THE EFFECT OF RENEWABLE ENERGY TO RETAIL ELECTRICITY PRICES: PANEL EVIDENCE FROM OECD AND EU COUNTRIES

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Overview

The centrality of electricity to everyday life is indisputable, and its optimal pricing thereof can have significant implications. The European Commission (2016) states that while low electricity prices "raise purchasing power," and increases both living standards and industry competition, high electricity prices act as a signal to move to cleaner energy and improve energy efficiency. Studying the effect of increasing renewables on electricity prices is crucial in understanding market signals. The purpose of this study is to examine the effect of the continuously increasing share of Renewable Energy Sources (RES) in the energy mix on electricity prices in 34 OECD countries for 1997 to 2015, considering the change in electricity market structure. This study extends on the research done by Moreno, López and García-Álvarez (2012) broadening the country group from European Union (EU) countries to include OECD countries as only EU countries fall under the emission trading scheme (EU-ETS). Extending the time period from 1997 to 2007 to include the most recent time period that was characterized by the financial crisis and its aftermath, allows us to view the subsequent constraints on investment as well as the decrease in the cost of renewable energy technologies.

Many IEA member countries embarked on the process of electricity market liberalization in the 1990s motivated by sector inefficiencies, the increasing trend of privatizing state-owned companies and the declining transitional cost towards a different system. Electricity market liberalization contributed to significant economic benefits, as competition increased efficiency within the sector, producing long-term consumer benefits. However, the system requires government involvement in upholding checks and balances (IEA, 2005). The European Union fully liberalized majority of their electricity markets in 2014, all member countries except Bulgaria and Malta are compliant. Industry electricity prices decreased in Australia, Denmark, Finland, Norway, Sweden, the United Kingdom, and the United States after market liberalization. However, retail electricity prices have seen an increase, largely due to increasing fuel cost and cost associated with CO2 emissions within Europe (IEA, 2005). Trujillo-Baute, del Río and Mir-Artigues (2018) attribute the sharp increase in retail elasticity prices over the years to the increase in renewable energy sources, while the European Commission (2016) states that wholesale electricity prices have decreased significantly although retail electricity prices tend to increase due to the “network price component, taxes, and levies". Transmission and distribution networks along with fuel cost are essential components of electricity prices, the former resulting from developments in economic regulation and not from increased competition in the electricity market. Fuel efficiency and ultimately energy efficiency has been a significant risk indicator for investors and determines the economic efficiency of a power plant (IEA, 2005). The International Renewable Energy Agency (IRENA, 2018) recently projected that within the next two years all renewable energy sources would be price competitive with fossils fuels. This new development is likely to increase the renewable energy share even further. The cost of renewable energy technologies decreased over the years and is expected to decrease further, which could potentially lower electricity prices in the future.

Methods

This paper’s methodology is based on one of the models employed by Moreno et al. (2012). Our model is defined as:

$$\ln(y_{i,t}) = \alpha_i + \beta_1 \ln(RESE_{it}) + \beta_2 \ln(GDPPC_{it}) + \beta_3 \ln(EIE_{it}) + \beta_4 ED_{it} + \beta_5 \ln(EGC_{it}) + u_{it}$$

Where y is household electricity prices as the dependent variable along with RES-E, GDPPC, EIE, ED and EGC as the explanatory variables, defined below:

- Electricity generated from renewable sources as a percentage of total gross electricity production (RESE), this variable will provide information on the share of renewable energy sources employed. Theory suggests that a positive relationship exist as public support schemes fund projects. It is important to note the impact of RESE on electricity prices given of the reduction of public support schemes;
- Gross Domestic Product per capita, measured in constant 2010 US dollars (GDPPC), this will measure the relative economic activity of each country;
- Greenhouse gas emissions by the energy sector as a percentage of total greenhouse gas emissions (EIE), since the countries engage in an Emissions trading scheme, fluctuation in this variable has a direct effect on the marginal cost of energy production;

- Energy Dependency (ED), the degree of which the countries are dependent on natural resource importation connects the price of electricity to the price of these resources;
- Market share of the largest generator in the electricity market (EGC, Electricity Generation Concentration), increased competition should have a significant role in the reduction of electricity prices.

The data utilized in this evaluation are obtained from the International Energy Agency (EIA), the World Bank, OECD and Eurostat database). Since data availability for wholesale electricity prices is restricted, only retail electricity prices will be examined form 1997-2015. Data availability for electricity price is not reported for the entire data span, and EGC is only available for EU countries (1997-2015), leading to an unbalanced panel dataset.

Results

The following models are estimated (after establishing the existence of cointegration among the variables), where each model has ln(Retail Price) as the dependent variable followed by the following explanatory variables: Model (1) ln(RES-E); Model (2) ln(RES-E), ln(GDPPC); Model (3) ln(RES-E), ln(GDPPC), and ln(EIE); Model (4) ln(RES-E), ln(GDPPC), ln(EIE) and ED; Model (5) ln(RES-E), ln(GDPPC), ln(EIE), ED, and ln(EGC). Given the results of the Hausman test, a two-way fixed effects estimation followed, to account for heterogeneity between cross- and year-sections while seeing the effects of each control variable as our number of cross sections change significantly when controlling for market structure. Model (1), (2) and (3) all have positive and statistically significant coefficients for RES-E, indicating that electricity generated from renewable sources does have a significant effect on retail electricity prices when controlling for GDP per capita, and energy industry emissions. Once we include energy dependence in model (4), the coefficient for RES-E remains positive but is not statistically significant. Staying true to Moreno et al. (2012), the results indicate the need to control for electricity generation market share, represented by model (5). Model (5) reduces our number of cross sections from 34 to 23 since the data for EGC is only available for EU countries. All variables are statistically significant, except for ED. The effect of EIE is much larger than in Moreno et al. (2012), indicating that the effect of emission trading schemes increased from 2007 to 2015. EIE does not have a significant effect in Model (4) which contains the OECD countries of which not everyone has a emissions trading scheme in contrast to Model (5) which contains only EU countries all employing a emissions trading scheme. ED has a negative sign, illustrating that more countries have become energy exporters, but is not statistically significant. A 1% increase in EGC leads to a 0.091% decrease in retail electricity prices, which is contradictory to theory indicating that increased competition leads to decreases in prices, but in line with the findings of Moreno et al. (2012) as they explained that countries with higher market concentration have more government subsidies decreasing electricity prices.

Conclusions

The purpose of this paper is to determine the effect of the increasing renewable electricity share on retail electricity prices for 34-OECD countries, considering the change in market structure for 23 EU countries in a panel data framework from 1997 to 2015. The results hold important implications for future policies encouraging renewable energy sources and understanding price signals as a consumer. The current increase of RES-E on electricity prices is marginal and is largely due "RES-E support schemes financed by the electricity market" (Moreno et al., 2012). IRENA (2018) projected that renewable energy sources would be price competitive with fossil fuels within the next two years, we suspect that with future data the relationship will eventually be negative. Encouraging private RES-E support schemes could effectively mitigating the increases in retail electricity prices bringing about this relationship sooner. Emissions trading schemes by the energy industries only hold a significant effect for EU countries. Most countries' energy dependency changed over the period, declining in both energy exports and imports (Dedeoğlu and Kaya, 2013) and holds no significant effects for retail electricity prices in this analysis.

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