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Morokhovych Vasyl
morv77@ukr.net, ORCID ID: 0000-0002-4939-6566
PhD, Associate Professor, Associate Professor of the Department of Management of Tourism, Hotel and Restaurant Business,
Uzhhorod Institute of Trade and Economics of State University of Trade and Economics, Uzhhorod

Hrabar Maryna
19marina88@ukr.net, ORCID ID: 0000-0002-2753-4462
PhD, Associate Professor of the Department of Tourism,
Uzhhorod National University, Uzhhorod

Kashka Mariia
m-kashka@ukr.net, ORCID ID: 0000-0001-7437-6156
PhD, Associate Professor, Associate Professor of the Department of Tourism,
Uzhhorod National University, Uzhhorod

CORRELATION AND REGRESSION ANALYSIS OF TOURISTS SERVED BY TOURISM ENTITIES IN UKRAINE: REGIONAL DIFFERENCES

Abstract. *Tourism is an important component of many countries, as the tourism sector works closely with other industries, attracting investment resources, strengthening the revenue side of the budget, improving the country's balance of payments, and promoting sustainable economic growth and welfare. The key indicator of the development of tourism is tourist flows that affect the spatial differences in the functioning of destinations and cause territorial socio-economic unevenness. The most significant determinants affecting the number of tourists serviced can be identified using correlation and regression analysis. The article analyzes the current state of the market of tourist services in Ukraine. The financial and economic crisis, which has intensified in recent years, the events related to the annexation of the Autonomous Republic of Crimea and the operation of the Joint Forces in the territory of Donetsk and Luhansk regions, led to a decrease in the inbound tourist flow in Ukraine. The factors that influence the development of the tourism market of Ukraine are studied. Using the correlation-regression analysis, a model of cause and effect relationships between the population of the region, its real incomes, the number of tourist enterprises and the resulting feature – the number of tourists served, have been formed. Econometric models indicate that number of tourist enterprises positively affects the resulting feature in 95.8% of the regions; the income per capita contributes to an increase in the number of tourists served in 91.7% of the regions; and the number of population affects an increase in the number of tourists in 66.7% of the regions. Thus, the hypothesis of factor variables has been confirmed in most regions of Ukraine. The study of the number of tourists serviced by enterprises of tourist industry in the regional context enables us to analyze the efficiency of their activities and to determine the parameters of the regions with greater mobility of the population, as well as to identify the regions that generate tourist flows. The practical importance of constructing econometric models lies in the possibility of using them to predict the development of the tourism industry in Ukraine.*

Key words: tourism, tourism market, tourist flow, correlation and regression analysis, Ukraine.

Морохович В. С
morv77@ukr.net, ORCID ID: 0000-0002-4939-6566
к.ф.-м.н., доцент, доцент кафедри менеджменту туристичного та готельно-ресторанного бізнесу,
Ужгородський торговельно-економічний інститут Державного торговельно-економічного університету, м. Ужгород

Грабар М. В.
19marina88@ukr.net, ORCID ID: 0000-0002-2753-4462
к.е.н., доцент кафедри туризму,
ДВНЗ «Ужгородський національний університет», м. Ужгород

Кашка М. Ю.
m-kashka@ukr.net, ORCID ID: 0000-0001-7437-6156
к.і.н., доцент кафедри туризму,
ДВНЗ «Ужгородський національний університет», м. Ужгород

КОРЕЛЯЦІЙНО-РЕГРЕСІЙНИЙ АНАЛІЗ ТУРИСТІВ, ЩО ОБСЛУГОВУЮТЬСЯ СУБ'ЄКТАМИ ТУРИСТИЧНОЇ ДІЯЛЬНОСТІ В УКРАЇНІ: РЕГІОНАЛЬНІ ВІДМІННОСТІ

Анотація. *Туризм є важливою складовою багатьох країн, оскільки суб'єкти туристичного сектору тісно співпрацюють з іншими галузями, забезпечуючи залучення інвестиційних ресурсів, зміцнюючи дохідну частину бюджету, покращуючи платіжний баланс країни, а також сприяє стійкому економічному зростанню та підвищенню добробуту населення. Ключовим показником розвитку туризму є туристичні потоки, які впливають на просторові відмінності у функціонуванні дестинацій та викликають територіальну соціально-економічну нерівномірність. Найбільш значущі детермінанти, що впливають на кількість обслуговуваних туристів, можна визначити за допомогою кореляційного та регресійного аналізу. У статті проведено аналіз сучасного стану ринку туристичних послуг в Україні. Фінансово-економічна криза, що загострилася останніми роками, та події, пов'язані з анексією АР Крим і дією Об'єднаних сил на території Донецької та Луганської областей, призвели до зменшення в'їзного туристичного потоку в Україні. Досліджено фактори, що впливають на розвиток туристичного ринку України. За допомогою кореляційно-регресійного аналізу сформовано модель причинно-наслідкових зв'язків між населенням регіону, його реальними доходами, кількістю туристичних підприємств та результуючою ознакою – кількістю обслуговуваних туристів. Економетричні моделі показують, що кількість туристичних підприємств позитивно впливає на результуючу ознаку в 95,8% регіонів; дохід на душу населення сприяє збільшенню кількості туристів, які обслуговуються в 91,7% регіонів; а чисельність населення впливає на збільшення кількості туристів у 66,7% регіонів. Таким чином, гіпотеза факторних змінних підтверджена в більшості регіонів України. Вивчення кількості туристів, що обслуговуються підприємствами туристичної індустрії в регіональному розрізі, дозволяє проаналізувати ефективність їх діяльності та визначити параметри регіонів з більшою мобільністю населення, а також визначити регіони, які генерують туристичні потоки. Практичне значення побудови економетричних моделей полягає в можливості їх використання для прогнозування розвитку туристичної галузі в Україні.*

Ключові слова: туризм, туристичний ринок, туристичний потік, кореляційно-регресійний аналіз, Україна.

