OPEN ACCESS

ISAR Journal of Economics and Business Management

Volume 3, Issue 5, 2025, Page: 55-59

Abbriviate Title- ISAR J Econ Bus Manag

ISSN *(Online)*- 2584-0169

https://isarpublisher.com/journal/isarjebm

Brent Oil Prices, Demand, and Oil Emissions in Indonesia: Long-Term Evidence

Septriani Septriani*

Department of Economic Development, Faculty of Economics and Business, University of Bengkulu, Bengkulu, Indonesia.

***Corresponding Author**
Septriani Septriani

Department of Economic Development, Faculty of Economics and Business, University of Bengkulu, Bengkulu, Indonesia.

Article History

Received: 17.03.2025

Accepted: 08.04.2025

Published: 31.05.2025

Abstract: *This study analyzes the effect of Brent oil price and oil demand on oil emissions in Indonesia during the period 1990-2023. This study was analyzed using multiple linear regression, while the data were obtained from the Energy Information Administration (EIA), World Development Indicators (World Bank). The results showed that Brent oil price has a positive and significant effect on oil emission, as well as the variable of oil consumption or demand has a positive and significant effect on oil emission. Although economic theory predicts that higher oil prices will reduce energy consumption, this effect is less pronounced in Indonesia due to government fuel subsidies. This finding has several important policy implications. First, the government needs to evaluate its fuel subsidy policy, which has been suppressing domestic prices, as large subsidies weaken the mechanism of controlling emissions through energy prices. A more realistic energy price adjustment could encourage consumption efficiency and reduce emissions. Second, the high oil consumption in the transportation sector emphasizes the importance of developing efficient and environmentally friendly public transportation, as well as encouraging the use of energy-efficient vehicles. Third, energy diversification towards renewable sources is a strategic step to reduce dependence on oil and reduce long-term emissions. Overall, the integration of economic, energy, and transportation policies is necessary for sustainable economic growth without increasing environmental pressures.*

Keywords: *Brent Oil Price, Oil Demand, Oil Emissions, Energy Policy*

Introduction

Climate change is one of the biggest global challenges of the 21st century, with carbon dioxide (CO_2) emissions from the energy sector being a major contributor to global warming (IPCC, 2021). Among various energy sources, petroleum (oil) plays a central role in modern economies, especially in developing countries with high levels of urbanization and economic growth. Dependence on oil not only drives economic growth, but also accelerates the accumulation of carbon emissions.

Indonesia is one of the largest developing countries in Asia. In this case, as a developing country, Indonesia also faces the same dilemma as other developing countries. Although the government has implemented energy diversification efforts, Indonesia's national energy consumption is still highly dependent on petroleum, especially in the transportation sector (MEMR, 2022). Based on emissions data per source, petroleum has consistently been the main contributor to CO_2 emissions compared to coal and natural gas throughout the 1990-2022 period. This condition shows that diversification policies have not been able to fully reduce the dominance of petroleum in the national energy structure. In fact, this dependence has an impact on the achievement of emission reduction targets. This is because the transportation sector always experiences an increase in energy demand in line with economic and population growth. The historical emission trends provide an important insight into Indonesia's challenges in achieving a sustainable energy transition. To clarify the comparison of emissions from oil, coal and natural gas, a visualization of Indonesia's CO_2 emissions data from 1990-2022 is shown below (see figure 1).

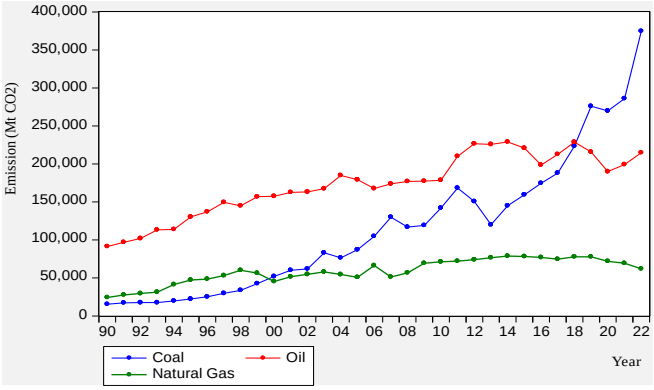

Figure 3. Trend CO2 Emission by enegry source (Mt)
Source: Processed research data (2025)

