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Does Energy Risk Lead to Tourism Fall in Europe? Insights from Partially Linear Functional-Coefficient Model

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ABSTRACT

The study empirically assesses the non-linear effect of energy risk on tourism in the case of 28 European countries during the period of 2000-2020. To this end, the partially linear functional-coefficient model (PLFC) is employed. The findings reveal that energy risk negatively impact on tourism, validating the theoretical linkage. As control variables, economic development positively impacts on tourism, whereas government effectiveness and foreign direct investment have negative effects on tourism in Europe. The policy implications such as implementing smart energy management systems, energy decentralisation, transition to renewable energy, cooperation between the different actors and stakeholders for achieving energy efficiency are proposed.

Keywords: Energy Risk, Tourism, Europe, Partially Linear Functional-coefficient Model
JEL Classifications: Q4, Z3, C33

1. INTRODUCTION

Energy consumption has long been growing in all sectors of the world economy. The energy mix of individual countries has long been based on non-renewable energy sources, particularly fossil fuels and nuclear power. Europe has depended to a significant extent on imported energy sources. This dependence gradually deepened during the last decade. In particular, the European Union has moved towards significantly promoting renewable energy sources. As a result, the share of renewable energy sources in total European energy production has increased, reaching more than 40% by 2023. The interplay of all the factors influencing the energy market in Europe, and in particular the EU, resulted in a notable increase in energy prices during the 2020s. At the same time, prices are at significantly higher levels than in most other countries in the world. OECD (2022) identified exogenous variables impacting the tourism recovery after the pandemics, when citing particularly threats of high prices and inflation induced among other by high energy costs and oil prices.

Tourism sector and tourism industry contribute importantly to the global energy consumption (Nižić et al., 2016). Especially some services in these sectors are highly dependent on energy availability and are quite energy-intensive (Alekseeva and Hercegová, 2021). Accommodation represents such a service. The hotel sector, on the one hand, is the largest contributor to tourism employment and income, but on the other hand, it is the largest energy consumer. In fact, hotels and other types of accommodation account for 2% of the 5% global CO_2 emitted by the tourism sector (Hotel Energy, n.d.). The problem with high energy consumption and at the same time frequent problem with low energy efficiency is clearly perceived (e.g. Valente et al., 2024; Dibene-Arriola et al., 2021; López-Bernabé et al., 2021; Warren and Becken, 2017; Pace, 2016). UN Tourism initiated a project called Hotel Energy Solutions (HES, 2024) that is aimed to support small and medium enterprises in the fields of tourism and accommodation in the EU 27 to enhance their energy productivity and use renewable energy sources. The World Bank (World Bank, 2020) advises its clients to incentivize renewable energy usage as a basis for Rebuilding Tourism Competitiveness and building tourism resilience in the post-pandemic and evolving global conflict environment of this decade.

The recovery of tourism in Europe has been completed by the achievement of the volume of International Tourist Arrivals, which was realized in the last pre-census year, i.e. in 2019 (UN Tourism Barometer, 2024). While the Middle East remained the strongest-growing region, with international arrivals growing at around 30% and Africa likely to show a 10% growth in 2024 compared to 2019 results, Europe remains the number one contributor to total global tourism receipts. Historical and cultural heritage remains an important element of the attractiveness of European countries for tourism (Barna and Serea, 2017; Ismagilova et al., 2015). In addition, Europe offers a long tradition of spas and spa care. The usual basis of spa care is hydrotherapy. Medical treatments in this case are often accompanied by thermal and mineral baths with hot springs. There are also mud, sea and sun baths or climatic baths. At the same time, spa tourism is a fast-growing sector of wellness tourism (Papadopoulou, 2020). Europe is then considered a leading player in wellness tourism (Bočkus, 2023; Papadopoulou, 2020; Dimitrova, 2019). Another important tourism is winter tourism (Unbehaun et al., 2008). Gradual climate change has brought a reduction in the extent of snowfall. Together with the increasing demands of tourists, solutions were sought, which were mainly artificial snowmaking, which was initially used to extend the season. Despite technological developments that have increased the energy efficiency of artificial snowmaking (Kanping, 2013; Epstein et al., 2001) it is still a very energy intensive activity (Abermann et al., 2022; Rixen et al., 2011). Maintaining winter sports opportunities is thus very sensitive to the price of energy. Many areas and regions are then significantly economically dependent on winter tourism.