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Formulation of the problem. In many countries tourism is an important economic sector that connects societies. The key indicator of the development of tourism is tourist flows that affect the spatial differences in the functioning of destinations and cause territorial socio-economic unevenness. According to the basic tourism system the following destinations are distinguished: destinations generating tourist flows, transit destinations and hosting destinations. The uneven location of the latter from the standpoint of natural resource base is justified by the availability of tourist resources: natural, historical, cultural social, and event. These tourism resources are the core of growth, which stimulates the development of the surrounding material base. However, a logical issue arises regarding the peculiarities of the spatial disproportion of destinations generating tourist flows and businesses directly involved in servicing tourists. Tourist flows represent a significant source of income for the tourism sector. This is also confirmed by the fact that in 2018 tourism industry accounted for 10.4% of world GDP, 319 million jobs or 10% of total employment [16]. Thus, the study of the number of tourists serviced by tour operators, travel agents and the key factors influencing their volumes are currently being updated.

The most significant determinants affecting the number of tourists serviced can be identified using correlation and regression analysis. This, in turn, will firstly help to form a clear picture of the number of tourists serviced in the context of the regions of Ukraine; and secondly, interpret the relationship between the number of tourist enterprises and the efficiency of their operation.

Therefore, it is important to analyze the determinants and the basic regularities of the formation of tourist flows. Hence the need for the construction of econometric models aiming to obtain statistically reliable results that fully describe the tourist flow and enable its forecasting.

Analysis of recent research and publications. Research of tourist flows on the example of France, which is one of the world's most visited destinations, was carried out by C. Terrier (2009). The research emphasizes the distinction between tourist flows along transport routes and intra-territorial flows. The author examines various systems used to measure tourist flows and discusses their usefulness and limitations, as well as presents the potential value of modern communication technologies for the study of population mobility. More specifically, the question is about establishing the correct balance between statistical accuracy and individual freedom.

T. Baldigara analyzes the determinants and basic regularities of tourism demand in Croatia. The main attention of the study was paid to the construction of an econometric model of tourism demand. It was suggested that the demand for tourism in Croatia can be approximated by the model of a second order polynomial regression (Baldigara & Koić, 2015).

Econometric models of tourism demand on the example of Greece were developed by N. Dritsakis and I. Athanasiadis (2008). The research focuses on foreign tourism due to its impact on the socio-economic structure of the host country. The application of the econometric model of tourism demand in the developed tourism market involves improving the tourism product.

The application of the regression model is reflected in the scientific work studying the correlation between climate change and tourism industry (Šverko Grdić & Krstinić Nižić, 2016). This research analyses the influence of temperature increase on the number of future tourist arrivals by 2025 through the regression model and exponential regression analysis, using one dependent variable (the number of tourists) and one independent variable (temperature). The model obtained in this paper shows that the temperature affects the number of tourists in the coastal and mountainous part of Croatia, while in the continental part (Zagreb) the temperature does not affect the tourist flow. It is stated that in the summer months climate change will reduce the demand in the coastal part and an increase in demand in the northern regions (mountainous areas) of Croatia.

The correlation-regression analysis is also applied in studies of such component of tourism as accommodation facilities (Pranić, Ketkar & Roehl, 2012). The analysis of business efficiency based on the correlation between the number of tourist arriving at the hotels and the number of nights is the best way to get good results (Popescu, 2016).

The use of models for forecasting tourist flows are illustrated on the example of the following destinations: Australia (Athanasopoulos & Hyndman, 2006), the Bahamas (Charles & Fullerton, 2011), Turkey (Yılmaz, 2015), Nepal (Subedi, 2017), Zimbabwe (Makoni & Chikobvu, 2018), Cambodia (Chhorn & Chaiboonsri, 2018), India (Chandra & Kumari, 2018), Hong Kong (Choi, 2019) et al.

As we see, econometric models are widely used in studies of international tourism; however, the problem is the lack of such research on the example of Ukraine. In addition, the study of regional differentiation will further contribute to the construction of reliable econometric models.

The purpose of the study is to carry out correlation and regression analysis of tourist flows serviced by tourism entities in the regions of Ukraine. This, in turn, will allow forming a model of causal relationships between the population of the region, its real incomes, the number of tourist enterprises and the resulting feature – the number of tourists serviced.

Presentation of the main research material. Ukraine is located in the center of Europe and has all the conditions for the proper development of the economy through tourism, but it is significantly behind the leading countries in the world in terms of the development of tourism infrastructure and quality of tourist services. The financial and economic crisis, which has intensified in recent years, the events related to the annexation of the Autonomous Republic of Crimea and the operation of the Joint Forces in the territory of Donetsk and Luhansk regions, led to a decrease in the inbound tourist flow, negatively affected the development of the tourism business in Ukraine.

