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Accounting for unobserved management in renewable energy & growth

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ABSTRACT

The paper employs a management random parameters frontier stochastic frontier and a simple frontier stochastic model to benchmark European countries according to their management efficiency in growth and renewable energy development. The results come from an empirical application of a panel with 31 European countries over a 14 year old period using a translog type stochastic frontier production function. In particular the paper focuses on results from a management random coefficients model and compares results with the conventional stochastic frontier model with inputs such as renewable energy, fossil fuel energy, employment and capital. The results suggest that the interaction of renewable energy with management affects growth in Europe and that the technical efficiency estimated by the management model is by 6.05% higher than the one produced by the simple stochastic frontier model.

1. Introduction

RES (Renewable energy sources) are currently unevenly and insufficiently exploited in the European Union, EU [33–35] with a small contribution of about 7.8–8% [21] to the overall gross inland energy production. Notwithstanding the solid start made by most European countries, the impetus has not and most probably will not be retained to reach 2020 goals [18]; mainly due to infrastructure problems and administrative barriers. This uphold is particularly felt in the wind sector.

In spite of the various European directives for the promotion of RES being the 2001/77/EC on electricity production from RES [13], the 2002/91/EC on energy performance of buildings [14], the 2003/30/EC on the promotion of biofuels and other bioliquids [15] and the 2009/28/EC on the promotion of the use of energy from RES [16], which demanded that RES in final gross energy consumption in Europe doubled from 6 to 12% and achieving 22% electricity production from RES by 2010, also a reduction in primary energy use by 20% and a reduction of greenhouse gases by 20% below the 1990 levels, still no-long run relationship between RES consumption and growth has been confirmed providing evidence for the neutrality hypothesis [34]. Besides the above mentioned directives, a new one is almost under way with a focus on the impact of indirect land-use change on emissions [17]. Nevertheless, the share of imported fuels remains high and is estimated to reach 70% of total energy consumption by 2020 [31]. EU Directive 2009/28/EC repeals EU Directives 2001/77/EC and 2003/30/EC and paves the way for an effective management of RES across member states in order to pursue their RES 2020 goals.

The overall 2020 potential for RES in the EU corresponds to a share of 28.5% of the overall current gross final energy demand. Member States possessing large RES potentials are France, Germany, Italy, Poland, Spain, Sweden and the UK, while Austria, Finland, Portugal and Sweden had already by 2005, fulfilled their 2020 planned potential. Sweden is the leader with 44.4% of gross final consumption while Malta is a laggard with a minor 0.2% [31]. A RES surplus amount equal to 2% (of the 2020 target) will be produced by at least 10 member states that expect to surpass their goals [19]. A breakdown of the RES potential in Europe reveals that the highest target has been set for the heat sector wherein the largest progress has been made [11].

Despite the current need to strengthen RES support investments [28], most member states hope to reach their 2020 RES goals and 60% of them expect to exceed them while Italy and Luxemburg plan to resort to co-operation mechanisms to achieve their goals [20] and smooth national discrepancies. Furthermore, the relevant industry forecasts a share in final energy consumption of about four

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percentage units above the share forecasted in their national renewable energy action plans [20] despite the financial crisis. By 2020 wind energy will represent 14.1% of the electricity consumption, hydropower 10.5%, biomass 6.5%, photovoltaics 2.35%, solar power 0.5%, geothermal energy 0.3% and ocean energy 0.15% [21]. The share of RES in heating and cooling will increase from 10.2% in 2005 to 21.3% in 2020. Renewable energy in transport would amount to 12.2% by 2020 [20]. There are also some hopeful estimates that by 2050 renewable electricity will provide 100% of the European power demand [46].

Up to date, the relationship between growth and renewable energy has been studied mainly with methods typically used in the growth-energy nexus literature, namely causality studies which provide results for the long-run and short-run relationships between the variables. These types of analysis assume either a production side perspective (using aggregate factors of production) or a demand side perspective (using prices of factor inputs). Together with the present study, there is only one study [35] which performs a DEA (Data Envelopment Analysis) benchmarking application and the Malmquist index of total factor productivity for the relationship between growth and renewable energy. Besides a benchmarking task, the present study estimates the unaccounted factors (management) that affect the relationship between growth and renewable energy. In the typical causality analysis, these unaccounted factors are usually explained by the constant terms in causality equations or the long-run relationship in cointegration equations.

