Assessing the Effectiveness of Feed-in-Tarrifs and Renewable Portfolio Standards: An Analysis of Global Renewable Energy Policy

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Overview

Countries across the world are commiting themselves to the reduction of greenhouse gas emissions and the diversification of their electricity portfolios. Two of the most common policies implemented by national governments to achieve these ends are the feed-in-tariff (FIT) and the renewable portfolio standard (RPS). A feed-in-tariff is a subsidy per unit of renewable electricity, as guaranteed over a set number of years. A renewable portfolio standard is a mandate of a specific amount or percentage of renewable energy by a set year, such as 20 percent renewables by 2020.

While we know a great deal about the motivations behind policy adoption among U.S. states and various countries (see, e.g., Bayer and Urpelainen 2016; Lyon & Yin 2010; Jenner et al. 2012; Schaffer and Bernauer 2014; Stadelman and Castro 2014; Carley et al. 2016a), as well as how RPS policies have fared in the U.S. context (for recent analyses, see, e.g., Maguire and Munasib 2016; Carley et al. 2016b; Upton and Snyder 2015a), we still know relatively little about how FIT and RPS policies have worked at the national level. Furthermore, empirical evaluation in this context is especially challenging since these policies are highly heterogeneous across countries (Carley et al. 2016b) and the possibility of policy endogeneity biasing causal inference is high (Upton and Snyder 2015a; Fowler & Breen 2013; Ming-Yuan, Carter & Langholtz 2007; Lyon & Yin 2007). Yet, as countries weigh their options for how to achieve a low-carbon future, information will be essential regarding how well these policies work, which renewable resources are developed as a result of these policies, and whether there are other market consequences such as changes in electricity price.

Methods

To assess the effects of FITs and RPSs on renewable energy generation and related market outcomes, we utilize a panel of more than 120 countries from 1990 until 2010. Combining data from multiple large cross-country data sources such as the World Bank's World Development Index and the Penn World Tables, we compare energy market outcomes in FIT and RPS countries, respectively, before and after policy implementation. To overcome the methodological challenges associated with previous empirical evaluations in this context, this study uses a synthetic control method (Abadie, Diamond, & Hainmueller 2010) that allows for the comparison of outcomes of interest in FIT and RPS countries, respectively, relative to countries that did not implement these policies with similar economic and political characteristics. We confirm the robustness of our approach through a series of placebo and robustness checks.

Results

We first estimate a baseline specification, which is simply a descriptive analysis of the actual change in renewable energy generation in FIT countries relative to non-FIT countries post policy implementation. Results reveal that FIT countries experienced a 20 percent increase in renewable generation per capita relative to non-FIT coutries. They experienced 121 percent increase in wind generation per capita and 21.9 percent increase in solar generation per capita. The baseline specification finds no change in fossil fuel generation per capita in FIT countries.

Next, our synthetic control method compares renewable generation in FIT countries relative to a synthetic country with similar economic and political characteristics in years that pre-date the policy. Results suggest that FIT countries experienced a 28.9 percent increase in RE generation in total, with a 60 percent increase in wind and 12 percent increase in solar, all on a per capita basis. Using the synthetic control analysis, we find that FIT countries experienced a 24.3 percent decrease in fossil fuel generation relative to synthetic countries. Also using the synthetic control method, we find that countries with an RPS policy have, on average, 94.4 percent more wind per capita than countries without the policy. Those countries with an RPS, however, do not have statistically significant differences in other renewable energy market outcomes. These various results are robust to placebo tests where a synthetic control is created for each non-treated country.

Our SC analysis finds that RPSs are less effective at increasing renewable energy generation than FIT policies. While we do estimate a 9.4 percent increases in wind energy generation per capita in RPS countries relative to SC non-RPS countries, we find no effect of renewable energy generation per capita in aggregate, nor do we find evidence of reductions in fossil fuel generation.

Conclusions

There are several important conclusions that one can draw from our analysis. First, the differences in estimates between the baseline and the synthetic control analysis suggest that adoption of these policies is not random, and failing to account for policy endogeneity with a technique such as a synthetic control can bias empirical results. Second, using this technique, we find that both FIT and RPS policies have achieved energy market diversification objectives. Third, while the RPS policy has nearly exclusively resulted in wind energy development, the FIT has incentivized a broader range of renewable energy technologies, including both wind and solar.

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