Figure 1 shows the trend of Indonesia's CO_2 emissions by major energy source (coal, oil and natural gas) over the period 1990-2022. It can be seen that emissions from petroleum (red line) have consistently been at high levels throughout the observation period, although they have tended to stabilize since mid-2010. In contrast, emissions from coal (blue line) experienced the sharpest increase, especially after 2005, as energy demand for industry and

Cite this article:
Septriani, S. (2025). Brent Oil Prices, Demand, and Oil Emissions in Indonesia: Long-Term Evidence. *ISAR Journal of Economics and Business Management*, *3*(5), 55-59.

power generation surged. Meanwhile, emissions from natural gas (green line) showed a relatively moderate increase and tended to stagnate in the last decade.

Although oil emission growth is not as fast as coal, its contribution remains large, making the oil-dependent transport sector a major challenge for energy decarbonization in Indonesia. This emphasizes the need for further research on oil emissions to understand the causes of oil emissions dominance and formulate policy strategies that can reduce transportation emissions. Such understanding is essential to support a sustainable energy transition and the achievement of national emission reduction targets.

The two main factors theoretically and empirically proven to affect oil emissions are oil demand and the Brent crude oil price. Oil demand has a direct relationship with emissions, as any increase in fuel consumption automatically increases the volume of carbon burned. The Environmental Kuznets Curve (EKC) framework explains that in the early stages of economic development, income growth encourages increased use of fossil energy, which in turn increases carbon emissions (Grossman & Krueger, 1991; Sugiawan & Managi, 2016; Chen, 2022). Furthermore, international crude oil prices theoretically affect consumption through the price elasticity of demand mechanism. Price increases should suppress oil consumption and reduce emissions, but research shows that in many developing countries, fuel price elasticity is very low, so the impact of prices on consumption and emissions is limited (Sa'ad, 2009; Dartanto, 2013). In Indonesia, the existence of fuel subsidies has led to imperfect transmission of world oil prices to domestic prices, resulting in weak price effects on emissions control..

Several studies have found that there is a close relationship between fossil energy consumption and carbon emissions in developing countries. Shahbaz et al. (2017) found that oil and other fossil energy consumption plays a dominant role in driving CO_2 emissions. Meanwhile, research by Apergis & Payne (2009) confirmed the long-term relationship between energy consumption and emissions growth in developing countries. Likewise, the results of Tokpah et.al (2024) found that oil prices have a positive effect on CO_2 emissions in oil exporting countries, while in oil importing countries oil prices have a negative effect on environmental degradation. Likewise, other studies have also found that brent oil affects CO2 emissions or oil emissions (Chen, 2022); 2022). In this case, there are still very few researchers who specifically analyze the role of oil demand and crude oil prices on oil emissions in Indonesia, even though these two factors are very relevant to national energy dynamics and energy transition policies. Therefore, this study has an urgency to examine how oil demand and crude oil prices affect oil emissions in Indonesia in the long term (1990-2023). This analysis is expected to make a theoretical contribution in strengthening the literature on the energy emissions nexus in developing countries, as well as a practical contribution in formulating more effective and evidence-based energy and climate policies for Indonesia.

Method

This study uses a quantitative approach with econometric methods to analyze the relationship between crude oil prices, demand for oil products and CO_2 emissions from oil consumption in Indonesia. The empirical model is estimated by multiple linear regression based on annual time series data for the period 1990-2023. All variables are analyzed in first-differenced form to overcome potential non-stationarity and spurious regression problems, as recommended by Gujarati and Porter (2009) and Wooldridge (2016). Furthermore, the research data is obtained from various international sources including the U.S. Energy Information Administration (EIA), World Development Indicators (World Bank). The empirical model used is formulated as follows:

$$\Delta(OIL\_EMISSION_t) = \alpha + \beta_1 \Delta(Br\_OIL\_P_t) + \Delta(D\_OIL_t) + \varepsilon_t$$

Where Δ(OIL_Emissiont) Δ(OIL_Emission$_t$) is is the change in oil emissions in period t, Δ(Br_OIL_Pt), is the change in international crude oil price (Brent oil price), then Δ(D_OILt) is the change in oil demand in period t, α is a constant that describes the influence of fixed factors outside the independent variables, while β1 and β2 are the magnitude of the influence of changes in world oil prices and domestic demand on variations in oil emissions, t is the time period (1990-2023), and εt is an error term that captures the influence of other variables not included in the model.

