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Causal relationship between trade openness, economic growth and energy consumption: A panel data analysis of Asian countries

Samia Nasreen *, Sofia Anwar

Department of Economics, Government College University Faisalabad, Faisalabad, Punjab, Pakistan

HIGHLIGHTS

- This study analyzes causality between energy, growth and trade in the Asian region.
- Empirical results supported cointegrating relationship between variables.
- Positive impact of growth and trade openness on energy usage is found in the long run.
- Bidirectional Granger causality is observed between selected variables in the long run.

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ABSTRACT

This paper explores the causal relationship between economic growth, trade openness and energy consumption using data of 15 Asian countries. The study covers the period of 1980–2011. We have applied panel cointegration and causality approaches to examine the long-run and causal relationship between variables.

Empirical results confirm the presence of cointegration between variables. The impact of economic growth and trade openness on energy consumption is found to be positive. The panel Granger causality analysis reveals the bidirectional causality between economic growth and energy consumption, trade openness and energy consumption.

1. Introduction

Rapid population growth, technological development and trade expansion have increased the demand for energy consumption in the recent decade. Around the world energy consumption, economic production and international trades tend to move together so it is significant to learn more about the relationship between energy consumption, economic growth and trade openness. Energy consumption and economic growth relationship is vital because if there is a strong relationship between energy consumption and economic growth, it is very hard to change energy and environmental policies. Furthermore, if the relationship between energy consumption and economic growth is not significant, then energy conservation policy may be adopted with no adverse impact on the economy.

Trade openness is an essential component of economic growth and increase in international trade increases the economic activities and the energy demand (Sadorsky, 2012). The economic condition of the country and the extent of relationship between economic growth and trade openness determine the impact of trade openness on energy consumption (Cole, 2006). Trade openness enables developing economies to import advanced technologies from developed economies. The adoption of advanced technology lowers energy intensity and produces more output. Similarly, energy affects trade openness via various channels. Firstly, energy is an important input of production because machinery and equipment in the process of production require energy. Secondly, exporting or importing manufactured goods or raw materials requires energy to fuel transportation. Without adequate energy supply, trade openness will be adversely affected. Consequently, energy is an important input in trade expansion and adequate consumption of energy is essential for expanding trade via expanding exports and imports. The relationship between trade openness and energy consumption is important. If energy plays its key role to increase the flow of exports or imports, then any policies aiming at reduction in energy consumption such as energy conservation policies will negatively impact the flow of exports or imports, and hence reduce the benefit of trade openness.

Asian countries account for more than 50% of the global population and nature has endowed them with an array of natural energy resources such as wind, coal, water, oil, wood and solar power and a large number of these resources have remained unexploited for decades. This region accounts for just over

* Corresponding author.
E-mail addresses: sami_lcu@yahoo.com (S. Nasreen), Sofia_ageconomist@yahoo.com (S. Anwar).

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one-quarter (28%) of the global primary energy demand, with more than half of this (17% of the global total) in China. Asian economies are relatively more coal-intensive than the rest of the world, accounting for more than half (53%) of the world's coal consumption. Electricity generation from renewable energy sources in Asia is projected to grow at an average annual rate of 5%, which would increase the renewable share of the region's total generation from 15%% in 2007 to 20% in 2035 (International Energy Agency, 2012). In the year 1980, the Asian region's average energy consumption was equivalent to 1102 Kg of oil while the amount increased to 2508 Kg of oil equivalent in 2011 (see Fig. 1).

Asian economies contribute to one-fourth of the world's trade in goods, after Europe. Exports from North America and Asia have grown faster than imports. The growth rate of Asian export was 13% while imports grew by 9%. More than 50% of Asian exports are conducted within the region. Parallel to growing intra-regional trade, Asia's inter regional trade has also increased over time. Europe (18.4%) and North America (21.4%) have become the two largest destinations of Asia's exports. The top merchandise exporter in 2011 was China (US$ 1.58 trillion). The second largest importer in 2011 was also China (US$ 1.40 trillion) (Source: World Trade Report, 2012).

Trade volume in Asia has been rising fast since the early 1970s. Asian region's merchandise trade (export plus import of goods) was worth US$ 0.8 trillion in 1980 but it has amounted to US$ 14 trillion in 2011 (see Fig. 2).

Sustained rapid growth, macroeconomic stability, and improvements in living standards are some of the remarkable achievements of the Asian economies over the past decade. Per capita income in the Asian countries has increased with the passage of time. Developing economies of East Asia and the Pacific region have become an engine of global growth, growing at 7.5% in 2012, higher than any other region in the world. The Asian region contributed to around 40% of global growth in 2012 and the global economy continues to rely on the regions's growth (World Bank Report, 2013). In 1980, the GDP per capita income was estimated as US$1155 but it increased to US$8489 in 2011 (see Fig. 3).

