WHY FIRMS INVEST (OR NOT) IN ENERGY EFFICIENCY? A REVIEW OF THE ECONOMETRIC EVIDENCE

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Overview

The importance of energy efficiency (EE) is beyond doubt. Energy efficiency has emerged as the most cost-effective way to fight against climate change and a major contributor to total emissions reduction (IEA, 2016). EE is especially important in the industrial sector. Industry is responsible for more than one third of worldwide energy primary consumption and the respective energy-related carbon dioxide emissions. The introduction of industrial EE improvements would deliver extraordinary benefits not only in terms of emissions reduction but also in economic competitiveness, economic growth and social welfare. Industrial firms still have room to improve their energy performance particularly in emerging and developing countries. Moreover, industry is responsible for introducing energy efficiency innovations that will apply to all sectors. For all of these reasons, it is of the highest importance to try to understand the reasons that explain or prevent the adoption of energy efficiency measures by industrial firms.

The motives that firms have for investing in energy efficiency have been widely analysed by the literature. Particularly, there is a huge literature on barriers to energy efficiency investment and adoption. This paper reviews the econometric analyses carried out in this field. Its main objective is to provide a general overview of the state of the literature on the determinants and barriers of energy efficiency investment. We examine the main features of these studies and particularly the results of the explanatory variables used. We have classified them into three groups, barriers, drivers and firm characteristics. The paper ends with some suggestions for further analyses in order to improve our knowledge of energy efficiency investment.

Methods

The purpose of the paper is to review the literaure on barriers, drivers and firm characteristics that affect firms' investment in energy efficiency. To that aim, we have designed a bibliometric analysis composed of several steps to obtain a definitive list of papers that use an econometric treatment. First, we have carried out a Scopus search with the following keywords "energy efficiency barriers" adding subsequently new words to create new searches like "industrial, drivers, investment, measures and adoption". In order to check the results obtained we have introduced the same keywords in Google Scholar. Using this double source of information increases the reliability on the search carried out and minimizes the possibility of missing some important papers. The final step has been to go through the literature cited in the most relevant papers found. An important source has been the overview of empirical studies addressing the role of barriers to adopting energy efficiency measures (Fleiter et al., 2012).

With this final step, we have compiled a list of 86 papers referring to barriers, drivers and characteristics affecting investment and adoption of energy efficiency measures in firms. However, for this review we were only interested in those papers that include an econometric analysis. After selecting those papers from the long list, we have ended up with 25 papers referring to firms' decisions on energy efficiency with an econometric treatment. Most of the papers have been published in the last 10 years (70 out of 86). This show the relevance that energy efficiency has gained recently and the reaction of academia in focusing research on this topic.

Results

The main characteristics of the empirical literature on energy efficiency are as follows:

First, regarding its geographical scope, most papers are focused on Europe and the U.S. while a few papers study developing countries. The countries most targeted by the study of energy efficiency barriers are Germany and the U.S.

Second, the principal source of information used in these studies is survey data usually obtained from structured questionnaires through interviews or email. Another important source of information is public programs related with energy audits or policies promoting the adoption of energy saving technologies. The source of information is very important for the development of this research topic. Good data on energy efficiency is still rare and mostly dependent on the action of public institutions.

Third, the econometric models are related with the characteristics of the dependent variable. In many cases, the variable to capture EE investment or decisions is a binary one and therefore logit and probit models have been frequently used. Another relevant characteristic of the econometric models employed is that most of them are cross-section analyses. The lack of information has made panel data approaches very difficult to use.

Fourth, different dependent variables have been used to measure EE. The most frequent is a dichotomous variable regarding the adoption or not of energy efficiency technologies. Another possibility is investment in EE measures. More inusual are the use of the barriers, or other options such as EE as on objective of innovation or the ratio between firms' profitability and energy intensity or the characteristics of a certain technology.

Finally, we have identified 84 different relevant explanatory variables used in the 25 papers gathered in this review. These variables mainly capture firm characteristics, drivers and barriers. A longer set of barriers has been also used in the different articles. Although some of the results are similar, there is still a lack of consensus regarding the main factors that explain or hamper EE investments.

Conclusions

The main conclusions obtained from the review of the econometric evidence concerning the determinants of energy efficiency investments, including some suggestions for future research, are as follows:

First, very few of the empirical papers provide a theoretical framework. The use of theoretical frameworks as a basis for the empirical models would help to clearly show what are the factors affecting the EE decisions of firms and the relationships between the different variables.

Second, the lack of data is a significant limitation in this field of research. The research questions that many papers propose are therefore restricted by the available data in some specific surveys or public programs. New sources of data and, in particular, panel data would help to perform more robust econometric analysis and to take into account the dynamic process of EE. It would also help to minimise endogeneity issues which is a significant concern in this empirical literature.

Third, there is some heterogeneity in the dependent variables used to measure EE. In addition, many independent variables, often with different definitions, have been used. This makes comparison of results and to obtain robust conclusions about the main barriers and drivers of energy efficiency difficult.

Fourth, it would be convenient to use the two main dependent variables used, the adoption of EE measures (a binary variable) and the amount of the investments in EE, jointly in the econometric analyses. This could help to understand the role of the barriers and some specific characteristics of the firms regarding their behaviour in EE better.

Finally, to improve EE in firms requires, as pointed out by many papers, a policy mix with the use of different instruments. Nevertheless, very few papers have carried out evaluation analyses of the impact of these instruments. In addition, it seems convenient to analyse in more detail potential heterogeneities in the behaviour of the firms regarding EE. In particular, sectoral differences seem to be quite important.

References

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