

THE IMPACT OF RESEARCH AND DEVELOPMENT INITIATIVES ON LABOR PRODUCTIVITY IN THE TOURISM INDUSTRY BEFORE COVID-19 PANDEMIC

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Abstract. The growth of sectors in the country's economy is to some extent influenced by the ability to innovate. Tourism represents an industry with a low knowledge nature. However, tourism can potentially contribute to the effects of the innovation environment in which it exists. The paper aims to identify the relationship between investments in research and development and labour productivity in the tourism industry. The regression analysis in selected six countries of the European Union: Czech Republic, Slovak Republic, Lithuania, Austria, Croatia, Norway, and non-EU country Great Britain fulfils the objective of the contribution. The years 2013–2020 were chosen as the reference period in the available data in this post. The economic growth of tourism is to a certain extent influenced by the innovative environment in which it is located. The results of our study show a clear dependence between the level of investment in research and development and labour productivity in the tourism industry in selected countries.

Keywords: labour market, productivity, R&D, development, investment, tourism.

JEL Classification: C33, J01, O32.

1. Introduction

In the constantly evolving environment of tourism, where innovations and productivity are key to sustainable growth, the role of research and development (R&D) initiatives appears as a crucial success factor. The tourism sector, known for its resilience and adaptability, stands at the intersection of global economic forces, cultural dynamics, and technological progress. In this complex environment, organizations in this industry are forced to seek new strategies to enhance their competitiveness and manage the evolving demands of today's traveller. At the heart of these strategies is the effort to innovate through research and development initiatives, which encompass a spectrum of efforts from technological advances to improvements in service delivery (Gavurova et al., 2021). Innovations are an important part of services and contribute to the development of tourism (Aldebert et al., 2011). The complex relationship between R&D initiatives and labour productivity within the tourism industry was investigated by authors Nguyen et al. (2021), who

found that labour productivity and tourism productivity are consistently low across most developed and developing market economies. The main goal of the article is to reveal the extent to which investments in research and development contribute to efficiency, effectiveness, and overall workforce performance. Our research goes beyond the traditional parameters of productivity assessment and includes the nuances of the rapidly changing environment of tourism. Considering the impact of technological innovations, shifts in consumer expectations, and the evolving nature of travel experiences, this research attempts to capture the multifaceted dimensions of labour productivity influenced by research and development efforts (Giannakis & Mamuneas, 2022). The impact of R&D on labour efficiency may vary depending on cultural, economic, and geographical conditions (Cahuc & Debonneuil, 2004). Our research aims to make a valuable contribution to the ongoing discussion about innovations, trends in the field of work, and improving productivity in the tourism sector.

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2. Literature review

Several studies suggest that the growth in labour productivity and innovation outputs of some countries plays a key role in economic growth (Coccia, 2010; Delgado et al., 2012). The value of expenditures on research and development is one of the possible expressions of the quality level of the innovation environment (Brunswick-er, 2016). Tourism is an industry that is oriented towards locations. Research and development, abbreviated as R&D, is a critical business process that involves creating and improving products, as well as solving problems in current business practices (Davcik et al., 2021; Platon, 2017). It also includes understanding the needs and behaviour of customers in existing markets and identifying new markets. International research and development activities are a fundamental aspect of any business network and can take the form of formal research and development departments within a company, inter-functional teams among different companies in the network (Brandão et al., 2019), or informal teams and business networks focused on acquiring new market insights, certifications, production standards, and more (Davcik et al., 2021). Tourism is a sub-sector with a low level of knowledge intensity, creating the opportunity to utilize resources for innovations directly from the innovation environment (Pikkemaat & Peters, 2016). Generally, the use of open innovation systems in the tourism sector is one of the pillars of its sustainable development (Della Corte et al., 2019).

Labour productivity represents the most important indicator demonstrating its importance in tourism (Joppe & Li, 2016). This indicator is a key factor in determining the growth of living standards (Sharpe & Gharani, 2000). Approaches to calculating and determining labour productivity in tourism vary. Some authors (Drakh et al., 2021; Joppe & Li, 2016) state that labour productivity is determined by the ratio of GDP to the number of employees, or GDP to hours worked. Authors Biagi et al. (2021) confirm that labour productivity is important in the context of tourism-related strategies and smart specialization policies in EU regions. It highlights the need for regions to improve innovation capacity to enhance their competitiveness in tourism. In the tourism sector exist specific factors of innovation. Kim et al. (2020) emphasize the role of technologies such as artificial intelligence and augmented reality in personalizing experiences and optimizing operational efficiency within tourism businesses. Gössling and Hall (2021) discuss sustainable innovation strategies, including eco-certifications, renewable energy integration, and community-based tourism initiatives, as essential for mitigating negative impacts and promoting long-term sustainability. According to Gretzel et al. (2022), harnessing big data analytics and predictive modelling allows destinations and businesses to anticipate traveller preferences, optimize resource allocation, and enhance marketing effectiveness. Femenia-Serra et al. (2021) highlight the role of collaborative