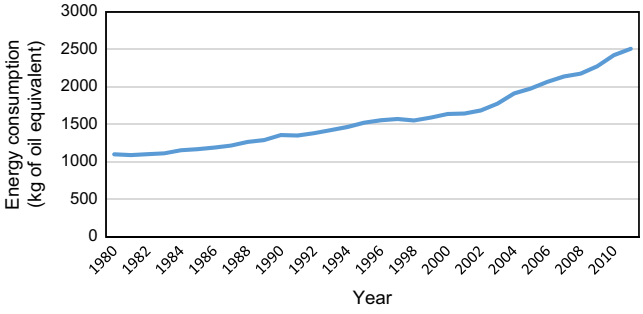

Fig. 1. Annual changes in energy consumption in Asia.
Source: World Development Indicators (CD-ROM, 2012).

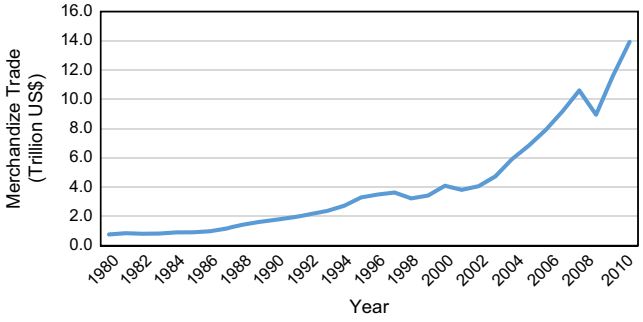

Fig. 2. Annual changes in merchandize trade in Asia.
Source: World Development Indicators (CD-ROM, 2012).

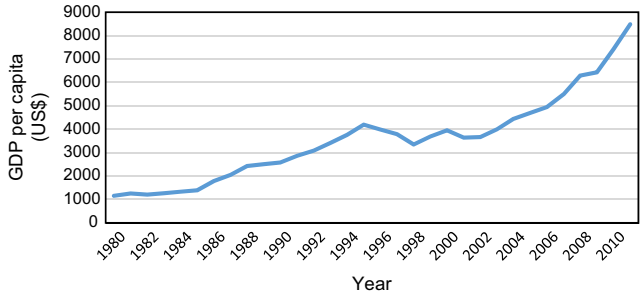

Fig. 3. Annual changes in per capita income in Asia.
Source: World Development Indicators (CD-ROM, 2012).

The existing energy economics literature seems to provide numerous studies which have investigated the causal relationship between energy consumption and economic growth (for example, see Yang, 2000; Narayan et al., 2008; Ozturk, 2010; Payne, 2010). Exports are also considered as an engine of economic growth in the theoretical growth model, and in international economics literature exports and output relationship is widely studied (Giles and Williams, 2000a, 2000b; Lean and Smyth, 2010; Halicioglu, 2010).

This paper extends the literature on energy consumption, economic growth and trade openness in three ways. First, this study uses aggregate variables for energy consumption, economic growth and trade openness so it is a more comparable study than the previous studies which used electricity consumption and exports variables to understand the relationship between energy consumption and trade. Second, in literature most of the researchers investigated only the relationship between energy consumption and economic growth or the relationship between economic growth and trade openness. But it is vital to understand the dynamic relationship of these variables; they must be taken in a combined model. Third, this paper investigates the energy consumption, economic growth and trade openness relationship for Asian countries, the area of the world's largest economies. Also, this is the first study to investigate the link between energy consumption, economic growth and trade openness in the Asian countries. This paper's results are vital for developing energy and environmental policy in the Asian countries.

The rest of the paper is organized as follows: Section 2 gives a brief review of empirical studies, Section 3 presents empirical model and data source, Section 4 provides estimation methodology, Section 5 reports the empirical analysis of results and finally Section 6 concludes the study.

2. Literature review

Theoretically there is a direct association between energy consumption and economic growth. Various studies have been conducted to support this association after the end of the 1970s energy crisis. All these studies (e.g., Kraft and Kraft, 1978; Akarca and Long, 1979, 1980; Yu and Choi, 1985; Abosedra and Baghestani, 1989) found a positive impact of energy consumption on economic growth. However, empirical evidence provided by Zahid (2008), Amirat and Bouri (2010), Noor and Siddiqi (2010), and Apergis and Payne (2010) is conflicting about the direction of causality. For instance, Yu and Choi (1985) investigated the causal relationship between national income and different forms of energy consumption by using cross-country analysis. This study was unable to find any significant relationship between energy and growth in the United States, Poland and United Kingdom. However, a significant relationship was observed between energy consumption and income growth in South Korea and Philippines.