Abstract: Volatility in Solar Renewable Energy Certificates: Jumps and Fat Tails

Charles Mason, H.A. True Chair in Petroleum and Natural Gas Economics, University of Wyoming
Neil A. Wilmot, University of Wyoming

1 Overview

Renewable energy sources form the centerpiece of a strategy aimed at reducing green house gas (GHG) emissions. Indeed, a fundamental transformation of the energy system is likely to be required if mankind is to limit potential future damages from climate change. An important part of this energy transition is likely to entail widespread adoption of renewables in general, and most likely solar power in particular.

Numerous policy and regulatory frameworks have been proposed to incentivize the instillation of renewable energy, so as to achieve long term reductions in carbon emissions. Many US states have introduced a renewable portfolio standard (RPS) to stimulate the production of energy from renewable sources. One policy, that can be used to comply with the RPS mandate, is the use of 'renewable energy certificates' (RECs). These RECs require a tradable certificate be issued to the generator of each MWh of renewable energy, who is then allowed to sell the REC in a market. New Jersey (NJ) was an earlier adopter of this system. Having adopted ambitious future targets for solar generation, NJ instituted a market for solar renewable energy certificates (SRECs), production credits awarded to owners of grid-connected solar PV systems.

Like many sources of renewable energy, the lion's share of the cost associated with a solar project is born up front. This raises the potential for slower adoption of solar technology. With large up-front costs, the economic benefits of an investment is substantially driven by the flow of earnings after installation, be they in the form of reduced energy bills (for homeowners) or credits from adopting the new technology such as SRECs. This benefit flow must be compared against the (sunk) cost of investment. When either benefits or costs are uncertain, the problem becomes on of "investment under uncertainty".

2 Methods

For this this type of problem, the decision-maker may choose at any point in time to invest immediately or to delay investment. If the payoff to the investment can either increase or decrease, as will naturally occur in the presence of uncertainty, delaying allows the decision-maker to reduce the potential for *ex post* regrets after making an investment that falls in value. In this way, delaying the investment can generate an increase in expected payoff; this increase in value is akin to the value associated with a financial option. A key point is that factors that increase the option value would strengthen the incentive to delay. These factors include changes in the underlying variance of the source of uncertainty, but they also can include

features that contribute to fat tails in the "stochastic process". Such fat tails can arise because of time-varying volatility or the presence of unanticipated dramatic changes, sometimes called "jumps".

Our goal in this paper is to formally assess the empirical importance of jumps and time-varying stochasticity in SREC prices. Using maximum likelihood estimation, we evaluate the percentage change in three key energy prices: SRECs, electricity spot prices and natural gas spot prices.

3 Results

We find that allowing for jumps and time-varying volatility provides statistically important improvements over models that do not account for such features, for each of these energy prices. The preferred econometric specification, which allows for both time-varying volatility and jumps, can then be used to estimate the implied probability that at least one jump would occur over a particular time interval (in our application, one day). Upon constructing these jump probabilities, we find that the estimated jump probability for SREC prices is large at a number of points in time, in particular from late 2011 to early 2013 – a period of relatively high electricity prices in New Jersey. Because the possibility of jumps raises the option value of waiting to invest, one conjecture is that tighter markets could be associated with a slower pace of investment – which in this application suggests an additional factor that could retard the transition to solar power. We also simulate the implied probability that at least one jump would occur in any given month. These implied probabilities indicate that jumps played a consistently important role in both SRECs and electricity prices. Jumps in SRECs appear to have been particularly noteworthy between late 2011 and early 2013, a period when electricity prices in New Jersey were relatively high. This result hints at the potentially important role of market structure in driving fat tails in price returns.

4 Conclusions

Economies are increasingly adopting renewable energy certificates as a policy mechanism to support the transition away from reliance on fossil fuels. We find that both jumps and time-varying volatility play an important role in the stochastic process describing SREC price returns. We also simulate the implied probability that at least one jump would occur in any given month. These implied probabilities indicate that jumps played a consistently important role in both SRECs and electricity prices. Jumps in SRECs appear to have been particularly noteworthy between late 2011 and early 2013, a period when electricity prices in New Jersey were relatively high. This result hints at the potentially important role of market structure in driving fat tails in price returns.