



Energy, pollution, and economic development in Tunisia



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ABSTRACT

Since the United Nations Conference on Environment and Development held its Rio meeting in 1992, where participants discussed the necessity of fighting against the hazardous effects of pollution and climate change, these issues have become even more pressing world-wide. The ever-increasing consumption of energy is depleting the planet's natural capital to a degree that could impact our future prosperity. According to the 2008 *Living Planet Report*, if demands for energy were to continue to grow at their current rates, by the mid-2030s we would need the equivalent of two planets to meet our global supply needs.¹

The rising level of energy consumption that is occurring internationally also is being mirrored at regional and national levels. An interesting case study along these lines is Tunisia, which is one of the high-growth economies in the Middle East and North African area yet lacks sufficient energy supply to satisfy its growing demand. Tunisia looks like many nations around the world with a young population, growing economy, increasing domestic energy consumption, and the need to balance economic development with environmental concerns.

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1. Introduction

Climate change has received great attention during the last decade for its impacts on human ecosystem and on the economy. One of the most questions worried out the researchers is: How can we attenuate negatives effects of climate change caused by CO₂ emissions? The world wide has discover the danger of climate change and the necessity to develop meaningful and rigorous policies and procedures whose primary objective is protecting environment and attenuating gas emissions at the atmosphere. The Johannesburg Summit 2002 on sustainable development reaffirmed the central role of energy as an engine of economic development, social equality and poverty alleviation. In this Summit, it was pointed out the disastrous and harmful impact of energy as a cause of pollution and over exploitation of resources on human health and the environment. The action plan of Johannesburg Summit 2002 has reaffirmed after the commission on sustainable development in its ninth session in 2001, the

necessity of developing policies and regulatory frameworks that create economic, social and institutional conditions required for expanded access to reliable energy services and environmental friendly. Research in the link between energy consumption, economic growth and CO₂ emissions has widely analyzed and it was been center of controversial and debate. Energy and climate change are intrinsically linked. The way in which we consume energy largely determines society's environmental impact. For this reason, examining energy use is one of the most fundamental ways that can help in obtaining sustainable development. The awareness on climate change and its repercussions makes it essential that there is some understanding of the causal effects of energy consumption on development. This paper begins with a brief review of the literature on causality link between economic growth, energy consumption and CO₂ emissions. The next section highlights data and methodology and empirical results and the last one concludes and states the policy implications of the results.

2. Literature review

The relationship between energy consumption and economic growth, as well as economic growth and environmental pollution, has been one of the most widely investigated in the economic literature in the three last decades. However, existing outcomes have varied considerably. Whether energy consumption stimulates, retards or is neutral to economic activities has motivated

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¹ World Wildlife Federation (WWF), *Living Planet Report 2008*(Gland, Switzerland: WWF, 2008).

curiosity and interest among economists and policy analysts to investigate the direction of causality between energy consumption and economic variables. The pioneer study by Kraft and Kraft (1978) found a uni-directional Granger causality running from output to energy consumption for the United States using data for the period 1947–1974. The empirical outcomes of the subsequent studies on this subject which differ in terms of the time period covered, country chosen, econometric techniques employed, and the proxy variables used in the estimation, have reported mixed results and supports and is not conclusive to present policy recommendation that can be applied across countries. Depend upon the direction of causality; the policy implications can be considerable from the point of view of energy conservation, emission reduction and economic performance. Most of the analyses on this topic have recently been conducted using Vector Autoregression (VAR) models. Earlier empirical works have used Granger (1969) or Sims (1972) tests to test whether energy use causes economic growth or whether energy use is determined by the level of output (Akarca and Long, 1980a,b; Yu and Hwang, 1984). Their empirical findings are generally inconclusive. Where significant results were obtained they indicate that causality runs from output to energy use. With advances in time series econometric techniques, more recent studies have tended to focus on vector error-correction model (ECM) and the cointegration approach. Masih and Masih (1996) used cointegration analysis to study this relationship in a group of six Asian countries and found cointegration between energy use and GDP in India, Pakistan, and Indonesia. No cointegration is found in the case of Malaysia, Singapore and the Philippines. The flow of causality is found to be running from energy to GDP in India and from GDP to energy in Pakistan and Indonesia. Using trivariate approach based on demand functions, Asafu-Adjaye (2000a,b) tested the causal relationship between energy use and income in four Asian countries using cointegration and error-correction analysis. He found that causality runs from energy to income in India and Indonesia, and a bidirectional causality in Thailand and the Philippines. Stern (2000) undertakes a cointegration analysis to conclude that energy is a limiting factor for growth, as a reduction in energy supply tends to reduce output. Yang (2000a,b) considers the causal relationship between different types of energy consumption and GDP in Taiwan for the period 1954–1997. Using different types of energy consumption he found a bi-directional causality between energy and GDP. This result contradicts with Cheng and Lai (1997a,b) who found that there is a uni-directional causal relationship from GDP to energy use in Taiwan. Soytaş and Sari (2003) discovered bidirectional causality in Argentina, causality running from GDP to energy consumption in Italy and Korea, and from energy consumption to GDP in Turkey, France, Germany and Japan. Paul and Bhattacharya (2004a,b) found bidirectional causality between energy consumption and economic growth in India. Wolde-Rufael (2005) investigates the long-run and causal relationship between real. Using cointegration analysis, Wietze and Van Montfort (2007) show that energy consumption and GDP are co-integrated in Turkey over the period 1970–2003 and found a unidirectional causality running from GDP to energy consumption indicating that energy saving would not harm economic growth in Turkey. The relationship between output and pollution level has also been well discussed in the literature of Environmental Kuznets Curve (EKC) where environmental degradation initially increases with the level of per capita income, reaches a turning point, and then declines with further increases in per capita income (Grossman and Krueger, 1991a,b; Shafik and Bandyopadhyay, 1992). The conclusions of Hettige et al. (1992), Cropper and Griffiths (1994), Selden and Song (1994) and Grossman and Krueger (1995) are consistent with the EKC hypothesis. Martinez-Zarzoso and Bengochea-Morancho (2004) find evidence that CO₂

