

Dissertation Abstract:

Essays on Energy and Environmental Economics

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1 Measuring Policy Uncertainty Using Coal Power Plants' Investment and Exit Decisions

Many coal-fired power plants are retiring since around 2012. The existing empirical studies have diverse conclusions regarding the relative impact of market conditions and environmental regulations on coal-fired power plants' retirement decisions. My study aims to better understand these two factors, with uncertainty in the environmental regulation, on coal-fired power plants' investment and exit decisions. A model incorporating these important factors can help guide the government in designing environmental regulations to reduce emissions efficiently. This study introduces a modified investment and exit model under policy uncertainty and discusses the counterfactuals of different scenarios.

2 Emissions from Coal-Fired Power Plant Retirements

The coal-fired power plant industry is a major polluting source of various emissions, including greenhouse gas (CO_2), sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Beginning in around 2012, many coal-fired power plants in the U.S. have started to retire, which creates a chance for evaluating their end-of-business-cycle polluting behavior. This paper examined the emission patterns of the coal-fired electric generating units (EGUs) when they approach retirement. I found a 4% efficiency drop in the last year of operation. The emission rates increase as EGUs approach retirement. As a result, in their final year of operation, each EGU on average emits 78.88 million lbs CO_2 (1.6%), 0.88 million lbs NO_x (10.1%) and 5.01 million lbs SO_2 (16.9%) more than the baseline level in 2012. Controlling for the start-up and shutdown frequency can explain about 43% of the efficiency lost. The efficiency lost explains almost all CO_2 emission rate increase but only 20% of the increase in the NO_x and SO_2 emission rates. EGUs under fee-for-service regulation exhibit a sudden efficiency drop in the final year of operation, while their counterpart, the not regulated ones, show lower efficiency in the last three years of operation.

3 Electric Vehicles Are Driven Less: selection or substitution?

A great deal of funding is spent in promoting electric vehicle adoption. The benefits of these subsidies depend not only on the cost effectiveness of the policy in terms of adoption, but also on how much mileage is actually substituted away from the traditional vehicles. Davis (2019) shows that electric vehicles are driven much less than traditional cars nationwide, which suggests much smaller environmental benefits than expected. Understanding the underlying mechanism can help improve policy design for promoting adoption and encourage electric vehicles usage. This paper investigates two potential explanations for lower mileage in electric vehicles by exploring the mileage changes in households purchasing electric vehicles. For average households purchasing an electric vehicle, there is no significant change in the mileage of the other cars. However, households incentivized to adopt electric vehicles substitute certain mileage away from other cars in their portfolio. The substitution mainly comes from households adding a car to their portfolio, but not households replacing a car.