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Short Communication

Convergence in energy consumption per capita among ASEAN countries

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HIGHLIGHTS

- We test for convergence in energy consumption per capita among the ASEAN nations.
- Univariate conventional unit root tests provide mixed evidence of convergence.
- Panel unit root tests with structural breaks support convergence hypothesis.

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ABSTRACT

We test for convergence in energy consumption per capita among ASEAN countries over the period 1971 to 2011 using the panel KPSS stationarity test and panel Lagrange multiplier (LM) unit root test. The results for the panel stationarity and unit root tests with structural breaks find support for energy convergence in ASEAN.

1. Introduction

A series of papers have examined convergence of energy consumption per capita or energy intensity using different methods (see e.g. Jakob et al., 2012; Liddle, 2009; Markandya et al., 2006; Maza and Villaverde, 2008; Miketa and Mulder, 2005; Mohammadi and Ram, 2012; Mulder and de Groot, 2012). At the same time, a series of studies have examined conditional convergence in other variables using unit root tests, including carbon dioxide emissions (see e.g. Barassi et al., 2008; Lee and Chang, 2008; List, 1999; Strazicich and List, 2003); Gross Domestic Product (GDP) (see e.g. Carlino and Mills, 1993; Guetat and Serranito, 2007), health expenditure (Narayan, 2007), stocks (Narayan et al., 2011) and tourist arrivals (see e.g. Narayan, 2006, 2007a; Lean and Smyth, 2008). Testing for conditional convergence, employing unit root testing, has advantages over conditional tests for convergence based on so-called β convergence, given the original Solow–Swan growth model (Solow, 1956; Swan, 1956), suggests conditional, rather than absolute, convergence.

Beginning with Narayan and Smyth (2007) a large literature has emerged which examines the unit root properties of energy consumption (see Smyth, 2013). Recently, Meng et al. (2013) extended this literature to apply unit root tests for individual time series tests to examine conditional convergence in energy consumption per capita in Organization for Economic Cooperation and Development (OECD) countries.

The purpose of this paper is to build on Meng et al. (2013)'s contribution, to apply unit root tests to examine conditional convergence in energy consumption per capita in Association of Southeast Asian Nations (ASEAN) countries. ASEAN came into existence in 1967 with five founding members: Indonesia, Malaysia, Singapore, Philippines and Thailand (the ASEAN-5). It later expanded to include five more countries; namely, Brunei Darussalam (joined 1984), Vietnam (joined 1995), Lao PDR, Myanmar (both joined 1997) and Cambodia (joined 1999). Our main results are presented for the ASEAN-5, as these nations were the founding members, remain the most influential members and, most importantly, were part of ASEAN for the whole period of the study (1971–2011). We also present robust checks for a broader sample of ASEAN countries for which data is available over the same period.

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Our contribution differs from Meng et al. (2013) in two respects. First, we examine energy convergence within a group of countries explicitly committed to greater economic (and energy) integration. Second, we apply panel tests to examine conditional energy convergence. We employ panel versions of the Lagrange multiplier (LM) unit root test and KPSS (Kwiatkowski et al., 1992) stationary test, with structural breaks. This has the advantage that it exploits both the cross-sectional and time series information available in the data on energy consumption to evaluate the convergence hypothesis, while still allowing for the potential for structural breaks.

The issue of energy convergence is important because it has implications for sustainable energy consumption and efforts to curtail carbon dioxide emissions. It is important to know how energy consumption changes in relation to growth in GDP. Many countries have adopted policies to decrease energy intensity and promote energy efficiency. At the same time, there has been a concerted effort to reduce carbon dioxide emissions. If there is evidence of rapid energy convergence and growth rates are relatively modest, this suggests that targets to contain growth in energy consumption are feasible. Reductions in disparities in energy consumption per capita between countries is, thus, evidence such policies have been successful.

A high proportion of the world's population is concentrated in the developing countries of Southeast Asia. There are 600 million people in ASEAN alone. These countries have experienced high growth rates in GDP and energy use. Average economic growth in the so-called ASEAN-6 (the ASEAN-5 plus Vietnam) in the lead up to the global financial crisis (GFC) (2003–2007) was 6 per cent. Projected growth rates for the same set of countries after recovery from the GFC (2011–2015) is 6 per cent (Organization for Economic Co-operation and Development (OECD), 2014). The growth rate in primary energy consumption in the Asia Pacific region, as a whole, is almost double the world average (Aguilera et al., 2014). At the same time, there is a high level of energy poverty, with relatively low rates of access to electricity across many of the ASEAN countries (Navarro et al., 2013). Fast growth in GDP and energy use in ASEAN has put the need for sustainable energy solutions front and centre in the ASEAN countries. This is reinforced by the finding that the ASEAN-5 are energy dependent countries (Lean and Smyth, 2010).