Furthermore, to ensure the reliability of the estimation results, classical assumption tests are conducted thoroughly in accordance with econometric rules. Residual normality is examined using the Jarque-Bera test, while autocorrelation is evaluated through the Breusch-Godfrey LM test. Potential heteroscedasticity is analyzed using the Breusch-Pagan-Godfrey approach, while multicollinearity is examined through the correlation matrix between independent variables. A correlation value exceeding 0.80 is generally considered an indication of a serious problem in the model. The application of these tests is in line with the methodological guidelines comprehensively described by Gujarati & Porter (2009) and Wooldridge (2016), which emphasize the importance of classical assumption verification to produce unbiased, consistent, and efficient estimates. After ensuring the fulfillment of classical assumptions, the significance of regression coefficients was tested through t-test to see the effect of each variable individually, as well as F-test to assess the significance of the model as a whole. The regression results were then analyzed to identify the direction and magnitude of each independent variable's influence on carbon intensity. In addition, the R2 value is used to measure how much variation in carbon intensity can be explained by the independent variables in the model.

Results and Discussions

The normality test confirms that the dataset used in this study is normally distributed.

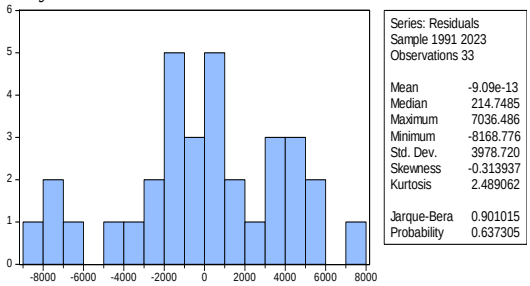

Figure 3. Normality Test Results
Source: Processed research data (2025)

Normally distributed. as indicated by a Jarque-Bera probability of 0.637306, exceeding the 5% significance threshold (α = 0.05). These results, presented in Figure 3, validate the suitability of the data for regression analysis. Furthermore, the autocorrelation test results show a Chi-Square probability value of 0.2220 which is greater than the 5% significance level (α = 0.05). This indicates that the regression model does not experience autocorrelation problems. Details of the results are presented in Table 1

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.405045	Prob. F(2,28)	0.2621
Obs*R-squared	3.009824	Prob. Chi-Square(2)	0.2220

Source: Research data (Processed 2025)

The regression model was also tested to ascertain the presence or absence of heteroscedasticity. The test results show no indication of heteroscedasticity, as indicated by the Chi-Square probability value on Obs*R-squared of 0.9653. A summary of the heteroscedasticity test results can be seen in Table 2.

Table 2. Heteroskedasticity Test Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey:			
F-statistic	0.032162	Prob. F(2,30)	0.9684
Obs*R-squared	0.070606	Prob. Chi-Square(2)	0.9653

Source: Research data (Processed 2025)

Finally, a multicollinearity test was conducted to assess the relationship between independent variables. The results of these tests are presented in Table 3.

Table 3. Multicollinearity Test Results

Variable	Δ (Br_OIL_P)	Δ (D_OIL)
Δ (Br_OIL_P)	1.000000	0.439105
Δ (D_OIL)	0.439105	1.000000

Source : Research data (Processed, 2025)

Furthermore, the regression results of this study can be seen in Table 4, providing insights into the partial and simultaneous effects of brent oil price and oil demand on oil emission in Indonesia during 1990–2023.

Table 4. Multiple Linear Regression Results

Variable	*Coeff.*	*Std. Error*	*t-Statistic*	Prob.
C	-175.7888	765.4294	-0.229660	0.8199
Δ(BR_OIL_P)	84.37686	48.50038	1.739715	0.0922
Δ(D_OIL)	0.071365	0.005617	12.70441	0.0000
R^2 : 0.883609				
Adj.R^2 : 0.875850				
F-statistic : 113.8764				
Prob (F-Statistic) : 0.000000				

Source : Research Data (processed, 2025)

Based on the test results in Table 4, the regression equation is obtained as follows:

$$OIL\_Emission = -3175.788 + 984.37686 D\_Br\_OIL\_P_t + 0.071369 D\_dOIL + \varepsilon_i$$

