Title

Smart Meters, Solar Panels, and Technological Disruption in Energy Markets

Description

Smart meters and solar photovoltaic (PV) panels are revolutionising global energy markets. These technologies have the potential to deliver an economically efficient and environmentally sustainable long-run energy supply; however, they are also creating immediate and significant challenges. Policymakers are finding themselves at critical junctures in designing policies to maximise benefits derived from these technologies as they are deployed worldwide.

Smart meters potentially allow electricity retailers to leverage real-time smart meter data on the volume and timing of household energy use to engage in price discrimination. Before smart meters, companies measured profits earned from a given household using quarterly electricity meter readings. These measurements were inaccurate because they did not account for the fact that household profitability crucially depends on how much electricity they use *and* the hours of the day that they use it. With smart meters, companies can measure profits earned from each household at the half-hourly level. With this new information, electricity companies can exercise their market power to engage in price discrimination across households with different daily energy usage patterns to earn higher profits. This is the basis for the project's first main research question: do smart meters facilitate price discrimination, and if so, what are the distributional welfare effects across households (e.g., high/low income) and between households and companies?

With solar panels, 'death spirals' are an emerging policy issue. These spirals occur as solar-powered households start disconnecting from the grid, leaving fewer households to pay higher electricity prices to cover fixed grid capital and maintenance costs. Higher grid prices create stronger incentives for additional households to adopt solar PV and disconnect from the grid, which leaves even fewer households paying even higher prices. This process continues until only low-income households (who cannot afford solar PV) are left on the grid paying very high prices. This leads to the second main research question: How should policies be designed to encourage renewable energy investments in solar power while ensuring a stable and equitable transition toward a sustainable long-run energy supply?

The primary aim of this project is to address the two main research questions regarding smart meters and price discrimination, and the dynamics of solar panel investments. More broadly, using field experiments and structural econometric methods we aim to develop new econometric frameworks for modeling demand and pricing for non-solar and solar power in smart meter-enabled electricity markets. These frameworks will allow me to address the stated research questions; more generally, they represent a toolkit for evaluating the impact of smart meters and solar panel on market efficiency, household welfare, and the environment. In this way, the frameworks that we propose represent significant inputs into policymaking as governments navigate the short and medium-run challenges that smart meters and solar

panels create, with the goal of maximising the long-run economic and environmental benefits from these technologies.