innovation networks in tourism destinations, facilitating cooperation between academia, industry, government, and communities to address complex challenges and promote inclusive growth. Leask and Yeoman (2023) explore the significance of cultural innovation in tourism, which involves creative reinterpretations of heritage assets, immersive storytelling, and participatory experiences that resonate with diverse visitor interests. Hall and Jenkins (2020) emphasize the importance of policy innovation in response to emerging trends and disruptive technologies, advocating for flexible governance structures and stakeholder engagement to address evolving challenges. Prideaux et al. (2023) discuss the role of health innovation in tourism, encompassing digital health passports, contactless technologies, and enhanced sanitation measures to mitigate health risks and enhance visitor safety. Innovation in the tourism industry is influenced by changes in society, particularly the globalization processes that have given rise to a “consumer society” where customers demand new services (Romão & Nijkamp, 2019).

Several authors researched the importance and relationship of the impact of research and development investment on labour productivity in tourism. Park and Allen (2019) investigate the relationship between R&D investments, exports, and labour productivity in the U.S. hospitality industry. Tziogkidis et al. (2021) examine innovativeness in the Greek hotel industry and its implications for labour productivity. Hjalager (2020) explores the impact of innovation and R&D on tourism development. These researchers proved that there is a significant relationship between R&D investment and labour productivity. However, there is still a gap in researching what is the impact of R&D investment on labour productivity in European countries (Albaladejo & Martínez-García, 2015).

3. Methodology

This paper aims to identify the relationship between labour productivity in the tourism industry and investments in research and development in selected European Union countries. For identifying this relationship, the following European Union countries were chosen: the Czech Republic, the Slovak Republic, Lithuania, Austria, Croatia, Norway, and the United Kingdom. The selection of countries was conditioned by the availability of data on R&D investments and labour productivity in tourism. To identify the relationship between the variables, the period 2013–2018 was chosen, with a total of 42 observations in the 7 selected countries.

RQ₁: Is labour productivity in the tourism industry influenced by expenditures on research and development?

H₀: There is no statistically significant relationship between expenditures on research and development and labour productivity in the tourism sector.

H₁: There is a statistically significant relationship between expenditures on research and development and labour productivity in the tourism sector.

To achieve the objective of the paper, several scientific methods were used, primarily mathematical-statistical ones. Analysis, synthesis, and abstraction were used in the processing of literary sources. The comparison method was utilized in the results section for comparing the outcomes of the studied countries. These methods were primarily used in the data set testing in Gretl software. The data set necessary for fulfilling the paper's objective comes from the Eurostat database, mainly due to its complexity. The main parameters of the obtained data were the volume of investments in research and development and labour productivity in tourism, which was calculated as the ratio of added value to the number of employees in tourism. In the Eurostat database, the tourism sector is classified according to NaceRev. 2 in these sections: I Accommodation and food service activities, N Travel agencies and tour operators, and R Arts, entertainment, and recreation. In the methodology part was used synthesis to describe the research methods used in this paper.

In the first step, the obtained data were subjected to a normality test, which assesses whether a data set is of a normal distribution. The test, in conjunction with the null hypothesis, evaluates the normality of the data distribution. In the next step, panel regression was performed in 7 selected EU countries based on 42 observations in the respective countries. The model of panel regression used is a pooled regression model – if the individual effect is only a vector of ones, then the only parameter is a common constant:

$$y_{it} = \alpha + \beta_1 x_{it1} + \beta_2 x_{it2} + \dots + \beta_k x_{itk} + u_{it}, \quad (1)$$

where: the index i denotes the cross-sectional dimension $i = 1, \dots, n$; the index t the time dimension $t = 1, \dots, T$; variables x_1 to x_k are explanatory variables not including the unit vector; variables Z_1 to Z_q represent individual effects – diversity, by which an individual or an entire group can be distinguished from other entities – a possible vector of units is included here. Individual effects do not change over time.

The results section was processed using a synthesis of the results developed in the practical part of the

contribution. The result is the identification of key relationships between the studied parameters and the proposal for future research.

