Dissertation Abstract

Chapter 1: Dynamic Responses to Carbon Pricing in the Electricity Sector (Job Market Paper)

Pricing carbon is often thought of as the first-best regulatory approach to addressing global climate change, though this type of regulation can change both the emissions of greenhouse gases (GHGs) as well as the emissions of co-pollutants with local impacts. Critics of carbon pricing contend that the policy's local impacts lead to worse air quality outcomes for regions that are already heavily polluted. Yet, understanding to what extent this occurs requires understanding how pricing carbon interacts with firm decision making in the regulated industry.

In my job market paper, "Dynamic Responses to Carbon Pricing in the Electricity Sector," I investigate how a carbon price affects firm decision making by developing a dynamic competitive equilibrium model, with novel methodological features to capture firm heterogeneity and endogenize efficiency. I calibrate the model to the cost structure of California's wholesale electricity sector, where electricity producers are regulated with a carbon price. In this model, electricity generating units act as firms and make decisions in two stages. First, they decide whether to invest to improve their efficiency. Second, they make repeated hourly production decisions, where the production decision is dynamic given the presence of start-up costs required to turn units on. I use the model to estimate how a carbon price alters the production and pollutants emitted by firms across space. The estimated model allows me to simulate market and local air quality outcomes across alternative policy scenarios, including the introduction of a location-specific tax on air pollution. The model also allows me to examine how investments in firm efficiency can be directed to maximize private and social returns.

I find that the cost structure of California's fossil-fuel electricity portfolio leads the carbon policy to result in minimal production re-allocation at current carbon prices. Thus, the carbon price interacts minimally with the spatial distribution of air pollutants emitted by the electricity sector. While this may quell concerns about potential negative unintended consequences of the policy, the analysis also reveals that the carbon price does little to improve air quality in heavily polluted regions, especially in comparison to a more targeted policy addressing the externalities of local air pollution.

Counterfactual simulations of local air quality outcomes under higher carbon prices show larger levels of production re-allocation compared to a no carbon policy scenario, leading to aggregate co-benefits attributed to the climate policy via its impact on NO_x emissions. However, only 30 percent of these benefits occur in the state's most heavily polluted regions. I compare this policy to a location-specific Pigouvian tax, which doubles the benefits from avoided NO_x damages and concentrates these benefits in relatively more polluted regions.

Chapter 2: Do Building Audits Save Energy? Evidence from a Natural Experiment (with Kenneth Gillingham)

Across the United States, cities are increasingly implementing building energy audits to manage urban energy use (IMT 2018). Yet, little empirical evidence exists quantifying the efficacy of these types of policies. This paper leverages a unique empirical setting in New York City (NYC) to identify the impact of energy audits on energy efficiency in commercial buildings. In 2013

NYC implemented a policy that randomly assigned building energy audits to the City's large commercial buildings. We exploit this randomization to estimate the effects of the policy on building energy consumption. Our intention-to-treat estimate shows that these interventions reduce energy consumption per square foot by 2 percent on average, while the local average treatment effects reduction is over 3 percent. Voluntary compliance and non-compliance, as well as pre-treatment building efficiency, contribute to substantial heterogeneity in the treatment effects. In addition, we find larger reductions in energy use when building owners are responsible for energy costs, indicating the influence of split incentives in the response to this policy intervention.

Chapter 3: The Impact of Urban Form on Driving Demand (with Kenneth Gillingham)
While the urban planning literature suggests that features of transportations networks and physical infrastructure (urban form) can be important determinants of transportation demand, little economic work exists that causally identifies this affect. Meanwhile, transportation is one of the largest sources of greenhouse gas emissions and NOx pollution in the United States with passenger travel comprising the majority of energy use from transportation (EPA 2018, EIA 2016). This paper uses detailed micro-data on driving demand and localized attributes of urban form to identify the impact of the built environment on the demand for private motorized travel. We quantify the built environment with traditional measures of urban form such as population and household density, as well as novel metrics, which capture the proximity and density of local amenities at refined geographic scales. The large individual panel data set used in this study to measure driving demand allows for multiple approaches to address the issues that arise from self-selection of drivers to residential location. Our preferred specification employs a first difference approach that captures the impact of changes in urban form on travel demand for drivers that move localities in our study period. Preliminary results indicate that on average a 10 point increase in our index of walkability can lead to a decrease in vehicle miles traveled by 600 miles annually per driver in Massachusetts. Further, we find that non-traditional measures of urban form relating to amenity accessibility and public transit supply play more important roles in shaping travel demand compared to coarser measures used in previous work. Thus, this study highlights the role of amenity accessibility in shaping travel decisions, as well as opportunities for urban planning to promote sustainable patterns of energy use from the transportation sector.