Hypothesis Test

Based on the regression results in Table 4, the regression model with the dependent variable of oil emissions shows statistically robust results. The R-squared value of 0.8836 and Adjusted R-squared of 0.8758 indicate that the variation of reduced oil emissions can be explained by 88.36% by the independent variables, namely changes in Brent oil prices and oil demand. In addition, based on the F-test, the F-statistic value is 113.8764 with a probability of 0.0000. These results indicate that the variables of crude oil price changes and oil demand are overall significant to oil emission at the 1% level. Meanwhile, partially, the oil product demand variable has a positive coefficient of 0.071365, with a t-statistic value of 12.704 and a probability of 0.0000. This result shows that an increase in oil demand will significantly increase oil emissions, making this variable the main determinant in the model. Meanwhile, the crude oil price variable shows a positive coefficient of 84.37686 with a t-statistic value of 1.739 and a probability of 0.0922. This figure shows that crude oil price has a significant effect on oil emissions in Indonesia at a significance level of 10%.

Discussion

Based on the regression results, from the t-test, the coefficient value of Brent oil price is 84.37686 and the t-statistic probability is 0.0922. These results indicate that the Brent oil price has a positive effect on oil emissions in Indonesia. That is, when Brent oil price increases by 1 USD per barrel, it will increase oil emission by 84 Megaton (Mt). In theory, an increase in global oil prices should suppress fossil energy consumption through the price elasticity of demand mechanism, so that emissions decrease (Pindyck & Rubinfeld, 2013). However, in the case of Indonesia, the result was different: despite the increase in Brent prices, oil emissions increased.

Theoretically, in microeconomics, an increase in world oil prices should suppress consumption through the price elasticity of demand mechanism, thereby reducing emissions. However, the effectiveness of this mechanism depends on the price pass-through to domestic prices and on the elasticity of domestic demand. If domestic prices are subsidized or if demand is relatively inelastic (especially in the short run), then an increase in global prices will not significantly reduce domestic consumption so the price coefficient in the regression could be weak or even positive, if there are other income/cost effects.

In addition, the cause of the discrepancy between these findings and the theory is the energy policy made by the government. During 1990-2014, Indonesia maintained large-scale fuel subsidies, which made domestic prices insensitive to global price fluctuations (Dartanto, 2013). Even when world oil prices spiked in the 2008 or 2011 crisis, domestic consumption remained high as consumers did not bear the full burden. In addition, despite the global crisis or pandemic, the demand for fuel oil has not decreased, because the demand for energy in the transportation sector is inelastic. This is evident when the Indonesian government reduced intervention in oil prices, but the demand for oil for consumption continued to increase. Therefore, the results of this study prove that the global price mechanism is not strong enough to influence energy consumption patterns in Indonesia, as it is influenced by structural factors such as subsidies, import dependency, and the lack of clean energy substitution. This is in

line with Sa'ad (2009) who found that fuel price elasticity in Indonesia is very low. This is supported by research from the Global Carbon Project (2023) that despite price and economic fluctuations, emissions from oil are relatively stable/increasing as base demand remains strong.

Empirical studies show that crude oil prices have a positive effect on carbon emissions, although the impact varies by sector, region and nonlinear characteristics. In China, Chen (2022) extended the STIRPAT model to include energy prices and used Ridge regression, finding that a 1% increase in crude oil prices increases CO_2 emissions by 0.12%, a result robust to control variables. In the GCC region, nonlinear and asymmetric panel analyses show a long-term positive relationship between oil prices and CO_2 emissions, with an asymmetric effect where decreasing oil prices are also correlated with increasing emissions (Ding & Wang, 2024; Mahmood et al., 2022). Studies on oil-exporting countries confirm the positive effect of oil prices on aggregate CO_2 (Tokpah et al., 2024), while a threshold panel study on 33 countries found that the effect of oil prices on transportation sector CO_2 becomes significant above the threshold of environmental policy stringency (Ashraf et al., 2022). Furthermore, Tokpah et.al (2024), in the long run oil prices are positive for exporting countries. Overall, this empirical evidence consistently supports a positive relationship between oil prices and CO_2 emissions, although the magnitude and direction of the effect may vary Al-Maamary et al. argue that as oil prices increase and energy consumption is higher, CO_2 emissions increase much faster than economic growth.