According to the 2019 Tourism Competitiveness Report, Ukraine had the fastest growth rate in TTCI scores in the Eurasia sub-region, rising 10 places to rank 78th globally. In particular, as the country stabilized and recovered economically, Ukraine drastically improved its business environment (124th to 103rd), safety and security (127th to 107th), international openness (78th to 55th) and overall infrastructure (79th to 73rd) [15].

The development of tourism in Ukraine is reflected in the dynamics of the number of participants in international tourism (Figure 1).

Analysis of the dynamics of tourist flows shows that in 2014 there was a sharp decline in the number of tourists who visited Ukraine. This is explained by political instability and hostilities in the east of the country and, accordingly, the loss of territories important for the development of the tourism industry. The number of foreign citizens who visited Ukraine this year has almost halved to 12.7 million. However, since 2015, there has been a slight positive trend in inbound tourism.

With regard to outbound tourism, this flow has a completely different dynamics. The number of Ukrainian citizens who went abroad during the analyzed period has been steadily increasing. The exception was 2014, which saw a slight drop in the numbers to 22.4 million people. Most often Ukrainian citizens in 2018 visited Poland, Hungary, Russia, Moldova, Belarus, Romania, Turkey, Egypt.

Tourism enterprises in Ukraine are economic entities that provide tourist services based on the use of tourist resources, as well as accommodation, catering and related infrastructure services.

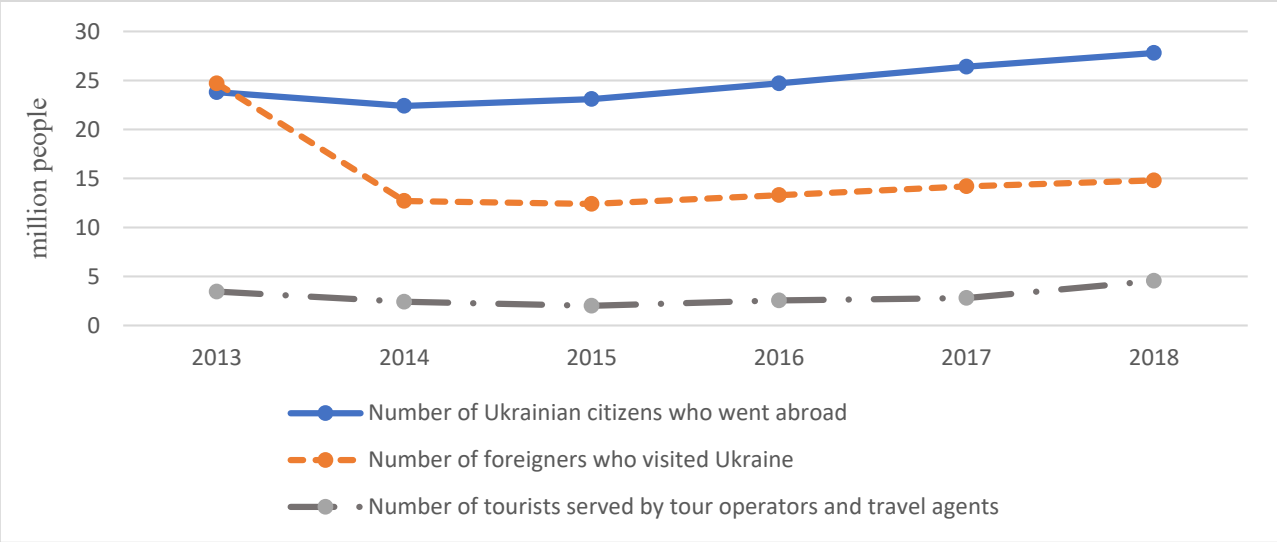

Figure 1. Dynamics of tourist flows in Ukraine

Source: developed based on [12] (Indicated without taking into account the temporarily occupied territories of the Autonomous Republic of Crimea, Sevastopol and the temporarily occupied territories in Donetsk and Luhansk regions)

Figure 1 shows that only part of the international tourism participants were served by tour operators or travel agencies that are intermediaries in the tourist services market during the organization of the trips. In 2014, the number of tourists served by tourist enterprises in Ukraine decreased by 1.0 million, which is 29.8% compared to 2013, and in 2015 by another 0.4 million, ie 17%. Since 2016, there has been a positive trend in the number of tourists served by tourism enterprises.

In order to take into account the dynamics of changes in the number of tourists serviced – which is the basis of a successful tourism industry in the country and a key indicator of the production efficiency of the enterprises – econometric models on the basis of correlation-regression analysis were built in designing the development programs for the industry.

They use data on the number of tourists serviced by tour operators, travel agents in the regions of Ukraine during 2013–2018. These figures are the resulting features by the regions (Y).

The following are taken as factors: the number of tourism entities (X_1), available income per capita (X_2), the number of population (X_3). The source data for correlation-regression analysis are given in Table 1.

