Decoupled Farm Payments and the Role of Base Updating under Uncertainty

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November 16, 2007
Motivation

- URAA (1994) of the WTO categorized agricultural support payments into three boxes:
  - **Amber Box**: Subsidies which cause most distortion
  - **Blue Box**: Subsidies that cause some distortion but are production limiting
  - **Green Box**: Subsidies that cause minimal or no distortion

**Definition of Decoupled Payments (URAA)**
- Financed by taxpayers
- Do not depend on current production, factor use, or prices
- Eligibility criteria are defined by a fixed, historical base period
- Production not required to receive payments
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- Expectations - Sumner (2003), McIntosh et al. (2006) and Coble et al. (2007)
Our Approach

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- National level analysis
Three Government Payments
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New base acreage for DP and CCP equals the average of the acreage planted during current policy regime
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Results
- The solution is the average optimal planted acreage, $\bar{A}$
- $\bar{A}$ is weakly increasing in $\delta$
- Maximum percent increase in $\bar{A}$ is 6%
Per Period Profit

- Period of analysis covers 2 Farm Bills: 2002-2011
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- Per period profit

$$\pi_t = \tilde{P}_t \tilde{Y}_t A_t + LDP + DP + CCP - TC(A_t)$$
Maximize Expected Present Value of profits over 2002-2011

\[
\max_{A_t} E \left[ \sum_{t=0}^{4} \beta^t \pi_t(A_t, \tilde{P}_t, \tilde{Y}_t) + \beta^5 (\delta \ast VB + (1 - \delta) \ast VNB) \right]
\]

- VB is the value function for the stochastic dynamic programming (SDP) problem associated with base updating
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- VB and VNB represent the possible values of future income from the market and government payments
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- \( VB \) is the value function for the stochastic dynamic programming (SDP) problem associated with base updating.
- \( VNB \) is the value function for the SDP problem associated with no base updating.
- \( VB \) and \( VNB \) represent the possible values of future income from the market and government payments.
- \( \delta \) captures farmer’s beliefs about possibility of base update.
Maximize Expected Present Value of profits over 2002-2011

$$\max_{A_t} E \left[ \sum_{t=0}^{4} \beta^t \pi_t(A_t, \tilde{P}_t, \tilde{Y}_t) + \beta^5 (\delta \ast VB + (1 - \delta) \ast VNB) \right]$$

- VB is the value function for the stochastic dynamic programming (SDP) problem associated with base updating
- VNB is the value function for the SDP problem associated with no base updating
- VB and VNB represent the possible values of future income from the market and government payments
- $\delta$ captures farmer’s beliefs about possibility of base update
- Supply effect of the expectation of base update: $\bar{A}_{|\delta > 0} - \bar{A}_{|\delta = 0}$
Value function associated with base update

\[ VB_t(S_t) = \max_{A_t} \left[ \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l} \pi_t + \beta \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l} VB_{t+1}(S_{t+1}) \right] \], \quad t = 1, 2, \ldots, 5. \]

\[ S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \]
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- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
- \( M \) is the probability transition matrix
Value function associated with base update

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- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
- \( M \) is the probability transition matrix
- Acres discretized into eight values: 900 acres to 1250 acres in increments of 50
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- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
- \( M \) is the probability transition matrix
- Acreage discretized into eight values: 900 acres to 1250 acres in increments of 50
- New base is average of acreage planted during 2002-06
Value function associated with base update

\[ VB_t(S_t) = \max_{A_t} \left[ \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l} \pi_t + \beta \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l} VB_{t+1}(S_{t+1}) \right], \quad t = 1, 2, \ldots, 5. \]

- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
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- Acreage discretized into eight values: 900 acres to 1250 acres in increments of 50
- New base is average of acreage planted during 2002-06
- Possible new base states equal 32768
Value function associated with base update

