Adaptation to Climate Change: the Role of Crop Insurance

Xiaoxue Du¹ and Fanglin Ye²
1: Assistant Professor, xiaoxuedu@uidaho.edu, Department of Agricultural Economics and Rural Sociology, University of Idaho
2: Assistant Professor, yefanglin@gmail.com, International Academy of Business and Economics, Tianjin University of Finance and Economics


Copyright 2018 by Du and Ye. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.
Adaptation to Climate Change: the Role of Crop Insurance
Xiaoxue Du\textsuperscript{1} and Fanglin Ye\textsuperscript{2}
\textsuperscript{1}University of Idaho, \textsuperscript{2}Tianjin University of Finance and Economics

Background
- There is strong evidence that weather extremes occur more frequently and intensely over the recent decades due to climate change (Coumou and Rahmstorf, 2012; Easterling et al., 2000)
- We explore the role of FCIP in agricultural adaption to extreme weather and estimate its induced loss under the circumstance of climate change.

Empirical Strategy

Fixed Effect Model:
\[ CornYield_{cst} = \beta CIP_{cst} + X'_{cst}\gamma + u_{st} + \epsilon_{cst} \]  
(1)
- CIP is crop insurance participation.
- X is a set of control variables.
- cst denotes the county c, state s, and time t.
- \( u_{st} \) and \( v_{st} \) are state by year fixed effects.

- We want to test whether \( \beta \) is significantly positive or negative.
- We are also interested in the interaction effect of crop insurance participation and extreme weather events on corn yield.

Defining Crop Insurance Participation (CIP)

Figure 1: CIP in Schlenker and Annan (2015)
Figure 2: CIP in this paper

Data
- County level crop insurance data come from the Risk Management Agency
- From National Agricultural Statistics Service (NASS), we obtain county-level yield and planted acreage data for corn and soybean over for rainfed counties.
- For each county-year observation, we use Parameter-Elevation Regressions on Independent Slopes Model (PRISM) data to get mean, minimum, and maximum temperature, as well as mean precipitation variables (monthly).
- Monthly Palmer Drought Severity Index (PDSI) from National Center for Atmospheric Research.

Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn yield (bushel/acre)</td>
<td>cornyield</td>
<td>114.8</td>
<td>31.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Growing degree days (GDD) (\textdegree C)</td>
<td>degree_days</td>
<td>2154.2</td>
<td>479.5</td>
<td>947.2</td>
</tr>
<tr>
<td>Square root of overheat degree days (\textdegree C)</td>
<td>degree_days_32_sept</td>
<td>1.9</td>
<td>3.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Total precipitation between March and August (\textdegree mm)</td>
<td>total_preci</td>
<td>609.0</td>
<td>150.3</td>
<td>226.0</td>
</tr>
<tr>
<td>Weighted Palmer Drought Severity Index between March and August (-10 to 10)</td>
<td>pdsi_total</td>
<td>0.4</td>
<td>2.0</td>
<td>-5.8</td>
</tr>
<tr>
<td>Weighted average coverage level of crop insurance in each county</td>
<td>level_totalinsurance</td>
<td>0.3</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Fraction of insured planted area</td>
<td>fraction total</td>
<td>0.5</td>
<td>0.3</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Results

\begin{tabular}{|c|c|c|c|}
\hline
& Baseline & BM (5) & With interaction with drought index \hline
degree_days & 0.008** & 0.008** & 0.008** & 0.008** \hline
degree_days_2 & -0.000*** & -0.000*** & -0.000*** & -0.000*** \hline
degree_days_32_sept & -1.257*** & -1.257*** & -2.109*** & -1.579*** \hline
total_preci & 0.177** & 0.177** & 0.133** & 0.097*** \hline
total_preci_2 & -0.000*** & -0.000*** & -0.000*** & -0.000*** \hline
level_totalinsurance & -0.272 & 59.583** & 61.706*** & (1.911) & (2.860) & (2.628) \hline
fraction_total & -1.149 & (0.012) & (0.106) & (0.520) & (0.615) & (0.290) & (0.073) & (0.872) \hline
inter_total_drought & -0.209 & (0.485) & (0.485) & (0.485) & (0.485) \hline
intra_total_drought & -3.142*** & (0.927) & (0.927) & (0.927) & (0.927) \hline
Constant & -38.277*** & 5.779 & 22.964*** & (8.965) & (8.965) & (8.965) & (8.965) \hline
\hline
\end{tabular}

\textsuperscript{*} p < 0.10, \textsuperscript{**} p < 0.05, \textsuperscript{***} p < 0.01

Conclusion
- Similar to Schlenker and Annan (2015), we find strong interaction effect between crop insurance participation and extreme weather events on corn yield. The interaction effect through drought index is larger than heat or precipitation alone.
- This preliminary finding suggests that crop insurance may reduce private incentives to adapt to climate change.

Acknowledgement
Du thanks Idaho Agricultural Experiment Station for funding. Ye thanks Tianjin University of Finance Economics for travel and research support.

References