Modeling the Development of the Tourism Industry Using the Koba-Douglas Function for Intelligent Management Systems

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Abstract

Modeling the influence of factors on the performance of tourism industry enterprises is very important for the development of intelligent management systems. This allows us to create mathematical models that can predict the consequences of various actions and reflect the relationships between different factors and outcomes. The paper analyzes the dynamics of growth rates of sales, capital and labor costs and the dynamics of labor productivity and fund intensity of subjects of the tourism industry of Ukraine, dividing them into three groups depending on the types of economic activity: the activities of travel agencies, the activities of tour operators and the provision of booking services. The study was conducted on the basis of statistical data of the State Statistics Service of Ukraine for the period from 2013 to 2021. Using the Koba-Douglas function, the influence of factors (capital and labor costs) on the development of the tourism industry in Ukraine is modeled (the volume of products sold is selected as the result indicator). It is revealed that for travel agencies, labor has a more significant impact on the result than capital. For tour operators, the impact on the result of capital is almost twice as great as labor. For organizations that provide booking services, on the contrary, the impact on labor results is almost twice as great as capital. Applying simulation results can help managers of travel companies make decisions based on the analysis of large amounts of data and statistics, in particular for forecasting sales, production costs, personnel planning, etc. The built models allow us to determine the optimal combination of factors of production, which ensures the highest level of efficiency of tourist enterprises and helps to assess what changes in capital and labor can lead to an increase in the volume of products sold.

Keywords

Tourism, travel agencies, tour operators, booking services, Koba-Douglas production function, intelligent management systems, capital, labor, volume of products sold, labor productivity, fund intensity.

1. Introduction

Taking into account the influence of factors on the effectiveness of the development of the tourism industry, in particular such as labor and capital, is important for effective production management of travel companies. Capital and labor are the two main factors of production that interact with each other and affect the effectiveness of production. Taking into account the impact of labor and capital on production can help determine the optimal balance between these two factors. For example, if a company has more capital, it can use machines and other means of production more efficiently, instead of attracting more employees. On the other hand, if production requires a large amount of

manual labor, then it is necessary to attract enough workers and ensure their efficient operation in order to ensure high productivity.

The tourism sector as a component of the service sector differs from the manufacturing sector in terms of providing enterprises with capital and labor. This is evident in the fact that the manufacturing sector is usually associated with the production of goods and services, while the tourism sector is associated with the provision of services related to recreation and travel [1]. This can affect the capital and labor needs that are needed to support industry operations. The tourism industry is often seasonal, which means that capital and labor needs can change depending on the demand for travel services throughout the year [2]. The production sector usually does not depend so much on seasonality. The tourism sector is distributed according to the demand and attractiveness of tourist places, while the production sector can be concentrated in certain regions. The tourism sector often operates small businesses such as hotels and restaurants, while the manufacturing sector may have large businesses such as factories and factories. This is also an important factor that determines the need for a certain level of providing enterprises with capital and labor.

The dual nature of providing tourism with capital and labor is as follows:

- job provision (security) – in tourism, experienced and qualified workers are a key element of a successful industry. Providing a high-quality workforce and capable managers helps ensure the quality of service and satisfaction of tourists. In addition, employee security (provision) can be important for increasing workers' salaries in the industry, which in turn can support the local economy and make the tourism industry more attractive to younger generations;

- capital security (provision) – in tourism, investment in the development of infrastructure and services is a necessary condition for ensuring the development and competitiveness of the industry. For example, the development of a hotel base, the creation of new tourist routes, and the opening of new businesses may depend on the availability of capital. If the tourism industry is provided with a sufficient level of capital, it can improve the quality of services and make the tourism product more attractive to potential customers.

Efficient use of labor and capital can help increase the number of products produced, reduce costs, and increase the competitiveness of a travel company. Inappropriate use of these factors can lead to unnecessary costs, reduced product quality, and reduced profitability [3; 4]. Therefore, taking into account the impact of labor and capital on the efficiency of tourism industry entities, in particular on the volume of tourist products sold, allows us to increase the efficiency of providing tourist services and ensure the successful operation of travel companies. In addition, further research on the impact of capital and labor on the development of the tourism industry can help in studying important factors that affect the sustainable development of tourism. For example, determining how capital and labor are effectively used to conserve natural and cultural resources can help reduce its negative impact on the environment.

Taking into account the above statements, the purpose of our research is to model the dependence of the development of the tourism industry in Ukraine on factors of production, such as labor and capital. It is suggested to use the Koba-Douglas production function as a tool. To achieve this goal, our research is aimed at solving the following problems:

1. Analyze the dynamics of growth rates in the volume of products sold, capital and labor costs of travel agencies, tour operators and organizations providing booking services.

2. Analyze the dynamics of labor productivity and fund intensity of travel agencies, tour operators, and organizations providing booking services.

3. Using the Koba-Douglas function, model the impact of factors (capital and labor costs) on the development of the tourism industry in Ukraine (the resulting indicator is the volume of sales of products).