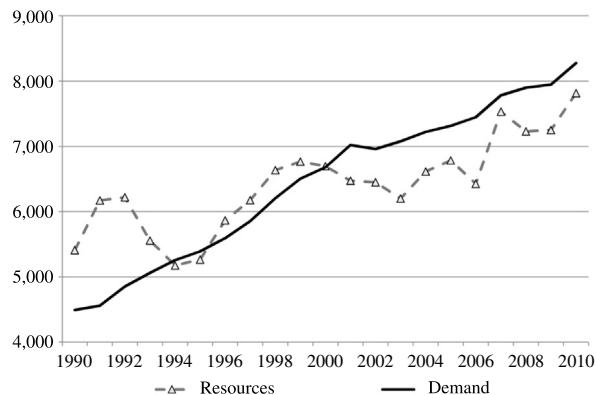


Fig. 1. National resources and domestic demand for primary energy in Tunisia, 1990–2010.

Source: Compiled by the authors based on data from Tunisia, National Agency for Energy Conservation (ANME), *The National Agency for Energy Conservation Report*, 3rd edition (Tunis, Tunisia: ANME, June 2011).

emissions and national income are negatively related at low income levels, but positively related at high-income levels. However, increased national income level does not necessarily warrant greater efforts to contain the emissions of pollutants. The empirical results of Shafik (1994) and Holtz-Eakin and Selden (1995) show that pollutant emissions are monotonically increasing with income levels. The existing literature reveals that empirical findings differ substantially and are not conclusive to present policy recommendation that can be applied across countries. In addition, few studies focus to test the nexus of output–energy and output–environmental degradation under the same integrated framework. Given that energy consumption has a direct impact on the level of environmental pollution, the above discussion highlights the importance of linking these two strands of literatures together (Ang, 2007 and 2008). Consequently, to avoid problems of misspecification, these two hypotheses must be tested under the same framework. This study for the case of Tunisian economy tries overcoming the shortcoming literature related with the linkage between economic growth, energy consumption and pollutant emissions under the same integrated framework, following the idea of Ang (2007 and 2008). Tunisia appears to be an interesting case study given that it is one of the highest growth economies in Middle East and North Africa region and energy supply in this country is insufficient to meet the increasing demand. Also, this empirical country study may be useful to formulate policy recommendation from the point of view of energy conservation, emission reduction and economic performance.

3. Tunisian economic and energy situations

The Energy and Environmental Situation in Tunisia: Tunisia is a country with limited natural resources confronted not only with continually increasing domestic energy demand but also with geopolitical and geo-economic upheavals that this sector has experienced. The energy sector is strategic and indispensable to Tunisian socioeconomic development, where the energy balance has started to show a deficit after having maintained a surplus for a period of four decades. Fig. 1 shows the trend of Tunisian demand outstripping resource supply. According to predictions, Tunisia's energy needs will continue to increase at a steady pace, which can be partially explained by the improvement in citizens' standard of living, whereas the national production is decreasing, which means that any durable development in Tunisia should rely, in the years to come, on new growth sources.

Fig. 2 provides an overview of Tunisia's greenhouse gas emissions by source; it highlights that the energy sector is the

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