We use in comparative method, synthesis, abstraction and systematization in other parts of this research paperwork. For the visualisation of data, we use an R programme.

4. Results

The fundamental data used for conducting the study were investments in research and development (R&D) and the level of labour productivity in the tourism sector in the European Union states from 2013 to 2018. Labour productivity was defined as the ratio of added value per employee in the tourism sector, which included industries according to the NACE classification I – Accommodation and food service activities, N – Travel agencies and tour operator activities, and R – Arts, entertainment, and recreation.

As a result of some countries not providing information on R&D investments, we selected seven states for our aggregated analysis: the Czech Republic, Slovakia, Croatia, Lithuania, Austria, Norway, and the United Kingdom. The higher amount of R&D value has the United Kingdom in 2015 year, which was more than 40 000 million Euro. The lowest R&D value is Slovakia in all selected years 2013–2018. This means, that Slovakia

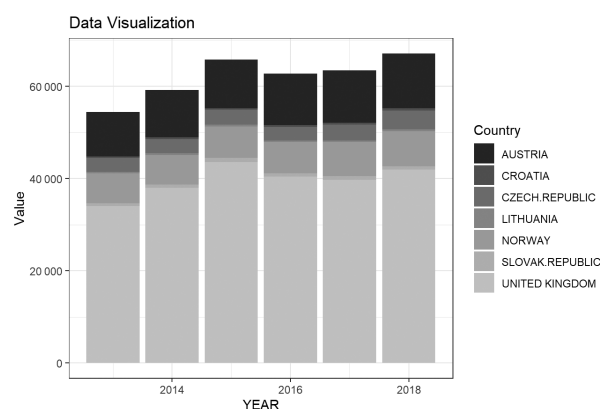


Figure 1. Czech Republic, Slovak Republic, Austria, Norway, Croatia, Lithuania, and the United Kingdom – investments in R&D (2013–2018) in million EUR (source: own processing according to Eurostat)

Table 1. Czech Republic, Slovak Republic, Austria, Norway, Croatia, Lithuania, and the United Kingdom – investments in tourism labour productivity (PP) (2013–2018) in million EUR (source: own processing according to Eurostat)

YEAR	CZECH REPUBLIC	SLOVAK REPUBLIC	AUSTRIA	NORWAY	CROATIA	LITHUANIA	UNITED KINGDOM
2013	0.01315	0.01361	0.03611	0.05901	0.01317	0.00665	0.03608
2014	0.01302	0.01206	0.03628	0.05086	0.01648	0.0073	0.03561
2015	0.01367	0.01342	0.03759	0.04443	0.01586	0.00855	0.04064
2016	0.01442	0.01037	0.04042	0.04469	0.01689	0.00967	0.04527
2017	0.01694	0.01075	0.04187	0.04319	0.01883	0.0101	0.0425
2018	0.01777	0.01134	0.04267	0.03996	0.01837	0.01243	0.04064

Table 2. Czech Republic, Slovak Republic, Austria, Norway, Croatia, Lithuania, and the United Kingdom – investments in R&D and tourism labour productivity (LP) (2013–2018) (source: own processing according to Eurostat)

YEAR	CZECH REPUBLIC R&D	CZECH REPUBLIC LP	SLOVAK REPUBLIC R&D	SLOVAK REPUBLIC LP	AUSTRIA R&D	AUSTRIA LP	NORWAY R&D	NORWAY LP	CROATIA R&D	CROATIA LP	LITHUANIA R&D	LITHUANIA LP	UNITED KINGDOM R&D	UNITED KINGDOM LP
2013	2 996,666	0,01315	610,876	0,01361	9 571,282	0,03611	6 500,596	0,05901	354,684	0,01317	332,426	0,00665	33 998,705	0,03608
2014	3 090,662	0,01302	669,632	0,01206	10 275,18	0,03628	6 447,728	0,05086	339,857	0,01648	376,827	0,0073	37 960,055	0,03561
2015	3 250,243	0,01367	927,272	0,01342	10 499,146	0,03759	6 727,586	0,04443	374,809	0,01586	389,67	0,00855	43 573,987	0,04064
2016	2 963,274	0,01442	640,835	0,01037	11 145,02	0,04042	6 818,16	0,04469	402,357	0,01689	327,612	0,00967	40 426,602	0,04527
2017	3 433,337	0,01694	748,955	0,01075	11 289,781	0,04187	7 416,769	0,04319	423,517	0,01883	378,906	0,0101	39 704,118	0,0425
2018	4 006,462	0,01777	750,947	0,01134	11 912	0,04267	7 582,923	0,03996	501,756	0,01837	426,306	0,01243	41 903,357	0,04064

does not have a lot of opportunities invest to in R&D due to a lack of innovation possibilities (e.g. see Figure 1).

