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Renewable energy consumption–economic growth nexus in Turkey

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ABSTRACT

This paper examines the renewable energy consumption–economic growth causality nexus in Turkey. Studies in the literature can be grouped as country-specific and multi-country studies. The results of these studies are inconsistent, and there is no agreement on the existence or the direction of causality between renewable energy consumption and economic growth. The results of this country-specific study support conservation hypothesis. The results of empirical tests from ARDL approach show that renewable energy consumption has a negative impact on economic growth, and the ones of Toda–Yamamoto causality tests show that there is a unidirectional causality running from economic growth to renewable energy consumption.

Contents

1. Introduction

Environmental consequences of global warming and greenhouse gas emissions increase the concerns of the consumption of fossil fuels; therefore, renewable energy sources have emerged as an important component of world energy consumption. Most important features of renewable energy sources are reducing carbon dioxide emissions and assisting to protect the environment. Theoretically, fossil fuels are considered to be able to renew themselves for a very long period of time, but they are in danger of complete extinction in the near future.

According to International Energy Outlook [1], a rapid growth took place in the field of renewable energy around the world; biofuel production in the world has increased 13.8%, and wind energy consumption has increased 15.5% in 2010. Although Turkey has a rich variety and potential of renewable sources of energy, it unfortunately uses less than 1% of its renewable energy potential. It has 8% of the geothermal energy potential and a high amount of hydro-energy and wind energy potential. It also gets a large amount of solar energy due to its geographical location. Furthermore, Turkey's energy market is nearly 70% of primary energy consumption, and 60% of the electricity consumption is dependent on import, so consuming local and/or renewable energy sources is very important.

It has generally been realized that both the production and consumption of renewable energy play a vital role for economy and environment. Also, the causal relationship between renewable energy consumption and economic growth is vital for environmental and energy policies. In the literature, the causal relationship between renewable energy consumption and economic growth has been investigated in a number of studies. These studies have focused on different countries, periods, variables and used different econometric methodologies. However, there is no consensus on empirical results of these studies, which show different causality directions. On the other hand, the kind of causal relationship is vital for the policy implications [2–6].

Directions of the causal relationship between renewable energy consumption and economic growth should be categorized into

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four hypotheses, each of which has important implications for energy policy [7]. *The growth hypothesis* suggests that unidirectional causality runs from energy consumption to economic growth. It implies that increase in energy consumption have a positive impact on economic growth. Therefore, energy consumption has a vital role in economic growth in production process. If there is a unidirectional causality from economic growth to energy consumption, it is called *conservation hypothesis.* This hypothesis supports that the reduction in energy consumption will have little/no effect on economic growth. Also, it is supported that an increase in real GDP causes an increase in energy consumption. *The feedback hypothesis* argues bidirectional causality between energy consumption and economic growth. This relationship implies that there is a joint effect between energy consumption and economic growth. In other words, energy conservation has negative effect on economic growth, and decreases in GDP have negative impact on energy consumption. No causality between energy consumption and economic growth is referred to as *neutrality hypothesis.* Under the neutrality hypothesis, energy consumption is not correlated with GDP, which means that the increase or decrease in energy consumption has no effect on economic growth and vice versa.

The aim of this study is to examine the relationship between renewable energy consumption, capital, labour, and economic growth for Turkey for the period of 1990–2010 using autoregressive distributed lag (ARDL) approach of Pesaran et al. [8] and Toda and Yamamoto [9] causality tests. This study extends the existing literature specifically on the causal relationship between renewable energy consumption and economic growth; in the literature, there is no study which has investigated this relationship in Turkey. The rest of the paper is organized as follows: Section 2 provides the previous literature regarding the causality between renewable energy consumption and economic growth for both country-specific and multi-country studies. Section 3 presents the data, method, and results. Section 4 provides conclusions.

