Research Statement
November 20, 2017

My interests lie in environmental, resource and computational economics. I employ a range of analytical/empirical techniques in my work, including computable general equilibrium modeling and applied microeconometrics. Broadly defined, my research examines the sub-national consequences of policy with a focus on environment and resources. I have worked on questions regarding the regional economic effects of groundwater scarcity, mining, strategic regulator behavior in ambient air quality monitoring and sub-national climate agreements. Part of my research has been devoted to building tools for applied general equilibrium analysis by both incorporating existing data frameworks and producing open source options. My research emphasizes differing empirical approaches depending on whether ex-ante or ex-post techniques are appropriate.

Resources:

Current Work:

I have three papers in resource economics. My job market paper, *Do Agricultural Pumping Restrictions Hold Water? General Equilibrium Cost Impacts of Regulated Groundwater Withdrawals*, looks at the regional economic costs of groundwater scarcity for agricultural irrigators. Agricultural irrigation is the single largest fresh water consumptive use category in the United States. It is unclear whether or not regulations on the amount of water used by farmers will have substantial microeconomic and/or macroeconomic effects because of the heterogeneity in fresh water availability across the country. The magnitude of these effects depends on the extent of the policy shock, the underlying elasticities governing production decisions and composition of the reference dataset. Methodologically, this question is challenging because often the price for fresh water does not reflect its true level of scarcity. I assess this question using county level data from Wisconsin in an ex-ante framework, basing the analysis on a calibrated static multi-regional, multi-sectoral computable general equilibrium model. The model relies on shadow prices generated on resource constraints to characterize the relative value of water in producing agricultural output. I find that the restrictions produce heterogeneous employment and welfare impacts across counties, depending both on the level of agricultural activity in the reference data and the policy instruments used to ration water use. Mandated command and control type regulations are expensive relative to market based mechanisms, though overall costs are small, suggesting that regulated water use in agricultural sectors with relatively small levels of value added as in Wisconsin are likely to have limited impacts to the overall regional economy.

A second paper on this theme, *Mining and Community Economic Growth* coauthored with Steven Deller, uses spatial regression techniques to assess the regional economic growth implications of non-gas and oil mining. This paper, appearing in *The Review of Regional Studies*, is motivated by the influx of "frack" sand mining, needed as a precursor for the hydraulic fracturing process in extracting natural gas. The analysis finds that non-oil and gas mining is associated with lower population growth and higher per capita incomes at the county level.

My third paper in resource economics is coauthored with Corbett Grainger and Fan Zhang and is entitled *Distributional Impacts of Energy Cross-Subsidization.* The work is affiliated with the World Bank and assesses the impacts of energy price reform across sectors and household income categories in Belarus using both input output and general equilibrium methods. In Post-Soviet countries like Belarus, revenues from an industrial tariff on electricity are used to cross-subsidize heating for households. We find that policy reducing the degree of cross-subsidization increases overall economic performance due to cheaper prices for electricity. The welfare impacts, however, across household income deciles are contingent on policy flexibility. Policy reform is regressive when using a blunt instrument to reduce subsidized heat as poorer households are overly burdened due to lost income from subsidized heat while richer households enjoy gains from cheaper market prices for goods. Computing household specific subsidy rates which achieve the same level public revenue from electricity tariff reductions but imposes an equalized welfare change constraint across households is both welfare neutral and achieves better overall economic outcomes.

Future work:

I have begun a project with Argonne National Laboratory on assessing the importance of considering the water and energy systems jointly in related policy making. This work characterizes the economic choice of energy technology adoptions and the resulting implications on water withdrawals in the domestic economy. Regional variation in the types of fuel and cooling technologies available for thermoelectric power generation will impact the water and carbon intensity of electricity production. We use computable general equilibrium modeling as an ex ante framework for understanding when separately imposed policies on energy and water may lead to perverse outcomes. For instance, the extent to which we may be trading off cleaner air with growing water scarcity or vice versa given state level policy.

Environmental:

Current Work:

The second theme of my research is on subnational environmental topics. My first paper on this theme coauthored with Corbett Grainger and Wonjun Chang, is entitled *Do Regulators Strategically Avoid Pollution Hotspots when Siting Monitors? Evidence from Remote Sensing of Air Pollution.* Under the Clean Air Act and its Amendments (CAAA), local regulators are provided the task of ensuring local ambient air quality satisfies the National Ambient Air Quality Standards (NAAQS). An understudied feature of this federal-state arrangement is how ambient pollution is actually monitored. Considerable flexibility is given to local regulators in exactly how to site a monitor. This question is important because non-attainment status is achieved through the readings of ambient monitors. Non-attainment designation and the resulting pollution reduction due to regulatory pressure has been used centrally in the economics literature; as an instrument in regression discontinuity design to identify, for instance, health and mortality impacts of the CAAA or distributional effects of regulations. Because ambient pollution monitors only record data at a

single point, we characterize alternative siting locations using remote sensing data from satellites to capture a distribution of pollution around the monitored site. Using a collapsed cross section of spatial grids and reduced form econometric techniques, we show that for monitors sited within marginal counties, or counties that are near or under the NAAQS, local regulators avoid areas of high concentration relative to non-attainment counties.

A second project in this area, with Thomas F. Rutherford, Christoph Böhringer, and Gokce Akin-Olcum is work affiliated with the Environmental Defense Fund seeking to identify the state level impacts of subnational climate agreements in the United States. As part of the project, we have constructed an open source build stream for generating state level datasets for applied general equilibrium analysis. The modeling makes a contribution to the public discussion on national cooperation with international climate agreements. Our paper assesses the general equilibrium implications of state level policies which agree with international agreements. We capture the leakage, both economic and environmental, that occurs as a result. This work also makes a contribution to the regional modeling literature because regional data are often a large limitation in modeling applications both due to cost and flexibility. Our work provides open source tools for constructing regional datasets from national sources in a flexible build routine, which offers tools for customizations depending upon the application of interest. Along similar lines, I have a paper with Thomas F. Rutherford, *Using IMPLAN Social Accounts for Applied General Equilibrium Modeling*, which illustrates a transparent build routine which translates social accounting matrices into a format amenable to general equilibrium model. The routine uses optimization based matrix balancing techniques to enforce accounting identities in a canonical general equilibrium modeling structure. Such data work provides analysts a set of tools to facilitate subnational economic modeling based research.

Future work:
One of the many challenges in using a computable general equilibrium model for policy analysis concerns describing model output in an accessible format. Quite typically, a standard model will generate a variety of indicators that can be used to describe changes from the benchmark equilibrium due to an initial policy shock. Model output can be challenging to describe to policy oriented individuals who may lack the necessary background in economics, but who are in a position of authority to influence legislative changes. Over the past few decades, the so called multiplier effect has been popularized as a convenient tool for discussing estimated impacts a policy change can have on an economy due to its industry and spatial inter-connectedness. Such calculations are typically found in the realm of input-output modeling and provide an intuitive (generally) per dollar impact of changes to the economy. In order to bridge the gap between the intuitive notion of the multiplier effect and more rigorous modeling frameworks, Thomas F. Rutherford and I have begun to work on providing a method for generating general equilibrium multipliers relying on techniques for local sensitivity analysis. We seek to apply our multipliers to environmental topics as a simple metric for understanding the per dollar impact of policy changes.

Looking Forward:

I anticipate continuing to study the effects of regulations and property rights, with a focus on environmental policy, natural resources and computational methods. In the near term, I hope to contribute to the literature by continuing to study the distributional and inter-regional effects of subnational regulations.