ASEAN has placed much emphasis on energy integration as part of more general economic integration. The target is for ASEAN to establish the ASEAN Economic Community (AEC) by December 31, 2015.[3] The ASEAN Plan of Action for Energy Cooperation (APAEC) 2010–2015 covers the energy component of the AEC blueprint. The centrepiece of APAEC is an ASEAN Power Grid (APG) and Trans-ASEAN Gas Pipeline (TAGP), which are designed to facilitate energy integration within ASEAN. The APG aims to link ASEAN members who are in power surplus with those in power deficit by 2020. The objective of the TAPG is to link suppliers and purchasers of gas within ASEAN. As of the end of 2013, there were 11 gas pipelines connecting ASEAN countries with a twelfth due to be completed in mid-2014 (Desker, 2013).

Energy market integration within ASEAN is seen as an important vehicle to promote energy efficiency and reduce carbon dioxide emissions. One study suggests that if 50 per cent of energy demand in ASEAN was met through trade as a result of APAEC, that the total cost of meeting energy demand would fall by 3.9 per cent, equivalent to $US 29 billion (Chang and Li, 2013). Asian Development Bank (ADB) (2009) estimates that the closely related Greater Mekong Subregion energy agreement will result in a 3 per cent reduction in carbon dioxide emissions.

The issue of energy convergence speaks directly to whether energy market integration promotes more equitable energy access across countries. An objective of energy market integration is more equitable access to energy in the region; however, the evidence on whether economic integration reduces the gap between countries is mixed (Sheng and Shi, 2013). Evidence of convergence in energy consumption per capita would be consistent with energy market integration in ASEAN promoting not only more efficient, but also more equitable access to energy within the region.

2. Method

2.1. Data

The data for per capita energy consumption for the five ASEAN countries for the period 1971–2011[4] were collected from the World Development Indicators (WDI) database. Per capita consumption use is expressed in kg of oil equivalent and is defined as the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.[5] Descriptive statistics for the energy series for each of the ASEAN-5 is in Table 1.

For each country i, we transformed the energy consumption series to a measure of relative energy consumption, using the following formula:

$$\text{Relative Energy Consumption}_{it} = \ln\left(\frac{\text{Per Capita Energy Consumption}_{it}}{\text{Average Per Capita Energy Consumption}_{t}}\right)$$

All the analysis is conducted on this transformed series. The transformed series is used to measure the convergence properties of energy consumption.[6] If relative energy consumption is found to be stationary, this suggests that energy consumption across the ASEAN countries is converging. The transformation has the advantage that it removes the cross-sectional shocks that affect all the countries in the panel. For instance, any positive shock to energy consumption across all the countries will increase the average by the same proportion and hence leave the relative energy consumption series unchanged (Meng et al., 2013). This implies that any structural breaks identified in the transformed series would be country specific.

In order to test the efficacy of this approach in removing cross-sectional dependence, we conducted the Pesaran (2004) cross-sectional dependence (CD) test on the energy consumption series, before and after transforming it into relative energy consumption. The results are reported in Table 2. The top panel reports the results for the untransformed energy use series. We note that the Pesaran CD statistic is highly significant at all the 4 lags, implying a strong rejection of the null of cross-sectional independence. The bottom panel reports CD statistics for the transformed series, where we fail to reject the null of cross-sectional independence, even at 10 per cent. These results suggest that cross-sectional dependence is not present in the data.

[3] Officially ASEAN remains committed to establishing the AEC by 2015, but increasingly regard 31 December, 2015 as a target and not as a deadline. ASEAN releases scorecards as to the progress of implementing the AEC Blueprint—the document outlining the targets, sectors and proposed measures covered under the AEC initiative. The scorecards produce a statistic referred to as the 'implementation rate', which is the ratio of measures that are fully implemented to total number of measures targeted. A news article published in February 2014 (Kyodo News, 2014) quotes ASEAN officials that place this figure at 72 per cent and notes that the overall progress has declined since 2013.

[4] As a robust check, we also use data for an ASEAN-8 over the same period (all ASEAN members, less Cambodia and the Lao PDR for which data are not available).

[5] Meng et al. (2013) also use primary energy consumption (also from the WDI database). The use of primary energy consumption facilitates comparison with their study.

[6] Using this measure of convergence follows the approach in Meng et al. (2013).