ELSEVIER

Energy Policy 35 (2007) 50–60

ENERGY POLICY

www.elsevier.com/locate/enpol

Household energy consumption versus income and relative standard of living: A panel approach

Roselyne Joyeux, Ronald D. Ripple*

Macquarie University, Sydney, Australia

Available online 21 November 2005

Abstract

Our fundamental premise is that energy consumption at the household level is a key indicator of standard of living. We employ state-of-the-art panel cointegration techniques to evaluate the nature of the relationship between income measures and energy consumption measures for seven East Indian Ocean countries. The general finding is that income and household electricity consumption are not cointegrated. Given this finding, we conclude that standard of living measures that rely on income measures and do not include household-level energy consumption information will necessarily miss important indications of both levels and changes of standard of living.

JEL classifications: 131; C33; Q43

Keywords: Standard of living; Household energy consumption; Panel cointegration

1. Introduction

This paper takes the analysis of the relationship between energy and income in a different direction than prior research, and it introduces panel cointegration techniques as an analytical tool to this area of research. The results of our research are important because they raise additional questions about the effectiveness of income as a proxy indicator for standard of living, and these conclusions are supported by the use of more powerful analytical techniques.

The fundamental premise of our research is that energy consumption at the household/residential level is a key indicator of the standard of living for the residents of a country. We have chosen household electricity consumption as our observable measure of residential energy consumption, as it is widely viewed and accepted as providing substantial standard of living (quality of life) gains. These gains come in many areas and suggest that observable household electricity consumption may provide useful insights into the nature of standard of living across countries and changes in standard of living over time. For example, the availability of electricity allows for the refrigeration of food, thus improving health. Another area of improvement is literacy, which will be enhanced through lighting, the use of computers, and potentially internet access. There are also potential productivity improvements due to the ability to work past sunset and environmental benefits due to reduced demands on traditional fuels. These characteristics suggest that household electricity consumption will be a key indicator of standard of living where it matters; at the household level.

Given that electricity consumption at the residential level is perceived to provide valuable insights into the standard of living of a country's residents, any index that aims to measure standard of living but does not capture this information should be questioned. In line with this premise, we examine whether or not observations of electricity consumption at the household level are adequately captured by traditional aggregate income-based measures of standard of living.

Aggregate income measures have been argued to be inadequate for the effective measurement of relative

*Corresponding author. Tel.: +61 2 9850 7063; fax: +61 2 9850 8586.
E-mail address: rripple@efs.mq.edu.au (R.D. Ripple).

0301-4215/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.enpol.2005.10.012

changes of standard of living among countries of the world. Typically some composite index is proposed, which will usually retain a role for an income measure. There is then additional research that argues that these composites also fail, with some of the emphasis on how they fail to capture anything significant beyond what a stand-alone income measure reveals.

Given the questions raised regarding the additional information content of composite indexes, we selected purchasing-power-parity-adjusted gross domestic product (PPP-GDP) as our measure of aggregate income. This provides an aggregate income measure reported on a comparable basis across the countries included in our analysis. We then examine the relationships between PPP-GDP and household electricity consumption.

The approach of our research is to employ panel cointegration tests to examine the information relationship between this measure of aggregate income and residential electricity consumption as they relate to measuring relative levels of standard of living. While the relationship between energy and income has been studied for quite some time, the focus of this paper differs from earlier work, as it assesses whether or not measures of income can capture the standard of living benefits of household energy usage, rather than whether or not energy consumption is a prime macroeconomic driver.

We find strong evidence that there is no cointegrating relationship between these two economic variables. This implies that observations on aggregate income will not be able to capture relevant information related to the contribution of household electricity consumption to standard of living. Our results, via a new avenue of research employing more powerful analytical techniques, support the conclusion that income is an inadequate proxy for standard of living. We also conclude that income measures will be meaningless for the evaluation of the long-run success or failure of targeted household energy development programs.

Evaluating the effectiveness of a proxy indicator is made more difficult when the variable of interest is unobservable, as with the concept of standard of living. The approach we have taken is to identify an observable variable at the household level that carries with it strong theoretical linkage to standard of living and one that is generally accepted as being strongly related to standard of living benefits. We then test whether or not a standard aggregate income measure is capable of capturing the information content of this household level variable.

Our alternative approach also introduces the state-of-the-art econometric time series panel techniques to the evaluation of the nature of the relationship between income measures and energy consumption measures, in general. While our focus is on the information content relationship between the PPP-GDP and residential electricity consumption series, we also have a little to say about some of the older questions addressed in earlier research regarding the relationships between income and broader definitions of energy consumption.

The paper proceeds with a discussion of the literature relating energy and income in section two. Section three will introduce the hypothesis of this paper related to the information content of energy versus income series. Section four will introduce the data, while section five will present the panel data time series techniques employed to test our hypothesis. Section six will summarize the results, and section seven will conclude with some suggestions for useful research extensions of the methods employed herein.

2. Energy and income—economic growth

The seminal paper inquiring into the relationship between energy consumption and aggregate income is Kraft and Kraft (1978). The focus of their paper, and much of the energy–income research that followed, is an attempt to determine a causal relationship between these two economic variables. The theoretical arguments ran in both directions.

The analyses were conducted at an aggregated, national level. Kraft and Kraft (1978) tested the causal relationship between gross energy consumption and gross national product (GNP) for the United States, with data covering the 1947–1974 period. Their motivation is captured in the following: ''According to a current view, there is a constant and unchanging relationship between gross energy consumption and GNP. A logical corollary is that energy conservation is an unacceptable policy option since it would adversely influence economic activity. This implies that the direction of causality runs from energy to GNP as well as the other way around.'' (Kraft and Kraft, 1978, p. 401) Their primary finding was that causality was unidirectional running from GNP to energy, suggesting that energy conservation programs would not adversely affect economic growth.

An extensive literature has followed. These include Akarca and Long II (1980), Yu and Choi (1985), Erol and Yu (1988), Abosedra and Baghestani (1991), Hwang and Gum (1992), Yu and Jin (1992), Masih and Masih (1996, 1997), and Soytas and Sari (2003). The findings of these papers, and others, provide anything but consensus. Indeed, Akarca and Long (1980) declare that the Kraft and Kraft (1978) results are spurious, based on a finding of no causal relationship in either direction, by changing the time period by just two years; a reduction, eliminating 1973 and 1974 data, which may introduce a structural shift into the series. This result suggested neutrality between GNP and energy consumption. The mixed results have been argued to be the result of different methods, different series, and different time periods. While outside the focus of this paper, the question of causality between macroeconomic income and energy consumption will likely benefit from the application of the estimation techniques introduced in this paper.

In one sense the work in the present paper may be seen as extending this line of research by analyzing the cointegrating relationships based on panel data. An