Sun and Lemons: Getting over Information Assymmetries in the California Solar Power Market

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Overview

Solar panel systems are significant investments for households and businesses that need to last at least a decade in order to be financially profitable even with significant subsidies. At the same time, individual homeowners or small contractors would incur great costs in verifying the quality of the main component of a solar system: the solar panels.

Generally, the market for rooftop solar panels can be expected to be particularly vulnerable to issues of asymmetric information on quality. Solar panels can be characterized as an ``experience'' good, where an investor needs to learn about the quality through use. In particular, poor quality panels will tend to show a higher degradation of output over time than high quality panels. Even then, solar panel owners may find it difficult to measure the degradation as it can happen gradually, over many years.

Given the difficulty of judging quality and lack of market mechanisms to signal quality, the established economic theory on the subject would suggest that the market may tend to provide low-quality panels.

However, over the period from 2010 to 2014, many of the larger solar contractors moved to leasing solar power systems to homeowners. The introduction of a leasing model could potentially get over this information asymmetry problem by shifting ownership to the large contractors that install and finance the solar systems. These contractors can then in turn take steps such as testing panels and visiting manufacturing sites to ensure quality of suppliers.

A testable implication that emerges is then that the quality of panels - as measured by degradation of output over time - is better in systems that are leased. In this paper, I use a data set of California solar power systems that includes monthly production data. I measure the average degradation of production over time as a proxy for the inherent quality of solar panel system. I use a Bayesian hierarchical model to test whether systems that were bought outright by owners displayed, on average, higher degradation over time than those that were leased.

The main finding is that solar panel systems that were leased tend to show significantly less degradation over time than those that were sold outright.

Methods

The data used in this paper is an intersection of two datasets from the California Solar Initiative (CSI). CSI provides data on all grid-connected solar panel systems installed in California since January 2007. In addition, CSI provides another data set of monthly production data from the solar panel systems that received production incentives.

The question of interest and the structure of the available data suggests a hierarchical structure to the empirical model. The individual production data are grouped by the different solar panel systems. Each system is then in turn grouped into categories of leased or host-owned. Seasonality must also be adequately accounted for. A natural choice is to use a hierarchical Bayesian model where parameters can be estimated through Markov Chain Monte Carlo (MCMC) simulation

techniques. To estimate the parameters of the model, I use the Stan Bayesian programming language and simulator which uses Hamiltonian MCMC to estimate a joint posterior distribution of the parameters.

Results

The model suggests that a leased solar panel system will on average experience degradation of about 1 to 2 percent after 5 years. A system that was sold out-right will on average experience degradation of approximately 3-4 percent.

Conclusions

The structure of the emerging solar industry in the US, as well as other parts of the world suggests that issues of information asymmetry may play an important role. The established theory on the subject suggests that under information asymmetry of quality, poor quality products may push out good quality products, at least in some sub-markets. In this article I have tested an implication of that theory for the case of solar panels in California. The results are consistent with the presence of significant information asymmetry in the market.

The theoretical literature on information asymmetry and quality is established and deep. The empirical literature for consumer durable investments is however more sparse, reflecting the difficulty of getting reliable data on purchases and long-term reliability. This article provides one of few case studies that both identifies a market that would be expected to have issues of information asymmetry of quality, and provides indirect evidence of the presence of information asymmetry of quality.

Beyond providing a case study and confirmation of well-known economic theory, the article also has policy implications for the emerging solar power industry. Taking the political goals of installing more renewable energy as a given, this article speaks to the strength of making policy instruments flexible in terms of who actually owns the generating investment. Subsidies in countries - like Germany, and US states - like North Carolina, have required the host of the solar panel system to also own the system in order to receive the subsidy.

This article should also be considered as part of a broader literature on the special characteristics of new distributed energy generation technologies. The investment behavior of home owners, farmers, and small cooperatives are bound to be substantially different than those of large, specialized energy companies that have traditionally done most of the investment in electricity generation. Understanding the quickly evolving energy and power industry requires taking into account informational and behavioral factors, and this is a rich field for further research