ENERGY USE, ECONOMIC GROWTH, TOURISM ON CO2 EMISSIONS: SPATIAL ANALYSIS

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***Abstract** -- High environmental pollution and increasing development in several industrial sectors, such as the tourism industry, are used as one of the drivers of the economy in a country, but this raises problems, namely as one of the causes of increasing global CO2 emissions. There is an increase in CO2 emissions, and this occurs due to the use of energy, one of which is transportation. Therefore this research was conducted to analyze the spatial autocorrelation between energy use, economic growth, tourism and CO2 emissions. Using cross-sectional data from 51 countries that have joined the Organization of Islamic Cooperation (OIC) in 2021. The results show that there is a significant and positive spatial dependence between CO2 emissions between these countries which tend to have a clustering pattern. Then the Spatial Error Model (SEM) regression results show that spatially the variables of energy use, economic growth and tourism have a significantly positive effect on CO2 emission variables. Based on this research's results, several proposed policy implications exist to improve environmental quality.*

Keywords : energy, economic growth, tourism, spatial

I. INTRODUCTIONS

Climate and environmental pollution are global problems that are challenging for every country to overcome. In 2022, the global CO2 emission value was recorded at 36.8 gigatons. This indicates that there is an increase of 0.5 gigatonnes from 2021. The increase in the value of CO2 emissions occurs due to an increase in energy combustion and industrial activities globally (*Databoks*). A country usually carries out these activities to encourage its economic growth. Namely, with increasing industrial growth, a country will get an income that will help increase the country's income. However, in their implementation, these industries consume energy. Therefore, in the long term, energy consumption and economic growth will increase the value of CO2 emissions, which will have a negative impact on the environment (Alshehry & Belloumi, 2015). The increase in income, accompanied by an increase in the value of a country's CO2 emissions, is an initial stage to increase the country's economic growth. The trend will reverse when the country reaches a peak in income level, known as the EKC hypothesis (Environment Kuznets Curve) (Jun et al., 2021).

Economic growth in a country can be seen from the country's GDP (gross domestic product). One of the economic sectors that contributes to the value of GDP is the tourism industry. In addition to contributing to the value of GDP, this industry is estimated by UNWTO to contribute to the value of CO_2 emissions, where there will be an increase from 2005 to 2035 by 130% (Scott, 2008). The high number of estimates is due to developments in various industrial sectors, one of which is the tourism industry, which is currently one of the economic sectors experiencing rapid development in the world. This development can be seen by UNWTO, which stated that the global tourism industry began to recover in 2021 after the outbreak of the Covid-19 disease. In contrast, in 2020, the outbreak decreased the tourism industry's contribution to GDP by 4.9 trillion. In 2021, the tourism industry began to recover, contributing to a GDP of 1 trillion from a decrease of 70%, and it continued to increase to 28% in July 2022 (Simpson, 2022). This shows that developments in the global tourism industry impact economic growth (Fatai et al., 2020).

In the long run, the tourism industry also positively impacts economic growth (Indriana, 2022). Where the tourism industry provided job opportunities in 2021, which is 289 million (Simpson, 2022), this is what makes the tourism industry important in a country's economic growth. Therefore, several countries are developing the tourism industry. The OIC (Organization of Islamic Cooperation) is one of the organizations where several members of the country are developing the tourism industry. Pakistan is a country that joins the OIC and has succeeded in developing the tourism industry, which includes cultural, religious, and religious elements in its tourism industry and positively impacts tourism growth in Pakistan (Aman et al., 2019). Then there is Saudi Arabia which makes Hajj and Umrah halal tourism, which positively impacts economic growth. However, the spending made by pilgrims makes energy consumption in the region, which increases the value of CO_2 emissions in the country (Ozturk et al., 2022).

