Environmental and energy efficiency analysis of EU electricity industry using an heterogeneous Bayesian dynamic estimator.

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Overview

Environmental and energy efficiency (EEE) in production, transformation and consumption allows to reach European Union (EU) greenhouse gas reduction target faster (EEA, 2016). EEE is a crucial key in the transformation sector to make carbon free power generation. Internal and external factors are changing the traditionally largely asset-based industry moving to a new and more complex decentralized generation system. Internal factors refer to technological changes (Jamasb and Pollitt, 2008) and to the fuel energy mix that deeply changed in EU countries also due to the widened spread of renewable energy sources. External factors involve policy and regulatory interventions (Knittel, 2002).
This paper intends to contribute to the literature enriching the framework to measure the efficiency of the electricity sector with three main novelties:
i) We develop an EEE index considering, along with the electricity production, the greenhouse gas emissions as the undesirable output (Scheel, 2001);
ii) We explore the boundary of regulation analysis taking into account, along with market regulation indicators, the effects of the environmental policy stringency;
iii) Our estimation strategy deals with the bias aggregation problems (electricity sector are heterogeneous mix of activities with different emission intensities and abatement costs) and some degree of cross-country heterogeneity due to unobserved difference across country regulations.

Methods

Using data from 2007 to 2014 for 19 major EU countries the analysis follows three steps. First, we compute the EEE measures in electricity sector using the Malmquist Index of Total Factor Productivity (TFP) through a non-parametric approach (Nakano and Managi, 2008). Second, we regress the EEE indexes derived in the first step on the market and environmental stringency applying a panel dynamic linear model. As the model is based on homogeneity assumption in the slope of parameters except for the country fixed effects (the intercept), we employ the dynamic fixed effect estimator to assess the impact of the regulatory policies on the TFP (Pompei, 2013; Hyland, 2016). Finally, in the third step, we relax the homogeneity assumption, assuming the country-variability of regressors' coefficients according to an underlying joint distribution. In this framework, the panel fixed effect estimates of the previous step are used as parameters for the prior distribution. The

obtained Bayes estimator is the best performing (Baltagi et al., 2008; Jobert et al., 2017).

Final considerations and expected results

The paper wants to enrich the current literature applying DEA methodology in the EEE field. We want to compare our outcomes with the findings of mainstream researches. In particular, our findings can be compared with an alternative heterogeneous Bayesian estimator using our previous estimates derived in Bigerna et al., (2018). EEE is a term advocated by policy makers, analyst and environmentalist given that in the public opinion better environmental performance might bring stakeholders great potential benefits.

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