The labour productivity in selected countries during 2013–2017 has been growing or was in the same high. The highest value of labour productivity in the tourism sector in 2017 was in the United Kingdom. However, the year 2013 has the highest value of labour productivity in Norway (e.g. see Table 1).

The value of labour productivity in the tourism sector (LP) does not reflect the development of investments in research and development (R&D) in the selected period (e.g. see Table 2).

It is not possible to determine the existence of a relationship between labour productivity and investments in R&D. A significant phenomenon is the decline in labour productivity in the tourism sector in the Slovak Republic in 2016. Observing the development of investments in R&D and labour productivity in tourism in Lithuania from 2013 to 2018 reveals a similar trend in the dynamics of both indicators, similar to the Czech Republic. On the other hand, the dynamics between R&D investments and labour productivity in tourism in Norway during the same period suggest the independence of these indicators. The independent relationship between these two variables is further analysed through panel regression (e.g. see Table 3).

Table 3. Summary statistics for the variable RD (investments in R&D) (source: own processing)

Mean	Median	Min.	Max.
8868,4	3170,5	327,61	43574,
Std. Dev.	C.V.	Skewness	Ex. kurtosis
13269,	1,4962	1,7697	1,6324
5% Perc.	95% Perc.	IQ range	Missing obs.
333,54	41682,	9905,6	0

For each country and the level of investments in research and development (R&D), we created a histogram that illustrates the data distribution (Figure 2).

The results suggest that investments in research and development vary among some countries, leading to a higher standard deviation than we would expect in a normal distribution (e.g. see Table 4).

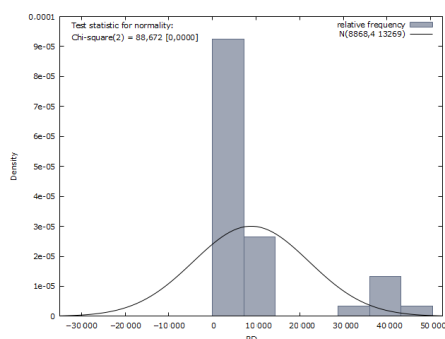


Figure 2. Histogram of the normality distribution of residuals for investments in research and development (RD) (2013–2018) (source: own processing)

Table 4. Summary statistics for the variable LP (tourism labour productivity) (source: own processing)

Mean	Median	Min.	Max.
0.025975	0.018071	0.0072976	0.059008
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.015047	0.57928	0.40127	-1.3776
5% Perc.	95% Perc.	IQ range	Missing obs.
0.0087175	0.050019	0.027830	0

In the next phase of our analysis, we examined whether the data have a normal distribution by using a normality test of the residual distribution. For each country and the data on labour productivity in tourism, we created a histogram that displays their distribution (e.g. see Figure 3).

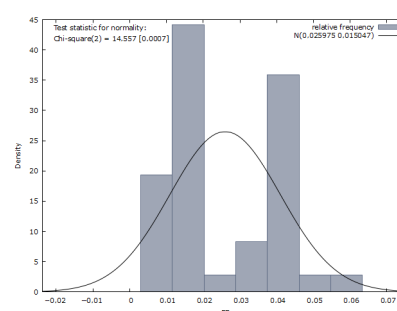


Figure 3. Histogram of the normality distribution of residuals for labour productivity (LP) (2013–2018) (source: own processing)

The data do not exhibit a normal distribution, suggesting that labour productivity in tourism varies among some countries. As a result, the standard deviation, as previously mentioned, is higher than what we would expect in the case of a normal distribution. The regression was carried out based on 42 observations, which included 7 cross-sectional units (Czech Republic, Croatia, Lithuania, Austria, Slovak Republic, Norway, United Kingdom) over 6 years (2013–2018) (e.g. see Table 5).

In this case, both coefficients appear to be statistically significant given the low p-values (<0.0001) and relatively high t-ratios. The F-statistic (23.91347) with its associated p-value (0.000017) indicates that the overall regression model is statistically significant. The Durbin-Watson statistic (0.883439) provides information about autocorrelation in the residuals. A value close to 2 suggests no significant autocorrelation. These results collectively provide insights into the relationship between the independent and dependent variables, the overall fit of the regression model, and any potential issues such as autocorrelation in the residuals. The visualisation of data from the t-ratio is provided in Figure 4.

