Exploring the Road toward Environmental Sustainability

Subjects: Others | Environmental Sciences

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Despite the fact that China's economy has grown swiftly since the reform and opening up, the problem of environmental degradation in China has become increasingly significant. Specifically, renewable energy consumption and oil rent contribute to environmental sustainability because of their negative effects on greenhouse gas emissions. On the contrary, economic growth and natural resources hinder environmental sustainability due to their positive effects on greenhouse gas emissions.

greenhouse gas emissions | natural resources | renewable energy consumption | economic growth | oil rent | environmental sustainability

1. Introduction

There are several solutions available to minimize greenhouse gas emissions in the face of the unsustainable development of natural resources, energy consumption, economic growth, and greenhouse gas emissions, as advocated by different experts. For example, Kirikkaleli and Adebayo [1] proposed that people could reduce greenhouse gas emissions by discouraging the use of non-renewable energy and increasing the amount of renewable energy. Magazzino et al. [2] thought that a complete transition from fossil to renewable resources could reduce greenhouse gas emissions. Ponce and Khan [3] came to the conclusion that improving energy efficiency was a substantial and successful strategy for reducing greenhouse gas emissions. Yuping et al. [4] discovered that globalization had reduced greenhouse gas emissions. In fact, many academics have proposed various strategies to limit greenhouse gas emissions [5][6][7]. Meanwhile, among the alternative solutions evaluated in the fourth assessment report of the International Panel on Climate Change were energy conservation and efficiency, a transition away from fossil fuels, use of new renewable energy sources, nuclear power, and carbon capture and storage. In reality, any portfolio of mitigation alternatives for reducing greenhouse gas emissions should be thoroughly evaluated, including their diverse mitigation potential, their contribution to sustainable development, and all related risks and costs.

2. Auto-Regressive Distributed Lag Model for Short- and Long-Run Analysis

The estimating results of the auto-regressive distributed lag for the short-run and long-run regressions are presented in **Table 1**.

Table 1. Results of auto-regressive distributed lag model for short and long-run analysis.

Model: log gge = f(log nr, log ec, log eg, log or)			
Variable	Long-run Effect	Variable	Short-run Effect
Section model	auto-regressive distributed lag (1,0,1,0,0)		
log ec	−0.292 *** (−3.860)	Δlog ec	−0.984 *** (−2.820)
log eg	0.458 *** (12.447)	Δlog eg	0.519 ** (2.544)
log or	−0.142 *** (−4.378)	Δlog or	−0.022 * (−1.817)
log nr	0.242 *** (5.800)	Δlog nr	0.046 ** (2.074)
Du_{2001}	0.047 * (1.938)	Du_{2001}	0.096 * (1.869)
C	2.057 *** (6.281)	ect_{-1}	−0.294 *** (−2.899)
Diagnostic Tests	F-statistic		*p*-value
Normality test	1.438		0.401
χ2serial	0.164 [8][9]		0.849
χ2white	0.508 [10][11]		0.479
χ2ramsey	2.121 [12][13]		0.154
CUSUM test		Stable	
CUSUM of Squares Test		Stable	

Note: T-statistics shown in parentheses; * 1% significant level; ** 5% significant level; *** 1% significant level; ect error correction term, maximum lag order was two, optimal lag order was selected by the Akaike information criterion, χ2 serial denotes serial correlation test, χ2 white denotes heteroscedasticity test, χ2 ramsey denotes functional test, epresents the optimal lag selection for diagnostic tests; unrestricted constant and no trend was used; Δ difference operator; C constant.

For the first stage, it was found that the effect of renewable energy consumption on greenhouse gas emissions was negative at the 1% significant level. To put it another way, a 1% increase in renewable energy consumption results in a 0.292% reduction in long-run greenhouse gas emissions and a 0.984% reduction in short-run greenhouse gas

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emissions. These findings imply that renewable energy consumption reduces gas emissions, and this is consistent with China's energy policy (gradually replacing fossil energy with clean energy) to promote environmental sustainability [14]. Furthermore, this is consistent with China's economic development and environmental goals. That is, in addition to attaining long-term economic growth, the environment's long-term sustainability must also be maintained [14][15]. Moreover, this finding is in line with the United Nations Sustainable Development Goals, which emphasize access to clean, responsible energy usage and climate change mitigation, as is customary practice across the world. In summary, renewable energy consumption can help to ensure China's environmentally sustainable future. This result is consistent with Chen et al. [16] and Dong et al. [17].