In summary, it is clear that the European tourism sector is significantly dependent on energy supply, price rises have reduced the competitiveness of European tourist destinations and potential supply fluctuations can threaten service delivery. There is therefore a need to address the level of risk associated with energy and the potential impact of individual risk situations. A number of authors have already investigated the impact of climate change requiring increased energy consumption, which includes deteriorating conditions for winter tourism and winter sports (e.g. Bausch and Gartner, 2020, Damm et al., 2017; Unbehaun et al., 2008) or rising temperatures that require cooling of monuments, increased protection of nature from fires, or increasing demands for air conditioning of spaces used for tourism and cultural events (Lucchi, 2024; Fouseki et al., 2020; Muñoz-González et al., 2016). Similarly, the energy requirements of accommodation buildings are increasing (e.g. Gössling and Lund-Durlacher, 2021; Hernández-Romero et al., 2019; Gössling, 2002).

Even though the literature covers the studies which explore the effect of various energy variables on tourism, the literature suffers from the lack of the application of energy risk as a determinant of tourism. Moreover, non-linear relation between tourism and energy variables are not explored with an advanced model such as the partially linear functional-coefficient model (PLFC). To fill in this gap of literature, the main intention of the current study is to examine the impact of energy risk on tourism in Europe, applying PLFC for non-linear analysis. Thus, the contribution of the work to the existing literature is twofold.

The rest of the paper is structured as the following: Section 2 provides literature review; Section 3 contains the description for the data and methodology; Section 4 shows empirical results; Section 5 concludes.

2. LITERATURE REVIEW

2.1. The Effect of Energy Risk on Tourism

Although understanding the notion of energy risk and how it affects other factors requires a thorough explanation, there is not yet a widely acknowledged and precise definition in the current literature. However, energy risk can be explained as a broad concept related to several aspects that can harm the stable and secure energy supply, including oil price fluctuations, infrastructure vulnerabilities, supply chain dependencies, natural disasters, wars and market fluctuations (Lu et al., 2014). It is also helpful to understand the concept of energy security defined by Azzuni and Breyer (2018) as a property (measurement, circumstance, or status) that enables the corresponding system to operate optimally, sustainably, and risk-free in all respects. As in other fields, energy risk is one of the most important factors for tourism development. In this case, not only price fluctuations but also political changes in the regions seriously affect the tourist infrastructure, the attractiveness of the destination and the quality of services. According to WEF (2024), the negative consequences of the Russian-Ukrainian war on the energy supply of European countries led to an increase in the price of tourist services, resulting in a decrease in the number of visitors. Moreover, Wang and Xi (2023) argue that the carbon tax, which is used as an environmental protection measure, negatively impacts the tourism sector, causing a growth in the price of tourist services, especially for long-distance and international trips. According to Hu (2022), energy policy decisions and geopolitical disputes cause the growth of energy prices, especially oil and gas prices, and ultimately the price of tourist services will increase. Similarly, due to the high importance of air transport in visiting the Canary Islands, the increase in fuel prices causes the destination to lose in attracting tourists and in competition with other destinations by increasing the cost of tourist services (Pescador, 2013). Thus, the negative effect of energy risk on tourism is postulated.

2.2. The Effect of Economic Development, Government Effectiveness and Foreign Direct Investment on Tourism

Understanding how the economic growth of countries influences tourism is also crucial while several scholars (e.g. El Menyari, 2021; Ozturk and Maryam, 2021; Selimi et al., 2017; Gricar et al., 2023; Ozturk et al., 2022) mentioned the potential contribution of tourism to the economy. Analysing the economy of Slovenia, Gricar et al. (2023) concluded that the economic growth of the country contributes greatly to the development of the tourism sector. Also, Zhang and Zhang (2021) concluded that China's tourism development depends on the country's economic progress which may ensure the growth of tourism by providing modern infrastructure and auxiliary facilities. However, both economic and tourism development may lead to a growth in energy risk and environmental problems by increasing energy consumption and CO_2 emissions (Ozturk et al., 2022; Gricar et al., 2023). Therefore, many countries try to reduce their environmental damage and avoid the negative consequences of energy risk by diversifying energy imports and using alternative energy sources. In particular, the fact that European countries such as Sweden, Denmark, and Finland ranked at the top of the energy transition index according to the results of 2024 (WEF, 2024) shows their special attention to the use of renewable energies (e.g. solar and wind energy) to decrease the energy risk. Besides, Papagiannakis et al., (2024) found using green technologies is effective in reducing energy risk. Green hotels in Croatia, for example, positively influence sustainability, but most tourists are not in favour of purchasing tourism services at high prices caused by it (Floričić, 2020). However, Patwary et al. (2023) concluded that tourists have a positive attitude towards green hotels in Malaysia and such hotels contribute to protecting the environment, especially in saving water and energy. When countries are economically developed, they can afford to implement the above-mentioned reforms and ultimately develop all sectors, including tourism.

