Analyzing Carbon Pricing Policies using a General Equilibrium Model with production parameters estimated using firm data

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices II (Chair: Mun S. Ho, Harvard University)
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Computable General Equilibrium (CGE) models are extensively used in simulating important environmental policies, such as carbon taxes or cap and trade policies. The simulation results from these models hinge on the production functions and the elasticities of substitution among inputs such as capital, labor and energy, or sub-tier substitution among different energy types. Many CGE models rely on parameters that are derived from other countries, other industries or from earlier periods given the difficulty in obtaining them; a common source of parameters is the GTAP database which is carefully compiled but only has a small set of elasticities.
China has ambitious carbon policies and given its major contribution to global emissions, these policies are much analyzed and discussed. In the empirical studies of these policies, there are few studies of production functions with energy input using firm-level data. We use firm level data, and the Ackerberg-Caves-Frazer method to estimate CES production functions by industry and find significant heterogeneity in substitution elasticities across different industries. We then incorporate these empirically estimated elasticities into the CGE model to simulate carbon price policies to reach Chinaâ€™s NDC targets in 2030. We compare simulated results using GTAP parameters and our empirically estimated coefficients. We find our empirical CGE model project lower base case GDP growth and higher total energy use, but with lower coal use and carbon emissions. In the carbon tax exercises, we found that empirical parameters would cause slightly larger GDP loss and greater energy use and carbon emission reductions, compared to GTAP parameters. Finally, we also conduct a sensitivity analysis applying empirical parameters in limited sectors to test the model sensitivity.