Meanwhile, based on the t test, the coefficient of the oil demand/consumption variable is 0.071365 with a probability of 0.0000. This result shows that oil demand has a positive and significant effect on oil emission. When oil demand increases by 1 Terajoule (TJ), it will increase oil emission by 0.07 Megaton (Mt). This increase in oil emission will ultimately have an impact on increasing CO2 emissions in Indonesia. The results of this study are in line with empirical conditions that occurred in Indonesia from 1990 to 2023. In that period, the consumption of fuel oil by the Indonesian people experienced a relatively sharp increase, especially in the land transportation sector. As data presented by the Ministry of Energy and Mineral Resources, which notes that more than 40 percent of national energy consumption is still dominated by fuel oil.

Theoretically, the results of this study are in accordance with the Environmental Kuznets Curve (EKC) framework, which states that economic growth in the early stages tends to increase fossil energy consumption and worsen emissions (Sugiawan & Managi, 2016: Lestari, 2025; Corneo; 2025). Where at this early stage of development, fossil energy consumption increases rapidly and encourages environmental degradation (Grossman & Krueger, 1991). The causes of high fuel demand in Indonesia are due to the relatively rapid urbanization drive, the increase in private vehicle ownership, and the lack of adequate public transportation (Wang et.al., 2019). If we adjust it to the ECG curve, then this condition shows that Indonesia is still in the upward phase of the ECG curve, where emissions increase as income and economic activity grow.

Based on data, in the early 1990s, high economic growth boosted demand for fuel oil mainly because prices were suppressed through subsidies. During the 1997-1998 financial crisis, consumption was suppressed, but since the early 2000s, energy demand has surged again along with economic recovery, urbanization, and increased motor vehicle ownership. Data from the Ministry of Energy and Mineral Resources (2022) shows that the transportation sector accounts for more than 40% of national fuel consumption, so its contribution to emissions is significant.

The results are in line with several previous studies that have also found that higher crude oil prices interpreted as triggering increased demand, utilization and throughput of oil products are associated with increased oil-related CO_2 emissions, with positive and statistically significant effects observed on transport sector CO_2 emissions under strict policy thresholds, as well as on aggregate emissions in some oil-exporting countries. However, in the case of importing countries, the response can be weaker or even negative (Ding & Wang, 2024; Mahmood et al., 2022; Tokpah et al., 2024; Ashraf et al., 2022; Chen, 2022; Javed et al., 2023).

Conclusion

Based on the regression results show that each variable of Brent oil price and oil demand has a positive and significant influence on oil emissions in Indonesia. Oil demand also significantly drives the increase in emissions, showing the direct contribution of fuel consumption to environmental stress. Although economic theory suggests that rising oil prices should reduce energy consumption, this effect is relatively weak in Indonesia due to fuel subsidies, low domestic demand elasticity, and limited clean energy substitution, especially in the transportation sector. This finding is in line with the rising phase of the Environmental Kuznets Curve, where economic growth and urbanization drive emissions increases. The results emphasize the need for energy subsidy reform, realistic price adjustments, development of efficient public transport, and diversification towards renewable energy. An integrative approach between economic, energy and transportation policies is needed to reduce oil emissions while supporting sustainable development..

References

1. Dartanto, Teguh. (2013). Reducing fuel subsidies and the implication on fiscal balance and poverty in indonesia: a simulation analysis. *Energy Policy, 58*,117-134. https://doi.org/10.1016/j.enpol.2013.02.040
2. Al-Maamary, H.; Kazem, H.; Chaichan, M. (2017). The Impact of Oil Price Fluctuations on Common Renewable Energies in GCC Countries. Renew. Sustain. Energy Rev., 75, 989–1007.
3. Apergis, N., & Payne, J. (2010). Renewable Energy Consumption And Economic Growth: Evidence From A Panel Of OECD Countries. Energy Policy, 38(1), 656–660.
4. Ashraf, S., P, J., & Umar, Z. (2022). The asymmetric relationship between foreign direct investment, oil prices and carbon emissions: evidence from Gulf Cooperative Council economies. Cogent Economics & Finance, 10(1). https://doi.org/10.1080/23322039.2022.2080316
5. Che, Qiaoling. (2022). How Does International Crude Price Affect China's Carbon Emission? Journal of Applied Finance & Banking, 12(4), 33–53. https://doi.org/10.47260/jafb/1242