2. Related works

Assessment of the impact of factors on the development of the tourism industry is a widely studied topic in scientific sources. For this purpose, different methods and approaches are used, depending on the specific task and subject of research. For example, surveys and questionnaires of various stakeholders, such as tourists, representatives of travel companies, local residents, etc., are used to

investigate their preferences, needs, and impressions of tourist services and infrastructure. The results of such studies can be used to improve the quality of tourist services and attract new tourists. Thus, by Chinese scientists Sun Hui et al. [5] the main factors influencing the choice of destination by ski tourism enthusiasts were investigated through a soft interview, followed by a questionnaire survey; researcher Zhang Yuanjing [6] conducted an online survey among 350 tourists to identify factors influencing the tourist experience. In addition, expert assessments are conducted based on the opinion and experience of representatives of the tourism industry and other experts from various industries to determine the most important factors influencing the development of the industry.

In the works of scientists, we find the analysis of statistical data and the construction of various economic and mathematical models of the relationship between various factors and the development of the tourism industry [7; 8]. Such models include socio-economic and cultural factors such as the economic situation of the country [8], the standard of living of the population [9], the level of health and morbidity risks [10], transport infrastructure [11], housing prices in a particular area or market [12], cultural heritage [13], factors influencing the consumption of tourist online products [14; 15], etc. Scientists Solyukova Nina, Viegas Cristina and Pinto Patrícia [16] using statistical methods, correlation and regression analysis analyzed the impact of the company's debt, lack of resources, sales growth, materiality and size of the firm on the return on assets (ROA), confirming the theory that the most profitable firms tend to borrow less because they do not need external capital.

Since 2020, the COVID-19 pandemic has affected many economic sectors, including the tourism industry, not only in Ukraine, but also in other countries [17]. The fact of the impact of the pandemic on the development of tourism is confirmed in many scientific works [18]. In particular, the Samad I. scientist [19] studied the role of internal resources and the influence of environmental factors on the efficiency of small and medium-sized enterprises in the tourism industry. The shift to an asset reduction strategy is a significant shift for travel companies in light of the global COVID-19 outbreak [20].

Scientists Faturohman Taufik and Noviandy Rashifa Anita [21] note that the capital structure is vital for each company, as it has a huge impact on the company's financial decisions. In particular, scientists have identified, that size and earnings volatility had significant negative correlations with net equity. Chambers Nurgul and Cifter Atilla [22] studied the influence of working capital on the company's performance in the hospitality and tourism industry and revealed an inverted U-shaped relationship between working capital and the company's productivity. A significant amount of research is aimed at studying the impact of human capital on the development of the tourism industry [23], and the possibilities of human capital as a key factor in determining the competitiveness of tourism industry enterprises are considered [24]. Research on the impact of capital and labor on the development of the tourism market is important for business, government and other stakeholders and can help solve problems and develop the industry more effectively.

One of the most common functions used to study the relationship between production and the use of factors of production, such as capital and labor, is the Koba-Douglas function. However, in most scientific studies, this function is used to analyze productive areas of the economy, such as industry [25] or agriculture [26], and less is studied for the service sector, such as tourism. However, with the development of the economy and the growing importance of the service sector, such as tourism, research on the impact of factors on this area is becoming increasingly important. Therefore, further research of the Koba-Douglas function for the service sector, in particular for tourism, is an urgent task. Such studies can be useful for planning and developing tourism development strategies, as well as for making decisions in the field of tourism.

3. Methods

The current state of the economy creates certain problems in analyzing the dynamics of industry development. To assess the effectiveness of the mechanisms of functioning of the tourism industry, mathematical modeling methods are used, which will allow not only to analyze the existing state, but also to conduct forecasting.

In economics, to determine the mathematical dependence of the amount of output produced on the amount of factors of production used, such as labor and capital, scientists have adopted the Koba-

Douglas production function, which is named after the economists Koba and Douglas who developed it in the 1920s. This function shows that an increase in the amount of labor and capital leads to an increase in production, but the marginal productivity of each additional factor of production decreases. It also reflects that technological progress can improve production efficiency regardless of the number of factors of production used.

Mathematical assessment of the effectiveness of the development of the tourism industry using the Koba-Douglas production function is expressed using the formula:

$$P = k \times K^{\alpha} \times L^{(1-\alpha)}, \tag{1}$$

where P – volume of products produced,

K – amount of capital (assets) involved,

L – amount of labor costs,

α – the Koba-Douglas model coefficient, which indicates which of the factors of production (capital or labor) has a greater impact on the result. If the coefficient α is greater than 0.5, then capital has a greater influence on the result, and if the coefficient α is less than 0.5, then labor has a greater influence on the result. If the coefficient α is 0.5, then capital and labor have the same effect on the result.

To find the unknowns k, α, and β, the gradient method of the fastest descent for the functional is used:

$$F = \sum_{j=1}^{J} \left(P_j - k \times K_j^{\alpha} \times L_j^{(1-\alpha)} \right)^2 \rightarrow min, \tag{2}$$

where J – number of observations over the years.

$$\left\{ P_j;\ K_j^{\text{a}};\ L_j^{(1-\text{a})} \right\} j = 1, \dots, J. \tag{3}$$

Equally important is the study of deviations from the calculated model during the study period in order to assess the effectiveness of management both in terms of capital use and labor.