The national government directs tourism, while local government manages tourism operations and collaborates with businesses and residents to deliver services and address issues (Pang et al., 2024) Tourism tax policies influence incoming tourism demand. Therefore, the efficiency of contemporary fiscal policies is a matter of concern for interesting international tourists (Adedoyin et al., 2023). Political stability and the absence of violence/terrorism, which are important dimensions of governance, as well as government effectiveness, have statistically significant positive effects on tourism demand (Topcu et al., 2023). The effect of governance on the tourism-led growth hypothesis, via an interaction term between institutional quality and tourist arrivals, was observed to invert the impact of tourism on growth from positive to negative in both high-income and tourism-reliant nations (Adedoyin et al., 2022). Improvements in the governance index correlate with elevated average levels of total tourism output (Detotto et al., 2021). Representatives of governmental institutions and organizations effectively assess the financial impact of publicly funded programs on the tourism sector. Municipal government entities can implement the proposed strategy for sustainable planning and development in tourism (Plzakova, 2022). The air routes positively influence inbound tourism demand from long-haul markets, but they are insignificant for short-haul markets. In light of the ongoing post-pandemic difficulties, analyzing the impact of air routes on tourism demand could be integrated into destination management initiatives (Tang et al., 2023).

It is crucial to investigate the negative influence of FDI on tourism development though the advantages of FDI have been emphasised by some scientists (e.g. Sokhanvar and Jenkins, 2022; Jena et al., 2022; Adeola et al., 2020; Fauzel, 2020; Widiatedja, 2019; Selimi et al., 2017). For example, Sharif et al. (2019) argue that excessive involvement of FDI in tourism development may make the economy dependent on foreign countries and negatively affect the success of local business entities. Mainly aiming to make a profit, foreign investors may not value the interests of local citizens and the environment, which increases risks such as the waste of the country's natural resources, damage to the ecology, and the disappearance of local customs (Malik and Latif, 2021). Dwyer (2022) listed some negative impacts of FDI on tourism: (1) Due to the tax, financial and other favourable conditions created for foreign investors, domestic investors' opportunities are limited and their incomes are reduced. (2) To meet the standards of developed countries, FDIs are mainly spent on imported goods and the amount of net foreign exchange receipts is reduced. (3) Due to the increased import of tourism outsourcing services from developed countries, wages of local workers will decrease and unemployment will increase. (4) results in a loss of democracy and public control over intergovernmental negotiations and rule-making in return for reducing the share of local governance. Moreover, by analyzing the role of attracting FDI to global hotel brands, Radić (2022) mentioned the loss of domestic ownership as the negative effect of FDI on Croatian tourism.

3. DATA AND METHODOLOGY

3.1. Data

The study for the first time empirically explores the effect of energy risk on European tourism sector during the period of 2000-2020, employing annual data of 28 countries[1]. The work applies two dependent variables: tourism receipts, measured in US dollars; tourist numbers, measured as number of arrivals. The core independent variable is energy risk, measured in score. Moreover, economic development, measured in GDP per capita in US dollars, government effectiveness, measured in index, and foreign direct investment, measured as percentage of GDP, are used as control variables (Table 1).

The data of energy risk is downloaded from Refinitive[2], whereas all other data including tourism receipts, tourism numbers, per capita GDP, government effectiveness and foreign direct investment are obtained from World Bank website.

According to the descriptive statistics given in Table 2, tourism receipts are counted as 11.600 billion US dollars on average per European country. Moreover, 25.900 million international tourists averagely visited each European country. Energy risk score is 43.578 on average. Gross domestic product per capita is 33685.62 US dollars on average. The index of government effectiveness is 1.65. Foreign direct investment is averagely counted as 8.742% of GDP.