The choice of the above factors is justified by the following hypotheses:

1) with a decrease in the number of tourism entities, the number of tourists serviced also reduces, since the reduction of production capacity limits the ability to serve a larger number of potential tourists;

2) with an increase in income the number of tourists also increases, as the availability of funds motivates for recreation and travel;

3) regions with more population generate a larger number of tourists.

The study of the statistical indicator Y showed some fluctuation in the regions. Thus, in 2018 there was an increase in this indicator in most regions: Vinnytsia, Volyn, Dnipropetrovsk, Donetsk, Zhytomyr, Zakarpattia, Zaporizhia, Kyiv, Kirovohrad, Luhansk, Lviv, Mykolaiv, Odessa, Poltava, Rivne, Sumy, Ternopil, Kharkiv, Kherson, Cherkasy, Chernivtsi, Chernihiv, due to the popularization of domestic tourism and growth of incomes.

Preliminary analysis of the source data shows that the factor variable – the disposable income per capita – increased in all regions during the period under study. This was achieved by targeted government policy of raising the minimum wage level.

There are direct and inverse relationships between the resulting and factor variables, which are distinguished depending on the direction of change of the resulting variable. Thus, there is an inverse relationship between the number of tourists serviced and the number of tourist enterprises, and direct relationship between the number of tourists and disposable incomes.

The relationship between the number of tourists serviced and the number of tourist entities, disposable income per capita and the number of population is reflected in the multi-factor model (multiple correlation).

On the basis of correlation-regression analysis of the number of tourists serviced by tourist entities, the following data were obtained.

The qualitative estimation of the communication density of the multiple correlation R coefficient (based on the Chaddock scale) shows that a high correlation is observed in the following regions: Volyn (0.81), Ivano-Frankivsk (0.81), and Lviv (0.80). A very high correlation is observed in the following regions: Vinnytsia (0.99), Dnipropetrovsk (0.99), Donetsk (0.99), Zakarpattia (0.99), Kyiv (0.99), Luhansk (0.99), Odessa (0.99), Rivne (0.99), Sumy (0.99), Cherkasy (0.99), Zhytomyr (0.98), Mykolaiv (0.98), Poltava (0.98), Kharkiv (0.98), Chernihiv (0.98), Kirovohrad (0.97), Kherson (0.97), Khmelnytskyi (0.96), Zaporizhia (0.95), Chernivtsi (0.94), and Ternopil (0.91). Thus, in the existing model 12.5% are highly dependent and 87.5% have a very high dependence.

The determination coefficient in the range of 0.9-0.99 is characteristic of the following regions: Vinnytsia, Dnipropetrovsk, Donetsk, Zhytomyr, Zakarpattia, Kyiv, Kirovohrad, Luhansk, Mykolaiv, Odessa, Poltava, Rivne, Sumy, Kharkiv, Kherson, Khmelnytskyi, Cherkasy, and Chernihiv. That is, 90-99% of the feature is determined by the investigated factors. The least value of the coefficient was obtained in Volyn, Ivano-Frankivsk, and Lviv regions. For the rest of the regions (Ternopil, Chernivtsi, Zaporizhia) the determination varies in the range of 0.8-0.9, which indicates that 80-90% of the variation is explained by the linear model, which means the correct choice of factors. The value of the determination coefficient indicates that the source data and the regression model are consistent, since its value maximally approaches 1.

High values of correlation coefficients and determination indicate that this dependence is sufficiently regular. The obtained Fisher's criteria show

Table 1

Source data for correlation-regression analysis

Years	Number of tourists serviced	TE*	Income per capita, UAH	Population, persons	Number of tourists serviced	TE*	Income per capita, UAH	Population, persons
	Y	X_1	X_2	X_3	Y	X_1	X_2	X_3
Vinnytsia					Volyn			
2013	29606	76	23000.6	1627038	19490	85	19804.9	1039958
2014	20744	69	23421.7	1618262	14593	80	20137.2	1041303
2015	22748	63	29637.1	1610573	15620	68	24979.9	1042918
2016	27485	68	34931.4	1602163	26526	69	30012.5	1042668
2017	38634	69	45436.2	1590357	17047	66	38514.0	1040954
2018	42178	87	54992.0	1575808	21807	74	46475.1	1038457
Dnipropetrovsk					Donetsk			
2013	81249	487	30300.6	3307795	113917	355	31048.5	4375442
2014	56803	324	32036.2	3292431	14834	84	26234.4	4343882
2015	46121	294	39142.0	3276637	3297	23	21346.4	4297250
2016	57770	322	44365.9	3254884	10874	33	20927.0	4265145
2017	75526	325	57332.5	3230411	9231	42	25278.4	4244057
2018	116981	416	72883.4	3231140	28425	93	31888.0	4200461
Zhytomyr					Zakarpattia			
2013	9613	58	21652.1	1268903	19892	82	17929.3	1254393
2014	6060	44	22102.1	1262512	11625	74	17358.1	1256850
2015	6283	47	27801.4	1255966	10656	67	22456.7	1259570
2016	8615	56	32979.1	1247549	11601	65	26856.2	1259158
2017	9516	47	42683.9	1240482	14652	63	33891.1	1258777
2018	17957	63	52135.9	1231239	25348	91	40471.6	1258155
Zaporizhia					Ivano-Frankivsk			
2013	54415	250	28388.1	1785243	77666	112	20987.8	1381788
2014	39010	231	30181.8	1775833	63848	99	20356.7	1382096
2015	30922	140	36277.4	1765926	65885	83	26540.1	1382553
2016	40376	161	43461.6	1753642	79973	107	31718.9	1382352
2017	47675	160	54261.0	1739488	73309	105	40579.5	1379915
2018	56374	188	67982.5	1723171	55781	128	48367.7	1377496
Kyiv					Kirovohrad			
2013	24459	134	27390.6	1722052	15036	70	21671.4	995171
2014	13143	104	28443.3	1725478	8484	56	21954.1	987565
2015	11560	90	33955.6	1729234	7830	46	27382.5	980579
2016	25008	119	40126.9	1732235	8854	47	32744.7	973150
2017	36983	116	50664.4	1734471	8436	43	42226.8	965456
2018	66385	217	63498.4	1754284	11556	54	51018.0	956250
Luhansk					Lviv			
2013	34716	225	25590.3	2256551	188520	272	23138.3	2540702
2014	791	15	19788.3	2239473	92128	235	23595.2	2538436
2015	939	11	15633.6	2220151	112472	221	29542.2	2537799
2016	1896	19	13792.7	2205389	181827	272	35325.0	2534174
2017	2825	17	16416.4	2195290	175150	282	44981.0	2534027
2018	6261	29	20618.6	2167802	182255	342	55510.7	2529608
Mykolaiv					Odessa			
2013	19003	75	23868.8	1173481	61589	302	25571.8	2395160
2014	9148	65	23458.5	1168372	43382	249	24242.0	2396493
2015	7464	60	29342.1	1164342	45809	245	32384.5	2396442

