Summary for non-specialists
Economic Papers No. 413 / June 2010
Economic Papers index

What is the Growth Potential of Green Innovation? An Assessment of EU Climate Change Policies

By Andrea CONTE, Ariane LABAT, János VARGA and Žiga ŽARNIĆ

There is an increasing consensus that fighting climate change requires a combination of policy instruments in order to induce technological innovations for bringing the economy on the sustainable growth path. Although price signals are important to direct R&D into favoured clean technologies, they cannot generate sufficient R&D capacity in the short-run. Due to a potentially wide dissemination of private firms' innovations, individual firms are not able to fully capture the market value of their investments in green R&D. These combined market failures provide a strong rationale for a portfolio of public policies to foster emission reductions through price signals and R&D subsidies to induce environmentally beneficial technological change.

A starting point of this paper is that a certain degree of government intervention is initially needed to resolve two market failures occurring simultaneously. First, there is little spontaneous demand for emission-reducing technologies, which chokes the supply of goods and services produced with commercially viable and non-polluting production technologies. Since a stable climate is a public good, the social benefits of climate action are not fully captured by those incurring the mitigation costs and autonomous climate change mitigation actions remain below the social optimum. Second, companies lack incentives to invest in clean technologies, because of the so-called appropriability effect associated with the lower level of expected post-innovation rents due to wide dissemination possibilities. Without mutually supportive environmental and innovation market policies, the markets alone will not put in operation a sufficiently wide portfolio of technologies to keep economic costs of climate change mitigation and adaptation at manageable levels. In times of tight fiscal balances, the countries will have to devise a cost-efficient policy-mix to safeguard reasonable levels of future economic growth without compromising the environment.

The paper assesses the theoretical potential of different EU climate and innovation policy options for directing innovation in the private sector towards an environmentally sustainable growth path. The focus lies on those policy options that previous literature highlighted as the most cost-efficient (Acemoglu et al., 2009; Aghion et al., 2009; Newell, 2009; Popp et al., 2009) and which are relevant for current EU policy making. To evaluate the growth potential of different policy options, we use a fully dynamic stochastic general equilibrium (DSGE) model with endogenous technological change developed by Roeger et al. (2009). In addition to the existing model, we include the environmental content in a multisectoral setting by building upon the theoretical model of Acemoglu et al. (2009). The essential contribution of our approach is to consider that green innovation occurs along the supply chain and is not necessarily bounded within a single sector. The introduction of an exhaustive sectoral input-output matrix allows us to capture the development and use of environmentally-friendly products substituting dirty products across different sectors of the economy. Such "green" multi-sectoral version of the model allows us to evaluate the marginal economic effects of sector-wide measures compared to economy-wide policy intervention in the environmental and innovation markets. In applied terms, this model is calibrated on our newly constructed

dataset that includes green R&D and CO_2 emissions for five sectors with a distinctive potential for nesting green activities.

Building upon the previous literature, we assess the claim that an appropriate policy set from a macro-economic perspective should combine instruments that tackle (i) environmental problems by emission pricing and (ii) innovation market problems by appropriate R&D support instruments. Our policy scenarios differ one from another with respect to the following distinctive elements (i) whether they address the double market failure nature of climate change or exclusively the environmental externality, and (ii) whether they account for the sectoral linkages of the economy or concentrate on specific sectors. These elements are gradually introduced in the model-based analysis, which allows us to trace back the contribution of each element to economic growth and to identify the scope of potential synergy or trade-off effects of a policy-mix on key macro-economic variables relative to individually implemented policies.

Taking into account the underlying assumptions adopted in the analysis, our results suggest that a "smarter and greener" policy-mix with higher potential for growth than other policies, which do not address simultaneously the environmental and innovation market failures. In our model, such policy-mix is represented by a carbon price recycling rule which considers that one part of carbon revenues is used to enhance fiscal consolidation through labour-market support. The rest is used to intensively stimulate green-targeted R&D in the short run but spreading non-targeted R&D support in the economy over the long run. Such "smarter and greener" recycling rule has several advantages. First, it appears to stimulate economic growth in the long run relatively more than other rules, which do not aim at reducing pre-existing labour tax distortions. Second, it corrects better the lack of market incentives to invest in green innovation compared to policy options supporting existing green technologies. Third, it is more cost-effective to correct the environmental problem compared to policy options supporting green consumption, because it diversifies products and offers more alternatives for reducing carbon emissions. Fourth, it appears more cost-effective than other recycling rules, which involve not targeted support to R&D, because research activities need sufficient time to accumulate knowledge about green technologies required to reverse unsustainable environmental trends. Finally, it is targeted to green innovation activities not only in the environmental goods and services sectors, but throughout the entire value chain.

From a policy making perspective, this analysis suggests the choice of recycling rules matters in terms of potential economic effects. Moreover, it seems that even decisions on small parts of recycled revenues influence the economic prospects. For example, there is a small difference between two recycling rules, one providing lump-sum transfers to households and another supporting renewable energy production with existing technologies. Yet this difference leads to more environmental and economic benefits when stimulating green R&D along the supply chain in the short-run and then supporting R&D in all sectors compared to using the same limited amount of carbon revenues for other purposes. The additional benefits compared to the alternatives come from effectively addressing the double market failure behind the climate change problem, while making sound use of public finances.

Streamlining the rules to recycling carbon revenues could help to alleviate the costs of climate action, so it is key for policy-makers to carefully consider the impacts of alternative recycling rules. Tightening environmental constraints could come at a cost if the time to accumulate knowledge capital and disincentive to privately conduct green innovation is not taken into account. It is worth addressing the double market failure when deciding on environmental policy, including when defining and refining the rules for recycling of carbon market revenues.