1. List of countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, Switzerland
2. Refinitive was accessed by Prof. Massimiliano Caporin, University of Padova, Italy. massimiliano.caporin@unipd.it

Table 1: Prescription of the studied variables

Variable types	Notation	Name	Definition	LOG transformation	Data source
Dependent variables	TR	Tourism receipts	International tourism, receipts (current US$)	LOGTR	World Bank Data
	TN	Tourist numbers	International tourism, number of arrivals	LOGTN	World Bank Data
Core independent variable	ENRISK	Energy risk	Energy Risk Score	LOGENRISK	Refinitive
Control variables	PGDP	Economic development	GDP per capita (current US$)	LOGPGDP	World Bank Data
	GEF	Government effectiveness	Government Effectiveness: Estimate. The higher the index is, the more effective government.	-	World Bank Data
	FDI	Foreign direct investment	Foreign direct investment, net inflows (% of GDP)	-	World Bank Data

The missing values of TR, TN, GEF and FDI are interpolated

Table 2: Descriptive statistics

Variable	Observation	Mean	Minimum	Maximum
TR	588	1.16e+10	1.53e+08	7.25e+10
TN	588	2.59e+07	315000	2.18e+08
ENRISK	588	43.578	15.14	93.962
PGDP	588	33685.62	1621.26	123679
GEF	588	1.165	-0.363	2.347
FDI	588	8.742	-117.375	279.361

For the data of tourism receipts, tourist numbers, energy risk and economic development the logarithmic transformation is applied. Converting data into logarithm allows to compress the size range of the original data, thus the scale of the data is changed. Converting reduces the data variability. Consequently, the extreme values' influence are weakened. Government effectiveness and foreign direct investment cannot be transformed into natural logarithm since the former contains negative values whereas the latter is already given in percentage.

VIF (variance inflation factor) test is employed to analyze if the multicollinearity exists or not among the studied variables in the linear regression model. VIF test examines the correlation degree between a variable and other variable by deriving the VIF value for each one. If VIF value is large, it means the collinearity is strong. Due to the rules of econometrics, the collinearity is considered as low if the VIF value does not exceed 10. In the case of this work, the values of VIF given to all variables and the mean value of VIF do not exceed 10, thus validating that the multicollinearity does not exist (Table 3).

Furthermore, the multiple linear regression model should satisfy the homoscedasticity assumption. Sometimes, this assumption is distorted, however. The current study employs White test to check heteroscedasticity. The null hypothesis for that test means the absence of heteroscedasticity, thus rejection of the null hypothesis leads to the assumption of heteroscedasticity. In this work, White test's results represent that the employed variables suffer from heteroscedasticity (Table 4).

3.2. Methodology

To empirically analyse the association among tourism, energy risk, economic development, government effectiveness and foreign direct investment, the representation of the baseline model can be expressed as:

Table 3: Multicollinearity test

Variable	VIF	1/VIF
LOGPGDP	2.88	0.346
GEF	2.88	0.347
LOGENRISK	1.14	0.876
FDI	1.10	0.906
Mean VIF	2.00	

Table 4: White's test

Dependent variable: LOGTR	Dependent variable: LOGTN
P-value of Chi-square	
0.000	0.000

***P<0.01

$$LOGTR_{it} = a_0 + a_1\, LOGENRISK_{it} + a_2\, LOGPGDP_{it} + a_3\, GEF_{it} + a_4\, FDI_{it} + \varepsilon_{it} \quad (1)$$

$$LOGTN_{it} = b_0 + b_1\, LOGENRISK_{it} + b_2\, LOGPGDP_{it} + b_3\, GEF_{it} + b_4\, FDI_{it} + \delta_{it} \quad (2)$$

Where a_j and b_j denote the coefficients for LOGENRISK, LOGPGDP, GEF and FDI respectively, a_0 and b_0 represent the intercepts, and ε and δ are the error terms for country i and time t.

Specification given in Equation (1) and (2) represent Pooled Ordinary Least Squares (POLS). In reality, the relationship between tourism and energy risk is affected by economic fluctuations caused by wars, natural disasters, climate change, financial crisis and pandemics. This kind of turbulences distort the assumption of POLS based on linearity. In literature, the interest to explore the non-linear analysis between tourism and energy variables has been growing recently. More specifically, Buallay et al. (2021) suggest that the relationship between ESG performance, which covers energy factor, and tourism firm's profitability and valuation is nonlinear. Wu et al. (2024) use decoupling approach for tourism and energy consumption, and find the non-linear effect.