Changes in the economic, socio-political landscape are determined by the following features [27]:

- inertia;
- subordination to economic laws of development;
- classical methods of analysis have strong limitations on application and do not give sufficiently clear results;
- short interval for research;
- complexity of using analytical methods.

Therefore, the need to develop effective analysis tools that would take into account such features of economic processes is being updated.

To analyze the intensity/efficiency of capital and labor use during this period, the following functionality is constructed:

$$F = \sum_{j=1}^{J} \left(P_j - k \times (\zeta_j \times K_j)^{\alpha} \times (\eta_j \times L_j)^{1-\alpha} \right)^2 + \chi \times \sum_{j=1}^{J-1} \left[(\zeta_{j+1} - \zeta_j)^2 + (\eta_{j+1} - \eta_j)^2 \right] \rightarrow min, \tag{4}$$

where ζ_j – capital use intensity coefficients;

η_j – labor intensity coefficients.

The gradient method of the fastest descent is used to find the unknowns: ζ_j, η_j, $j = 1, \dots, J$.

The proposed methodology is tested on statistical data published in the public domain by the State Statistics Service of Ukraine on the website: https://www.ukrstat.gov.ua. To establish the basis for the preparation and dissemination of statistical information on types of economic activity in Ukraine, the state classifier DK 009:2010 (classification of types of economic activity KVED-2010) was approved. The basic principle of KVED is to combine enterprises that produce similar goods or services or use similar processes to create goods or services (i.e. raw materials, production process, methods or technologies) into groups. State statistics bodies calculate the main type of economic activity based on data from state statistical observations in accordance with the statistical methodology based on the results of enterprises' activities for the year. To characterize tourism, we will use the statistics of the KVED-2010, in particular those presented in Section 79 of Section N "Activities in the field of administrative and support services" [28]. Section 79 is divided into two groups:

79.1 Activities of travel agencies and tour operators. This group includes the activities of travel agencies, transportation and accommodation in temporary accommodation facilities for tourists and

travelers, organization and conduct of tours that are sold by travel agencies or directly by agents, such as tour operators. Group 79.1 is divided into 2 classes:

79.11 Activities of travel agencies. This class includes the activities of agencies involved in organizing trips, tours, and providing short-term accommodation services based on their wholesale and retail sales to a wide range of consumers or commercial clients [29].

79.12 Activities of tour operators. This class includes organizing and conducting tours that are implemented through travel agencies or directly by tour operators. The organization of tours may include: transportation; provision of accommodation; meals; visits to museums, places of historical and cultural monuments, theater, music or sports events [30].

79.9 Provision of other booking services and related activities.

Taking into account the distribution of subjects of tourist activity by types of economic activity, which is used in the KVED-2010, further analysis of the dynamics of the development of the tourist market is carried out for three groups:

- activities of travel agencies;
- activities of tour operators;
- provision of booking services and related activities.

The information source of data on the volume of products sold, capital and labor costs is the statistical data of the State Statistics Service of Ukraine for the period 2013-2021, which are published in the section "Economic statistics / Economic activity / Activities of enterprises" [31].

4. Results and discussions

The theoretical concept of our research is based on the choice of a classical model that takes into account such three basic factors that reflect the activities of tourism industry entities as the volume of products sold, capital (assets), and labor costs. Time period of the study is from 2013 to 2021. Initial data are presented for three types of economic activity that characterize the activities of subjects of the tourism industry of Ukraine, namely: the activities of travel agencies; the activities of tour operators; the provision of booking services and related activities (Tables 1-3).

Tables 1-3 also show the results of calculating the basic growth rates of sales, capital and labor costs in relation to the base period – 2013. A graphical representation of the growth rate for travel agencies is shown in Figure 1, for the activities of tour operators – in Figure 2, and for the provision of booking services – in Figure 3.

Table 1
Indicators that reflect the activities of travel agencies in Ukraine

Years	Volume of products (goods, services) sold, mln. UAH	% by 2013	Capital, mln. UAH	% by 2013	Labor costs of enterprises, mln. UAH	% by 2013	Labor productivity	Fund intensity
2013	1323.655	100.00	2202.069	100.00	162.706	100.00	8.135	1.664
2014	913.124	68.99	1165.654	52.93	122.035	75.00	7.483	1.277
2015	1134.863	85.74	1210.410	54.97	154.239	94.80	7.358	1.067
2016	1416.276	107.00	1350.084	61.31	169.948	104.45	8.334	0.953
2017	1530.509	115.63	1673.200	75.98	226.824	139.41	6.748	1.093
2018	1841.803	139.15	2024.089	91.92	248.573	152.77	7.410	1.099
2019	2140.567	161.72	2420.621	109.92	331.893	203.98	6.450	1.131
2020	984.717	74.39	2207.303	100.24	211.686	130.10	4.652	2.242
2021	1867.129	141.06	2008.923	91.23	221.346	136.04	8.435	1.076

Source: Compiled by the authors based on [31]

