Utilities Policy xxx (2016) 1–8

Contents lists available at ScienceDirect

Utilities Policy

journal homepage: www.elsevier.com/locate/jup

Are shocks to electricity consumption transitory or permanent? Sub-national evidence from Turkey

Eyup Dogan

Department of Economics, Abdullah Gul University, Sumer Campus, Office#B211, Kayseri, Turkey

ARTICLE INFO

Article history:
Received 16 October 2015
Received in revised form
7 June 2016
Accepted 7 June 2016
Available online xxx

Jels Codes:
C22
Q47
Q48

Keywords:
Unit root
Electricity consumption
Sub-national data

ABSTRACT

This is the first study that aims to investigate policy shocks to energy consumption in terms of unit root properties by sector. More precisely, we analyze the stationarity of electricity consumption for 12 regions of Turkey by four sectors in addition to total electricity consumption by region (for a total of 60 cases). We find that 48 cases are non-stationary and 12 cases are stationary. Thus, policies to decrease or stimulate the use of electricity have permanent effects on electricity consumption in 80% of the cases and transitory effects in the rest. Findings and policy implications are further discussed.

1. Introduction

Research on the stationarity of energy consumption has increased substantially over the past decade (Smyth, 2013; Smyth and Narayan, 2015). The stochastic behaviors of relevant variables are worth knowing for several reasons (Hasanov and Telatar, 2011). First, shocks to electricity consumption will have temporary effects if found to be stationary[1]. In the case of stationarity, government policies in this area may not be effective because innovations in the electricity sector may not have permanent impacts and electricity consumption will likely return to its original equilibrium level. Second, the non-stationarity of electricity consumption may alter the integration properties of some macroeconomic variables, such as interest rates, inflation rates, and GDP. Third, the stationarity of electricity consumption is important for estimating a reliable econometric model. In particular, a cointegration test must be used in when variables in a model are non-stationary because otherwise the coefficients of the independent variables become suspect. Finally, electricity consumption can be easily forecast if it is stationary; it cannot be easily forecast if it is non-stationary due to the stochastic nature of key factors.

Despite being an important subject for energy economics and having the attention of many studies, we see several limitations in the existing literature following Smyth (2013), and Smyth and Narayan (2015). First, the majority of studies consist of multi-country studies, which prevents researchers from investigating various disaggregated energy consumption by sector. Identifying heterogeneity across sectors is of central importance to policy makers since the stationarity of energy consumption factors may depend on the sector in which they are consumed. Even though many studies analyze single-countries, only a few consider stationarity properties by sector. Second, there is clearly a geographic toward the United States (U.S.); Smyth (2013) notes that 38% of single-country studies focus on the U.S. Furthermore, much of the existing literature considers aggregate energy consumption. Disaggregation has value because one form of energy consumption may contain a unit root whereas other forms of energy consumption may not contain a unit root[2]. Strategies proposed by policy

E-mail address: eyup.dogan@agu.edu.tr.

[1] Shocks or sudden changes in consumption is related to socioeconomic, technological, and policy changes that affect prices or other key consumption factors.

[2] Referring to Wooldridge (2015), a *unit root* is a *feature* of *processes* that *evolve through time* that *can cause problems* in *statistical inference involving time series models*.

http://dx.doi.org/10.1016/j.jup.2016.06.007
0957-1787/

makers should differentiate among types of energy consumption accordingly.

The last and prominent limitation in the literature is that only a small number of studies employ sub-national data. Exploring possible differences in energy use across regions within a country is important for at least two reasons. If energy consumption is found to be stationary in one region and non-stationary in another region, national policies to encourage or discourage energy consumption, taken as shocks to consumption, will have transitory and permanent effects in these regions, respectively. In this regard, governments may want to understand the reasons behind the heterogeneity across regions in order to apply different policies to each region. The use of regional data is of great utility. It takes into account several specificities and differences among regions, which allows for drawing more accurate conclusions and crafting more sustainable policies. Furthermore, it helps policy makers explore heterogeneity across sectors within a region, the heterogeneity for a specific sector across regions, and the heterogeneity across regions for a country.

In light of these considerations, this study contributes to the existing body of knowledge, both theoretical and practical, by empirically investigating unit root properties of electricity consumption for 12 regions of Turkey across four sectors in addition to total electricity consumption by region[3]. The investigation of electricity sector of Turkey is important to the literature because Turkey is the sixth largest consumer of electricity in Europe after Germany, France, the UK, Spain, and Italy (CIA World Factbook)[4]. Turkey is also an impressive country in regional and world affairs, a candidate country for the European Union, and a member of the G-20 countries.