6. Corneo, T. A., Afsari, A. T., Handayani, L. D., Deli, V. R., & Septriani, S. (2025). Analisis Pengaruh Investasi dan Pertumbuhan Ekonomi terhadap Degradasi Lingkungan di Indonesia. Salam (Islamic Economics Journal), 6(1), 204–223.
7. Dartanto, Teguh. (2013). Reducing fuel subsidies and the implication on fiscal balance and poverty in Indonesia: a simulation analysis. Energy Policy, 58, 117–134. https://doi.org/10.1016/j.enpol.2013.02.040
8. Ding, X., & Wang, M. (2024). The Impact of Oil Price on Carbon Dioxide Emissions in the Transport Sector: The Threshold Effect of Environmental Policy Stringency. Energies, 17(17), 4496. https://doi.org/10.3390/en17174496
9. Global Carbon Project. (2023). Supplemental data of Global Carbon Budget 2023 (Version 1.1) [Data set]. Global Carbon Project. https://doi.org/10.18160/gcp-2023
10. Grossman, G. M., & Krueger, A. B. (1991). Environmental Impacts of a North American Free Trade Agreement. National Bureau of Economic Research Working Paper, No. 3194. Cambridge, MA: NBER.
11. Gujarati, D. N., & Porter, D. C. (2009). Basic Econometrics (5th ed.). New York, NY: McGraw-Hill.
12. IPCC. (2021). Climate Change 2021: The Physical Science Basis. Cambridge University Press. https://doi.org/10.1017/9781009157896
13. Javed, A., Rapposelli, A., Shah, M., & Javed, A. (2023). Nexus between Energy Consumption, Foreign Direct Investment, Oil Prices, Economic Growth, and Carbon Emissions in Italy: Fresh Evidence from Autoregressive Distributed Lag and Wavelet Coherence Approach. Energies, 16(16), 5885. https://doi.org/10.3390/en16165885
14. Lestari, W., Angraini, C. P., Apriyanti, W., Rifa'ah, A. S., & Septriani, S. (2025). Determinasi Kualitas Udara pada Wilayah Pertambangan: Bukti Empiris dari Peran PDRB, Produksi Batubara, dan Kepadatan Kendaraan Truk di Indonesia. Salam (Islamic Economics Journal), 6(1), 224–237.
15. Mahmood, H., Asadov, A., Tanveer, M., Furqan, M., & Yu, Z. (2022). Impact of Oil Price, Economic Growth and Urbanization on CO2 Emissions in GCC Countries: Asymmetry Analysis. Sustainability, 14(8), 4562. https://doi.org/10.3390/su14084562
16. Sa'ad, Suleiman. (2009). An Empirical Analysis Of Petroleum Demand For Indonesia: An Application Of The Cointegration Approach. Energy Policy, 37(11), 4391–4396. https://doi.org/10.1016/j.enpol.2009.05.058
17. Shahbaz, M., Nasreen, S., Ahmed, K., & Hammoudeh, S. (2017). Trade Openness–Carbon Emissions Nexus: The Importance Of Turning Points Of Trade Openness For Country Panels. Energy Economics, 61, 221–232. https://doi.org/10.1016/j.eneco.2016.11.008
18. Shahbaz, M., Shafiullah, M., & Mahalik, M. K. (2019). The dynamics of financial development, globalisation, economic growth and life expectancy in sub-Saharan Africa. Australian Economic Papers, 58(4), 444–479.
19. Sugiawan, Y., & Managi, S. (2016). The environmental Kuznets curve in Indonesia: Exploring the potential of renewable energy. Energy Policy, 98, 187–198. https://doi.org/10.1016/j.enpol.2016.08.029
20. Tokpah, J.T., Saliminezhad, A., & Ozdeser, H. (2024). CO2 emissions–economic growth nexus: validity of EKC in oil-exporting and oil-importing countries. OPEC Energy Rev., 48(3), 151–166. https://doi.org/10.1111/opec.12301
21. Wang, S.; Li, G.; Fang, C. (2018). Urbanization, Economic Growth, Energy Consumption, CO2 Emissions: Empirical Evidence from Countries with Different Income Levels. Renew. Sustain. Energy, 81, 2144–2159.
22. Wooldridge, J. M. (2003). Introductory Econometrics: A Modern Approach, 2nd Edition. Nashville: South-Western.