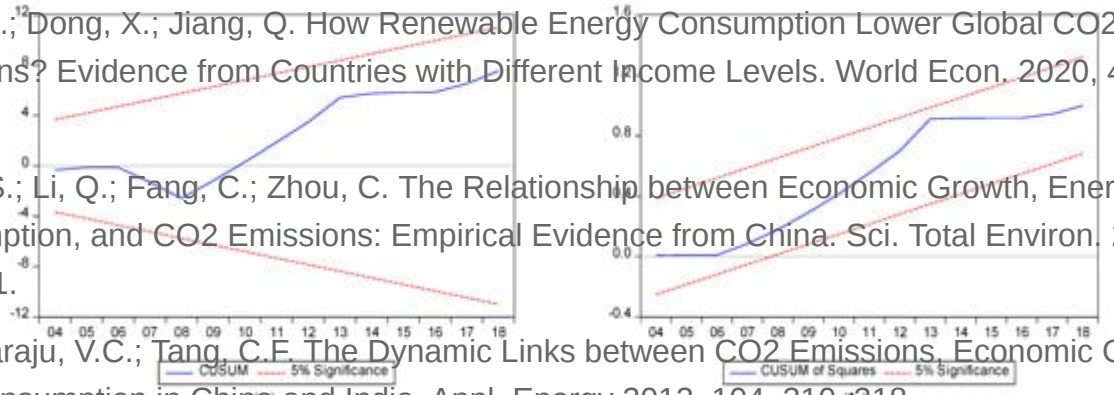
For the second stage, statistically positive effects of economic growth on greenhouse gas emissions were detected, with a 1% rise in economic growth increasing and depleting the environment by 0.458% and 0.519%, respectively, in both the short and long run. As a result, it appears that an increase in human activities that promotes economic growth degrades the environment's quality. This result is consistent with Wang et al. [18] and Govindaraju and Tang [19]. This discovery, of course, has policy implications in China. This poses a quandary, in that there is ongoing pressure to boost economic development and raise residents' living standards, while the aforesaid economic trajectory has intrinsic environmental costs and repercussions. As a result, prudence is required in controlling economic activity without compromising economic growth.

For the third stage, it was observed that oil rent negatively affects greenhouse gas emissions. That is to say, oil rent has been discovered to enhance China's environmental quality. Specifically, a 1% rise in oil rent results in a 0.142% reduction in long-run greenhouse gas emissions and a 0.022% reduction in short-run greenhouse gas emissions. The possible reason for this is linked to the fact that oil emissions in China are low in comparison to other energy sources such as coal, which release significant pollution. Reducing oil rent emissions implies that the country's oil resources may be utilized to diversify the energy sector and portfolio while also implementing other environmental sustainability strategies. As a result, it refers to the nature of China's oil structure as well as the country's environmental sustainability.

For the fourth stage, the dummy variable and the error correction term were taken into account. The coefficients of the dummy variable were positive and significant at the 10% level. Concretely, a 1% increase in dummy variable results in a 0.047% increase in long-run greenhouse gas emissions and a 0.096% increase in short-run greenhouse gas emissions. In other words, after 2001, the environmental deterioration in China worsened. This finding is consistent with the real situation of China. A possible reason for this phenomenon is that in 2001, there was a hiatus in greenhouse gas emissions. The increase in greenhouse gas emissions in 2001 might be attributed to China's WTO membership. During that time, a large number of severely polluting enterprises were introduced to China in order to grow the economy. Although China's economy has developed rapidly, so has China's environmental degradation.

For the fifth stage, the discussion turns to diagnostic tests. The normal distribution test, serial correlation test, heteroscedasticity test, and functional misspecification test were used to examine the residuals of the estimated

model. The results reveal that there is no autocorrelation and heteroscedasticity in the model as the model's functional form is appropriately employed and the residuals are normally distributed. Moreover, the cumulative sum and cumulative sum squared tests were used to ensure the model's stability. Results from **Figure 1**, within 5% critical bounds, support the position that the investigated variables in the error correction model are stable.



(a) (b)

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Figure 1. Diagnostic test results. (**a**) Plot of cumulative sum of recursive residuals; (**b**) Plot of cumulative sum of squares of recursive residuals.

3. Conclusions

China plays a significant role in global concerns such as environmental sustainability, economic growth, and energy consumption. Therefore, this paper uses China as a sample to investigate the effects of highlighted variables on greenhouse gas emissions (a proxy for environmental sustainability) over the period 1971–2018. Employing econometric techniques to perform an empirical analysis, the results reveal that there is a long-run equilibrium relationship between highlighted variables and greenhouse gas emissions. In particular, the link between renewable energy consumption and environmental pollution reveals that a 1% increase in renewable energy consumption results in a 0.292% long-run decrease in greenhouse gas emissions and a 0.984% short-run reduction in greenhouse gas emissions. On the contrary, in the long run and short run, there is a 0.458% and 0.519% rise in economic growth-induced environmental deterioration, respectively. In addition, there is a strong positive relationship between China's total natural resources and greenhouse gas emissions. Moreover, oil rent appears to lessen the impact of environmental degradation in China, which is interesting. In addition, in a robustness test that was performed by using the fully modified ordinary least squares approach and dynamic ordinary least squares approach, the findings also support the above results.

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