The development of the tourism industry in a country causes an increase in the consumption of energy used. It will cause environmental pollution through CO_2 emissions (Shi et al., 2020). This issue is because visits made by both domestic and international visitors will cause demand for transportation and accommodation, housing and infrastructure services such as hotels, restaurants, and roads, as well as changes in land use (Paramati et al., 2018). These things cause increased energy consumption, increasing the value of CO_2 emissions in a region. This issue is supported by Mahmudul Alam, whose research results reveal that the growth of the tourism industry has a positive and significant effect on CO_2 emissions in Malaysia, Thailand, and Singapore (Azam et al., 2018).

However, in their research, there are different opinions when Lee and Brahmarene stated that a well-managed tourism industry could reduce CO_2 emissions in the region (Lee & Brahmasrene, 2013). And research conducted by Najid and Xuejiao, where the results of their research revealed that the tourism industry hurts CO_2 emissions so that it can reduce pollution. This issue is because the increasing tourism industry in Singapore, Hong Kong, and South Korea makes the country continue to carry out environmental renewal by using renewable energy (Ahmad & Ma, 2022). This presentation shows that CO_2 emission conditions in one country can affect CO_2 emission conditions and the environment in other countries. Therefore, CO_2 emissions have spatial linkages between regions. Therefore, researchers will analyze the influence of the tourism industry, energy use and economic growth on CO_2 emissions in OIC countries with an econometric spatial approach.

II. LITERATURE REVIEW

This section will briefly discuss empirical studies related to economic growth, tourism, energy use, and CO_2 emissions, as follows:

Economic Growth, Tourism, Energy Use with CO_2 Emissions

Economic growth is a long-term problem in a country that is achieving a better state in a certain period. Economic growth is closely related to the state's increased production capacity, interpreted as national income (Ernita et al., 2013). Measure the economic growth of a country, which can be seen from the national income of a country, namely GDP (Sukirno, 2012). Some countries increase the value of the country's GDP by carrying out developments in the industrial sector, one of which is the tourism industry, where the more visitors who make purchases or transactions will increase the income of the regions. Indonesia is one of the countries where the tourism industry contributes to its economic growth, but in addition to having a positive impact, the development of the tourism industry has led to the depletion of natural resources in Indonesia (Moslehpour et al., 2023).

Environmental damage occurs due to visitor activities that cause an increase in energy consumption, such as transportation and space services, so there is a change in land functions that become buildings, such as hotels (Paramati et al., 2018). This activity can trigger an increase in CO2 emissions in an area. If the country uses non-renewable energy, it will cause environmental pollution (Le et al., 2020). This issue shows that increasing revenues in the tourism industry will increase CO2 emissions in the region. Furthermore, several studies have been conducted with similar results, namely research conducted by Khalid et al., where the results of the study's revealed that CO2 emissions in East Asia and the Pacific triggered by tourism on energy use in the country. The research conducted by Ilhan Ozturk revealed that Hajj and Umrah pilgrims in Saudi Arabia, in addition to increasing the country's income, also triggered a demand for positive energy consumption that had a significant effect. (Ozturk et al., 2022). This can be avoided if a country uses renewable energy sources, in which case the increased economic growth also reduces CO2 emissions, which is often the case in high-income countries (I. Khan et al., 2022).

III. RESEARCH METHODS

The type of research used in this study is descriptive quantitative research, a process used to obtain information using numerical data as an analytical tool which is then interpreted in sentence form (Balaka, 2022). The population in this study is countries that joined the OIC, where the sample used was 51 OIC countries are Afghanistan, Egypt, Algeria, Albania, Bahrain, Azerbaijan, Faso, Benin, Bangladesh, UAE, Brunei, Uzbekistan, Burkina, Iran, Cameroon, Chad, Maldives, Comoros, Cote d'Ivoire, Gabon, Lebanon, Gambia, Sudan, Guyana, Togo, Indonesia, Iraq, Jordan, Syria, Kazakhstan, Kyrgyz, Libya, Malaysia, Suriname, Mozambique, Niger, Pakistan, Kuwait, Saudi Arabia, Nigeria, Mali, Senegal, Sierra, Tajikistan, Guinea, Turkey, Tunisia, Oman, Uganda, Morocco, Qatar, and Yemen. The sample selection is based on the purposive sampling methods where the selected samples are countries that have completed data in 2021. The data used is secondary data obtained from various World Banks, AIE, WTTC, and Edgar reports. This study uses the spatial regression analysis method to see the level of CO2 emission linkage between countries using Geoda software tools.

