Land Value and Credit Conditions Survey

- Federal Reserve Bank of Chicago (7th District)
- IL, IN, IA, MI, and WI
- About 25% of US agricultural banks
- Midwest agriculture: corn, soybeans, hogs, eggs, dairy, cattle, fruit & vegetable
7th District Agriculture Products

(5 states as % of U.S. total, 2016)
Participating Banks in 7th District Land Value and Credit Conditions Survey
Land Value and Credit Conditions Survey

What trend in farmland values do you expect in your area in the next three months?
Possible answers: Up, Down, or Stable

• Good predictor of District farm real estate values (Covey, 1999; Zakrzewicz, et al., 2013 (KC Fed survey))
• Report diffusion index (balance statistic) quarterly
  • (Up – Down) + 100
Diffusion Index of Expected Changes
Diffusion Index of Expected Changes

![Graph showing the relationship between Expectations (Diffusion Index) and Observed Changes (%). The x-axis represents years from 1992 to 2016, while the y-axis represents the diffusion index. The graph displays a trend over time, with fluctuations in both expectations and observed changes.]
Land Value and Credit Conditions Survey

What trend in farmland values do you expect in your area in the next three months? Answers: Up, Down, or Stable

Very common elicitation method in business surveys:
• Respondents reluctant to report quantitative assessment
• Avoids “spurious precision”
• Less respondent burden

Yet...
• Can be difficult to interpret: *What do bankers actually mean by “up”*?
• Assumes symmetry of “up” and “down”
Theory

Assume:

• Respondents have some unobservable continuous distribution of expectations (latent expectations)
• The (ordinal) discrete responses are based on unobserved threshold values
Bankers’ (Latent) Expectations

\[ y_{it}^* = f(\cdot) \]

\[ y_{i,t} = \downarrow \quad \mu_1 < y_{i,t}^* \leq \mu_2 \quad \mu_2 < y_{i,t}^* \]

\[ y_{i,t} = \approx \quad y_{i,t} = \uparrow \]

\[ y_{i,t} \leq \mu_1 \]

\[ \mu_1 < y_{i,t}^* \leq \mu_2 \]

\[ \mu_2 < y_{i,t}^* \]
Bankers’ (Latent) Expectations

We do not observe $y_{it}^*$

We observe $y_{it}$ such that:

$$y_{it} = \begin{cases} 
  \uparrow & \text{if } y_{it}^* > \mu_2 \\
  \approx & \text{if } \mu_1 < y_{it}^* \leq \mu_2 \\
  \downarrow & \text{if } y_{it}^* \leq \mu_1 
\end{cases}$$

$$y_{it}^* = f(\cdot)$$
Bankers’ (Latent) Expectations

The region $\mu_1 < y_{it}^* \leq \mu_2$ is known as the “indifference interval” within which bankers report expected change of zero ($y_{i,t} = \approx$)
Bankers’ (Latent) Expectations

- A number of empirical methods have been proposed to estimate quantitative “mean” expectations ($\bar{y}_{it}^*$) and indifference interval ($\mu_1, \mu_2$) from aggregate survey responses
  - Probability method of Carlson and Parkin (1975)
- Methods have a number of recognized limitations (Nardo, 2003)
  - Restrictive assumptions of indifference interval
  - Respondent heterogeneity
  - Assumed distribution of $y_{it}^*$
- More recent studies exploit respondent-level data (Lahiri and Zhao, 2015)
Empirical Model

- Estimate the distribution of bankers’ (latent) expectations \(y_{it}^*\) through ordered choice regression

\[
y_{it} = \begin{cases} 
\uparrow & \text{if } y_{it}^* = \sum_t \alpha_t D_{it} + \varepsilon_{it} > \mu_2 \\
\approx & \text{if } \mu_1 < y_{it}^* = \sum_t \alpha_t D_{it} + \varepsilon_{it} \leq \mu_2 \\
\downarrow & \text{if } y_{it}^* = \sum_t \alpha_t D_{it} + \varepsilon_{it} \leq \mu_1 
\end{cases}
\]

where \(D_{it}\) is a dummy variable = 1 if bank \(i\) responded in quarter \(t\)
Ordered Choice Regression

• Bankers’ expectations are a function quarter and i.i.d. error
• We must make an assumption on the distribution of the error (link function): $F(\cdot)$
• The model estimates the probabilities:

\[
P[y_i = \uparrow] = 1 - F\left(\frac{\mu_2 - \alpha_t D_{it}}{\sigma}\right)
\]

\[
P[y_i = \approx] = F\left(\frac{\mu_2 - \alpha_t D_{it}}{\sigma}\right) - F\left(\frac{\mu_1 - \alpha_t D_{it}}{\sigma}\right)
\]

\[
P[y_i = \downarrow] = F\left(\frac{\mu_1 - \alpha_t D_{it}}{\sigma}\right)
\]
Ordered Choice Regression

• The ordered choice model can be estimated under a variety of link distributions
  • Probit (normal)
  • Logit (logistic)
  • Log-log
  • Cauchit (cauchy)

• Can include additional regressions (observed heterogeneity)
Preliminary Results

• Ordered probit model (standard normal link function)
• 787 banks
• 1992Q4 – 2016Q4 (97 quarters)
• 21,121 observations
• Mean of 36.6 responses per bank
Responses per Bank

![Bar chart showing the number of responses per bank. The x-axis represents the number of responses, ranging from 1 to 91. The y-axis represents the number of banks, ranging from 0 to 35. The chart shows a distribution of responses with a peak around 20 responses for some banks.]
### Preliminary Results

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_1$</td>
<td>$-1.472$</td>
<td>$0.059$</td>
<td>***</td>
</tr>
<tr>
<td>$\mu_2$</td>
<td>$0.862$</td>
<td>$0.058$</td>
<td>***</td>
</tr>
</tbody>
</table>

$*** \alpha \leq 0.01$

- Lenders have asymmetric indifference interval
- In order to report “down,” bankers believe that farm real estate values will fall by more than 1.47%
- In order to report “up,” bankers believe that farm real estate values will rise by more than 0.86%
Preliminary Results
Preliminary Results
Preliminary Results

Graph showing observed change (%), with years from 1993 to 2015 along the x-axis and observed change (%) along the y-axis.
Future Research

- Evaluate alternative distributions (e.g., logit)
- Test for observed heterogeneity of respondents
  - Location
  - Bank attributes
Thank you