Impact of Carbon Tax Policies on the Global Agricultural Economy: A Computational Spatial Partial Equilibrium Modeling Approach

Zhu, Mary

Developed amid the Paris Agreement controversy, this spatial equilibrium model projects the environmental and economic impacts of carbon tax policies from 2012 to 2050. Simulating the Climate Protection and Justice Act of 2015 (CPJA) as an example, the model projects the impacts of this proposed carbon tax on the global agricultural market under the following scenarios: i) Status Quo, with no country adopting the CPJA, ii) CPJA Developed, adopted by only major developed countries, and iii) CPJA World, adopted by all countries. The sector model utilizes linear programming to optimize an objective function (total social welfare) subject to multiple sets of constraints across 11 commodities and 17 countries/regions. Implemented with an interior point convex quadratic solver (BPMPD) and Microsoft Visual Basic for Applications (free/home software), the model in the static phase completes a comparative analysis of the scenarios' trade-offs; in the dynamic phase, it generates iterative projections of their impacts. The model's versatility also permits changes in policy to be efficiently reflected and its constraints and objectives to be customized. Validated by historical data with up to 83% accuracy, the results show that under CPJA Developed, although developing countries suffer potential carbon leakage and developed countries drop in production and exports, 5.5 billion tons of carbon are reduced. Under CPJA World, all countries experience a share of the rising prices and decreased trade/production while 15.5 billion tons of carbon are reduced. Thus, with global cooperation, the world will benefit environmentally and more evenly share the economic burden.

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