2. Literature review

Several studies in the literature have examined the relationship between renewable energy consumption and economic growth. The results of these studies have no consensus because of using different data, period, and methodological approach. Therefore, some studies have found unidirectional causality running from renewable energy consumption to economic growth, and running from economic growth to renewable energy consumption. On the other hand, others have found no causality and/or bidirectional causality between renewable energy consumption and economic growth. The chronological list of the empirical literature on the causality between renewable energy consumption and economic growth is displayed in Table 1, presenting the author, period, methodology, and empirical results.

These studies show that the results regarding the causal relationship between renewable energy consumption and economic growth are conflicting and mixed across different countries as shown in Table 1.

Sarı et al. [10] examine the relationship between renewable energy consumption and industrial output with ARDL approach in the US over the period of 1969–2009, and find that industrial output has a positive impact on hydroelectric, waste, and wind energy consumption and a negative impact on solar energy consumption. For the US, Payne [11] uses Toda–Yamamoto causality tests to examine the relationship between renewable and non-renewable energy consumption and economic growth for the period of 1949–2006, and the results show no causality between renewable energy consumption and economic growth.

By using Granger causality test, Menyah and Wolde-Rufael [12] explore the causal relationship among renewable and nuclear energy consumption and economic growth for the US over the period of 1960–2007. The results suggest no causality between renewable energy and CO_2 emissions, but unidirectional causality from nuclear energy consumption to CO_2 emissions. Bowden and Payne [13] use Toda-Yamamoto long-run causality test for US from 1949 to 2006 to examine the causality between sectorial non-renewable/renewable energy consumption and real GDP. The test results suggest neutrality hypothesis for commercial and industrial renewable energy consumption and real GDP nexus, while they suggest feedback hypothesis for commercial and residential non-renewable energy consumption and real GDP nexus. Also, there is a unidirectional causality running from residential renewable energy consumption to GDP.

Payne [14] examines the causal relationship between biomass energy consumption and real GDP by using the Toda–Yamamoto causality tests for Granger causality within a multivariate framework for the US for the period of 1949–2007. The empirical tests show unidirectional causality running from biomass energy consumption to real GDP.

For the period of 1994–2003 in 18 emerging countries, Sadorsky [15] uses panel error correction model to test the relationship between economic growth and renewable energy consumption, and the results support conservation hypothesis. Empirical results show that real income increases have positive and statistically significant impact on per capita renewable energy consumption. For G7 countries, Sadorsky [16] indicates that increase in oil price have small and negative impact on renewable energy consumption.

For 13 Eurasia countries, Apergis and Payne [17] examine the causal relationship between renewable energy consumption and economic growth for the period of 1992–2007 in both the short-run and long-run, by using Granger causality tests. Empirical results support the feedback hypothesis. In addition, the findings of Apergis and Payne [18] support the feedback hypothesis for a panel of twenty OECD countries over the period of 1985–2005.

Apergis et al. [5] use panel error correction model for a group of 19 developed and developing countries for the period of 1984–2007 to explore the causal relationship among nuclear energy consumption, renewable energy consumption, and economic growth. For the long-run, the empirical results show negative association between nuclear energy consumption and emissions, but a positive relationship between emissions and renewable energy consumption. In the short-run, Granger causality test results indicate that nuclear energy consumption is important for reducing CO_2 emissions, whereas renewable energy consumption is not. Apergis and Payne [6] use the same method for a panel of six Central American countries to examine the causal relationship between renewable energy consumption and economic growth for the period of 1980–2006. In the short and the long-run, the results suggest feedback hypothesis.

For 27 European countries, Menegaki [19] uses multivariate panel framework random effect model for the period of 1997–2007. Empirical test results suggest no causality between renewable energy consumption and GDP.

Salim and Rafiq [20] use fully modified ordinary least square (FMOLS), dynamic ordinary least square (DOLS) and Granger causality tests to determine the relationship between renewable energy consumption and GDP in Brazil, China, India, Indonesia, Philippines, and Turkey for the period of 1980–2006. The results suggest that renewable energy consumption is significantly determined by income in the long-run. In both the short- and long-run, Apergis and Payne [21] suggest feedback hypothesis for 80 countries for the period of 1990–2007 by using panel error correction model to test the relationship among renewable and non-renewable energy consumption and economic growth.