Table 1. Description of variable usage

Variable	Symbol	Source
CO2 emissions, (Metric ton) (Y)	CO22	EDGAR
Energy use, (billion Btu per capita) (X1)	E2	AIE
Economic growth, GDP (billion US$) (X2)	G2	WDI
Tourism, visitor spend in international and domestic (billion US$) (X3)	T2	WTTC

Spatial Analysis

In conducting spatial analysis, there are several stages, namely the formation of a spatial weighting matrix on the bound variable, and spatial dependency testing is carried out on the bound variable using Moran's index. If it does not become autocorrelation, then it can only use OLS regression. If autocorrelation occurs, it will be continued with testing the *Lagrange Multiplier* (LM) Test and finally embracing the selection of spatial regression models, namely SLM, SAR and SEM.

Weighting Matrix (W)

In this study, varying CO2 emissions were used weight matrix. Spatial weight matrix or weights (W), is a spatial weight based on continuity, that is, the spatial interactions that occur when adjacent regions touch region boundaries. There are three types, namely Rook (contact between one side area and the other side of the area), Bishop (contact between one area vertex point with another area's), and Queen (contact that occurs from one side or area vertex point with another area) (Anselin et al., 2006).

Indeks Moran's

In this study, the variable used is the CO2 emissions of each country. Moran's index is a local statistical test used to see the correlation between bound and free variables in space (Pfeiffer, D, 2008). A variable can be said to have autocorrelation if it meets the formula below:

The expected values of the Moran's Index:

$$E(I)=I_o = -\frac{1}{n-1} \text{ (Lee, J. \& Wong, 2001)}$$

This means that if the value I of the dependent variable is more significant than I_0, there is a positive autocorrelation. If, vice versa, there is a negative autocorrelation between locations so that spatial analysis can be used. Furthermore, if the value of I is equal to zero, then the variable has no autocorrelation.

Lagrange Multiplier* (LM) *Test

Lagrange Multiplier testing was used to determine the best spatial regression model between the spatial autoregressive (SAR) model and the spatial error model (SEM). The Lagrange Multiplier (LM) test is a test on bound variables and residual values by masking the spatial weighting matrix (LeSage JP, 2009).

Spatial Autoregressive Model (SAR)

The spatial Autoregressive Model (SAR) or also called the Spatial lag Model (SLM), is a model that combines linear regression with spatial lag in response variables (Anselin, 1988). Spatial lag occurs when a value of a variable object bound to an area is correlated to a dependent variable in another location, resulting in a spatial correlation between dependent variables.

The equation of the SAR regression model is as follows:

$$y_i=\rho W_{ij}y_i+ \beta_i X_i + \varepsilon_i$$
$$\text{with } \varepsilon \sim N(0,\sigma^2 I)$$

Where, yi is the dependent variable in area i, ρ is the parameter value of the spatial lag coefficient, Wij is the spatial weighting matrix in area i, β i is the value of the regression coefficient parameter in area i, Xi is the independent variable in area i, and ε is an error in area i.

Spatial Error Model (SEM)

The spatial Error Model (SEM) is a spatial regression model with spatial dependence on the error. Where the form of error in area i is a function of error in area j where j is the area around the area i. Here is what the spatial regression model looks like (Anselin, 1988):

$$y_i = \beta_i X_i+ \lambda W_{ij}u_i + \varepsilon$$
$$\text{with } \varepsilon_i \sim N(0,\sigma^2 I)$$

Where yi is the dependent variable in area i, βi is the parameter value of the regression coefficient in area i, Xi is the independent variable in area i, Wij is the spatial weighting matrix, ε is the error in area i, u is the error in area j, and λ is the parameter value of the spatial error coefficient.