Table 2
Indicators that reflect the activities of tour operators in Ukraine

| Years	Volume of products (goods, services) sold, mln. UAH	% by 2013	Capital, mln. UAH	% by 2013	Labor costs of enterprises, mln. UAH	% by 2013	Labor productivity	Fund intensity
2013	3937.727	100.00	1960.589	100.00	216.164	100.00	18.216	0.498
2014	2683.723	68.15	2078.432	106.01	183.427	84.86	14.631	0.774
2015	3088.542	78.43	2860.945	145.92	219.776	101.67	14.053	0.926
2016	3845.716	97.66	4095.164	208.87	247.055	114.29	15.566	1.065
2017	4773.367	121.22	3667.749	187.07	347.970	160.98	13.718	0.768
2018	7029.984	178.53	4442.438	226.59	363.687	168.25	19.330	0.632
2019	9736.5312	247.26	6214.208	316.96	536.796	248.33	18.138	0.638
2020	4640.442	117.85	5555.959	283.38	401.481	185.73	11.558	1.197
2021	10928.968	277.55	8255.705	421.08	443.294	205.07	24.654	0.755

Source: Compiled by the authors based on [31]

Table 3
Indicators that reflect the activity of providing booking services in Ukraine

Years	Volume of products (goods, services) sold, mln. UAH	% by 2013	Capital, mln. UAH	% by 2013	Labor costs of enterprises, mln. UAH	% by 2013	Labor productivity	Fund intensity
2013	266086,2	100.00	806722,8	100.00	35203,6	100.00	7.558	3.032
2014	277473,1	104.28	734278,2	91.02	25748,7	73.14	10.776	2.646
2015	387355,4	145.58	817119,6	101.29	35277,1	100.21	10.980	2.109
2016	441307,1	165.85	739962,5	91.72	46947,4	133.36	9.400	1.677
2017	423900,5	159.31	744345,7	92.27	61449,9	174.56	6.898	1.756
2018	595067,6	223.64	1782491,5	220.95	68641,3	194.98	8.669	2.995
2019	909105,3	341.66	1632840,4	202.40	100061,7	284.24	9.085	1.796
2020	569128,5	213.89	2019447,0	250.33	98388,7	279.48	5.784	3.548
2021	901728,9	338.89	1549717,4	192.10	151091,3	429.19	5.968	1.719

Source: Compiled by the authors based on [31]

Monitoring of the growth rates of indicators that reflect the activities of travel agencies for the period 2013-2021 shows their decline in 2014, which is due to the occupation of Crimea by the Russian Federation and its invasion of the territory of the Ukrainian part of Donbas. During 2014-2019, we observe an upward trend in the analyzed indicators, as Ukraine becomes more attractive for foreign tourists, as well as the ability of the local population to relax and travel increases. Due to the spread of the COVID-19 pandemic, a decrease in the values of the analyzed indicators is again observed in 2020. The growth rate of labor costs exceeds the growth rate of capital, which indicates that personnel is a key resource in the development of travel agencies.
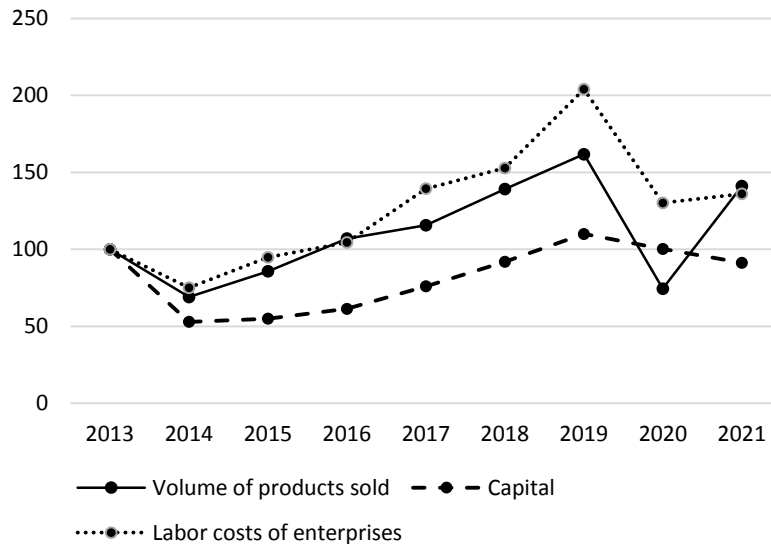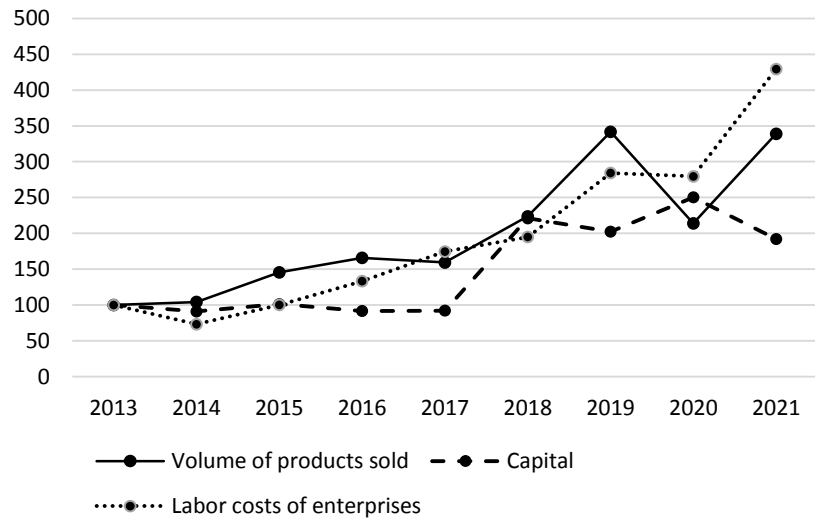
Figure 1: Dynamics of growth rates of indicators reflecting the activities of travel agencies in Ukraine
Source: compiled by the authors
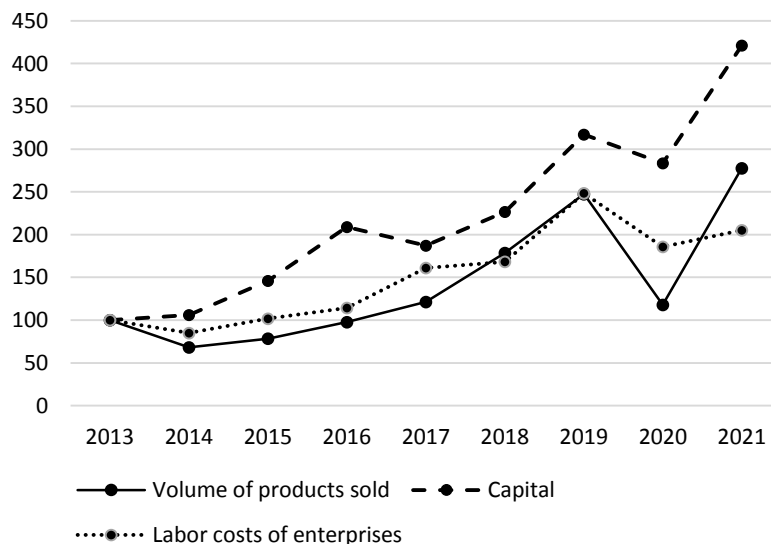
Figure 2: Dynamics of growth rates of indicators reflecting the activities of tour operators in Ukraine
Source: compiled by the authors

