Eco-innovation, energy policies and performances. The case of energy efficiency in the residential sector

Valeria Costantini 1 , Francesco Crespi 1, Alessandro Palma 1
1 : Roma Tre University

Abstract

This work is an attempt to shed some light in the poorly explored field of residential energy efficiency technologies. Energy efficiency represents one of the most effective mean for achieving energy security and reducing polluting emissions. Recent efforts by advanced economies are directed towards enhancing energy efficiency performances in all economic fields. While efficiency gains in the industrial sector over the past decades are relevant, the residential sector is still energy intensive, and consumption patterns are constantly increasing. Recent policy documents by OECD and EU have emphasized that energy efficiency improvements should be mainly achieved by policy supports directly linked to technological innovation.

This bearing in mind, it is important to test the research hypothesis according to which part of the invention efforts in this technological domain might be driven by particular elements with respect to others. Most importantly, it is worth analyzing the size of the contribution of these drivers in boosting energy efficiency through the process of generation of new economy-useful knowledge.

In order to answer this question, two main issues have been addressed. The first attains to the measuring of innovation and to the lack of a complete patents classification related to climate change mitigation technologies, of which energy efficiency constitutes a relevant share. As a matter of fact, although the recent attempts made by both WIPO and EPO for developing a classification system mapping the ‘green technologies', the specific field of residential energy efficiency mostly remains uncovered. In order to overcome this problem, an ad hoc classification method based on semantic search has been developed. One difficulty for mapping patents in the energy efficiency sector is due to the fact that this latter rarely constitutes the final aim of a patent, but it is further the result of one or several innovative contents of the patent itself, which may be also not explicitly mentioned in the main search text fields (title, abstract and claims). By using boolean operators specific search strings were used for searching patent applications, following a multi-level top-down approach. Only EPO's patent applications have been considered since giving protection within the thirty-two EPO member states, they are more expensive than applications to national patent offices.

Furthermore, considering only EPO applications, avoids the problem to distinguish between countries promoting propensity to patent and countries which do not. The first level of search, performed on full-text, (title, abstract, claims and description of each patent application) was used in order to identify, as widely as possible, the ‘energy efficiency' macro-domain. A second level search string was applied to reduce the macro-domain to a meso-domain, that is on those patents classifiable as inherent to energy efficiency technologies applied to domestic

residential sector. Finally, patent applications were extracted and classified according to specific types of electrical appliances and sorted by application date and assignee country.

The second part of the work develops an empirical framework in order to identify and measure the contribution of the main drivers of invention process in the field of residential energy efficiency, extending the analysis to a large set of countries (23 high-income OECD countries) and focusing on the role of government interventions in boosting energy efficiency using the IEA Energy Efficiency Policies Database.

The core of the second part consists in an econometric analysis using a balanced panel of 483 observations over the period 1990-2010. A fixed-effect negative binomial regression model (FE-NBRM) has been used to estimate EPO patent applications count as dependent on a set of explanatory variables. In modeling the empirical specification, different policy instruments, national and sectoral innovation systems as well as energy-demand system have been taken into account. Moreover, enlarging the institutional framework, some global events such as Kyoto Protocol ratification, and the entering into force of National Energy Efficiency Plans (NEEPs) in EU have been also considered. Lastly, in order to capture geopolitical characteristics and long-term energy strategy, net energy Balance-of-Trade and the level of energy intensity have also been calculated and included in the model using data of IEA Extended Energy Balances.

The empirical analysis confirms the important role of government intervention in affecting the pace and direction of the generation process of new economy useful knowledge. In the particular case of residential energy-efficiency technologies, the study demonstrates that energy-efficiency policies moderately and positively affected the invention process measured by the number of new patent applications, particularly during the second decade of analysis 2000-2010. Both demand-pull (prices) as well as technology-push (R&D flows and knowledge stock) drivers have been found positively and significantly to affect the level of energy efficiency technologies.

Notwithstanding, the analysis indicates different effects depending on the sector and policy type considered. Indeed, at sectoral level, a relevant result is that – in the case of domestic electrical appliances – regulatory standards (in particular information policies such as energy labeling) had a stronger role in affecting the number of new patent applications with respect to standard economic instruments (taxes and subsidies), even though these latter showed positive and significant effects. A further relevant result comes from a second set of estimations, specifically for EU countries. Although the structure and the significance of the effects on energy efficiency innovation remain the same, their magnitude of the impacts appears lower, suggesting the existence of a gap between the EU and the rest of high-income OECD countries in the process of energy-efficiency technologies invention.

The lesson we can draw from this work can be summarized in two issues. The first one is that the government intervention in creating new technology in this specific sector matters. The second conclusion is that the EU should provide stronger efforts in order to mind the gap with the rest of OECD countries for being a leader in energy efficiency innovation.

Keywords: energy efficiency, residential sector, innovation, patents, energy policies