Crop Insurance and Soil Health

Barry J. Barnett
Federal Crop Insurance

- Partnership between the federal government and private insurance companies.
- Private insurance companies:
  - Sell and service insurance policies (required to sell to all eligible farmers).
  - Conduct loss adjustment.
  - Retain some premium and loss risk.
- Federal government:
  - Provides reinsurance to private insurance companies.
  - Reimburses administrative and operating costs (as a percentage of premium).
  - Establishes policy language and premium rates.
  - Provides premium subsidies.
Federal Crop Insurance Insured Acres

Fiscal Year

Millions
These 4 crops account for more than 70% of insured acres.
Federal Crop Insurance Premium Subsidies

Fiscal Year

$ Millions

How Did the 2014 Farm Bill Impact U.S. Crop Insurance?

- New “shallow loss” crop insurance products (SCO/STAX).
- Almost all federal support for cotton producers will be via crop insurance.
- Even for commodities other than cotton, crop insurance will be the primary mechanism for federal support of crop agriculture in the United States.
- Farmers must now be in compliance with federal soil conservation guidelines to be eligible to purchase federal crop insurance.
Calculating a Crop Insurance Indemnity

- \( \text{Trigger Yield} = \text{Approved Yield} \times \text{Coverage} \)
  where \( 50 \leq \text{Coverage} \leq 85\% \)

- \( \text{Indemnity} = \max(0, (\text{Trigger Yield} - \)
APH Yield

- Actual Production History (APH) Yield: simple rolling average of most recent 10 years of yields on the insured unit.
Example of APH Calculation

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Yield (bu/ac)</th>
<th>2014 APH</th>
<th>2015 APH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>172</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>181</td>
<td>181</td>
<td>181</td>
</tr>
<tr>
<td>2006</td>
<td>176</td>
<td>176</td>
<td>176</td>
</tr>
<tr>
<td>2007</td>
<td>203</td>
<td>203</td>
<td>203</td>
</tr>
<tr>
<td>2008</td>
<td>210</td>
<td>210</td>
<td>210</td>
</tr>
<tr>
<td>2009</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>2010</td>
<td>213</td>
<td>213</td>
<td>213</td>
</tr>
<tr>
<td>2011</td>
<td>204</td>
<td>204</td>
<td>204</td>
</tr>
<tr>
<td>2012</td>
<td>160</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>2013</td>
<td>221</td>
<td>221</td>
<td>221</td>
</tr>
<tr>
<td>2014</td>
<td>232</td>
<td></td>
<td>232</td>
</tr>
<tr>
<td></td>
<td>Simple Average APH Yield</td>
<td>194</td>
<td>200</td>
</tr>
</tbody>
</table>
APH Yield

- Actual Production History (APH) Yield: simple rolling average of most recent 4-10 years of yields on the insured unit.
- If crops are grown in rotation, it takes more than 10 years to get 10 years of yield history.
- Can begin with as few as 4 years of yield history and build up to 10.
- If fewer than 4 years of yield history, RMA-determined T-yields are used to replace the missing years. These are generally significantly lower than expected yields.
From APH Yield to Approved Yield

- May elect to substitute 60% of T-yield for any actual yields that are less than 60% of T-yield.
- Approved yield not be less than a specified percentage (generally 80%) of the T-yield.
- Approved yield may not decrease by more than 10% in successive years.
- If the county yield is at least 50% below the simple average yield for the previous 10 years, all policyholders in that county (and contiguous counties) may elect to exclude that year from APH calculations.
- For some crops and areas, APH yields can be trend-adjusted.
- Other favorable adjustments for new farmers, added land, and prevented planting.
Potential Soil Health Implications

- APH yield modifications disproportionately benefit growers in high risk areas.
- Are soils in these areas more fragile?
Potential Soil Health Implications

- APH yield modifications disproportionately benefit growers in high risk areas.
  - Are soils in these areas more fragile?
- APH yield modifications disproportionately benefit growers who use higher risk production practices.
  - Disincentive to use conservation practices (e.g., reduced- or no-tillage) if those practices reduce yield losses in drought conditions.
What is a Premium Rate?

- Premium rate = premium / liability (or premium per dollar of liability).

- Insured’s total premium = premium rate \times insured’s liability (liability = dollar amount of protection).

- Crop insurance producer premium = total premium \times (100\% - \% subsidy).

- How does one calculate a premium rate?
Premium Rate for 70% Coverage

Yield or revenue distribution
Premium Rate Varies with Coverage Level
Higher Risk Implies Higher Premium Rate

Density

70% Coverage
Yeah but . . .

- We never actually observe unit-level yield or revenue distributions.
What we Actually Observe (unit-level products)

Maximum of 10 years of unit-level yield data.
So Now What?

- Obviously 10 observations is insufficient to fit a probability distribution.

- Instead, these observations are used to estimate the central tendency of the yield distribution for the insured unit.
  - Can be large errors in estimating the central tendency with only 10 observations – especially for riskier crops/regions.
Loss Cost

- Loss cost = indemnity / liability.
  - Impossible to predict loss cost for a given year.

- Actuarially-fair premium rate = \( E(\text{Loss Cost}) \).

- Rather than trying to fit a distribution for each insured unit, actuaries attempt to estimate the \( E(\text{Loss Cost}) \) for various classifications of insured units.
So How is $E(\text{Loss Cost})$ Estimated?

- For yield insurance products:
  - $E(\text{Loss Cost})$ varies by crop.
  - $E(\text{Loss Cost})$ varies by county.
  - $E(\text{Loss Cost})$ varies by production practices.
  - $E(\text{Loss Cost})$ varies by types/varieties.

- For revenue insurance products, there are also:
  - Differences in price risk for different crops and differences in price-yield correlation for different crops and regions – all of which impact $E(\text{Loss Cost})$. 
Risk Differences Across Insured Units for a Crop/County/Type/Practice

• May be due to differences in soil quality, drainage, practices not recognized by RMA, producer ability, etc.

• In some cases (e.g., high risk land in a flood plain) explicit premium rate loads are applied.

• In other cases (where differences are not easily attributable to a specific factor):
  • For a given county/crop/type/practice combination, $E(\text{Loss Cost})$ for insured units is assumed to be lower (higher) the higher (lower) the estimate of yield central tendency (APH yield).
Premium Rate Adjustments for Soil Conserving Practices

- Any resulting increase in expected yield is already being captured by the APH yield (which, in turn, reduces premium rates).
- Must be able to demonstrate that the practice reduces yield variability.
  - Much more data are required to demonstrate variance reduction than are required to demonstrate mean impacts.
  - Marginal impact on variance reduction likely depends on geographic region, management ability, interactions with other practices.
Subsidy Impacts

- Even if premium rate adjustments could be obtained for practices that improve soil health, the incentive impacts would be greatly reduced by the premium subsidy.
- On average, growers pay only about 40% of the total premium cost.
Subsidy Impacts

- A more important incentive issue may be that premium subsidies are a percentage of the total premium.
  - Total premium is higher in higher risk areas, so dollars of subsidies per acre are higher for higher risk regions

Example:
- Non-irrigated corn, 65% coverage (59% premium subsidy), APH yield is typical, $500,000 policy.
- DeKalb County, IL, premium rate is 0.8%, subsidy is $2,360.
- Fort Bend County, TX, premium rate is 8.0%, subsidy is $23,600.

- Are soils in higher risk regions more fragile?
Thank you!