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Social equity issues in the distribution of feed-in tariff policy benefits: A cross sectional analysis from England and Wales using spatial census and policy data

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ABSTRACT

The feed-in tariff has become a popular policy instrument globally for deploying clean energy, often involving substantial public spending commitments. Yet relatively little attention has been paid to how payments made under this policy type get distributed across socioeconomic groups. This paper links information on individual domestic photovoltaic (PV) installations registered under the feed-in tariff for England and Wales, to spatially-organised census data. This makes it possible to observe which socioeconomic groups are benefitting most and least under the policy. Comparing the observed benefit distribution to a counterfactual distribution of perfect equality, a moderate to high level of inequality is found. Cross-sectional regressions suggest that settlement density, home ownership status, physical dwelling type, local information spillovers, and household social class shaped this outcome. Greater sensitivity to these factors in policy design could improve distributional outcomes under feed-in tariff policies in England and Wales, and beyond.

1. Introduction

A feed-in tariff (FiT) is a policy instrument for promoting clean energy production that works by guaranteeing a fixed payment to clean energy installations for each unit of electricity produced. Typically, it guarantees the price by contract for 10 or more years (Couture and Gagnon, 2010; Madlener and Stagl, 2005; NREL, 2010). As of 2010, feed-in tariffs were the most popular policy approach globally for promoting clean energy deployment, with more jurisdictions using feed-in tariffs than either tax credits or renewable portfolio standards (NREL, 2010; Schmalensee, 2010). The United Nations Environment Program and Bloomberg New Energy Finance estimate that, as of 2010, 75% of all globally installed photovoltaic (PV) capacity had been deployed with the support of feed-in tariffs (UNEP/BNEF, 2013).

Social equity issues are material in the context of feed-in tariff policies because these policies tend to involve very large public and private spending commitments. For example, the California Solar Energy Initiative, which facilitated deployment of mostly small-scale solar PV capacity between 2007 and 2016, had a total budget of USD 2.1 billion (CPUC, 2013). The empirical subject of this paper is the feed-in tariff in England and Wales. The impact assessment carried out ahead of its launch estimated the total cumulative cost to 2030 at GBP 8.6 billion (DECC 2010).[1] By contrast, in Germany, an estimated EUR 53 billion in payments were made between 2000 and 2010 to PV installations alone under the feed-in tariff provided for by the country's Renewable Energy Sources Act (Frondel et al., 2010: 10). Given this scale of spending, more attention should be paid to social equity in the distribution of the benefits of these policies.

This paper uses rich, comprehensive data for small statistical geographies in England and Wales to examine how the benefits of the feed-in tariff in England and Wales have been distributed across socioeconomic groups to date. The novel dataset links information about 564,074 small-scale PV installations to household socioeconomic and demographic information from the census of England and Wales, at what can be thought of as the 'neighbourhood' level. The combined dataset is used to measure the degree of inequality in the distribution of the benefit across socioeconomic groups and to test different explanations for this outcome that are relevant to feed-in tariff policy design.

The paper proceeds as follows: Section 2 frames the feed-in tariff, as a policy instrument, within a broader discussion about the distribu-

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[1] The present research estimates the total annual cost of the program at GBP 447 million for the FiT year April 2014-March 2015 – see Section 3.4. Said impact assessment estimated the annual average cost at GBP 610 million over 20 years.

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tional impact of taxes and subsidies in an energy and environment policy context. Section 3 discusses the empirical methods used, which involve linking policy and census information across small statistical geographies, then comparing the actual benefit distribution to a counterfactual distribution of perfect equality across socioeconomic groups. Section 4 describes the data. Section 5 presents the results and tests various hypotheses for the observed unequal outcome. Section 6 returns to the discussion of social equity in feed-in tariff design and suggests ways that such policies can be made more sensitive to equity issues, in Britain and beyond.

2. Equity issues with subsidies in energy and environment policy

Broadly speaking, policymakers attempting to decarbonise and modernise energy systems have two basic options for changing investment and consumption behaviour: taxes and/or subsidies. Questions of political feasibility aside, these options have very different distributional implications when compared in the abstract. Taxes are often designed to discourage negative externalities connected to consumption and production behaviour by penalising the externality. Taxes on energy system pollution, however, are frequently directly *regressive* because worse-off households spend a greater proportion of income on energy goods affected by the tax, and so pay a greater proportion of income under the tax than better-off households (Advani et al., 2013; Bento et al., 2009). However, one advantage of taxes is that they can be augmented with policies that reduce or eliminate their first-order negative distributional incidence by returning some of the public income from the tax to poorer households (Bento, 2013; Kotlikoff and Summers, 1987). This is done in British Columbia, for example, where some of the revenue raised via carbon taxation is returned to worse-off households though a policy-specific, income-linked deduction on annual tax returns (Murray and Rivers, 2015).