Given the evidence of non-linearity of the relation between tourism and energy risk, the partially linear functional-coefficient model (PLFC) with fixed effects (Zhang and Zhou, 2021) is employed whose specification is represented as:

$$LOGTR_{it} = h(LOGPGDP_{it})LOGENRISK_{it} + X'_{it}\beta + \gamma_i + u_{it} \quad (3)$$

$$LOGTN_{it} = h(LOGPGDP_{it})LOGENRISK_{it} + X'_{it}\beta + \gamma_i + u_{it} \quad (4)$$

Where h($LOGPGDP_{it}$), h(GEF_{it}) and h(FDI_{it}) are the unknown functional coefficient, which measures the marginal effect of energy risk on tourism. It is assumed that the functional coefficient h is affected by $LOGPGDP_{it}$, capturing the varying impact of energy diversification on energy risk. More specifically, In their studies, Nepal et al. (2021), Subramaniam et al. (2023) and Zhang et al. (2023) incorporate economic development as a determinant of energy security and find that economic development ensures energy security. Thus, it can be assumed that economic development reduces energy risk, because energy risk is an opposite side of energy security.

Therefore, it is presumed that the nonlinear impact of energy energy risk on tourism is mainly driven by economic development. X_{it} is a $p \times 1$ vector of explanatory variables assumed to have an invariant impact on tourism. γ_i shows unobserved heterogeneity, and the error term is denoted by u_{it}.

The semi-parametric structure of the model allows for a flexible relationship between tourism and energy risk. This modeling approach is advantageous for capturing nonlinearity of energy risk caused by the complex international situation (Ma et al., 2024), and heterogeneous effects in panel data settings, making it suitable for analyzing the effect of energy risk on tourism under varying economic conditions, government effectiveness and foreign direct investment.

The estimation of the model involves estimation of the unknown functional coefficient $G(LOGPGDP_{it})$. The nonlinear part of the regression is modelled as the linear combination of sieve basis functions. The sieve method approximates the functional coefficients using a set of basis functions that can increase in number as the sample size grows and it is preferred for its computational efficiency (Du et al., 2020).

In the estimation let $h_L(\cdot) = [h_1(\cdot), h_2(\cdot).,h_L(\cdot)]'$ be basis functions with L degree. Then the basis functions can be approximated as $h_k(\cdot) \approx h_L(\cdot)'c_k$ for $k = 1,2,3,\ldots,p_d$ where c_k is the coefficient of the sieve basis functions. In our model, the basis functions can be expressed in a more compact form as $h_{it} = h(LOGPGDP_{it})$. After these algebraic simplifications the model in Equation (3-8) can be rewritten as:

$$LOGTR_{it} = h_{it} LOGENRISK_{it} + X'_{it}\beta + \gamma_i + u_{it} \quad (9)$$

$$LOGTN_{it} = h_{it} LOGENRISK_{it} + X'_{it}\beta + \gamma_i + u_{it} \quad (10)$$

Where $v_{it} = u_{it} + \epsilon_{it}$ and ϵ_{it} is known as the sieve approximation error. Equation (9-10) transforms the functional coefficient model into a linear dynamic panel data model as the time dimension T and cross-sections N rise.

The estimation is undertaken by implementing a two-stage least squares (2SLS) approach using the sieve method to approximate the nonparametric components (Baltagi and Li, 2002; Chen, 2007). In the first stage a reduced form equation for the endogenous regressors is estimated using sieve approximation. In practice, several sieve methods exist for the approximation of the unknown functions. In this study, B-splines are preferred among the alternative functions because of their piecewise polynomial functions that are widely used for approximating unknown functions. They are known for their flexibility and computational efficiency, as highlighted by Du et al. (2020) and Libois and Verardi (2013). In the second stage the structural equation in (9-10) is estimated with OLS using sieve approximations obtained from the first stage. Further details on the estimation and implementation of PFLC can be found in Du et al. (2020).

