The Impact of Climate Change on Rice Yields: Heterogeneity and Uncertainty

Kamilya Tazhibayeva
Robert Townsend

December 2012

Abstract

We specify a three-stage production function for rice cultivation which incorporates the sequential nature of both production shocks, including weather, and input choices based on sequentially updated information sets of history of realized shocks and observed changes in crop growth. The production function is CES across stages, thus taking into account substantial complementarities between different phases of the biophysical crop growth process, in contrast to the substitute nature of commonly used Cobb-Douglas specification. This framework is particularly well-suited for evaluating the effect of climate change on crop cultivation practices and yields. We apply the model to 11-year panel of rice farmers in Thailand. The panel structure of our data allows us to analyze both the cross sectional effects of weather shocks and climate change on yields, and the effects on the mean levels and shape of yield distribution for individual farmers. We find substantial heterogeneity among farmers in the effect of both weather shocks and climate change on yields. We consider two alternative climate change scenarios for Southeast Asia, one with mild increases of temperature and rainfall throughout the year and the other with more extreme temperature increases and less rainfall during months of rice cultivation. While from the farmer's perspective uncertainty of yields decreases with more extreme climate change, cross sectional heterogeneity in uncertainty increases. Our focus is on detailed partial equilibrium analysis of the effects of climate change on yields at the crop-plot level, accurate understanding of which is essential for global general equilibrium modeling of environmental changes. We integrate our economic model of rice production with soil science crop growth modeling, weather simulators, and global climate change models.