Heterogeneity in the Effects of Climate Change on Soybean Yields

Menghan Yuan, Nord University Business School

Abstract

Using a panel of 74 countries that spans nearly 60 years, this paper investigates the effects of climate change on global soybean yields. In alignment with other research, we find a global non-linear relationship between growing season average temperature and yield growth—a parabola that minimizes around $24.9^{0}C$. It indicates that effects of warming change from being beneficial to harmful, and reach to the most damaging at the optimum temperature; however, beyond the optimum, warming becomes less detrimental probably due to adaption of local crop variety to heat at countries that have been persistently hot.

However, by incorporating regional dummies to our empirical model, we find significant heterogeneity in different regions. For example, in contrary to the global response function that opens upwards, the opposite direction, a downward open response function, is found for Southeast Asia, such that crop yield growth maximizes at $24.23^{0}C$. We also demonstrate non-linear effects of precipitation. In contrast to the large heterogeneity in temperature effects, the regional response functions for precipitation are more consistent over the world.

Except for regions not sensitive to precipitation change, Southeast Asia, Eastern Europe & Central Asia, and Sub-Saharan Africa all show a downward open parabolic response curve to precipitation. In addition to temperature and precipitation, we highlight the importance of considering diurnal temperature range (*dtr*) in assessing climate change impacts on crop yields. We find global significance of *dtr*—an additional $1^{0}C$ *dtr* will slow global soybean yield growth by 4.1 percentage points.