In a broader sense [36], attempt to estimate a portion of the unaccounted factors (political environment) separately for each European country and for each year in a panel of European countries. Their focus however, is growth and total energy, not solely renewable energy. In essence, the unaccounted factors can be regarded as anything not included in the model but affects the relationship. In the Alvarez et al. management model [2,3], the term "management" accounts for various possible unaccounted factors enclosed in the broad term of management within a business or sector.

However, because a country, is not a business in its known micro concept, the term "management" at a country level has to be much wider and may encompass concepts such as government ability, the growth strategy a certain economy follows, foreign direct investment [29], financial development [38], technology [41], innovation, R&D level or politics [36]. Because the focus of the current study is renewable energy management and development, discussing how "management" affects other production inputs such as capital or labour, is outside the scope of this paper, although it might also affect the administration and management of the rest of the inputs in a country. Therefore, the following section (Section 2) is devoted exclusively on the constituents of the renewable energy management.

As far as the structure of this paper is concerned, after this introduction, the rest of the paper is organized as follows: Part 2 explains the constituents of good (ideal) management vis-à-vis the realized management of RES by European countries. Part 3 presents the management random coefficient stochastic frontier approach (MSF (management stochastic frontier)) for efficiency measurement juxtaposed to the conventional SSF (simple frontier model). Part 4 deals with data description and results and last, part 5 is the conclusion.

2. Efficient management of renewable energy resources; a conceptual framework

The management that countries need to perform, focuses on increasing RES penetration (at least according to 2009/28/EC Directive demands) in the market while at the same time minimizing public costs. Management must be exercised in such a way so as to keep RES industry consumers and producers interested to participate in the transaction. It is a challenge to reconcile the latter two groups into a joint agreement and reconcile their different pursuits. Table 1 addresses all the RES management defaults noted today and proposes solutions consistent with the 2009/28/EC Directive.

For the industry agents, a guarantee of a continuous demand of RES technology is crucial to keep them in the game. Investors, depending on their risk attitudes, are interested in as much high a producer surplus as possible. Consumers are interested in low prices. Today and until 2010, most countries have performed BAU (Business-as-Usual) policies and they worked towards a harmonization of European objectives. Assuming that energy consumption grows with time and that CO_2 prices pass directly to energy prices, increased RES deployment will decrease CO_2 prices. It is crucial to know the potential domestic and realistic supply of energy from each RES technology: biogas, biomass, biowaste, on-shore/off-shore wind, small/large scale hydro, solar, thermal, photovoltaic, tidal, wave and geothermal energy.

Costs are adapted by endogenously technology-specific learning rates and estimate the long-run marginal social cost. Policy makers must decide whether they will remain at BAU solutions leading to the most cost-effective technology which however excludes expensive in the short-run novel technologies. Existing and new plants should be distinguished and handled differently by support mechanisms. Support should be stable but limited upto a certain time and might as well become integrated with other policies such as climate change or agricultural policy. Technological learning must be reflected in the feed-in-tariff system by taking into account and correct any overcompensation produced by uniform tariffs, namely introducing tariff degression based on the technological progress made. Local electricity stations must be obliged to buying green energy at priority. Tariff levels can vary depending on local conditions, the size or fuel type of the plant. The idea of setting a plant as a reference point increases transparency, so that not only the most favourable conditions in a country are exploited and the risk of over-subsidizing the very efficient plants is lowered. Premium tariffs paid on top of the electricity market prices are a move towards a more market based support instrument. It leads to a more efficient allocation of the grid costs and gives producers an incentive to feed electricity into the grid at times of peak demand. Penalty payments for non-compliance can ensure quota fulfilment. Abolishment of subsidies for fossil and nuclear energy will redistribute investment interest on RES.

Markets need to be deregulated at a higher degree, so that consumers will not bear the burden of RES development while producers will go free. TSOs (Transmission System Operators) must be provided the possibility of acting independently so that this leads to the development of the transmission infrastructure capable to integrate RES. The intermittent nature of wind or solar energy and the seasonality of biomass and hydropower are important to take into account and incorporate in the demand. According to [46]; until EU has a fully liberalized electricity market, RES must have priority access to the grid. In particular [25] suggest some interesting form of electricity liberalization which consists of a combination of competitive energy and retail markets with regulated transmission and distribution activities.

Countries which develop RES, also increase employment (2 million full time jobs would have been created by 2010 [30]; projecting at 4.4 million jobs by 2030 and 6.1 million jobs by 2050 [46]); and industrial development and at the same time decrease local pollution (728 million tons/year of CO_2 emission reduction in 2020, representing 17.3% of the total GHG emissions in 1990 [30];. Cross-border power trading through the building of grid infrastructure can be enhanced. The creation of a single power market