Commodity Support Payments and Climatic Variability

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The views expressed are the authors’ and do not necessarily represent those of the Economic Research Service or the US Department of Agriculture.
Background

- The 2014 Farm Bill introduced Price Loss Coverage (PLC), Agriculture Risk Coverage (ARC) programs

- Farm producers are required to make a one time, irrevocable decision to elect either PLC or one of ARC options for the entire period from 2014-2018

- PLC: Farmers will receive payments if a covered commodity's national average marketing year price is below its “reference price”

- ARC
  - County option—Farmers will receive payments if the ARC-County actual crop revenue is less than the ARC-County revenue guarantee
  - Individual option—Farmers will receive payments if the actual revenue from all covered commodities is less than the ARC-Individual guarantee

- The establishments of these new initiatives raise questions about the level of support farmers receive under each of them
Objectives

Investigate the expected payments of ARC-CO and PLC from 2015 to 2018 for corn and soybeans using anticipated climate variability
Model: Overview

- Quadratic Model: Yield Predictions
  - Historical Yield Data
  - Historical Climate Data
  - Projected Climate Data
  - Predicted Yields

- Storage Model: Price Predictions
  - Predicted Yields

- PLC and ARC payments
  - Predicted Price
Model: Yield Predictions

• Regress historical county level yields on a quadratic model of historical weather variables and time trend

• Holding time trend constant, predict county yields for 2015-2020 using only climatic variability

• Weighing by planted acres, aggregate county yields to national yield

• Run 1000 bootstraps with 9 climate projections results in 9000 yield predictions for each county in each year and 9000 national yield predictions in each year
Model: Price Predictions

- With predicted yield data in 2020, solve for solution of the storage model in 2020, assuming that the models parameters, yield distribution, and equilibrium remains constant after 2020.

- Use backward induction to find multiple storage equilibria from year 2019 back to 2014, assuming the respective predicted yield distribution for each year that we found earlier.

- Feed the national yield distribution from 2014 to 2018 through the sequence of storage equilibria of the same years to find the national price distributions

- The use of backward induction results in path dependent price series (i.e., how price gradually adjust over time instead of several disconnected static point)

- Model parameters are calibrated using a grid search to minimize score generated from simulated GMM objective function. Simulated price and yield distributions in 2014 was calibrated to match the following moments:
  - national corn and soybeans price reported in crop year 2014
  - historical corn price and yield correlation
  - historical soybeans price and yield correlation
  - historical corn and soybeans price correlation
Data

• Historical county yield data from National Agricultural Statistics Service - USDA. Keep only counties with continuous production between 1975-2013

• Historical weather data from PRISM climate group – Oregon State University

• Projected weather data from Forest Service – USDA (A1B: CGCM, CSIRO, MIROC; A2: CGCM, CSIRO, MIROC; B2: CGCM, CSIRO, HADN)
Results

Probability of Exceeding 2014 National Yield

- Corn:
  - 2015: 0.47
  - 2016: 0.43
  - 2017: 0.43
  - 2018: 0.38

- Soybeans:
  - 2015: 0.48
  - 2016: 0.46
  - 2017: 0.45
  - 2018: 0.41
Results

Crop Prices Distribution Over Time

![Graph showing crop prices distribution over time for years 2015 to 2018. The x-axis represents projected prices in dollars per corn bushel and soy bushel, with probability on the y-axis. Each year is represented by a different color line.]
Results


<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th></th>
<th></th>
<th></th>
<th>Soybeans</th>
<th></th>
<th></th>
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<tbody>
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<td>PLC</td>
<td>25.4</td>
<td>22.5</td>
<td>20.8</td>
<td>19.9</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
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<td></td>
<td>(28.0)</td>
<td>(28.2)</td>
<td>(28.7)</td>
<td>(29.4)</td>
<td>(0.3)</td>
<td>(0.3)</td>
<td>(0.3)</td>
<td>(0.3)</td>
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<tr>
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<td>[0 - 89.9]</td>
<td>[0 - 90.4]</td>
<td>[0 - 92.7]</td>
<td>[0 - 95.5]</td>
<td>[0 - 0]</td>
<td>[0 - 0]</td>
<td>[0 - 0]</td>
<td>[0 - 0]</td>
</tr>
<tr>
<td>ARC</td>
<td>42.2</td>
<td>30.3</td>
<td>9.9</td>
<td>7.1</td>
<td>15.2</td>
<td>13.6</td>
<td>8.6</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>(12.6)</td>
<td>(12.2)</td>
<td>(9.3)</td>
<td>(12.0)</td>
<td>(3.5)</td>
<td>(3.2)</td>
<td>(2.9)</td>
<td>(2.0)</td>
</tr>
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<td>[14.7 - 62.9]</td>
<td>[10.6 - 58.8]</td>
<td>[0.8 - 40]</td>
<td>[0.1 - 52]</td>
<td>[8.5 - 21.4]</td>
<td>[7.8 - 20]</td>
<td>[3.6 - 14.5]</td>
<td>[0 - 7.3]</td>
</tr>
</tbody>
</table>

Mean
(Standard deviation)
[95% confidence interval]
Conclusion

Assuming 2014 prices as starting point:

• ARC results in higher payments for soybeans between 2015 – 2018

• ARC for corn is higher in 2015 and 2016 while PLC is higher in the latter years

• ARC for corn varies less than PLC, presumably because of the negative correlation between yield and price