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Strategic subsidies for renewable energy

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GREEN GROWTH
Knowledge Platform

Strategic subsidies for renewable energy

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Policymakers around the world are concerned about the problem of global climate change. Yet, while carbon pricing is considered the most cost-effective way to reduce carbon emissions, most if not all governments are hesitant to impose it in any form strict enough to produce the needed reductions. Rather, a variety of alternative instruments are introduced, particularly those targeting renewable energy.

Examples are plentiful: In the United States, the prospects for national CO_2-pricing are weak. Instead, fuel efficiency standards and biofuels requirements are imposed nationally, and renewable portfolio standards (RPS) for the electricity sector are imposed in a majority of the states. (Regional cap-and-trade systems for CO_2-emissions are also in operation, but only in a minority of the states.) In the EU, although a cap-and-trade system is in place (EU ETS), the price of CO_2 remains low due in part to supplementary goals and instruments (OECD 2011). In addition to emissions targets, the EU countries have jointly agreed upon renewable energy targets, both in total consumption and in the transport sector, as well as upon energy efficiency targets. Lastly, China's current Five Year Plan (2011-2015) includes targets for the share of non-fossil fuels in primary energy consumption.

Renewable energy targets can be achieved through market-based mechanisms such as blending mandates for biofuels and green certificates for renewable energy. At the same time, most governments also provide direct subsidies to renewable energy, both in the forms of additional adoption incentives and manufacturing and innovation incentives. However, such subsidies are beginning to raise suspicions within the framework of the World Trade Organization (WTO), which places restrictions on industrial policies that distort trade. In a recent dispute, the WTO appellate body found problems with Ontario's feed-in-tariff, which incorporated domestic content requirements. In another set of cases, the EU and US have brought anti-dumping and anti-subsidy complaints against China, charging that large Chinese subsidies in the form of cheap loans, land, and capital to photovoltaic producers constitute illegal aid. According to the WTO, supporting the deployment and diffusion of green technologies is not hindered by WTO rules (WTO 2011), but nonetheless concerns are growing about the need to properly define the appropriate parameters for green industrial policy.

We examine the rationale for such supplementary subsidy policies when countries have already set in place other climate policies. By requiring that a certain share of energy be generated from renewable sources, renewable portfolio standards encourage deployment and create new profit opportunities for firms that supply renewable energy capital. They also reduce emissions to the extent they displace dirty energy sources. A carbon tax would also encourage clean deployment and displacement of fossil fuels. To what extent, then, do supplementary renewable energy subsidies further contribute to these goals? In the European Union and elsewhere, renewable support policies also reflect the belief that high environmental standards stimulate innovation and business opportunities, including for exports. With imperfect competition among technology suppliers, supplementary technology policy could be used strategically to achieve such goals. Moreover, it may matter for industrial policy whether subsidies are provided downstream or upstream i.e., to suppliers of electricity or transport fuels, or upstream, i.e., to suppliers of capital to produce renewable electricity or fuel. Importantly, the climate policy context matters: the emissions consequences are quite different depending on whether the overlapping instrument is a carbon tax or renewable energy targets. To our knowledge our paper is the first paper to analyze such a case for green industrial policy.

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We consider a closed and competitive downstream market in each country, such as the electricity or the transport sector in large countries or jurisdictions (EU, U.S., China etc.). In the upstream market, by contrast, producers of technology equipment can both sell domestically and export to foreign regions. Furthermore, as the number of upstream suppliers is relatively small for new clean energy technologies, such as due to patent restrictions, risk, and other barriers, the upstream market is less than perfectly competitive. As such, we assume Cournot competition between the upstream suppliers, with a uniform global price of technology equipment.

In this context, we find that there is a potential rationale for subsidies, even absent the climate consequences. The rationale is partly due to the upstream market failure (imperfect competition among technology suppliers), which leads to underprovision if not corrected, and partly due to strategic interests in shifting the profit opportunities created by the renewable energy standards to national firms. From a national strategic perspective, positive subsidies upstream provide the national upstream industry with an advantage, and addresses the market power issue. A downstream subsidy, on the other hand, reinforces the negative strategic effect from the renewable standard, which spurs foreign firms' supply of renewable energy capital, and the government instead might want to tax the use of equipment.

Emissions consequences also influence optimal subsidies, and here the underlying policy context matters. With carbon taxes in place, lowering the costs of renewable energy technologies will crowd out fossil fuels and further reduce emissions. Thus, to the extent the taxes are below social costs of carbon, an additional incentive is present to subsidize renewable energy. From a national perspective, in particular, upstream subsidies are preferred. However, with renewable energy targets, additional deployment of renewable energy actually crowds *in* fossil energy, as the flip side to a binding renewable energy share is a binding fossil energy share. If the social costs of emissions are sufficiently high, the emission effect can dominate the profit shifting effect and the market power issue, implying that the upstream supply of renewable capital should also be taxed.

We compare globally optimal policies to national strategic policies in both a theoretical and numerical framework. From a global perspective, it matters less whether subsidies are introduced upstream or downstream if implemented globally. Interestingly, the noncooperative equilibrium can in fact lead to an optimal set of subsidies, provided that the individual countries each value domestic emissions by the global cost of carbon. In the strategic trade literature, a Nash-equilibrium in subsidies tends to be a Prisoner's Dilemma; we find that this is not necessarily the case with our transboundary environmental externality. In unilateral policy, an upstream subsidy may be combined with a downstream subsidy or tax to help shift deployment to where the emissions consequences are more beneficial. We parameterize the model for the U.S. and EU electricity markets. We illustrate that if the EU priced carbon at the social cost of carbon (while the U.S. had no carbon tax), the EU would prefer to add an upstream subsidy plus a small downstream one; the social planner, however, wants a bigger upstream subsidy and a downstream tax on deployment in the EU to shift more abatement to the U.S., where generation is more carbon intensive. On the other hand, if each region has a binding renewable energy target instead, the EU strategic subsidies remain similar, but the socially optimal strategy would be to tax upstream manufacturing in the EU and subsidize their deployment downstream, in order to raise the shadow cost of the renewables target in U.S. Such counterintuitive results emphasize the need to examine both overlapping market failures and policies in evaluating green technology strategies in a global context.

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