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SOME INSIGHTS INTO THE DETERMINANTS OF INNOVATION IN ENERGY EFFICIENCY[1]

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The aim of this paper is to identify the firm-level determinants of innovative activities in the field of energy efficient technologies (henceforth EET) among Swiss firms. To this end, I empirically analyse the factors explaining R&D (a measure of innovation input) and market success of innovations (a measure of innovation output), both related to EET. Binary indicators (whether firms perform R&D directed to enhancing energetic characteristics of their products and processes, and whether they actually sell products of this kind) are used; with demand-pull as well as technology push (such as human capital and competition) effects being considered as explanatory variables. An extension of this analysis consists of (a) a comparison to the determinants of overall (not strictly EET related) innovative activity in order to identify the specific conditions for EET innovation; and (b) an investigation into the determinants of intensity of innovation (as measured by EET related R&D investments and by shares of EET innovative products among total sales) in order to make full use of the data available.

For this purpose, a novel dataset of innovative activity covering a broad range of energy-efficient technological applications has been conducted recently (spring 2009) among Swiss firms belonging to both the manufacturing and service sectors. More than 2300 participants returned valid questionnaires (resulting in a response rate of nearly 40%), providing some general insights related to issues relevant to corporate management as well as for the academic and political debate.

An abundant body of related empirical literature exists in the broader field of ecological innovations. This seems sensible, given that issues such as sustainability of natural resource and ecosystems use, or prevention of local and global ecological hazards call for integrated solutions and management systems within enterprises and institutions. Nevertheless, concerns about the sustainability of the current patterns of energy use have gained such prominence in recent years (raising awareness about the scarcity of energy sources, price volatility and, last but not least, climate change being the main concerns) that it seems justified to pay particular attention to questions related to energy and energy efficiency from an economist's viewpoint (Popp et al. 2009). In particular, ambitious emission reduction goals for greenhouse gases have been called for by environmental lobbyists and natural scientists (and are increasingly being formulated by policymakers). There is an overwhelming consensus, at least among economists, that in order to meet these goals, the pace of technological progress enabling more efficient generation, transmission and use of energy needs to be fastened dramatically.

Fostering innovation of energy efficient technologies has thus become a policy priority. A better understanding of the economic environment in which such EET innovations are best brought to success is indispensable if such policy is to be formulated. One goal of my analysis is to take into account demand-pull determinants (related to the characteristics and size of markets that current and potential providers of such technology operate in) as well as technology-push factors (firms' and industries' intrinsic capabilities to generate innovations) and to reveal how they differ from determinants of overall innovative activity.

[1] This study has been financed by the Swiss Federal Office of Energy (SFOE).

The following empirical findings emerge: Induced innovation (in the sense of Hicks, 1932) may be deemed important in the sense that both research and market success of EET are positively influenced by past and expected (future) evolution of sales. However, some of my estimation results suggest that a pattern of *market-orientedness* that is observed for overall innovation does not hold for the narrower concept of EET related innovation: factors like competition and customer involvement in the innovation process stimulate overall but not EET related innovativeness. Conversely, risks related marketability of new products can be observed for EET but not overall innovators. Further investigations might be required to shed some light on this phenomenon and whether it has any policy implications.
The analysis of *intensity measures* for innovation reveals that determinants of *how much* research or innovative activity is conducted in a firm (given the case that there is any activity of this kind) may differ from those determining *whether* such activities exist in the first place. Given that these results rely on a much smaller number of observations and that econometric issues of selectivity need to be taken into account (in the spirit of Crépon et al. 1998 and Mohnen et al. 2006), these findings may not be as informative as those obtained in the analysis of binary innovation indicators (they do not, in any case, provide any results that would be in contradiction with those latter ones).
In retrospect, our effort of undertaking the 2009 survey briefly described above and the subsequent empirical analysis both seem to be justified, considering that standard methods of econometric analysis of research and innovation were successfully applied to the narrower field of energy efficient technology (EET) innovation and that meaningful empirical results could actually be found.

Keywords: Energy Efficiency, Innovation, R&D

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