(End of Table 1)

Years	Number of tourists serviced	TE*	Income per capita, UAH	Population, persons	Number of tourists serviced	TE*	Income per capita, UAH	Population, persons
	Y	X_1	X_2	X_3	Y	X_1	X_2	X_3
2016	9023	69	34970.5	1158207	59077	268	39132.1	2390289
2017	11805	63	45355.7	1150126	72302	264	50111.1	2386516
2018	19002	87	55543.9	1141324	81381	270	61165.6	2383075
Poltava					Rivne			
2013	20125	130	25371.2	1467821	13545	78	21165.0	1156868
2014	12947	110	26195.7	1458205	8936	69	21781.0	1158851
2015	9497	91	31996.5	1448975	6640	59	26707.7	1161151
2016	14608	88	37938.4	1438948	9022	66	31294.8	1161811
2017	19032	93	48663.0	1426828	11168	60	40325.4	1162763
2018	32007	155	60217.5	1413829	22027	93	47729.1	1160647
Sumy					Ternopil			
2013	13498	59	23558.6	1143249	13490	70	18993.8	1077327
2014	8574	51	23938.1	1132957	9066	49	18400.5	1073327
2015	7567	53	30572.3	1123448	6668	43	24040.1	1069936
2016	8819	57	36084.4	1113256	7536	53	28194.7	1065709
2017	11185	58	45852.3	1104529	9558	45	36203.8	1059192
2018	16178	79	55934.4	1094284	13103	63	43512.5	1052312
Kharkiv					Kherson			
2013	91648	358	26098.2	2744419	16112	69	21724.0	1078232
2014	71437	309	26274.0	2737242	15818	70	20727.9	1072567
2015	31233	264	32197.9	2731302	11720	53	27880.0	1067876
2016	40429	255	38196.6	2718616	16584	72	32967.9	1062356
2017	51929	263	48370.4	2701188	20278	67	41695.0	1055649
2018	62232	266	60117.7	2694007	26130	80	50109.4	1046981
Khmelnytskyi					Cherkasy			
2013	24402	100	22789.0	1313964	15984	99	21633.2	1268888
2014	19027	84	22686.1	1306992	9694	82	21760.5	1259957
2015	25426	78	29291.9	1301242	8520	75	26969.7	1251816
2016	19885	89	34394.5	1294413	11684	86	32327.2	1242965
2017	26829	90	43638.1	1285267	20953	92	41853.5	1231207
2018	25738	89	52487.6	1274409	26383	101	50292.6	1220363
Chernivtsi					Chernihiv			
2013	18578	121	19438.2	907163	9424	59	23599.7	1077802
2014	16560	68	18475.6	908508	7689	57	23093.4	1066826
2015	15662	65	23929.0	909965	7052	55	28440.4	1055673
2016	19415	66	28360.8	909893	11698	51	33231.3	1044975
2017	20341	65	36214.5	908120	15974	51	42501.2	1033412
2018	29562	77	42850.4	906701	22306	58	50895.4	1020078

TE* – tourist entities

Source: formed according to the data [12]

that the regression equation is statistically significant and can be applied. Indicators of the reliability of the model show that all parameters of the regression equation are statistically significant and can not accept zero values. The obtained correlation-regression analysis of the indicators enables us to construct a model of influence on the resulting variable – the number of tourists serviced.