4. EMPIRICAL RESULTS

4.1. Baseline Results

4.1.1. Cross-sectional dependence test

As an initial step, the cross-sectional dependence test is applied. The results of the cross-sectional dependence test allow to decide which generation unit root and cointegration tests should be run. The results are provided in Table 5. Since the P-values of all the tests are statistically significant at 1% level, the presence of the cross-sectional dependence is confirmed.

4.1.2. Second generation unit root

As long as the cross-sectional dependence exists among the residuals, second generation unit root test should be performed to check stationarity of the employed variables. Therefore, CIPS unit root (Pesaran, 2007) test is run. The results are given in Table 6. According to the results, the variables have mixed stationary at level. However, they all become stationary when the first differences are applied.

4.1.3. Second generation cointegration test

Since there is a cross-sectional dependence among the residuals (Table 5), and the variables are stationary at the first differences (Table 6), the second generation cointegration test must be run. To this end, Westerlund (2007) cointegration test is conducted. The results are shown in Table 7. Due to the results of Westerlund cointegration test, there is cointegrating relation among the variables. This motivates to proceed with the model estimations.

4.1.4. Linear effects

The estimations performed by POLS method show that energy risk negatively impacts tourism in Europe (Table 8). This result is consistent with the results of studies such as Poutakidou and Menegaki (2023), Moore (2019), and Usman et al. (2020). In particular, Poutakidou and Menegaki (2023) concluded that high energy prices will increase tourism-related costs and negatively affect tourists' intention to travel. Similarly, Moore (2019) noted that energy supply problems raise tourism costs and delay its development. To be more precise, hotels are suffering from

Table 5: CD test

Test	Dependent variable LOGTR		Dependent variable LOGTN	
	Statistic	P-value	Statistic	P-value
LM	1830	0.000	2300	0.000
LM adj*	107.2	0.000	143.1	0.000
LM CD*	25.82	0.000	37.43	0.000

***P<0.01

Table 6: CIPS unit root

Variables	Level	1st difference
LOGTR	−1.949	−3.121***
LOGTN	−2.301**	−3.322***
LOGENRISK	−1.560	−3.154***
LOGPGDP	−1.429	−3.158***
GEF	−1.959	−4.293***
FDI	−2.925***	−5.101***

***P<0.01, **P<0.05

Table 7: Westerlund cointegration test

Statistical measure	Dependent variable LOGTR		Dependent variable LOGTN	
	Statistic	P-value	Statistic	P-value
Variance ratio	−2.224	0.013	−1.724	0.042

**P<0.05

Table 8: The estimations performed by POLS

	Dependent variable: LOGTR	Dependent variable: LOGTN
	Model 1	Model 2
Variables		
LOGENRISK	−0.513***	0.182
LOGPGDP	1.030***	0.226**
GEF	−0.558***	−1.000***
FDI	−0.005***	−0.005***
Constant	14.669***	14.466***
F-statistics	61.80***	27.59***

***P<0.01, **P<0.05

some issues related to increased operating costs and equipment damage caused by power outages. As a solution, the authors noted that energy risk problems can be reduced by employing diesel generators, as well as solar energy. Usman et al. (2020) found that a rise in energy prices can increase tourism costs. In particular, this problem has led to an increase in service prices in hotels and restaurants. As a result, the destination will lose in terms of price competitiveness. In short, energy risks negatively impact economic stability in the tourism sector, which negatively influences tourists' travel intentions. It confirms that effective energy management and pricing policies are essential for the development of the sector.

4.1.4.1. Economic development has a positive effect on tourism

This aligns with Fauzel and Tandrayen-Ragoobur's (2023) study, which states that economic growth contributes to the development of sustainable tourism, along with all other sectors. Besides, it helps to decrease CO_2 emissions and solve ecological problems. The better the sustainable development of a country, the higher the development of tourism in the country (Fauzel and Tandrayen-Ragoobur, 2023). This result of our study is also coherent with the study of Kharatyan and Tigranyan (2021) which concludes that the economic growth of a country advances existing infrastructure, attracts innovation, and contributes to the development of tourism. In particular, modern infrastructure conditions increase the quality of tourism services meanwhile tourism also contributes to the development of the country's economy by attracting investments and creating new jobs (Fauzel and Tandrayen-Ragoobur, 2023). However, according to Safaa et al. (2023), every country should implement measures to reduce the impact of tourism on the environment by developing sustainable tourism and solving environmental problems. To achieve this goal, the country must develop economically, and create good infrastructure and service conditions for tourism. In general, economic growth is of great importance for countries in terms of reducing unemployment by creating new jobs, improving the standard of living with increasing incomes of the population and attracting investments in the tourism sector.

