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Renewable energy in Turkey: Great potential, low but increasing utilization, and an empirical analysis on renewable energy-growth nexus

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ABSTRACT

Concerns about the exhaustion of fossil energy sources, energy security problems, and increasing environmental problems have led policy makers to pay greater attention to renewable energy sources all over the world. Additionally, high current account deficits stemming from energy import dependency make substitution of fossil energy with renewable energy a necessity for Turkey. Although Turkey has a great potential in terms of renewable energy, it has not begun to utilize this great potential until recent years. However, Turkey has many motives to utilize renewable energy further.

This paper aims to investigate whether renewable energy consumption raises GDP in Turkey. For this purpose, the paper uses data spanning the period 1990–2015 and employs cointegration and causality tests which can present efficient output in small samples. The findings indicate that GDP is not related to renewable energy consumption and there is no causality between GDP and renewable energy consumption in Turkey. In conclusion, the paper argues that these findings may stem from the low share of renewable energy in total energy and Turkey needs to utilize renewable energy sources further to (i) meet energy needs for economic activities, (ii) mitigate environmental problems, and (iii) reduce energy import dependency and current account imbalances.

1. Introduction

There has been a strong opinion in the literature and global political sphere about decreasing the use of fossil energy sources, i.e. oil, natural gas, and coal, in the past few decades. Main reasons of this fact are (i) concerns about depletion of fossil sources since they are non-renewable energy sources, (ii) the urgent need to take action against global climate change, (iii) other alarming environmental effects, air pollution in particular, and (iv) the volatility of their prices (Lau et al., 2012; Nejat et al., 2015; Bilgili et al., 2017a, 2017b; Bulut, 2017). In case of Turkey, there are two additional reasons against the predominant use of fossil energy sources: (i) high levels of energy imports which contribute to large trade deficits, and ii) low self-sufficiency of the country by means of current available energy sources. Turkey's energy production is not sufficient to meet the continuously increasing energy demand of the country. As a result, Turkey has been a net importer of energy and these imports contribute to significant trade deficits. Put differently, energy import dependency of Turkey is one of the essential reasons of high trade deficit and current account deficit. These issues have brought the necessity of a rapid shift towards renewable energy sources in Turkey.

Apart from these, environmental factors have become key issues for Turkey as they are for the rest of the world. Turkey has been suffering from air pollution which (i) affects human health negatively, (ii) causes many diseases some of which are fatal, and (iii) causes health expenditures to rise and significant losses of workdays. Air pollution is mostly caused by burning of fossil fuels. Actually, burning of fossil fuels is the main reason behind the global warming and all of the other alarming climate change phenomena.[1] Climate change represents an enormous long term threat to global ecosystems and national economies (Hansen and Skinner, 2005). Turkey is a Mediterranean country and is predicted to be impacted severely by climate change effects, such as water shortage, drought, difficulties in agriculture, and heat waves (Sen,

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[1] National Aeronautics and Space Administration (NASA) defines global warming "the upward temperature trend across the entire Earth since the early 20th century, and most notably since the late 1970s, due to the increase in fossil fuel emissions since the industrial revolution". On the other hand, climate change refers to "a broad range of global phenomena created predominantly by burning fossil fuels, which add heat-trapping gases to Earth's atmosphere. These phenomena include the increased temperature trends described by global warming, but also encompass changes such as sea level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events" (NASA, 2018).

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2013; Sahin et al., 2016). These urgent matters obligate Turkey just like every country to take serious measures in order to mitigate negative environmental effects of fossil fuel usage. Renewable energy based energy systems and policies offer the most probable solution in this matter since they are green, sustainable, and affordable due to the rapid developments in this sector. Renewable energy sources, namely biomass, geothermal, hydroelectric, solar, and wind, have much less negative effects on environment. Moreover, these effects can be minimized by some production technologies, careful planning, and by application of control measures (Toklu, 2013). Considering economic, political, and environmental reasons altogether, domestic production of renewable energy to meet the major part of the country's energy requirements seems to be the most reasonable and eventually the imperative option for Turkey.

Turkey possesses an important potential to produce renewable energy which is sustainable on the contrary to exhaustible fossil fuels. In the literature, there are several studies suggesting that renewable energy sources must have a greater share in Turkey's energy mix and that Turkey's energy policy should be reconstructed with a special focus on renewable energy because of the concerns listed above (Ediger and Kentel, 1999; Kaygusuz and Sari, 2003; Ocak et al., 2004; Ozgur, 2008; Bilgen et al., 2008; Yuksel and Kaygusuz, 2011; Capik et al., 2012; Baris and Kucukali, 2012; Simsek and Simsek, 2013; Toklu, 2013; Sahin et. al, 2016; Ozcan, 2018). Turkey's oil and lignite coal reserves are far from meeting country's fuel needs. Turkey's energy imports account for more than half of its energy requirement. In other words, shortage of supply and increasing consumption are economic reasons behind the energy imports, which in turn cause high import dependency and great trade deficits. On the other hand, depending solely on fossil fuels and a few major fossil fuel exporting countries undermine self-sufficiency of Turkey (Ozcan, 2018). Turkey would benefit a great deal from diversification of energy sources which also indicates the necessity of domestic renewable energy production for the country.