The complex interaction of all factors (x_1,x_2,…,x_n) with the resultant index (Y) can be described by the equation of the linear multivariable regression of the type:

$$Y = a_0 + a_1x_1 + a_2x_2 + ... + a_nx_n .$$

The following regression equations were obtained in the regions of Ukraine (Table 2). Econometric models indicate that factor variable X_1 (the number of tourist enterprises) has a positive effect on the resulting variable in 95.8% of the regions; X_2 (income per capita) contributes to an increase in the number of tourists serviced in 91.7% of the regions; X_3 (the number of population) affects the growth of the number of tourists serviced in 66.7% of the regions.

One of the key indicators of the quality of the model is the independence of its residuals. If this condition is violated, there is autocorrelation resulting from the existence of a dependence between the preceding and the following values of the effective indicator. Let us check the model of the number of tourists serviced for the autocorrelation using the Durbin-Watson criterion (Table 3).

The presence or absence of autocorrelation of the residuals is checked by comparing the actual value of the DW with the critical ones found in a special table depending on the level of significance of the DW, the number of factors m and the number of observations n.

Using the table of critical values of the Darwin-Watson criterion, we will find the value $d_l = 0.82$, $d_u = 1.75$ (α = 0.05, n = 6, k = 3). The obtained criterion values for all regions are $DW > 1.75$, which makes it possible to state that there is no correlation. The condition of independence of residuals is observed, therefore the regression parameters are reasonable and efficient. Since $DW > DW_u$ (upper limit) we conclude that there is no correlation between the following residuals and the previous ones.

Conclusions. The investigations allow to conclude that the developed models of multiple linear regression explain the real impact of socio-economic indicators on the development of the tourism industry in the regions of Ukraine. The regional differences in tourist flows are given on the basis of hypotheses put forward, we can state the following: factor variable X_1 in 23 regions has a positive effect on the resulting variable. That is, on 95.8% of the territory of Ukraine, except Khmelnytskyi region, the increase in the number

Table 2

Multifactor regression equation

Region	Linear multifactor regression equation
Vinnytsia	$Y = –2007295,42 +37,06x_1 + 2,35x_2 + 1,22x_3$
Volyn	$Y = –9589833,64 + 2045,58x_1 + 1,6x_2 + 9,04x_3$
Dnipropetrovsk	$Y = –1039910,4 + 186,52x_1 + 1,65x_2 + 0,3x_3$
Donetsk	$Y = 518661,49 + 402,3x_1 – 1,33x_2 – 0,12x_3$
Zhytomyr	$Y = –456696,75 + 249,86x_1 + 0,62x_2 + 0,35x_3$
Zakarpattia	$Y = 1834767,83 + 247,35x_1 + 0,43x_2 – 1,47x_3$
Zaporizhia	$Y = –2451041,85 + 101,93x_1 + 2,44x_2 + 1,35x_3$
Ivano-Frankivsk	$Y = –12613815,02 + 522,72x_1 + 0,68x_2 + 9,13x_3$
Kyiv	$Y = 1707745,34 + 325,99x_1 + 1,32x_2 – 1,02x_3$
Kirovohrad	$Y = –351010,99 + 188,06x_1 + 0,46x_2 + 0,34x_3$
Luhansk	$Y = 88974,59 + 160,4x_1 + 0,13x_2 – 0,04x_3$
Lviv	$Y = –17053194,78 + 1017,33x_1 + 0,82x_2 + 6,67x_3$
Mykolaiv	$Y = –1777212,99 + 289,95x_1 + 1,4x_2 + 1,48x_3$
Odessa	$Y = 1804150,45 + 315,88x_1 + 0,6x_2 – 0,77x_3$
Poltava	$Y = –910537,27 + 114,76x_1 + 1,21x_2 + 0,6x_3$
Rivne	$Y = 1978552,07 + 107,58x_1 + 0,52x_2 – 1,72x_3$
Sumy	$Y = –476726,38 + 161,93x_1 + 0,61x_2 + 0,41x_3$
Ternopil	$Y = –184014,17 + 215,92x_1 + 0,22x_2 + 0,17x_3$
Kharkiv	$Y = 2580653,69 + 736,26x_1 – 0,51x_2 – x_3$
Kherson	$Y = –241324,54 + 304,99x_1 + 0,45x_2 + 0,21x_3$
Khmelnytskyi	$Y = –2279056,79 – 396,59x_1 + 2,24x_2 + 1,74x_3$
Cherkasy	$Y = –689552,82 + 207,83x_1 + 1,22x_2 + 0,52x_3$
Chernivtsi	$Y = 1139311,09 + 20,57x_1 + 0,39x_2 – 1,25x_3$
Chernihiv	$Y = –205755,35 + 141,37x_1 + 0,84x_2 + 0,17x_3$

Source: own development

Table 3

Evaluation of the quality of the models according to the Darwin-Watson criterion in the regions of Ukraine

