Economic Effects of Renewable Energy Consumption

Subjects: Others

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Environmental deterioration has resulted from an over-reliance on fossil-fuel usage to develop economies. Therefore, renewable energy consumption has become the goal of all governments. Of course, the economic effect of renewable energy consumption has piqued the curiosity of many academics. They have not come to a cohesive conclusion, despite studying the issue in numerous countries, using different approaches, and throughout different time periods.

renewable energy consumption economic growth Granger causality test

1. Introduction

Non-fossil energy sources, such as wind, solar, hydro, and geothermal energy, are all examples of renewable energy. It is a sustainable form of energy. Yu et al. [1] considered it a crucial component of China's multi-wheel drive energy supply system, as it is non-polluting and low-carbon. Batel [2], Olabi and Abdelkareem [3], Dincer and Rosen [4], and Mahmood et al. [5] concluded that it was critical for developing energy infrastructure, conserving the environment, dealing with climate change, and achieving sustainable economic and social growth.

Indeed, numerous academics have employed a variety of approaches and samples to investigate the potential implications of renewable energy from diverse perspectives. Ocal and Aslan [6] used the auto-regressive distributed lag method and the Toda–Yamamoto causality test to explore the effect of renewable energy consumption on economic growth in Turkey. They found that renewable energy consumption negatively affected economic growth. Meanwhile, they also found a unidirectional causality running from economic growth to renewable energy consumption. Aydin [7] used 26 OECD countries as a case to study the causality between renewable energy consumption and economic growth. Employing the Croux and Reusens test for empirical analysis, he found that a bidirectional permanent and temporary causality existed. Moreover, Koengkan et al. [8] used the Southern Common Market as an example to study this topic. Using the panel error correction model to conduct empirical analysis, they found that there was a long-run and short-run relationship between renewable energy consumption and economic growth. However, in Italy, Magazzino [9] found a unidirectional causality running from renewable energy consumption to economic growth using the Toda–Yamamoto approach for analysis. Using different methods, time spans, and countries, Grabara et al. [10], Khan et al. [11], and Banday and Aneja [12] also found the above results.

2. Analysis of Economic Effects of Renewable Energy Consumption across the World

According to one school of thought, renewable energy consumption has no significant economic effect. Ozcan and Ozturk [13] examined the association between renewable energy consumption and economic development in 17 rising nations from 1990 to 2016. They used the bootstrap panel causality test developed by Kónya [14] for empirical study. They found that there was no causality running from renewable energy consumption to economic growth. Similarly, Rasoulinezhad and Saboori [15], Yildirim et al. [16], and Dogan [17] held the same view. Meanwhile, Bhat [18] used a neoclassical aggregate production and stochastic impacts by regression on population, affluence, and technology modeling framework to investigate the relationship between disaggregated energy consumption and economic growth in five countries from 1992 to 2016. He used robust unit root, cointegration, and long-run elasticity estimation approaches, such as pooled mean group and the differenced panel generalized method of moments. He found that renewable energy consumption could not affect economic growth. Moreover, these ideas were also supported by Zhe et al. [19], Hung-Pin [20], and Xiarchos et al. [21].

Another group of scholars discovered that renewable energy consumption has a considerable influence on economic growth. Ito [22] attempted to objectively investigate the relationship between renewable energy consumption and economic development using panel data from 42 industrialized countries from 2002 to 2011. He discovered that renewable energy consumption had a long-run favorable impact on economic growth. Meanwhile, Rahman and Velayutham [23] examined the link between renewable energy consumption and economic growth for five countries from 1990 to 2014. Using the Pedroni [24] and Kao [25] tests and the Dumitrescue–Hurlin [26] panel causality test to perform empirical analysis, they found that economic growth was positively affected by renewable energy consumption. Similarly, Cetin [27], Le et al. [28], Narayan and Doytch [29], Sahlian et al. [30], and Shahbaz et al. [31] found the same results. However, Maji et al. [32] employed panel dynamic ordinary least squares to evaluate the influence of renewable energy on economic development in West African countries during the period 1995–2014. They discovered that renewable energy consumption hindered economic development in these countries. Simultaneously, Qi and Li [33] and Venkatraja [34] obtained the conclusion that the economic effect of renewable energy consumption was negative. Of course, some other scholars [35][36][37] also supported these findings.