IV. RESULTS AND DISCUSSION

Spatial Analysis

Spatial analysis in this study was conducted to determine the existence of Spatial dependence on bound variables, namely CO2 emission variables in 51 countries included in the Organization of Islamic Cooperation (OIC). Here is Figure 1. Shows the grouping of CO2 emissions into 10 parts, as follows:

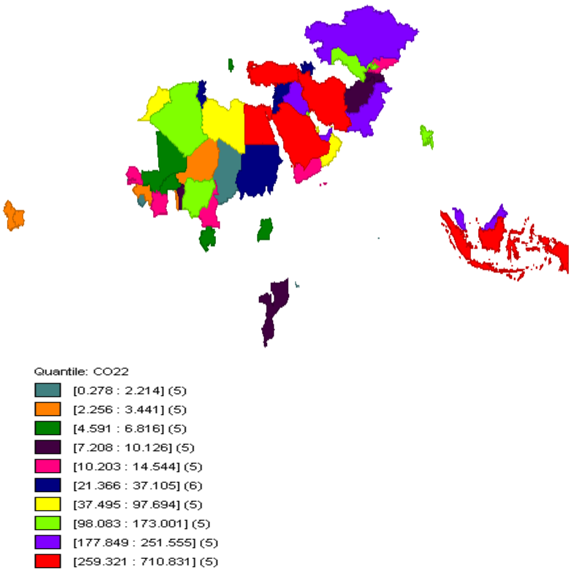

Figure 1. Map of 51 Countries by CO2 Value Grouping
Source: processed data 2023, Geoda

Figure 1 shows that the lowest group has a CO2 emission value where five countries have a total CO2 emission of 0.278-2,214 emissions, while the highest amount of CO2 emissions is in group 10, where there are five countries with a total CO2 emission value of 259,321-710,831.

Weight Matrix (W)

In forming a weighting matrix in this study using queen contiguity, which is known as the number of neighbours from each country with the contact of the sides and points of each country's territory. The results can be seen in Figure 2:

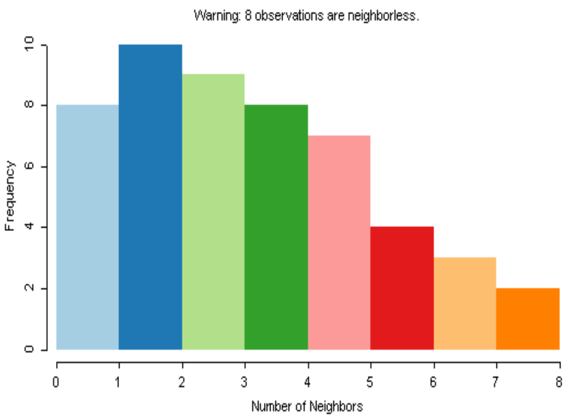

Figure 2. Weight Matrix in 51 Countries
Source: processed data 2023, Geoda

In Figure 2. It was explained that from 51 countries, there are eight groups, of which the most significant groups are 10 countries, each of which has as many neighbours as every two countries.

Moran's Index

The results of Moran's Index testing on the dependent variable, namely CO2 emissions in 51 countries that are members of the OIC, can be seen in Figure 3. as follows:

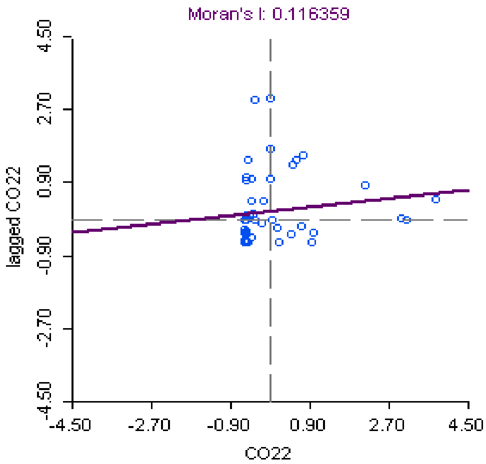

Figure 3. Moran's Index
Source: processed data 2023, Geoda

Figure 3. shows that the value of Moran's index on CO2 emissions is 0.116359, where the value is greater than the value of E(I), which is -0.02, which means that there is a positive autocorrelation relationship between the 51 countries and has a distribution pattern that tends to cluster. This shows the value of CO2 emissions in these countries. The same results are also stated by studies conducted (Su & Yu, 2020) and (Li & Lv, 2021).