№	Forecast	Residuals	e_i^2	$(e_i - e_{i-1})^2$	Forecast	Residuals	e_i^2	$(e_i - e_{i-1})^2$
Vinnytsia					Volyn			
1	29669.25	-63.25	4000.15	-	16245.83	3244.17	10524624.86	-
2	19717.05	1026.95	1054627.44	1188530.16	18708.06	-4115.06	16933744.72	54158280,51
3	24719.99	-1971.99	3888741.09	8993639.17	16516.67	-896.67	804025.85	10358023.0
4	27091.92	393.08	154512.09	5593553.14	24363.73	2162.27	4675421.44	9357157.82
5	37407.9	1226.1	1503323.7	693923.59	16351.48	695.52	483747.21	2151364.09
6	42788.9	-610.9	373193.87	3374557.88	22897.22	-1090.22	1188582.82	3188870.33
Total			6978398.34	19844203.94	Total		34610146.91	79213695.75
DW				2.84	DW			2.29
Dnipropetrovsk					Donetsk			
1	82514.66	-1265.66	1601884.4	-	113954.62	-37.62	1415.4	-
2	50409.72	6393.28	40874016.4	58659281.07	14997.83	-163.83	26839.7	15928.09
3	51828.81	-5707.81	32579124.09	146436416.73	2365.98	931.02	866791.29	1198684.57
4	59198.61	-1428.61	2040913.69	18311612.93	10661.77	212.23	45040.75	516656.49
5	73849.09	1676.91	2812027.67	9644227.51	10922.91	-1691.91	2862549.97	3625731.06
6	116649.12	331.88	110147.4	1809093.7	27674.89	750.11	562669.37	5963462.17
Total			80018113.64	234860631.94	Total		4365306.47	11320462.38
DW				2.94	DW			2.59
Zhytomyr					Zakarpattia			
1	10081.94	-468.94	219900.25	-	19016.89	875.11	765818.17	-
2	4649.94	1410.06	1988265.97	3530618.75	13179.42	-1554.42	2416235.18	5902639.15
3	6642.19	-359.19	129015.33	3130231.01	9656.43	999.57	999140.31	6522887.66
4	9165.35	-550.35	302888.87	36544.58	11671.27	-70.27	4937.69	1144554.93
5	10443.94	-927.94	861065.18	142568.6	14781.05	-129.05	16654.59	3455.56
6	17060.65	896.35	803448.33	3328029.53	25468.93	-120.93	14625.2	65.9
Total			4304583.93	10167992.48	Total		4217411.13	13573603.2
DW				2.36	DW			3.22
Zaporizhia					Ivano-Frankivsk			
1	52124.83	2290.17	5244868.17	-	72479.56	5186.44	26899149.56	-
2	41879.33	-2869.33	8233059.67	26620425.72	68064.55	-4216.55	17779298.98	88416213.57
3	34141.62	-3219.62	10365934.73	122700.49	68096.78	-2211.78	4891970.84	4019105.1
4	37274.87	3101.13	9616982.36	39951794.0	82345.21	-2372.21	5627398.88	25739.04
5	44481.41	3193.59	10198988.24	8548.76	65107.11	8201.89	67271046.96	111811734.8
6	58869.93	-2495.93	6229672.24	32370599.37	60368.79	-4587.79	21047792.82	163575920.76
Total			49889505.4	99074068.34	Total		143516658.05	367848713.27
DW				1.99	DW			2.56
Kyiv					Kirovohrad			
1	24504.3	-45.3	2052.35	-	14637.72	398.28	158629.11	-
2	12607.59	535.41	286663.89	337227.51	9516.89	-1032.89	1066857.79	2048249.8
3	11480.43	79.57	6331.96	207786.81	7726.06	103.94	10803.29	1292375.56
4	26014.5	-1006.5	1013043.11	1179556.88	7820.99	1033.01	1067113.95	863176.99
5	36668.25	314.75	99069.11	1745709.18	8777.44	-341.44	116581.81	1889120.66
6	66262.93	122.07	14900.4	37127.6	11716.9	-160.9	25890.35	32593.24
Total			1422060.83	3507407.98	Total		2445876.3	6125516.26
DW				2.47	DW			2.5
Luhansk					Lviv			
1	34702.03	13.97	195.2	-	179499.69	9020.31	81365946.57	-
2	960.83	-169.83	28843.79	33784.67	127126.45	-34998.45	1224891650.1	1937651193.6
3	573.24	365.76	133782.96	286865.35	113501.48	-1029.48	1059828.75	1153891076.66
4	2226.59	-330.59	109290.89	484910.64	145949.63	35877.37	1287185361.9	1362115240.31
5	2671.81	153.19	23466.85	234043.73	163040.59	12109.41	146637699.07	564915931.9
6	6293.5	-32.5	1056.09	34479.49	203234.15	-20979.15	440124587.39	1094852265.89
Total			296635.79	1074083.89	Total		3181265073.8	6113425708.36
DW				3.62	DW			1.92

(End of Table 3)