A feed-in tariff – a payment made to clean-energy producers – is, on the other hand, a subsidy. Subsidies in an energy and environment policy context do not address negative externalities but rather promote alternative modes of production or consumption that reduce or avoid those externalities. On their own, subsidies produce no revenue that could be re-distributed, so, unlike taxes, policies like feed-in tariffs cannot fund complementary social equity programs. Insofar as the policy objective behind a feed-in tariff is to reduce pollution, a feed-in tariff is a technology-specific abatement subsidy. Abatement subsidies effectively grant polluters the right to pollute, then oblige whoever pays for the subsidy to compensate the polluters for cleaning up.[2] Taxes, by contrast, penalise the behaviours that result in pollution in the first place. This is one reason that abatement subsidies tend to be seen as second-best to taxes in terms of distributional outcomes (Bovenberg and Goulder, 2001; Parry et al., 2005; Wodon, 2006).

A major political attraction of the feed-in tariff as a policy choice to date has been the argument in favour of economic efficiency. Relative to a renewable portfolio standard or other crude, quota-based deployment policy, feed-in tariffs give agents incentives to minimise the cost of a renewable energy installation while maximising production, over a long time period, given a fixed or semi-fixed compensation price. The private profit incentive that this policy design creates is likely to lead to more efficient technology, scale, location, siting, ownership, and financing outcomes than when policymakers are left to decide the technical aspects of deployment (Lyon and Yin, 2010; Lesser and Su, 2008; Mendonça et al., 2011). Under a feed-in tariff, the agents with the best deployment opportunities should select themselves into the policy – that is, participation only occurs when the subsidy on offer compensates an agent for all investment costs (physical capital, information gathering, time, and transaction costs), after adjusting for risk and uncertainty. Unlike a tax policy, no agent should be made directly worse off by the introduction of such a subsidy, but some will be eligible to claim the allocated funding.

Consider a feed-in tariff policy where individual *households* are encouraged to participate, as in the policy analysed in this paper. It seems plausible that the efficiency-improving aspect, whereby agents are allowed to select themselves into participation, may limit participation by certain households. This might occur through multiple channels: worse-off households (that is, economically less prosperous households) may lack access to financial capital to participate in the policy at all; or they may be are unable to participate to the same extent as better-off households (Feng et al., 2010; Moser, 2013; Parry et al., 2005). Additionally, worse-off households may be less likely to know that the policy exists; they may lack financial resources, including credit, to purchase an installation (Haines et al., 2007), or they may be precluded from participation by housing tenure status such as renting (Druckman and Jackson, 2008). Worse-off households may be shut out of participation because they occupy housing stocks with a limited lifespan, making a long-term investment uneconomical on its face. Finally, such households may be deterred from participation by the unpredictability of installation maintenance costs or by the technical knowledge perceived to be required to own and operate an installation (Feng et al., 2010).

Recent empirical studies of the distributional impact of clean energy subsidies have produced results consistent with these hypotheses. Borenstein and Davis (2015) used tax return data from the United States to assess which households participated in tax credit programs for home weatherisation, solar panels, and hybrid and electric vehicles. They found that the bottom three quintiles of earners by income received about 10% of all tax credits, while the top quintile received about 60%. Rausch and Mowers (2014) examine the distributional impact of clean energy standards on US households. They find that these policies are regressive because they place a larger burden on regions that depend on dirty fuels (coal), and a smaller burden on (richer) regions with abundant hydropower and wind resources. Murray and Rivers (2015) show how policymakers successfully anticipated and managed distributional impact issues arising from the British Columbia carbon tax. There, tax credits for low income families were created to offset the otherwise negative incidence of the tax. Other research has sought to address these outcomes pre-emptively by providing practical guidance on fairly distributing the *cost* of feed-in tariffs (Granqvist and Grover, 2016; NREL, 2010).

This conceptual comparison of the differences between taxes and subsidies for social equity outcomes, plus the findings of this recent empirical work, lead to the following hypotheses about the benefit distribution of the feed-in tariff for England and Wales. The hypotheses are that (A) the benefits of the policy are being distributed across socioeconomic groups in a substantially unequal way and (B) that this distribution is explained at least partly by factors that could be addressed through policy design that is more sensitive to equity outcomes.

3. Methods

3.1. Distributional analysis

The approach to testing these hypotheses starts with linking data from the regulatory agency administering the feed-in tariff in England and Wales to census data for those countries, on the basis of small statistical geographies. The observed distribution of policy benefit across statistical geographies is then compared to a counterfactual distribution of perfect equality. The comparison is made by using Lorenz curves, by deriving Gini coefficients from them, and by

[2] Bovenberg and Goulder point out the philosophical assumption that is implicit in this: 'In the case of an abatement subsidy, the government effectively grants pollution rights to firms, and obligates taxpayers to compensate firms for any reductions in pollution. This is consistent with the *victim pays* principle whereby the recipients of pollution must pay to induce pollution reductions' (Bovenberg and Goulder, 2001: 40).