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In an effort to reduce fossil fuel consumption and the resulting carbon externality, renewable energy generation has become a vital aspect of public policy. Given that the residential sector accounts for more than 25 percent of final energy consumption in the EU and that rooftop space provides ample space for solar photovoltaic (PV), the housing market has been an obvious target for the renewable energy transition. Solar PV subsidies have been popular to stimulate renewable energy generation among households. Especially at times when solar PV adoption was still nascent, subsidies were introduced to provide a financial incentive to early adopters. Although solar PV subsidy programs have been widely implemented across a large variety of countries, there is limited evidence on their effectiveness.

In their study, Erdal Aydin, Dirk Brounen, Linde Kattenberg, and Nils Kok study a subsidy program aimed at stimulating residential solar PV adoption in the setting of early adopters. To assess the effectiveness of the subsidy on solar adoption, they exploit a natural experimental setting where a solar PV subsidy is randomly assigned to applying households by means of a lottery. In this way, they can observe what would have happened to applying households if they would not have received subsidy. The potential presence of solar panels is identified through analyzing aerial images of the roofs of these households. By studying the subgroup of applying households during the early stage of technology adoption, we learn how government subsidies affect households that are already primed to respond to renewable energy technology subsidies.

Main findings

The results highlight that, without targeting, a subsidy program tends to attract a select group of applicants. This group is wealthier, higher educated, younger, and uses more electricity. The paper shows that, within this group, providing a subsidy leads to a 14.4% higher adoption rate, whereas the solar PV is also installed 1 year earlier and in a 33.2% larger quantity. Moreover, overall electricity use is 8.1% lower. Although the authors find a significant effect, it is questionable whether this was a cost-efficient allocation of taxpayer money. In comparison, more than half of the households in the group that was rejected for the subsidy program also installs solar panels within 7 years after the subsidy application. If the saved carbon emissions and costs of the subsidy program are translated to a cost of carbon, a back of the envelope calculation reveals that the costs to reduce CO_2 emissions by one ton with this subsidy program were €2,202. In 2008, the market price for one ton of CO_2 in the EU ETS system was €26. This finding implies that mitigating CO_2 emissions through the subsidy program came at a substantial cost.

Implications for practice

In the early stage of a technology, stimulating adoption by 'early adopters' can be an important driver for take-up by a larger share of the population. The paper observes a clear sorting effect where households that are wealthier, higher educated, and younger are more likely to respond to apply for the solar PV subsidy. In the literature, these household characteristics are linked to having lower barriers to adopting renewable energy technology. Although the subsidy significantly increases solar adoption, at the extensive and intensive margin, the subsidy costs is relatively high.

The results of the paper show that the subsidy program mostly attracted the converted. More than half of the applicants installs solar panels without receiving the subsidy. Given that subsidies are widely present and costly to ratepayers, governments or both, the extent to which they can effectively stimulate adoption is important. To effectively allocate available public resources, a targeted program that can reach households with higher barriers to investment, could lead to a higher subsidy program effectiveness.

Reference: Kattenberg, L., Aydin, E., Brounen, D., Kok, N. (2023). On the Economics of Residential Solar PV Subsidies: Impact on Adoption and Savings. *Working Paper,* available at [Link]