№	Forecast	Residuals	e_i^2	$(e_i - e_{i-1})^2$	Forecast	Residuals	e_i^2	$(e_i - e_{i-1})^2$
Mykolaiv					Odesa			
1	18920.6	82.4	6790.2	-	61029.21	559.79	313365.92	-
2	7866.91	1281.09	1641196.54	1436855.92	42463.48	918.52	843676.33	128685.49
3	8676.01	-1212.01	1468977.49	6215576.26	46090.81	-281.81	79415.57	1440783.08
4	10064.21	-1041.21	1084114.68	29174.53	62138.54	-3061.54	9373019.47	7726904.74
5	10876.11	928.89	862829.46	3881272.01	70336.55	1965.45	3862987.65	25270600.34
6	19041.16	-39.16	1533.4	937110.73	81481.41	-100.41	10082.48	4267777.56
Total			5065441.76	12499989.45	Total		14482547.42	38834751.2
DW				2.47	DW			2.68
Poltava					Rivne			
1	19712.59	412.41	170080.16	-	13306.83	238.17	56724.25	-
2	12621.42	325.58	106004.49	7538.48	9254.21	-318.21	101259.17	309559.81
3	11907.64	-2410.64	5811188.27	7486921.5	6770.92	-130.92	17138.94	35080.04
4	12720.64	1887.36	3562125.65	18472804.63	8754.89	267.11	71349.99	158427.86
5	18985.77	46.23	2137.53	3389744.85	11128.5	39.5	1560.55	51806.5
6	32267.94	-260.94	68091.43	94357.6	22122.66	-95.66	9150.5	18268.77
Total			9719627.54	29451367.06	Total		257183.4	573142.99
DW				3.03	DW			2.23
Sumy					Ternopil			
1	13412.52	85.48	7307.34	-	13218.73	271.27	73586.49	-
2	8148.64	425.36	180933.88	115518.6	7895.08	1170.92	1371051.83	809371.77
3	8608.34	-1041.34	1084381.05	2151207.2	7259.63	-591.63	350029.93	3106591.31
4	8434.29	384.71	148004.35	2033617.24	9619.44	-2083.44	4340725.12	2225489.38
5	10947.32	237.68	56490.36	21619.68	8548.38	1009.62	1019323.73	9566997.44
6	16269.9	-91.9	8445.68	108621.26	12879.73	223.27	49849.85	618338.19
Total			1485562.67	4430583.98	Total		7204566.96	16326788.1
DW				2.98	DW			2.27
Kharkiv					Kherson			
1	94416.92	-2768.92	7666915.63	-	16068.48	43.52	1894.28	-
2	65406.86	6030.14	36362577.45	77423433.43	14734.57	1083.43	1173823.51	1081408.79
3	35172.91	-3939.91	15522888.14	99401872.12	11784.44	-64.44	4152.23	1317603.66
4	38132.48	2296.52	5274015.08	38893084.71	18710.44	-2126.44	4521742.17	4251848.23
5	56204.52	-4275.52	18280034.74	43191685.0	19705.83	572.17	327383.1	7282511.35
6	59574.32	2657.68	7063281.53	48069251.38	25638.25	491.75	241816.1	6468.34
Total			90169712.56	306979326.64	Total		6270811.39	13939840.38
DW				3.4	DW			2.22
Khmelnytskyi					Cherkasy			
1	24592.12	-190.12	36145.59	-	16333.1	-349.1	121873.44	-
2	18544.09	482.91	233198.63	452964.51	8317.05	1376.95	1896001.25	2979274.07
3	25686.34	-260.34	67774.88	552409.45	8979.3	-459.3	210960.2	3371842.18
4	20837.77	-952.77	907775.57	479468.28	13194.34	-1510.34	2281133.52	1104681.18
5	25186.85	1642.15	2696671.8	6733647.15	19938.21	1014.79	1029802.53	6376301.99
6	26459.83	-721.83	521042.09	5588434.88	26456.0	-73.0	5328.34	1183281.32
Total			4462608.57	13806924.28	Total		5545099.29	15015380.74
DW				3.09	DW			2.71
Chernivtsi					Chernihiv			
1	18998.64	-420.64	176935.85	-	9361.5	62.5	3906.41	-
2	15852.99	707.01	499868.27	1271596.91	6750.28	938.72	881204.58	767768.01
3	16124.64	-462.64	214039.6	1368099.3	9010.19	-1958.19	3834504.91	8392111.7
4	17981.37	1433.63	2055298.56	3595860.37	10600.6	1097.4	1204294.23	9336646.09
5	23265.12	-2924.12	8550450.27	18989954.97	16357.35	-383.35	146960.5	2192643.32
6	27895.25	1666.75	2778062.19	21076062.42	22063.09	242.91	59007.13	392211.75
Total			14274654.74	46301573.97	Total		6129877.76	21081380.87
DW				3.24	DW			3.44

Source: own development

of tourist enterprises contributes to the increase in tourist flows, therefore, for these regions hypothesis 1 was confirmed.

Hypothesis 2 according to regression models was confirmed for 22 regions, namely: Vinnytsia, Volyn, Dnipropetrovsk, Zhytomyr, Zakarpattia, Zaporizhia, Ivano-Frankivsk, Kyiv, Kirovohrad, Luhansk, Lviv, Mykolaiv, Odesa, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, and Chernihiv. The increase in incomes does not contribute to the number of tourists serviced in Donetsk and Kharkiv regions. In these regions, despite the increase in wages, the number of tourists serviced does not increase.

The presented hypothesis 3 was confirmed in 16 regions: Vinnytsia, Volyn, Dnipropetrovsk, Zhytomyr, Zaporizhia, Ivano-Frankivsk, Kirovohrad, Lviv, Mykolaiv, Poltava, Sumy, Ternopil, Kherson, Khmelnytskyi, Cherkasy, and Chernihiv. The growth of population in these regions contributes to the increase in the number of tourists serviced. Consequently, we see that the presented hypotheses were confirmed in most regions of Ukraine.

The practical importance of constructing econometric models lies in the possibility of using them to predict the development of the tourism industry in Ukraine.

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