Big Data Meets Local Climate Policy: Energy Star Time-of-Day Savings in Washington, D.C.'s Municipal Buildings

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Abstract:

Most analyses of energy efficiency do not account for the effect of large intra-day variations in wholesale electricity prices when comparing the value of different programs. However, the advent of smart meters and other high frequency energy measurement technologies has created new opportunities for testing energy policy outcomes. More broadly, the use of 'big data' sets in economics are increasingly enabling the study of phenomena that were previously difficult to quantify (Einav and Levin (2014)). This study utilizes high frequency energy consumption data from municipal buildings in the District of Columbia (DC) to provide insight on the time-of-day savings profile associated with the EPA's Energy Star program.

In the energy setting, a question that economists and policymakers have long considered important, but until recently could not precisely measure empirically, relates to whether energy conservation policies and investments deliver savings during peak demand times, when their economic value is highest (CAISO (2013)). In California, hourly energy consumption measurements have been used to assess the realized benefits of residential sector energy efficiency investments and the intra-day timing savings (Boomhower and Davis, 2016; Novan and Smith, 2016; Novan et al., 2017).

At the same time, there is an ongoing trend towards municipal governments implementing a multitude of proactive policies aimed at reducing energy consumption and thereby contributing to mitigating climate change (Broto and Bulkeley, 2013). Cities have long been settings in which effective policy experiments have subsequently been scaled up to higher levels of government (Linstroth and Bell (2007)). Local governments are a desirable setting to evaluate a number of energy policies since over half of greenhouse gas (GHG) emissions originate in cities (Bulkeley (2010)), and city governments manage or coordinate many policies with a direct impact on GHG emissions, such as energy codes, energy benchmarking ordinances, and transit investments.

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This paper takes advantage of a unique sunshine policy on energy consumption adopted by DC in 2012. I use hourly consumption and temperature data from approximately 130 municipal buildings, between early 2013 to spring 2018, together with monthly energy star scores from the EPA's portfolio manager. The main covariates of interest are a set of interaction terms between a building's energy star points achieved and a vector of indicator variables for hour-of-day. Lagged values of monthly energy star scores are used as instrumental variables for current energy star scores, to account for potential simultaneity bias. The coefficients are identified from within-building-hour differences between buildings with different portfolio manager scores. The results suggest that an additional unit increase in the Energy Star score is associated with a statistically significant decrease in hourly consumption of approximately 0.6 kWh, but that the savings are almost equally distributed across hours of the day. This suggests that building operators are not making investments with higher peak-time savings.

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