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CLIMATE POLICIES WITH POLLUTION EXTERNALITIES AND LEARNING SPILLOVERS

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OVERVIEW

Government strategies to cope with greenhouse gas emissions from energy generation are based on a policy mix in many countries. On the one hand, regulators implement market-based policies such as permit trading schemes or taxes to price greenhouse gas emissions. On the other hand, support schemes have been implemented to promote renewable energy sources and an alternative to fossil-fueled electricity generation. The most common approach has been the so-called feed-in tariff [1]. Feed-in tariffs have a remarkable track record throughout Europe [2]. However, it has remained somewhat out of focus whether feed-in tariffs interact with emission policies existing in parallel. Can emissions still be reduced at least cost under market-based emissions policies if feed-in tariffs are in place in addition? This question is addressed in this article.

Theoretical literature suggests that a combination of emissions policies and policies for technology support can be justified in the presence of two types of market failures: a pollution externality and spillovers related to technological learning-by-doing [3]. Learning-by-doing has been observed for renewable energy technologies in numerous studies [4-8]. However, learning-by-doing also generates spillovers to other market participants than the one adopting the technology [9]. Thereby, competitors may benefit from experiences made during the adoption process without incurring learning costs themselves and without compensating the adopter. Thus, the learning firm cannot appropriate the entire social benefits of learning-by-doing, and will invest too little in the learning process from an economic point of view. Empirical studies have confirmed spillovers of learning-by-doing in the manufacturing sector in general [10-13] as well as in the renewable energy industry [5, 8, 14].

Fischer and Newell [15] provide an in-depth analysis of the combination of emissions policies and policies supporting renewables. They assume a partial equilibrium model of the energy sector with fossil-fueled energy generators and operators of renewable energy installations. The renewable operators experience learning-by-doing. Fischer and Newell show that an emissions price imposed on fossil-fueled generators and an output subsidy, which is paid in addition to the electricity price to renewable energy generators, achieves a first-best outcome. However, they neglect that the actual design of feed-in tariffs as it can be found in many countries often deviates from their theoretical model. They do not consider that the tariff is often paid as a fixed price per unit of electricity produced, which is independent of the prevailing electricity price. Moreover, they do not take into account that unlike conventional subsidies, this fixed price is not funded by the government but by a uniform add-on to the electricity price. Thus, electricity consumers pay eventually for renewable energy support. The implications of both design features for the overall efficiency of the policy mix are analyzed in this paper.

RESULTS

Using a theoretical partial-equilibrium model of the electricity sector, the article shows that a policy mix of an emissions price and the feed-in tariff system can also be designed efficiently. However, the theoretical results regarding how to design optimal policies deviate significantly from those made in previous studies. In contrast to a policy mix with a simple output subsidy, the optimal feed-in tariff does not only depend on the maturity of renewable energy technologies and the number of adopters. It also has to be adapted continuously as the electricity price changes. Moreover, funding the feed-in tariff by the add-on has three important implications for the efficient design of the emissions price. All of these implications challenge the classical concept of uniform Pigovian emissions pricing, which is also promoted by previous policy mix studies. (1) The optimal emissions price has to be below the Pigovian level. (2) The optimal emissions price has to be differentiated across fossil fuels. (3) The optimal emissions price has to be adapted as renewable energy technologies become more mature, the number of adopters increases and the share of renewable electricity rises. Thus, feed-in tariff and emissions price have to be adapted continuously. However, these requirements may pose a formidable challenge for regulators. Typically, changes of environmental and energy policies cannot be realized ad hoc but rather have to be approved in a tedious political process. If policy makers aim at implementing efficient environmental policies that are easy to administer, they should choose a relatively simple policy mix of an emissions policy and a simple output subsidy for renewable energy technologies. However, a final judgement on the efficiency of this policy mix would also have to consider possible distortions in a general equilibrium model. These may arise from taxes which are raised to fund the output subsidy.

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