Lagrange Multiplier (LM) Test

The results of the Lagrangian multiplier test (LM in this study are shown in Table 2 below.

Table 2. Lagrange Multiplier (LM) Test Results

TEST	VALUE	PROB
LM (lag)	0.1811	0.67043
LM (error)	3.0472	0.08088
LM (SARMA)	3.2902	0.19299

Source: processed data 2023, Geoda

Table 2 shows that the probability value of the Lagrange Multiplier (error) is 0.08088, which is smaller than α = 0.1, then H0 is rejected, indicating a spatial dependence between errors in the model at a confidence level of 90%. So, the spatial capital used in this study is the Spatial Error Model (SEM).

Spatial Error Model (SEM)

The results of the Spatial Error Model (SEM) test in this study can be seen in Table 3. as follows:

Table 3. Spatial Error Model (SEM) Results

Variabel	Coefficient	Probability
CONSTANT	2.06449	0.82103
T2	0.00581156	0.00029
G2	0.000154542	0.00000
E2	0.0945877	0.09968
LAMBDA	-0.364943	0.02130
R-squared: 0.847012		

Source: processed data 2023, Geoda

Table 3. shows that the variable amount of tourist spending, both carried out internationally and domestically, the amount of GDP, and the amount of energy consumption have a probability value smaller than the value of α = 0.1 so that the three independent variables have a positive and significant effect on the dependent variable, namely the amount of CO2 emissions. The value of the Lamda coefficient shows that if a country is surrounded by other countries as much as n, So the influence of each country is 0.364943 multiplied by the error value in each country. Then the R-square value of 0.847012 means that the independent variable provides 84.7 percent of the information in predicting the variation of the dependent variable, and the rest, or 15.3 percent, is explained by other variables outside the model at a 90 percent confidence level.

From Table 3. then the Spatial Error Model regression equation model can be formed as follows:

$$y = 2.06449 + 0.0945877\, X_1 + 0.000154542\, X_2 + 0.00581156 X_3 - 0.364943\, W_{ij}u_i + \varepsilon_i$$

The Spatial Error Model (SEM) model can be interpreted as if other factors are considered constant. When energy usage increases by 1 billion Btu, it will spatially increase the value of CO2 emissions in neighbouring countries by 0.0945 metric tons. This shows that energy use in 51 OIC countries positively impacts CO2 emissions in those countries. The same result was also found in a study conducted by Yu Yang, which showed that car users' energy consumption positively impacted CO2 emissions in the Yangtze River in China (Yang et al., 2019). Anwar Khan et al., in their research, stated that energy use and income encourage the increase in CO2 value in Belt & Road Initiative (BRI) countries (A. Khan et al., 2020). Then, Jun et al., who subsequently conducted research in Indonesia, stated that the increase in energy consumption would increase environmental pollution, leading to an increase in Indonesia's carbon dioxide emissions (Jun et al., 2021). The increase in CO2 emissions in an area due to an increase in energy consumption in the region is due to the region using non-renewable energy, resulting in pollution or environmental damage in the region (Le et al., 2020). This issue can be overcome by using renewable energy to reduce CO2 emissions (Rahman et al., 2022).