A similar picture, as with the activities of travel agencies, is observed in the dynamics of growth rates of indicators that reflect the activities of tour operators: a decrease in 2014 with further growth until 2019 and a significant drop, which is due to the spread of the COVID-19 pandemic. Growth is recovering in 2021. However, the activities of tour operators show better results and higher growth rates than those of travel agencies. Tour operators, unlike travel agencies, tend to deal with more complex issues related to the organization of tours and package offers, including transportation, accommodation, meals and excursions. This allows them to offer customers comprehensive services that include everything they need to travel. Also, tour operators can work with discounts and special offers from tour operators, which allows them to offer more affordable prices for customers. The growing popularity of tourism in Ukraine for more comprehensive services offered by tour operators has led to better results of their activities compared to travel agencies in this period. However, unlike travel agencies, the growth rate of labor costs is lower than the growth rate of capital, which indicates that capital is a key resource in the development of tour operators.

Figure 3: Dynamics of growth rates of indicators that reflect the activity of providing booking services in Ukraine

Source: compiled by the authors

The dynamics of activity in the provision of booking services is also demonstrated by similar trends in the growth rate of indicators, in particular, a decrease in 2014 with further growth until 2019 and a fall in 2020, which is due to the spread of the COVID-19 pandemic and the resumption of growth in 2021 only in the volume of products sold and labor costs, and capital experienced a reduction in 2021. As with travel agencies, the growth rate of labor costs exceeds the growth rate of capital, which indicates that staff is the predominant resource in the development of organizations that provide booking services. However, as can be seen from Figure 3, the lag in capital growth rates from the growth rate of labor costs is insignificant, except for 2021.

