



The long-run causal relationship between electricity consumption and real GDP: Evidence from Japan and Germany

Masako Ikegami ^{a,*}, Zijian Wang ^b

^a Department of Innovation Science, School of Environment and Society, Tokyo Institute of Technology, Ookayama 2-12-1-W9-42, Meguro-ku, Tokyo 152-8552, Japan

^b Center for Pacific Asia Studies, Uppsala, Sweden

Available online 20 October 2016

Abstract

We examine the long-run relationships between total electricity consumption (and two electricity types, i.e., combustible fuels electricity and nuclear energy) and real GDP for Japan and Germany, respectively, in a four-variable cointegration framework over 1996Q4–2015Q2. In each country's case, we find a significant cointegrating relationship between total (and type) electricity consumption and real GDP. We then examine Granger causality between total (and type) electricity consumption and real GDP for each country. In Japan's case, real GDP is dependent on electricity consumption over 1996Q4–2015Q2. In Germany's case, electricity consumption follows fluctuations in real GDP. Both countries had an oversupply of nuclear energy in relation to real output over 1996Q4–2011Q1. The oversupply of nuclear energy in Germany has been eliminated following the recent nuclear phase-out. Japan, however, has a revived tendency to hang on to nuclear power. © 2016 The Society for Policy Modeling. Published by Elsevier Inc. All rights reserved.

JEL classifications: C22; O57; Q43

Keywords: Bounds test; Fukushima; Granger causality; Nuclear phase-out; Structural break

1. Introduction

Understanding the long-run relationship between electricity consumption and real GDP is crucial to national energy policy-making. Beginning with the seminal work of [Kraft and Kraft](#)

* Corresponding author.

E-mail address: maike@valdes.titech.ac.jp (M. Ikegami).

(1978), a vast literature has been devoted to the nexus between energy (and types of energy) consumption and economic growth in different countries. The statistically significant association between energy consumption and real GDP in itself does not suggest any causal relationship as to whether energy consumption has spurred real output (and vice versa). The long-run relationship including causation between energy consumption and real GDP is the ultimate concern. In extant literature, cointegration and Granger causality tests have mostly been used for estimating the long-run causal relationships between energy (electricity) consumption and real output for different countries. The empirical results, however, have remained contradictory for a single country and often mixed across countries. [Ozturk \(2010\)](#) provides an informative literature review in this regard.

In energy economics, the energy consumption-real GDP relationship, based on the empirical findings on Granger causality directions, has been summarized as follows ([Payne, 2010](#)): (1) the growth hypothesis, given the unidirectional causality running from energy consumption to real GDP, suggests that energy consumption has a direct impact on real GDP while real output is dependent on energy consumption; (2) the conservation hypothesis, given the unidirectional causality running from real GDP to energy consumption, suggests that energy consumption is driven by real output while decreased energy use would not adversely affect real output. In this case, energy conservation is a feasible choice; (3) the feedback hypothesis, given the bidirectional causality between energy consumption and real GDP, suggests that energy consumption and real GDP are mutually dependent; and (4) the neutrality hypothesis, given no causality between energy consumption and real GDP, suggests that energy consumption and real GDP have virtually no impact on each other. These four hypotheses are policy-relevant. It is empirically important to determine the direction(s) of Granger causality between energy (including different types of energy) consumption and real output.

In extant literature, very few studies have focused on the nexus between electricity (nuclear energy) consumption and real GDP in Japan and Germany. Such ambitious cross-country studies as [Wolde-Rufael and Menyah \(2010\)](#), [Lee and Chiu \(2011\)](#), [Nazlioglu, Lebe, and Kayhan \(2011\)](#), and [Chu and Chang \(2012\)](#), have included Japan or Germany in their samples when analyzing the long-run causal relationships between nuclear energy and real GDP in a time series (and panel data) setting. These studies yield mixed results specific to Japan and Germany but provide little insight into the causal mechanism unique to each country, let alone any sensible comparison. This gap in existing research motivated us to carry out the present study. Japan and Germany are highly comparable in terms of GDP, capital stock and labor force measures. In particular, their respective shares of combustible fuels electricity and nuclear energy in total electricity generation are quite similar. Given their similar patterns of electricity use, a study comparing the nexus between total (and type) electricity consumption and real GDP in Japan and Germany is meaningful. Following the Fukushima nuclear disaster of March 2011 (hereafter Fukushima disaster), Germany decided firmly to phase out nuclear energy in response to the social and environmental hazards associated with the nuclear power plants. In other words, the Fukushima nuclear disaster has a direct bearing on the subsequent nuclear phase-out in Germany. This particular background makes our research policy-relevant.

Most previous studies of the nexus between energy (electricity) consumption and real output rely on annual data with short time spans and do not differentiate between various energy (electricity) types in their analyses. This paper provides disaggregated analyses of electricity types and, hence the long-run relationships between nuclear (and combustible fuels) electricity and real output are considered. The choice of the sample period 1996Q4–2015Q2 was subject to data availability. Most previous studies are based on a bivariate system (i.e., energy use and real output

Download English Version:

<https://daneshyari.com/en/article/5101705>

Download Persian Version:

<https://daneshyari.com/article/5101705>

[Daneshyari.com](https://daneshyari.com)