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- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
- \( M \) is the probability transition matrix
- Acreage discretized into eight values: 900 acres to 1250 acres in increments of 50
- New base is average of acreage planted during 2002-06
- Possible new base states equal 32768
- Total number of states \( 64 \times 32768 = 2097152 \)
Value function associated with no base update

\[ VNB_t(S_t) = \max_{A_t} \left[ \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l}_t \pi_t + \beta \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l}_t VNB_{t+1}(S_{t+1}) \right], \ t = 1, 2, ..., 5 \]

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Value function associated with no base update

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- Total number of states equal 64
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- \[ S_t = (\tilde{P}_t, \tilde{Y}_t) \]
- Total number of states equal 64
- Base acreage for DP and CCP remain the same as the 2002-06 period
Main Problem

$$\max_{A_t} \sum_{t=0}^4 \sum_{k=1}^8 \sum_{l=1}^8 \beta^t M_{i,j,k,l}^{i,j,k,l} \pi_t + \beta^5 \sum_{k=1}^8 \sum_{l=1}^8 M_{i,j,k,l}^{i,j,k,l} (\delta \star \overrightarrow{VB} + (1 - \delta) \star \overrightarrow{VNB})$$

- Farmer maximizes the Expected Present Value of the stream of income over 2002-2011, over all base states
Results

- Results are determined by the price states
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- Solution to the problem is the Average Optimal Planted Acreage for 2002-06, (\(\bar{A}\)), conditional on farmer’s beliefs, \(\delta\)
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- Solution to the problem is the Average Optimal Planted Acreage for 2002-06, $\bar{A}$, conditional on farmer’s beliefs, $\delta$
- $\bar{A}$ is weakly increasing in $\delta$
## Average Optimal Planted Acreage over 2002-06

<table>
<thead>
<tr>
<th>Price State</th>
<th>$0$</th>
<th>$0.25$</th>
<th>$0.5$</th>
<th>$0.75$</th>
<th>$1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.625</td>
<td>990</td>
<td>1000</td>
<td>1000</td>
<td>1020</td>
<td>1040</td>
</tr>
<tr>
<td>1.875</td>
<td>1000</td>
<td>1000</td>
<td>1020</td>
<td>1040</td>
<td>1050</td>
</tr>
<tr>
<td>2.125</td>
<td>1000</td>
<td>1020</td>
<td>1040</td>
<td>1050</td>
<td>1060</td>
</tr>
<tr>
<td>2.375</td>
<td>1030</td>
<td>1050</td>
<td>1050</td>
<td>1060</td>
<td>1080</td>
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<tr>
<td>2.625</td>
<td>1050</td>
<td>1060</td>
<td>1070</td>
<td>1090</td>
<td>1100</td>
</tr>
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<td>2.875</td>
<td>1070</td>
<td>1090</td>
<td>1100</td>
<td>1100</td>
<td>1120</td>
</tr>
<tr>
<td>3.125</td>
<td>1100</td>
<td>1100</td>
<td>1120</td>
<td>1130</td>
<td>1140</td>
</tr>
<tr>
<td>3.375</td>
<td>1120</td>
<td>1130</td>
<td>1140</td>
<td>1150</td>
<td>1160</td>
</tr>
</tbody>
</table>
Percent change in $\bar{A}$ relative to $\delta = 0$

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<th>$\delta$</th>
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<tbody>
<tr>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>1.625</td>
<td>1.01</td>
</tr>
<tr>
<td>1.875</td>
<td>0.00</td>
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<tr>
<td><strong>2.125</strong></td>
<td><strong>2.00</strong></td>
</tr>
<tr>
<td>2.375</td>
<td>1.94</td>
</tr>
<tr>
<td>2.625</td>
<td>0.95</td>
</tr>
<tr>
<td>2.875</td>
<td>1.87</td>
</tr>
<tr>
<td>3.125</td>
<td>0.00</td>
</tr>
<tr>
<td>3.375</td>
<td>0.89</td>
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Concluding Remarks

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- Maximum percent increase in $\bar{A}$ is 6%
- Policy implication