

Carbon abatement, sector heterogeneity and policy responses: evidence on induced eco innovations in the EU

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Abstract

Innovation is a crucial factor to achieve a sustainable and competitive economic development. Technological progress is the only exogenous driver of long run growth in income per capita in classic Solow-like models; endogenous growth theory has emphasised the role of R&D and human capital as main forces behind countries (heterogeneous) performances; neo Schumpeterian evolutionary theory poses innovation in a broad techno-organisational meaning at the heart of economic systems development. In studies of environmental and economic performances, innovations – technological, organisational, behavioural - has gained increasing relevance as a key factor to obtain sustainable transitions (Costantini and Mazzanti, 2012).

Narrowing down the focus on environmental innovations (EI), it is worth noting that they are crucial to creating synergies between sustainability and competitiveness towards a greener economy (EEA, 2013; Gilli et al., 2013). Environmental innovations (Rennings, 2000, 1998) are a key factor, as it is well known that sustainable economic growth depends upon investment in technological and new organisational/labour related ways of managing production. We here link the analysis of EI adoption (not invention, namely patents) to policy and sectoral frameworks, thus with emphasis on idiosyncratic factors that characterize 'sector agents' (Chappin et al., 2009). Until twenty years ago, the economic discipline was dominated by the idea that any attempt conducted by environmental regulation in abating pollution would necessarily translate into an increase of internal costs for the compliant firm. Moreover, many theoretical studies during the 1970s support the idea that a country's comparative advantage could have been affected in a negative manner by stringent environmental regulation (Pethig, 1975, Siebert, 1977). Nevertheless, in the last two decades, many scholars have challenged this dominant idea. In particular, Porter and Van der Linde, in different contributions (Porter, 1991 and Porter and Van der Linde, 1995), strongly criticised this approach, underlining that the consolidated

paradigm was not considering all aspects of the environmental regulation/competitiveness relationship. Moving from the static approach in which technology was held constant to a dynamic context, the authors showed how in practice some of the loss of competitiveness related to environmental regulation was compensated by an increase in innovation driven by the policy itself. In the view of Porter and Van der Linde, a properly designed policy framework may place pressure on firms, pushing them to develop new innovations and promoting technological change. Within this view, the additional policy-driven innovation may offset the loss of competitiveness due to the additional costs of regulation.

From a conceptual point of view, we mainly refer to the integrated concepts of sectoral and national systems of innovation, which have been consolidated into innovation-oriented evolutionary theory (Malerba, 2004) and have been exploited in environmental economics literature examining EI and policy (Crespi, 2013; Costantini and Mazzanti, 2012). Malerba promotes a sectoral system view of innovation. He stresses that sectors differ greatly with respect to their knowledge basis, technologies, production processes, policy and institutional environments, complementarity between innovations and market demand. Regarding policies, both within a strict innovation/industrial aspect and for what concerns an environmental aspect, these arguments matter. A 'one size fits all' approach may be not effective in supporting innovation diffusion and consequently economic and environmental performances. This is a hot issue in the EU, where 'mainstream economics' have probably influenced the implementation of policies that were constructed on the one-size-fits-all paradigm. The alternative is to shape policies according to sector and regional features following more bottom up and diversified approaches.

The Research hypothesis

This paper assesses *whether and to what extent energy and environmental policy instruments have been relevant forces behind the adoption of environmental innovations in the EU*. We focus on technological and organisational innovations of product and process nature; incremental and radical features are additionally scrutinised. The focus is thus on the ex post assessments of EI drivers, by looking at *single and interaction effects of policies*.

We take a sectoral perspective that is theoretically based on neo Schumpeterian evolutionary theory to qualitatively investigate the factors that characterise the adoption of techno-organisational innovations aimed at enhancing energy efficiency and abating CO₂ through interviews with industry representatives of key EU sectors: energy, chemical, paper and cardboard, ceramics and cement, metals/steel, coke and refinery. In terms of policy, though the EU ETS is an obvious keystone, the attention of the analysis is on 'drivers and obstacles' of innovation with some focus on the complementarities and trade off among policy tools as they emerge from interviews.

We claim that given the consolidated econometric evidence on the drivers of eco-innovations, qualitative investigations analyse the concrete developments of eco-innovation adoptions in sectors in an original way, by providing examples and evidence of specific technologies. This offers a unique contribution to the field of eco-innovation studies. Interviews, which are by definition not aimed at providing representative results but rather 'sector case studies', have the additional

positive property that they may cover the EU as a whole under a dynamic perspective. The current availability of eco-innovation data in the EU (Community Innovation Survey data) , on the other hand, limits the analysis to certain countries / years.

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