі вбудовані статистичні функції в програмному ресурсі «Statistica».

За результатами моделювання нами отримані чисельні виробничі функції, регресійні рівняння, моделі, які дозволили визначити залежність та вплив туристичних потоків на основний макроекономічний показник країни. Зазначена методика аналізу залежності валового внутрішнього продукту від туристичних потоків є базою для подальшого прогнозування окреслених тенденцій.

Взаємозалежність індексу сезонності та валового внутрішнього продукту у розрахунку на одну особу з використанням економіко-математичних методів та моделей засвідчує неоднозначність у висновках та описах результативного моделювання. Адже, потік туристів протягом календарного року залежить від багатьох чинників та туристичних вподобань, може впливати як на загальне виробництво валового внутрішнього продукту, так і на інші макропоказники національної економіки.

Ключові слова: туристична діяльність, туристичні потоки, туроператори, турагенти, валовий внутрішній продукт, виробничі функції, індекс сезонності.