The constant is statistically significant ($p < 0.0013$), as well as the value of investments in R&D ($p < 0.0001$). R-squared (0.374) indicates a positive relationship between investments in R&D and calculated tourism labour productivity. If R&D investments were increased by one

Table 5. Model 1: Pooled OLS using 42 observations. Including 7 cross-sectional units. Time series length = 6. Dependent variable: LP (tourism labour productivity) (source: own processing)

Coefficient	Std. Error	t-ratio	p-value	S.E. of regression	S.D. dependent var	Adjusted R-squared	Akaike criterion	Hannan-Quinn	Durbin-Watson
const	0.0198238	8.83	<0.0001						
RD	0.000000693639	4.89	<0.0001						
Mean dependent var					0.015047				
Sum squared resid						0.012052			
R-squared						0.358508			
F(1, 40)		23.91347	0.000017						
Log-likelihood							-250.0171		
Schwarz criterion								-248.7433	
rho									0.030492

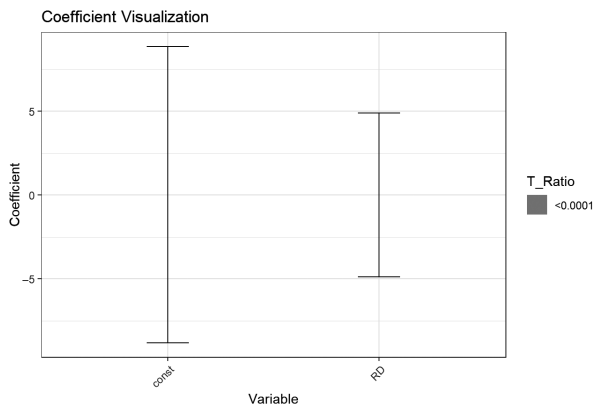


Figure 4. Visualisation of data for descriptive statistics (source: own processing)

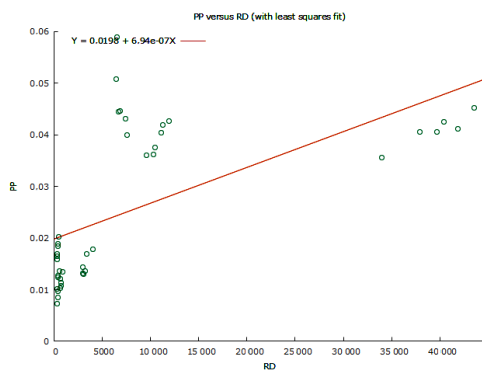


Figure 5. Regression line between investments in research and development and labour productivity in tourism in EU countries (2013–2018) (source: own processing)

unit (million EUR), tourism labour productivity would increase by $6.93639e-07$.

As evident from Figure 5, most countries confirm the existence of this relationship; however, some exceptions do not justify this relationship. A relationship between labour productivity in tourism and investments in research and development is apparent, but there is also a certain clustering in the data, suggesting the possible influence of another factor. The results of the regression analysis suggest a potential linear relationship between labour productivity in tourism and investments in R&D, as well as with another factor that could be affecting productivity. Therefore, it is important to give further attention to this research and subject it to a deeper analysis.

5. Conclusions

The results of our study indicate a relationship between the level of investments in research and development and labour productivity in the tourism industry. Therefore, we reject the null hypothesis, which states that there is no relationship between investments in research and development and labour productivity in tourism and accept the alternative hypothesis confirming the existence of this relationship. Investments in research and development help create an innovative environment from which tourism can draw synergistic benefits. It is important for entities in the

tourism sector to engage in collaboration with partner organizations to utilize and share new technologies and for knowledge transfer. Due to insufficient published information regarding the value of R&D, it was not possible to compare with other countries. In the future, it would be appropriate to compare other countries with similar parameters. Therefore, we suggest that further studies be conducted in the area of examining labour productivity and the impact of R&D investments. The findings not only inform the academic discussion but also offer practical information to industry professionals, policymakers, and stakeholders involved in the sustainable development of the tourism sector. This research aims to present a nuanced story that meaningfully contributes to the ongoing dialogue about innovation, labour dynamics, and productivity enhancement in the tourism industry.

Limitations of research

The limitations of the contribution are primarily the availability and currentness of data and information on the researched issue and the individual indicators of added value and investments in research and development. Another limitation of the contribution is the complexity of the data, as in most EU countries the data were not available, which creates a space for a narrow delimitation of the results of this contribution.

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Disclosure statement

Authors declare whether or not they have any competing financial, professional, or personal interests from other parties.

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