Decoupled Farm Payments and the Role of Base Updating under Uncertainty

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Motivation

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Coupling mechanisms of Decoupled Payments

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- Expectations - Sumner (2003), McIntosh et al. (2006) and Coble et al. (2007)
Our Approach

- Follow Duffy and Taylor (1994)
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- Combine Dynamic Programming with Expected Present Value calculations and maximize the stream of profits over the two policy regimes
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- National level analysis
Three Government Payments
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  ▶ Direct payments (DP)

Bhaskar & Beghin (ISU)
Three Government Payments

- Direct payments (DP)
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Results
- The solution is the average optimal planted acreage, $\bar{A}$
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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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\max_{A_t} E \left[ \sum_{t=0}^{4} \beta^t \pi_t(A_t, \tilde{P}_t, \tilde{Y}_t) + \beta^5 (\delta \cdot VB + (1 - \delta) \cdot VNB) \right]
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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

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

- \( V_B \) is the value function for the stochastic dynamic programming (SDP) problem associated with base updating
- \( V_{NB} \) is the value function for the SDP problem associated with no base updating
- \( V_B \) and \( V_{NB} \) 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: \( \tilde{A}_{\delta>0} - \tilde{A}_{\delta=0} \)
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
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- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
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- Acreage discretized into eight values: 900 acres to 1250 acres in increments of 50
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- \( S_t = (\tilde{P}_t, \tilde{Y}_t, BA') \)
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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
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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

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

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Value function associated with no base update

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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

\[
\max_{a_t} \sum_{t=0}^{4} \sum_{k=1}^{8} \sum_{l=1}^{8} \beta^t M^{i,j,k,l} \pi_t + \beta^5 \sum_{k=1}^{8} \sum_{l=1}^{8} M^{i,j,k,l} (\delta \ast \overrightarrow{VB} + (1 - \delta) \ast \overrightarrow{VNB})
\]

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

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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>$\delta$</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>
<td></td>
</tr>
<tr>
<td>1.875</td>
<td>1000</td>
<td>1000</td>
<td>1020</td>
<td>1040</td>
<td>1050</td>
<td></td>
</tr>
<tr>
<td>2.125</td>
<td>1000</td>
<td>1020</td>
<td>1040</td>
<td>1050</td>
<td>1060</td>
<td></td>
</tr>
<tr>
<td>2.375</td>
<td>1030</td>
<td>1050</td>
<td>1050</td>
<td>1060</td>
<td>1080</td>
<td></td>
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<tr>
<td>2.625</td>
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<td>1070</td>
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<td>1090</td>
<td>1100</td>
<td>1100</td>
<td>1120</td>
<td></td>
</tr>
<tr>
<td>3.125</td>
<td>1100</td>
<td>1100</td>
<td>1120</td>
<td>1130</td>
<td>1140</td>
<td></td>
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</tr>
</tbody>
</table>
A over 2002-06

Results

Average Optimal Planted Acreage

Del=0
Del=0.25
Del=0.5
Del=0.75
Del=1
Percent change in $\tilde{A}$ relative to $\delta = 0$

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<td>1.94</td>
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<td>0.89</td>
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