More information about the dynamics of the development of the tourism industry in Ukraine can be obtained by studying the ratio of capital use and labor costs to production and sales volumes. In Figure 4 shows the dynamics of labor productivity (the ratio of volumes of products sold to labor costs), and Figure 5 – fund intensity (the ratio of capital to the volume of products sold) of travel agencies, tour operators and organizations that provide booking services.
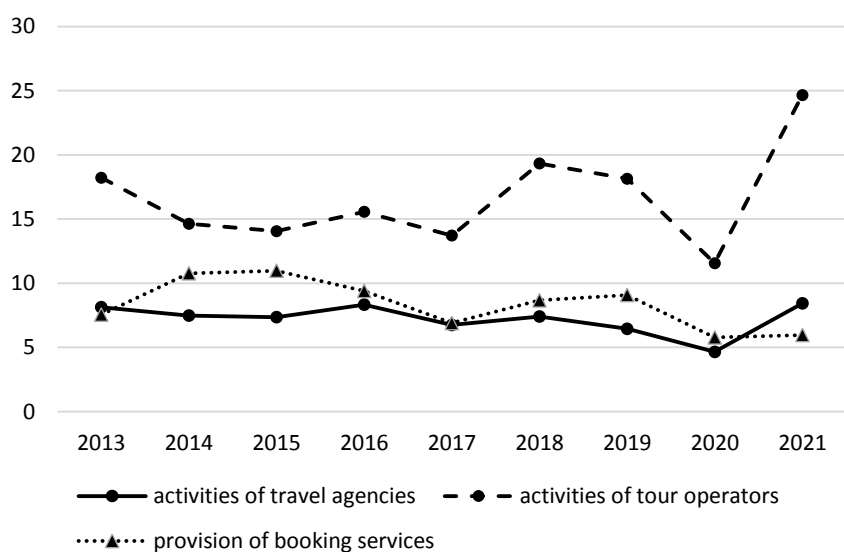
Figure 4: Dynamics of labor productivity of travel agencies, tour operators and organizations providing booking services in Ukraine
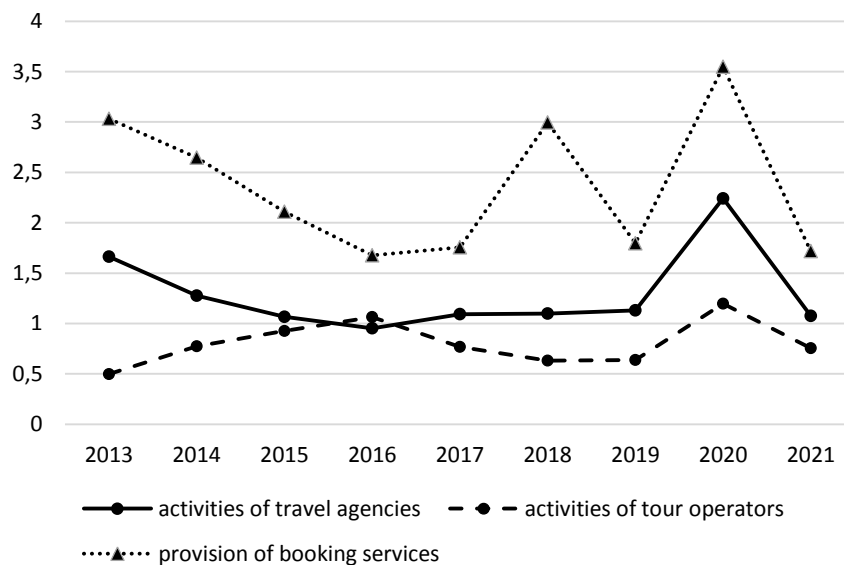
Source: compiled by the authors

Labor productivity shows the ratio of the production result to the Labor used. This means that labor productivity indicates how much of a product or service can be produced per unit of time using a certain amount of labor. High labor productivity can indicate that employees perform their work efficiently and use resources such as equipment, materials, and time efficiently. This can have a positive impact on the profitability of the enterprise, increase wages, and improve the quality of the product or service [32]. As shown in Figure 4, the labor productivity of tour operators exceeds the labor productivity of travel agencies and organizations providing booking services. This is due to the fact that tour operators are usually engaged in creating tours and selling them, which requires fewer employees compared to travel agencies that provide services for booking hotels, air tickets, transfers and other similar services. In addition, tour operators usually have a large database of tours that can be sold, as well as more opportunities in tour planning and travel organization. In addition, tour operators may have more opportunities for efficient use of information technologies and automated control systems, which can also provide higher labor productivity.

There is a decrease in the productivity of travel agencies, tour operators and organizations providing booking services in the period from 2013 to 2020, only in 2021 there is an increase. The decline in labor productivity in the tourism industry of Ukraine is associated with the influence of such factors as [33; 34; 35]:

- political and economic instability in the country – since 2013, Ukraine has experienced significant political and economic difficulties, including a political crisis and military operations in the east of the country;
- changes in consumer demand – over the past few years, consumers have become more demanding and demanding about the quality and price of travel services, which has led to a more complex and time-consuming process of selling and organizing travel;
- competition-the tourism market of Ukraine is quite competitive, with many players in the market, which has led to the fact that travel agencies and operators are forced to spend more effort and resources on attracting customers and maintaining a stable business;
- technology has evolved and changed rapidly over the past few years, which requires travel agencies and operators to pay more for software updates, employee training, and other expenses that also reduce productivity.

However, the measurement of labor productivity should be supplemented with other indicators, such as product quality, customer satisfaction, employee safety, etc., to ensure a complete assessment of the performance of tourism industry entities.

Figure 5: Dynamics of fund intensity of travel agencies, tour operators and organizations providing booking services in Ukraine
Source: compiled by the authors

Fund intensity characterizes the effectiveness of providing capital to the activities of tourism industry entities. This means that the enterprise must have a sufficient amount of capital, as well as ensure the efficient use of this capital. Fund intensity is an important indicator for an enterprise, as it affects its ability to receive financial resources and develop, so a higher level of fund intensity provides the enterprise with better conditions for development. As shown in Figure 5, the efficiency of providing capital to the activities of tour operators and organizations providing booking services during 2013-2019 was stable; in 2020, we see an increase in the indicator almost twice and a return in 2021 to the value of 2019, due to the impact of the pandemic. Despite the fact that the fund intensity of travel agencies exceeds the value of the fund intensity of tour operators and organizations providing booking services, the value of the indicator decreases during 2013-2017; in 2018 and 2020, we observe an increase in the indicator almost twice and a return in 2021 to the value of 2017.