Then, if the value of GDP increases by US $ 1 billion, it will spatially increase the number of CO2 emissions in neighbouring countries by 0.0001545 Metric tons. This shows that the value of GDP, which reflects economic growth in the 51 OIC countries, has a negative impact on the environment in the country because it will increase CO2 emissions in the country. An increase in CO2 emissions accompanied by increased income in a region is commonly known as the Kuznet hypothesis, which usually occurs in developing countries (Jun et al., 2021). Developing countries, in increasing their income, will increase energy use, whereas the energy used in developing countries is energy that is classified as non-renewable. This is one of the causes of increasing CO2 emissions in developing countries (Waheed et al., 2019). The same results were also stated by Atef Saad et al., who, in their research, revealed that in the long run, economic growth in a region will have a positive impact on CO2 emissions, which is due to the use of energy (Alshehry & Belloumi, 2015). The research conducted by Jamiu &; Husam states that economic growth in Indonesia, Mexico, Turkey, and Nigeria has unidirectional causality for the increase in energy use, which causes an increase in the value of CO2 emissions in the country (Odugbesan & Rjoub, 2020).

The total value of tourism visitor spending in international and domestic increases by US $ 1 billion, then it will partially increase the number of CO2 emissions in neighbouring countries by 0.00581 Metric tons. This shows that the development in the tourism industry in the 51 countries that are members of the OIC can not only increase the country's income but, on the other hand, also has a negative impact on the environment which increases the value of CO2 emissions in the country. The increase in CO2 emissions caused by tourism due to visits made by visitors both domestically and internationally will cause a demand for transportation and accommodation, housing, and infrastructure services such as hotels, restaurants, and roads, as well as changes in land use change (Paramati et al., 2018). These things cause increased energy consumption, increasing the value of CO2 emissions in a region (Eyuboglu & Uzar, 2020). Furthermore, there are several studies conducted by (Eyuboglu & Uzar, 2020), (Jiaqi et al., 2022), (Azam et al., 2018), (Ahmad & Ma, 2022), (Zaman et al., 2016), (Ozturk et al., 2022), and (Moslehpour et al., 2023) which reveal that the tourism industry has a significantly positive impact on CO2 emissions in the regions.

V. CONCLUSION

The Organization of Islamic Cooperation (OIC) has 51 joined countries. According to research on energy use, economic growth, and tourism on CO2 emissions, the Morans index value of CO2 emissions is 0.116359, which indicates that there is a positive spatial autocorrelation tend to have a clustered distribution pattern in the 51 countries. It demonstrates that each country's CO2 emissions have an impact on those of its neighbors. The variables of energy usage, economic growth, and tourism have a strong positive impact on CO2 emission variables in 51 nations, according to the findings of the spatial regression analysis utilizing the Spatial Error Model (SEM). Therefore, whenever there is an increase in energy consumption, economic expansion, or tourism in these 51 nations, there will also be an increase in CO2 emissions in the region. Therefore, it may be concluded that environmental contamination and rising CO2 emissions are caused by increased energy usage, economic development, and tourism in the 51 countries that have signed up for the OKI.

Suggestion

The recommended suggestion is that in the development process to increase economic growth, a country should pay attention to the environment so that, along with increasing economic growth, it will have a good impact on the environment. Furthermore, there needs to be a policy in each country to use renewable energy and tourism management properly in every activity, both industrial and individual, so that the use of energy used for visitors and the community does not have a negative impact on the environment.

REFERENCES

Ahmad, N., & Ma, X. (2022). How does tourism development affect environmental pollution? *Tourism Economics*, *28*(6), 1453–1479. https://doi.org/10.1177/13548166211000480

Alshehry, A. S., & Belloumi, M. (2015). Energy consumption, carbon dioxide emissions and economic growth: The case of Saudi Arabia. *Renewable and Sustainable Energy Reviews*, *41*, 237–247. https://doi.org/10.1016/j.rser.2014.08.004

Aman, J., Abbas, J., Mahmood, S., Nurunnabi, M., & Bano, S. (2019). The influence of Islamic religiosity on the perceived socio-cultural impact of sustainable tourism development in Pakistan: A structural equation modelling approach. *Sustainability (Switzerland)*, *11*(11). https://doi.org/10.3390/su11113039

Anselin, L. (1988). *Lagrange multiplier test diagnostics for spatial dependence and spatial heterogeneity*. Geogr Anal.