4.1.4.2. Government effectiveness negatively affects tourism

This result is consistent with the findings of Zhang and Zhang (2018), which suggest that government fiscal policies may have a negative impact on tourism development. Carbon taxes, in particular, increase the cost of tourism services, which in turn reduces tourism demand. Interestingly, according to Kristjansdottir (2021), countries can use value-added tax as a macroeconomic tool in their strategies to provide the appropriate infrastructure conditions to meet the needs of visiting tourists. According to the research, value-added tax does not reduce the attractiveness of a destination but rather helps to provide it with modern infrastructure and does not negatively affect tourism development. Similarly, according to Nugraha et al. (2024), government and community participation are important in developing sustainable tourism. Therefore, strategic policies related to natural resource management, environmental protection, and increasing local community participation are important in providing an enabling environment for the development of ecotourism. Also, supporting local government initiatives to accelerate sustainable tourism development is important to encourage community participation.

4.1.4.3. Foreign direct investment has a negative effect on tourism

This result is opposite to the findings of Qamruzzaman (2023), who concluded that FDI has a positive impact on tourism activity in the economy.

Because, according to his research, FDI enables host countries to connect to tourism networks around the world, which increases the number of visitors to the country and the amount of revenues earned from tourism-related activities. Similarly, according to Nguyen et al. (2024), FDI brings innovative knowledge and technology to the country and contributes to the development of local enterprises. Therefore, FDI has a positive impact on the economic development of the country (Ngoc and Xuan, 2024; Nguyen et al., 2024). However, the increase in CO_2 emissions resulting from the introduction of technologies through FDI and rapid urbanization damages the country's ecology and negatively impacts the economy (Fauzel and Tandrayen-Ragoobur, 2023; Ngoc and Xuan, 2024). Thus, when attracting FDI, smart cities try to reduce environmental damage and achieve economic growth through sustainable urbanization, the utilization of renewable energy sources, and green technologies. Meanwhile, smart cities create digital infrastructure conditions and increase the investment attractiveness of smart tourism destinations. Because modern infrastructure conditions improve communication with foreign investors and help attract foreign investment to the destination (Matyusupov et al., 2024). Likewise, according to Qamruzzaman (2023), the use of renewable energy sources can improve the environmental condition of tourist destinations and help reduce energy costs for tourism businesses. Besides, FDI contributes to the employment of local people by creating new jobs (Alfalih, 2024; Nguyen et al., 2024). However, according to Xiong et al. (2022), investors who come to the country to reduce their costs will leave the country due to the increase in the minimum wage in the country, which causes a rise in their labour expenses. This trend may negatively impact tourism, along with all other fields. Therefore, when attracting FDI, countries should critically and adequately evaluate their negative consequences and implement measures that will make this process beneficial to the country.

4.2. Main Results: Non-linear Effect

OLS method yields an average effect. Since the relationship between tourism and energy risk is assumed to be non-linear, the partially linear functional-coefficient model is employed.

Figure 1: Marginal effect of energy risk on tourism receipt: LOGPGDP is in the function of LOGENRISK

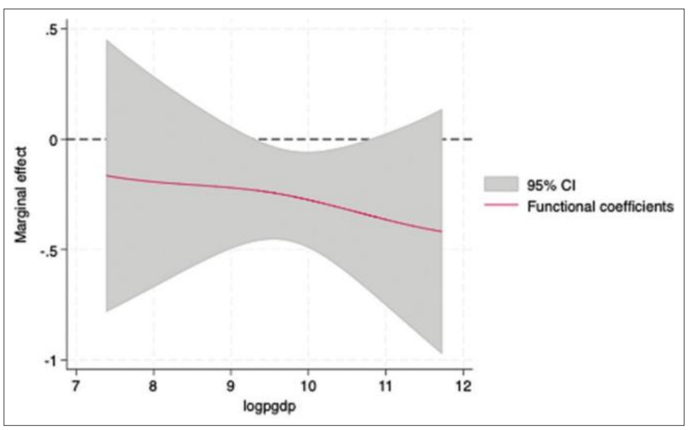
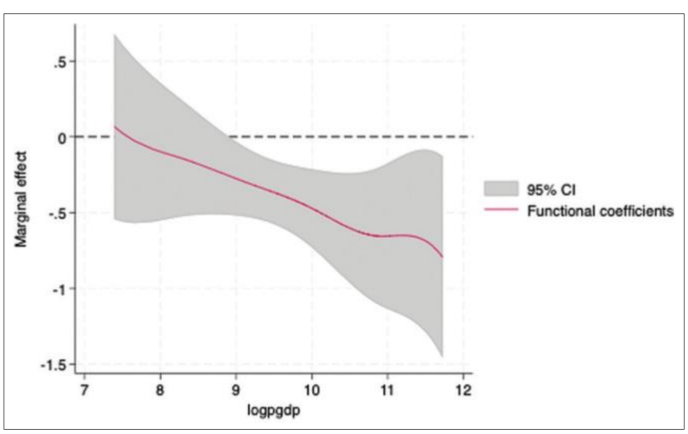


