Emmanuel Murray Leclair

Ph.D. Candidate in Economics – University of Western Ontario

Thesis Abtract

"Balancing Production and Carbon Emissions with Fuel Substitution" (Job Market Paper)
I evaluate the role of substituting "dirty" fuels for cleaner fuels in shaping the output cost of emission reduction, which is central to debates on carbon policy. While fuel substitution reduces the output cost from carbon taxation, *technology lock-in* prevents the widespread adoption of cleaner fuels. Adoption entails high fixed costs, which many plants are too inefficient to pay, thus not transitioning away from "dirty" fuels. However, heterogeneity in plants' ability to use different fuels creates variation in exposure to the tax, with more polluting plants being more exposed. As these plants become less competitive, production reallocates towards cleaner plants, mitigating output losses from emission reduction. To get these results, I develop a dynamic production model where plants choose a combination of coal, gas, oil, and electricity. These choices reflect inter-temporal substitution between fuels and heterogeneity in plants' abilities to use different fuels. I estimate the model using a panel of steel manufacturing plants from the Indian Survey of Industries (2009-2016), one of the most energy intensitve and difficult to decarbonize industry.

"Asymmetric Environmental Regulation, Interfuel Substitution and Carbon Leakage"
This paper studies the effect of market-based environmental regulation on manufacturing plants' stationary emissions of greenhouse gases from fossil fuel combustion. I build a model of imperfect competition with multiple fuels as energy inputs, which allows for region-specific carbon taxes. Such asymmetric carbon taxes decrease the emissions of regulated firms. However, it also increases the emissions of unregulated firms through the reallocation of production across regions due to competition between plants, a phenomenon known as carbon leakage. I estimate the structural model with publicly available Canadian plant-level data on a wide range of pollutants emitted in the air to quantify the effect of the British-Columbia and Quebec carbon taxes implemented in 2008 and 2007, respectively. I find little evidence of carbon leakage in other Canadian provinces. Indeed, a one percent decrease in GHG emissions in regulated provinces is associated with a 0.06% decrease in emission in unregulated provinces, suggesting that the direct benefits of asymmetric carbon taxes outweighs their drawbacks by a factor of 15. Moreover, I document important empirical regularities that should guide future research on firm's use of multiple polluting inputs and fuel substitution.

"Long-Term Contracts and Secondary Markets: Theory and Evidence from Natural Gas Pipelines" *(Joint with Yanyou Chen and Adam Wyonzek)*
We evaluate the efficiency of the U.S. natural gas pipeline network in inter-temporally allocating pipeline capacity in response to demand shocks through a secondary market. Large demand shocks are increasingly common due to extreme weather events induced by climate change. Capacity holders can lease capacity to other shippers through the secondary market in daily open-season auctions. Using novel daily transaction data for the entire U.S. natural gas pipeline network between 2005 and 2023, we find that the secondary market responds to large regional fluctuations in demand for natural gas. For example, the February 2021 extreme cold storm in Texas increased capacity released in the secondary market by 30%. However, concerns about market power erode some of the efficiency gains of the secondary market. Marketeers engage in arbitrage opportunity, renting capacity jointly with natural gas in hubs far from the shock and reselling to hubs where the demand increase is located. We also provide stylized facts about the functioning of the secondary market that can guide the implementation of similar Coasian markets.