To the best of our knowledge, this is the first time in the literature to investigate integration properties for a type of energy consumption by sector at the sub-national level. Karanfil (2009) asserts that policy makers care much more about the robustness and consistency of outcomes rather than time periods and econometric approaches employed in research studies. Because Smyth (2013) suggests the use of multiple unit root tests to make the results robust and consistent, we apply the Dickey-Fuller unit root test based on Generalized Least Squares regression, the Phillips-Perron unit root test, and the Zivot-Andrews unit root test with one endogenous structural break.

The rest of this study is as follow. The next section reflects on the state of the art, Section 3 describes the data and the methodology, Section 4 explores the results and compares them with the existing literature, and the last section concludes with findings and policy implications.

2. Literature review

A number of research studies have investigated the stationarity of energy consumption and related factors (Narayan and Smyth, 2007; Chen and Lee, 2007; Narayan et al., 2008; Lean and Smyth, 2009; Gil-Alana et al., 2010; Apergis and Tsoumas, 2011; Ozturk and Aslan, 2011; Lean and Smyth, 2013; Barros et al., 2013; Shahbaz et al., 2014; Yilanci and Tunali, 2014). Starting with studies focusing on national data, Narayan and Smyth (2007), applying Augmented Dickey-Fuller unit root test (ADF) to annual data, revealed that energy consumption is stationary in 31% of 182 countries. Chen and Lee (2007) found that energy consumption is stationary based on a panel study of 104 countries that employed panel unit root tests with structural breaks. Narayan et al. (2008) found evidence of mixed order of integration for crude oil consumption based on a panel of 60 countries and using several panel unit root tests without structural breaks (although their model did not contain a unit root after the authors accounted for possible structural breaks in their time-series). For a panel of 13 Pacific Island Countries, Mishra et al. (2009) provided evidence of mixed order of integration for energy consumption, employing stationarity tests without structural breaks; however, energy consumption was found to be stationary once the possibility of breaks was considered. Apergis and Tsoumas (2011) investigated integration properties related to the consumption of disaggregated solar, geothermal, and biomass for the U.S. by sectors, and noted that stationarity properties depend on the type of energy and vary by sector when using fractional unit root tests with and without structural breaks. By applying LM univariate unit root tests with up to two structural breaks to the Turkish sectoral data at national level, Ozturk and Aslan (2011) found that energy consumption includes no unit root in all sectors. Lean and Smyth (2013) show that the production of renewable energy, biofuels, and biomass for the U.S. are integrated of order one based on the LM univariate unit root tests with up to two structural breaks. Regarding natural gas consumption for a total of 43 countries, Shahbaz et al. (2014) revealed that the null hypothesis for the unit root test can be rejected for nearly 40% of these countries. Yilanci and Tunali (2014), using Fourier LM unit root test with structural breaks, showed that shocks to aggregate energy consumption are transitory in only 26 of 109 countries.

A small number of studies found in the literature use sub-national data. We are aware of only five that used sub-national data to investigate the integration properties of energy variables; surprisingly, four are based on U.S. data and one uses Australian sub-national data. Apergis and Payne (2010), using two different unit root tests with endogenously determined structural breaks, concluded that petroleum consumption is stationary in the majority of U.S. states. Narayan et al. (2010) found mixed evidence by applying stationarity tests with structural breaks as they investigated unit root properties of energy consumption for Australian states across nine sectors. Apergis et al. (2010a) showed that shocks to coal consumption are temporary based on a panel study of U.S. states where they applied several panel unit root tests with structural breaks. Apergis et al. (2010b) analyzed integration properties of natural gas consumption for U.S. states by employing several panel stationarity tests with and without structural breaks, claiming that the time-series data become stationary once structural changes are considered. Also looking at natural gas consumption, Aslan (2011) found that the null hypothesis regarding a unit root can be rejected for only 23 of the 50 U.S. states.

3. Data and methods

The annual data on electricity consumption by sector for 12 regions of Turkey were obtained from the Turkish Statistical Institute (www.turkstat.gov.tr)[5]. The data are from 1995-2013[6]. These sectors considered are industrial (IND), business (BUS), agriculture (AGR), and residential (RES) in addition to total electricity consumption (TOT). The regions are denoted by TR1 (Istanbul), TR2 (West Marmara), TR3 (Aegean), TR4 (East Marmara), TR5 (West Anatolia), TR6 (Mediterranean), TR7 (Central Anatolia), TR8 (West Black Sea), TR9 (East Black Sea), TR10 (Northeast Anatolia), TR11

[3] Regions and sectors are formed by the Turkish Statistical Institute.

[4] Please use the URL for an online version of the World Factbook https://www.cia.gov/.

[5] Construction and public buildings are not included in this study due to data unavailability. The database used here can be provided upon request for those who find it difficult to download the data from the source.

[6] These data are not available prior to 1995.

Please cite this article in press as: Dogan, E., Are shocks to electricity consumption transitory or permanent? Sub-national evidence from Turkey, Utilities Policy (2016), http://dx.doi.org/10.1016/j.jup.2016.06.007