Anselin, L., Syabri, I., & Kho, Y. (2006). GeoDa: An introduction to spatial data analysis. *Geographical Analysis*, *38*(1), 5–22. https://doi.org/10.1111/j.0016-7363.2005.00671.x

Azam, M., Alam, M. M., & Haroon Hafeez, M. (2018). Effect of tourism on environmental pollution: Further evidence from Malaysia, Singapore and Thailand. *Journal of Cleaner Production*, pp. *190*, 330–338. https://doi.org/10.1016/j.jclepro.2018.04.168

Balaka, M. Y. (2022). Metode penelitian Kuantitatif. *Metodologi Penelitian Pendidikan Kualitatif*, *1*, 130.

Databoks. (n.d.). https://databoks.katadata.co.id/datapublish/2023/03/03/emisi-karbon-global-naik-lagi-pada-2022-pecahkan-rekor-baru

Ernita, D., Amar, S., & Syofyan, E. (2013). Jurnal Kajian Ekonomi, Januari 2013, Vol. I, No. 02 ANALISIS PERTUMBUHAN EKONOMI, INVESTASI, DAN KONSUMSI DI INDONESIA Oleh : Dewi Ernita ∗ , Syamsul Amar ∗∗ , Efrizal Syofyan ∗∗∗. *Jurnal Kajian Ekonomi*, *I*(02), 176–193.

Eyuboglu, K., & Uzar, U. (2020). The impact of tourism on CO2 emission in Turkey. *Current Issues in Tourism*, *23*(13), 1631–1645. https://doi.org/10.1080/13683500.2019.1636006

Fatai, F., Victor, F., Driha, O. M., & Balsalobre-lorente, D. (2020). The effects of air transportation, energy, ICT and FDI on economic growth in the Industry 4.0 era: Evidence from the United States. *Technological Forecasting & Social Change*, *January*.

Indriana, D. (2022). *TOURISM AND ECONOMIC GROWTH: EVIDENCE FROM ASEAN COUNTRIES*. *10*(2), 100–131.

Jiaqi, Y., Yang, S., Ziqi, Y., Tingting, L., & Teo, B. S. X. (2022). The spillover of tourism development on CO2 emissions: a spatial econometric analysis. *Environmental Science and Pollution Research*, *29*(18), 26759–26774. https://doi.org/10.1007/s11356-021-17026-z

Jun, W., Mughal, N., Zhao, J., Shabbir, M. S., Niedbała, G., Jain, V., & Anwar, A. (2021). Does globalization matter for environmental degradation? Nexus among energy consumption, economic growth, and carbon dioxide emission. *Energy Policy*, *153*(July 2020). https://doi.org/10.1016/j.enpol.2021.112230

Khan, A., Chenggang, Y., Hussain, J., Bano, S., & Nawaz, Aa. A. (2020). Natural resources, tourism development, and energy-growth-CO2 emission nexus: A simultaneity modelling analysis of BRI countries. *Resources Policy*, *68*(October 2019), 101751. https://doi.org/10.1016/j.resourpol.2020.101751

Khan, I., Han, L., & Khan, H. (2022). Renewable energy consumption and local environmental effects for economic growth and carbon emission: evidence from global income countries. *Environmental Science and Pollution Research*, *29*(9), 13071–13088. https://doi.org/10.1007/s11356-021-16651-y

Le, T.-H., Chang, Y., & Park, D. (2020). Renewable and Non-renewable Energy Consumption, Economic Growth, and Emissions: International Evidence. *The Energy Journal*, *41*(2), 73–92. https://doi.org/10.5547/01956574.41.2.thle

Lee, J. & Wong, S. . (2001). *Statistical Analysis with ArcView GIS*. John Willey & Sons. Inc.

Lee, J. W., & Brahmasrene, T. (2013). Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. *Tourism Management*, *38*, 69–76. https://doi.org/10.1016/j.tourman.2013.02.016

LeSage JP, P. R. (2009). *Introduction to Spatial Econometrics*. CRC Press, Boca Raton.