Except for the above analyses, Shakouri and Khoshnevis Yazdi [38] investigated the links between economic growth and renewable energy consumption in South Africa from 1971 to 2015. They discovered that there was a bidirectional relationship between renewable energy consumption and economic development. The feedback theory was validated by this finding. Apergis and Payne [39], Apergis and Payne [40], and Marinașet al. [41] also agreed with these results. On the contrary, with a sample of Tunisians from 1990 to 2015, Ben Mbark et al. [42] used the Granger causality test and a vector error correction model to uncover the short- and long-run relationships between renewable energy consumption and economic growth. In the short term, they discovered a unidirectional relationship between both of them. Furthermore, Kahia et al. [43] investigated the relationship between economic development and energy consumption in two samples of MENA net oil exporting nations from 1980 to 2012. They found a unidirectional causality between economic growth and renewable energy consumption. These findings were also in line with Saad and Taleb [44], Azam et al. [45], Cho et al. [46], and Xie et al. [47].

3. Analysis of the Economic Effects of Renewable Energy Consumption in China

For a long time, China's economic growth mode was based on the use of fossil fuels, which resulted in environmental degradation. In order to preserve sustainable economic development, a number of academics started to investigate alternatives to fossil fuels. For the period 1977–2011, Lin and Moubarak [48] examined the link between renewable energy consumption and economic growth. By integrating intermittent variables such as carbon dioxide emissions and labor, the autoregressive distributed lag method, Johansen cointegration approach and Granger causality were used. They found a bidirectional causality between renewable energy consumption and economic growth. In other words, China's growing economy was favorable for renewable energy development, which, in turn, supported economic growth. Meanwhile, Long et al. [49] incorporated nonrenewable energy and carbon dioxide emissions and used the data from 1952 to 2012 to study this topic. Via a Granger causality analysis, they also found a bidirectional causality between economic growth and gas consumption, and electricity consumption. Similarly, Bloch et al. [50] conducted empirical research using both the vector error correction model and autoregressive distributed lag approach. They discovered that renewable energy consumption drove economic growth. Meanwhile, economic expansion increased demand for renewable energy. However, Dong et al. [51] used the Granger causality of vector error correction model for analysis. They found that there was no causality between economic growth and renewable energy consumption. Moreover, this results were supported by Zhang et al. [52], Zhang and Da [53], and Fei et al. [54].

Chen et al. [55] used the fully modified ordinary least squares, dynamic ordinary least squares, and panel Granger causality to examine how economic growth and renewable energy consumption affected each other. They found that there was a bidirectional causality between renewable energy consumption and economic growth. Using Chinese provincial data from 2000 to 2015, Fan and Hao [56] employed the panel vector error-correction model and Granger causality for analysis. They found that economic growth could cause renewable energy consumption, while renewable energy consumption could not cause economic growth. Using unique Morlet wavelet analysis, Arain et al. [57] offered a new understanding of the robust relationship between renewable energy consumption and economic growth. According to wavelet analysis's economic perspective, they found that renewable energy consumption contributed to the improvement in China's economy. Wang et al. [58] used the panel autoregressive distributed lag of pooled mean group model to investigate the link between economic growth and renewable energy consumption in China at the national and regional levels from 1997 to 2017. They found that economic growth was positively affected by renewable energy consumption. Wang and Wang [59] discovered that higher renewable energy consumption had a favorable influence on economic development, implying that greater renewable energy consumption contributed to economic growth. These results are also consistent with Pao and Fu [60]. Furthermore, these findings were supported by Li et al. [61], Zhang et al. [62], Zhang and Cheng [63].

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