As was denoted above, there are five main types of renewable energy sources in the world. Turkey has a significant potential in all these types of renewable energy sources. As a matter of fact, there is an awareness at governmental level about the potential of Turkey in renewables, the necessity of renewable energy production, and the need to increase the share of renewable energy in total energy production and consumption in Turkey. There have been some efforts to promote renewable energy sector and to shape legislative regulations accordingly. However, there is a need for a more immediate, comprehensive, and formidable approach and a breakthrough in order to achieve renewable energy goals of the country and to solve the economic and environmental problems associated with the use of fossil fuels.

In general, policy makers and public have two expectations about renewable energy as Fang (2011) remarks. The first one is to meet energy demand for continuity in economic activities while the second one is to mitigate environmental problems that stem from the use of fossil energy sources. As Turkey is an import dependent country in terms of energy, an additional third expectation shows up for Turkey. Accordingly, policy makers can expect renewable energy to reduce import dependency and trade deficit of Turkey as well. While one needs to estimate an empirical model to examine whether renewable energy can meet the first and second expectations, he/she does not need an econometric analysis to test whether more renewable energy can decrease import dependency and trade deficit of Turkey. Because, more energy production from renewable sources can reduce energy imports and directly improve trade balance of Turkey.

Based on the explanations above, this paper focuses on the first expectation for Turkey. Put differently, the paper investigates the effects of renewable energy consumption on GDP in Turkey using annual data over the period 1990–2015. The contributions of the paper to the energy economics literature are threefold. First, though there is an extending empirical literature on renewable energy-growth nexus, there are a few papers examining this relationship for Turkey. Moreover, only Dogan (2016) investigates the effects of both non-renewable and renewable energy consumption on GDP in Turkey. Therefore, one can argue that there seems to be a research gap in this field. Second, this paper estimates a Cobb-Douglas production function to remove model specification errors and potential omitted variable problem. While doing that, the paper employs a modern perspective on economic growth. Accordingly, the empirical model includes not only conventional factors of production, namely technology, capital, and labour, but also democracy as the indicator of the institutional quality. We add democracy to the model because institutional economics has taken place in the mainstream economics in the last decades and many papers have explored that economic growth is positively related to democracy (see Barro, 1996; Acemoglu et al., 2002, 2014; Baum and Lake, 2003; Doucouliagos and Ulubasoglu, 2008; Acemoglu and Robinson, 2012, among others). Moreover, the effects of institutional quality on economic growth are neglected in the papers focusing energy-economic growth nexus. Therefore, this paper also provides researchers with new perspectives for the energy-growth nexus. Third, unlike Dogan (2016), this paper employs two estimators and two bootstrap Granger causality tests in order to yield more reliable findings about the relationship between renewable energy consumption and GDP. All these methods are capable of presenting efficient output in small samples.

The rest of the paper is organized as follows: Section 2 presents the developments in renewable energy in Turkey. Literature review is given in Section 3. Section 4 introduces the model and data. Methodology is presented in Section 5. Section 6 reports the findings. Section 7 concludes the paper with a summary of main findings and some policy proposals.

2. Current state of renewable energy utilization in Turkey

Turkey is an emerging economy and energy consumption of Turkey has rapidly grown especially in recent years. For instance, with regard to International Energy Agency (2018) (hereafter IEA) data, while Turkey's energy consumption was 40,169 ktoe in 1990, it was 57,908 ktoe in 2000, and reached 85,545 ktoe in 2014. In Turkey, the rapid pace of urbanization, positive demographic trends, economic growth and increasing per capita income are boosting energy consumption and energy consumption of Turkey is estimated to increase around 4–6% per year up to the next decade (Kaplan, 2015). On the other hand, energy production of the country appears to be poor compared to energy consumption. As a result, Turkey's dependence on foreign energy level has shown a significant increase, especially since the early 1990 and has started to run around 70% since the early 2000s (Turkish Petroleum (TP), 2017; Ministry of Energy and Natural Resources (MENR), 2018).

Turkey's import dependency of energy along with the price fluctuations of these imports make energy security one of the top priorities of the government. In the framework of energy security, commissioning of new energy production investments, ensuring the diversity of energy sources, and providing the highest level of energy efficiency stand out as important goals for Turkey. In order to avoid risks from high levels of energy dependence and to develop a sustainable energy model, the governments have made significant reforms in the last decade. For instance, due to liberalization of energy markets, many private entities participated in energy markets, which in turn created more competitive energy markets. Hence, the share of private entities in electricity generation increased to 75% in 2017 while it was 32% in 2002 (Invest in Turkey, 2018). Besides, Energy Exchange Istanbul (EXIST) was founded in 2015. Main objectives of EXIST are to manage energy markets and to provide all market participants with transparent and reliable market conditions (EXIST, 2018; Association of European Energy Exchanges (Europex), 2018). In addition, Turkish governments plan on promoting alternative solutions based on renewable energy. Over the last decade, Turkey has been pursuing an innovative energy policy for the future where renewable energy plays an important role. Turkey has proved international cooperation by signing Kyoto Protocol in 2009 and by