Li, S. S., & Lv, Z. (2021). Do spatial spillovers matter? Estimating the impact of tourism development on CO2 emissions. *Environmental Science and Pollution Research*, *28*(25), 32777–32794. https://doi.org/10.1007/s11356-021-12988-6

Moslehpour, M., Firman, A., Lin, C. H., Bilgiçli, İ., Tran, T. K., & Nguyen, T. T. H. (2023). The moderating impact of government support on the relationship between tourism development and growth, natural resources depletion, socio-cultural degradation, economic environment, and pollution reduction: the case of the Indonesian economy. *Environmental Science and Pollution Research*, *0123456789*. https://doi.org/10.1007/s11356-023-26231-x

Odugbesan, J. A., & Rjoub, H. (2020). Relationship Among Economic Growth, Energy Consumption, CO2 Emission, and Urbanization: Evidence From MINT Countries. *SAGE Open*, *10*(2). https://doi.org/10.1177/2158244020914648

Ozturk, I., Aslan, A., & Altinoz, B. (2022). Investigating the nexus between CO2 emissions, economic growth, energy consumption and pilgrimage tourism in Saudi Arabia. *Economic Research-Ekonomska Istrazivanja* , *35*(1), 3083–3098. https://doi.org/10.1080/1331677X.2021.1985577

Paramati, S. R., Alam, M. S., & Lau, C. K. M. (2018). The effect of tourism investment on tourism development and CO2 emissions: empirical evidence from the EU nations. *Journal of Sustainable Tourism*, *26*(9), 1587–1607. https://doi.org/10.1080/09669582.2018.1489398

Pfeiffer, D, et al. (2008). *Spatial Analysis in Epidemiolog*y. Oxford University Press.

Rahman, M. H., Voumik, L. C., Islam, M. J., Halim, M. A., & Esquivias, M. A. (2022). Economic Growth, Energy Mix, and Tourism-Induced EKC Hypothesis: Evidence from Top Ten Tourist Destinations. *Sustainability (Switzerland)*, *14*(24), 1–16. https://doi.org/10.3390/su142416328

Scott, D. (2008). Climate Change and Tourism : Responding to Global Challenges CTO / CRSTDP Regional Workshop. *Tourism*, *March* 18–19.

Shi, H., Li, X., Zhang, H., Liu, X., Li, T., & Zhong, Z. (2020). Global difference in the relationships between tourism, economic growth, CO2 emissions, and primary energy consumption. *Current Issues in Tourism*, *23*(9), 1122–1137. https://doi.org/10.1080/13683500.2019.1588864

Simpson, J. (2022). Economic Impact 2022. *Wttc*, pp. 1–36. https://wttc.org/Portals/0/Documents/Reports/2022/EIR2022-Global Trends.pdf

Su, Y., & Yu, Y. Qi. (2020). Spatial agglomeration of new energy industries on the performance of regional pollution control through spatial econometric analysis. *Science of the Total Environment*, *p. 704*. https://doi.org/10.1016/j.scitotenv.2019.135261

Sukirno, S. (2012). *Pengantar Teori Makroekonomi*. Rajawali Press.

Waheed, R., Sarwar, S., & Wei, C. (2019). The survey of economic growth, energy consumption and carbon emission. *Energy Reports*, *p. 5*, 1103–1115. https://doi.org/10.1016/j.egyr.2019.07.006

Yang, Y., Zhou, Y., Poon, J., & He, Z. (2019). China’s carbon dioxide emission and driving factors: A spatial analysis. *Journal of Cleaner Production*, pp. *211*, 640–651. https://doi.org/10.1016/j.jclepro.2018.11.185

Zaman, K., Shahbaz, M., Loganathan, N., & Raza, S. A. (2016). Tourism development, energy consumption and Environmental Kuznets Curve: Trivariate analysis in the panel of developed and developing countries. *Tourism Management*, *54*, 275–283. https://doi.org/10.1016/j.tourman.2015.12.001