Climate Change Volatility and Crop Choices*

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1 Extended Abstract

Climate change has generated much attention. Upward trends in average temperature are well documented facts. Relatively less studied is the impact of the increase in climate volatility, including weather extreme events, on behavior. In standard models with uncertainty, precautionary motives, and lack of formal insurance, agents self-insure by building up assets, or engaging in other type of behavior designed to reduce to impact of risk on outcomes. The goal of our project is to investigate the impact of increasing climate volatility on choices made by farmers around the world, and in particular in developing countries. In this note we describe the data used and provide some descriptive evidence on rainfall and temperature volatility and on the relation between temperature volatility and crops production, cultivated land and crops diversity.

Firstly, we collected data on temperatures and rainfall for the entire globe and for many years. We used both actual climatic station data as well as gridded data. We complemented these data with information on production and soil characteristics for a variety of crops. We use an imputation method to transform aggregate crop production data available at the level of individual country onto gridded data. Our data come from different international sources that are meant to be of high quality, such as the Food and Agricultural Organization of the United Nations (FAO) and the National Oceanic and Atmospheric Administration (NOAA). Our final data set contains information on about 200 countries, 30,000 weather stations, and about 160 crops. We limit our descriptive analysis to the past sixty years, where we have a larger and more consistent sample to work with.

We first establish a series of facts about the time series and cross-sectional profiles of temperature and rainfall. In particular, we confirm the general increase in average temperature recorded in the past decades, as documented in Stern (2007), with however a large degree of heterogeneity across space. Second, and more importantly for our project, we establish some facts about the evolution of weather risk, expressed in terms of the volatility of the residual of temperatures and rainfall regressions.[1] In particular, we find that: (a) the (yearly) coefficient of variation of temperature is increasing over time; (b) there is a significant heterogeneity

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[1]In particular, we define weather risk as the coefficient of variation, over a specified time frame, of the residual of a regression of temperature (or rainfall) on month, station, and hemisphere fixed effects.

in the estimated changes in the volatility of temperatures, with some countries and locations experiencing a large increase, and others a large fall in volatility. In terms of rainfall the picture seems quite different: (a) on average the residual volatility seems to be falling over time, although (b) even in this case there is a significant amount of heterogeneity in the data when organized by country or location.

We then investigate the relation between (long-run) temperature volatility and crops yields, cultivated land and crops diversity. We find that increased temperature volatility translates into lower production of many of the studied crops, with economically large effects for the more sensitive crops (e.g. fresh fruits), further to an expansion in cultivated land and an increase in the number of harvested crops. We take this descriptive evidence as suggestive that increased climate uncertainty can generate potentially large welfare losses, and that farmers are responding to increased uncertainty with a set of risk coping strategies, such as crop diversification.