Figure 2: Marginal effect of energy risk on tourist numbers: LOGPGDP is in the function of LOGENRISK



The advantage of PLFC model is that functional coefficients are estimated, allowing a more intuitive portrayal of the impact of the degree of energy risk on tourism. Unlike other previous studies which obtained non-linear impacts, the new dimensions are added in the current work. Energy risk depends on the economic development stage, government effectiveness and foreign direct investment, therefore per capita GDP, government effectiveness and foreign direct investment are used in the function of energy risk.

The results of non-linear coefficients are presented in Figures 1 and 2. In Figure 1 and 2, the abscissa is LOGPGDP, and the ordinate is marginal effect of LOGENRISK ON LOGTR and LOGTN respectively. Figure 1 and 2 show that energy risk hinders tourism, both receipts and arrivals. It should be noted that marginal effect of energy risk on tourism outcomes is increasing negative. The growth in economic development does not help to mitigate energy risk's effect on tourism in Europe.

5. CONCLUSION

Current work performs an analysis to assess the effect of energy risk on tourism in Europe using the partially linear functional-coefficient model spanning the period from 2000 to 2020. The analysis presented here confirms that energy risk limits tourism and has a negative impact on tourism receipts. Therefore, with the persistence of energy risk, the usual contribution of tourism to individual national economies cannot be relied upon. The current situation in Europe, where energy risk is of several kinds, is complicated. The energy risk certainly lies in the dependence on imported energy sources, especially if the source or transit countries are located in politically unstable areas. This risk then causes price volatility to some extent. The energy mix affected by the green deal policy (European Union) or even a complete energy transition such as the German Energiewende is also problematic in some respects. The latter concept represents a fundamental transformation system from fossil fuels and nuclear power to renewable energy. However, the latter runs up against the limits of renewable sources, particularly in the case of electricity. Here, these sources are not always able to ensure a continuous stable supply of energy and, consequently, they face technological limits that do not yet allow surplus production to be stored efficiently. An important observation is that the negative impact of energy risk on tourism persists even when energy risk is related to the level of economic development and the level of economic growth. This does not confirm the reasoning of some decision-makers that it may be appropriate to promote more tourism as a contributor to GDP to compensate for the shortfall in industrial output. These decision-makers are based on the idea that European energy-intensive industry consumes significantly more energy to generate the same contribution to GDP than tourism.

Policy makers and decision-makers in the field of tourism management in Europe have to take into account the persistent energy risk in view of the current situation and the future outlook. This means both the risk of energy scarcity and the persistence of high prices that negatively affect the competitiveness of European tourism. Policy makers should definitely engage in the consideration of energy decentralisation and support technological developments in smart energy management. In the case of electricity, the situation calls for methodologies to strengthen the deployment of renewable energy generation on-site at tourism services or tourism attractions. In the case of functional destination management, it will also be appropriate to set up methodologies and promote cooperation between the different actors and stakeholders in finding and providing appropriate energy solutions. In the case of transport, it is necessary to promote efficiency improvements within integrated transport systems.

An important finding for theory is the conclusion that while economic development has a positive effect on tourism, the negative effect of energy risk on tourism persists even when energy risk depends on economic development. This conclusion should be confirmed by further studies, not only in European countries but also outside Europe. It is also important to look for ways to reduce the energy intensity of tourism and related services and to seek technological solutions for the increasing use of renewable energy sources.

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