Along with political and economic instability, Ukraine is characterized by a low level of investment in the development of the tourism industry. This was the reason for the lack of infrastructure development, which led to a decrease in the overall efficiency of providing capital to activities. In general, limited access to loans and other sources of capital, and the lack of an effective state policy in Ukraine regarding the development of tourism have led to a lack of incentives for investment in this sector [1; 36].

To model the influence of factors (capital and labor costs) on the volume of products sold in the tourism industry of Ukraine, we will use the Koba-Douglas function. This function allows you to evaluate the efficiency of using production resources, as well as understand which factors of production have the greatest impact on productivity. It allows you to determine the optimal combination of factors of production, which ensures the highest level of production at minimal costs. The Koba-Douglas function is an important tool for analyzing and planning the activities of tourism organizations and developing the tourism industry.

Using formulas (1-4), the following representation of the Koba-Douglas production function for Ukrainian tourism industry entities is obtained:

- for the activities of travel agencies:
$$P = 6,2208 \times K^{0,0556} \times L^{0,9444};$$
- for the activities of tour operators:
$$P = 3,3844 \times K^{0,6366} \times L^{0,3634};$$
- to provide booking services:
$$P = 2,9751 \times K^{0,3227} \times L^{0,6772}.$$

The dynamics of capital and labor efficiency, based on the average model of development of the tourist market of Ukraine, for travel agencies, tour operators and organizations providing booking services is shown in Figures 6-8.
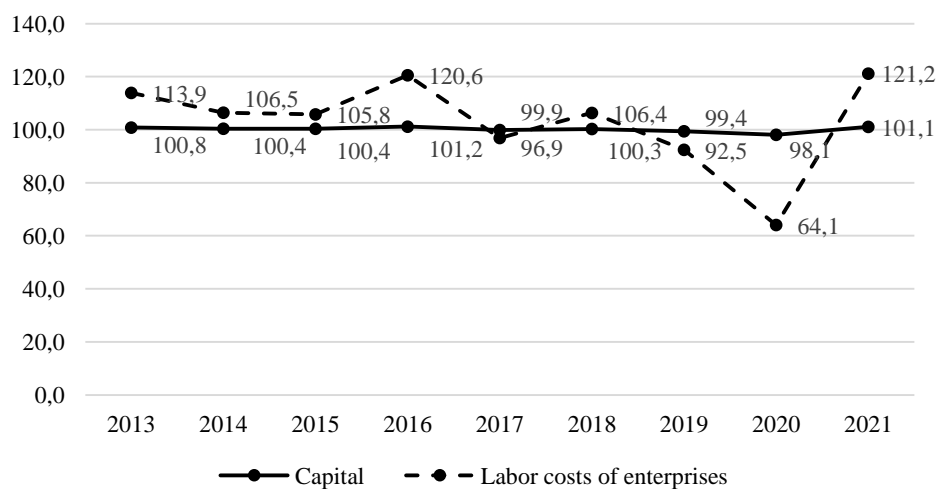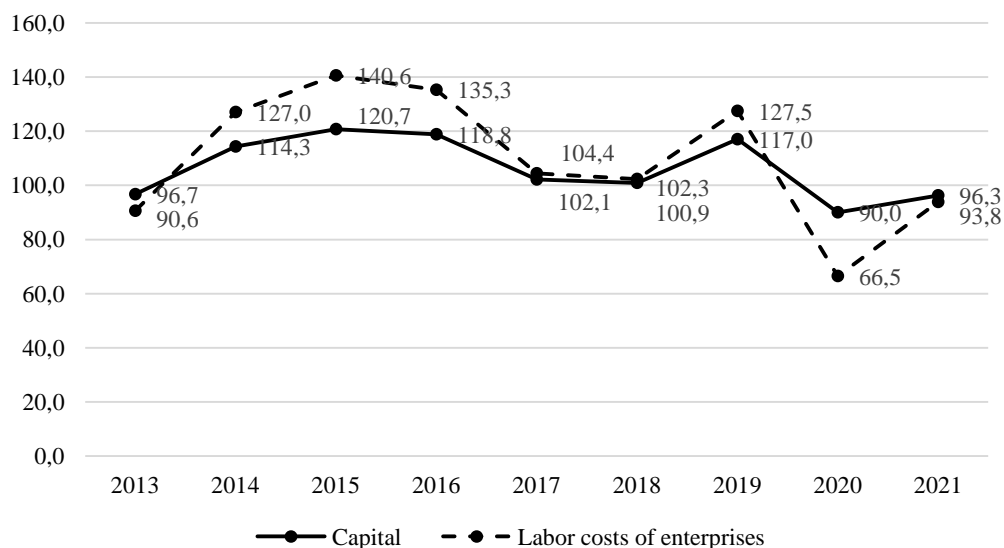

Figure 6: Dynamics of efficiency of capital and Labor use, based on the average model of development of the tourist market of Ukraine, for travel agencies
Source: compiled by the authors
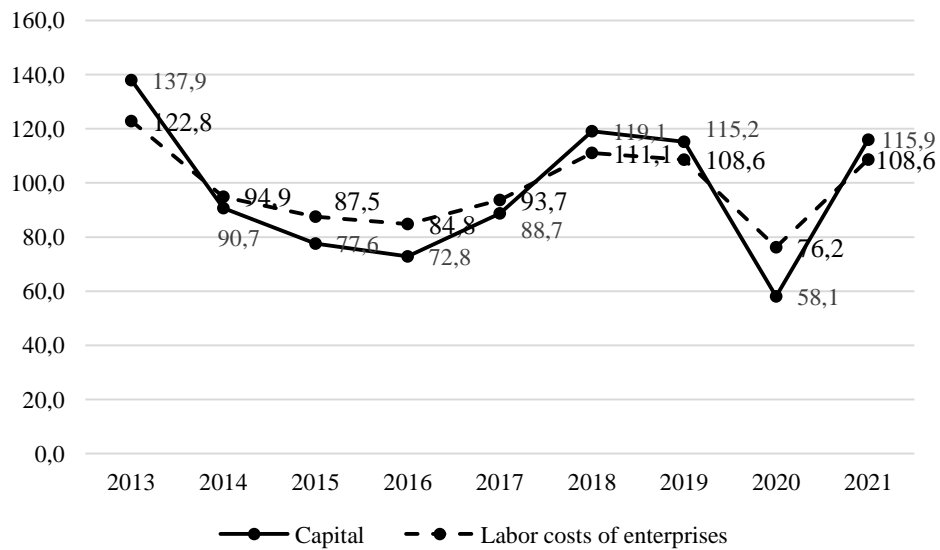
Figure 7: Dynamics of efficiency of capital and Labor use, based on the average model of development of the tourist market of Ukraine, for tour operators
Source: compiled by the authors

Figure 8: Dynamics of capital and labor efficiency, based on the average model of development of the tourist market of Ukraine, for organizations providing booking services
Source: compiled by the authors

We can conclude that for travel agencies, work with a significant advantage has a greater impact on the result than capital. For tour operators, capital has almost twice as much impact on the result as Labor. For booking service organizations, on the contrary, Labor has twice as much impact on the result as capital.

5. Conclusions

Availability of labor and capital are key factors for the success of the tourism industry, which help to ensure a high level of service and development of the tourism product. However, as the results of the study showed, for different subjects of the tourism industry, the level of influence of labor and capital on the results of their activities is different. Analysis of the dynamics of indicators that reflect

the development of the tourism industry has shown that for travel agencies and organizations providing booking services, the growth rate of labor costs exceeds the growth rate of capital, which indicates that personnel is a key resource in the development of organizations. For tour operators, on the contrary, the growth rate of labor costs is lower than the growth rate of capital, which indicates that capital is a key resource in the development of tour operators. In general, the activities of tour operators and organizations providing booking services show better results and higher growth rates than those of travel agencies.

These results are confirmed by modeling the influence of capital and labor on the volume of products sold using the Koba-Douglas production function. Models built using the Koba-Douglas function allow you to assess the efficiency of using production resources, as well as understand which factors (capital or labor) have the greatest impact on the development of the tourism industry in Ukraine. It was found that for travel agencies, work with a significant advantage has a greater impact on the result than capital. For tour operators, capital has almost twice as much impact on the result as labor. For booking service organizations, on the contrary, Labor has twice as much impact on the result as capital.

In general, we can state a tendency to increase the volume of products sold by tourism industry entities, as well as the cost of capital and labor costs, except for periods of exposure to unpredictable factors (such as the Russian invasion of Ukraine, the spread of the COVID-19 pandemic). This is confirmed by the growth of absolute and relative performance indicators of travel agencies, tour operators and organizations providing booking services.

Our research has some limitations. First, among the factors of production, the impact of which was assessed on the performance of tourist enterprises, only capital and labor costs were studied. At the same time, a number of factors are not taken into account, such as cultural and social aspects of the tourism industry, which can significantly affect the choice of tourist destinations and types of recreation. Second, the Koba-Douglas function involves a constant change in labor and capital without changing their quality. In other words, the possibility of improving the quality of Labor and capital is not taken into account, which can lead to changes in the fund intensity or productivity of enterprises. It also does not take into account possible interactions between factors of production that may affect the productivity and efficiency of the tourism industry.

The results of modeling the dependence of the development of the tourism industry in Ukraine on factors of production, such as labor and capital, play an important role for intelligent management systems. Knowing which factors of production have the greatest impact on the development of the tourism industry will allow investors and producers of travel services to focus their efforts and resources on these factors in order to ensure maximum production efficiency. Knowing which factors of production have the greatest impact on the development of the tourism industry can help managers predict what changes in these factors may lead to changes in demand for tourism services and how to develop the tourism industry in the future. The results obtained can also help determine the optimal level of resource use and ensure maximum production efficiency in the tourism industry.

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