Producers' Yield and Yield Risk: Perceptions versus Reality and Crop Insurance Use

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Abstract

Using survey data from 258 Illinois corn farmers, we investigate the relationship between subjective and objective yield measures and their effect on the use of crop insurance. Our findings show that producers view themselves as better than average with respect to yields and in terms of their variability, and that over- and underconfidence also influence their use of crop insurance. The effects are not symmetric, overconfidence is primarily reflected in the larger-than-average yield, while underconfidence emerges mainly in the larger-than-average variability. Crop insurance use is further affected by risk preferences and county yield variability.

Key words: crop insurance, overconfidence, perception, risk attitude, yield, yield risk

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Successful risk management is important for the long-term economic survival of farms, and various instruments exist in the market place for that purpose. Futures and options markets allow farmers to transfer price risk, whereas crop insurance provides protection from production risk. Despite the appealing benefits of these instruments, the use of futures markets among producers is limited and participation in crop insurance programs low unless heavily subsidized (Makki and Somwaru 2001; Sherrick et al. 2004a). Although the economic literature proposes several explanations for this behavior, producers' subjective expectations and psychological factors have received little attention. Yet, how individuals perceive yields, risk, and risk preferences can strongly influence their decision-making behavior and subsequent choice of whether or not to use particular instruments. A farmer who perceives his subjective yield and yield risk differently from its objective reality, might assign a lower than actuarially fair value to a particular risk management tool and avoid its use even if it is in his economic advantage. Such incongruence between subjective and objective measures may lead to suboptimal decisions at the farm-level, and consequently high costs to society in form of excessive farm subsidies (LaFrance et al. 2000; Hayes et al. 2003) and government emergency payments.

The paper evaluates the subjective yield and yield risk expectations of Illinois corn producers. By contrasting farmers' subjective expectations to objective measures, our study seeks to identify whether areas of incongruence exist, as well as their potential magnitude and direction. We also assess how risk aversion and yield perceptions influence the choice to buy crop insurance. An understanding of these relationships is critical for several reasons. First, including risk and subjective yield perceptions extends and complements the existing body of research on the use of crop insurance in an important dimension (Mahul and Wright 2003; Sherrick et. al. 2004a). Second, a greater insights into the factors that affect decision making is an important prerequisite for designing suitable risk management tools that could lead to more effective producer decisions, and ultimately to lower subsidies and government payments. Finally, an understanding of farmers' subjective yield distributions is also essential for extension agents who can conduct programs to better educate farmers and make recommendations for the use of risk management instruments.

Literature

The recent body of research that examines producers' subjective perceptions is small. Bessler (1980) aggregates producer subjective yield information elicited in probability form to examine their relationship to county yields. He examines one-period ahead ARIMA-forecasts generated from historical yields and finds them to be consistent with the aggregated yield distributions in the mean but not at higher moments. Aggregate subjective distributions are also examined by Eales at al. (1990), who focus on grain price forecasts by different groups of market participants. The means of the elicited distributions correspond in most cases to subsequent futures prices, but the variability severely underestimated market volatility. In contrast to Bessler (1980) and Eales et al. (1990), Pease (1992) assesses disaggregated subjective yield expectations of Kentucky corn and soybean farmers. He reports that one-period ahead forecasts expressed as the distributions' implied means were slightly above for soybeans, but somewhat below for corn the linearly de-trended historical yields for each farm. In most cases, producers tended to understate yield risks. In short research indicates that elicited producer distributions provide rather accurate representations of objective mean prices and yields, but fall short for higher moments.

Recent literature from finance has identified cases where the incongruence between subjective perceptions and observed measures can influence behavior. The notion of overconfidence has emerged as the key concept, where overconfidence has been defined in various ways, including a miscalibration between subjective and objective distributions, optimism, and better than the average. Optimism, and better than the average are the two definitions most consistent with the common use of the term "overconfident," and the better-than-average effect is the most straightforward and easiest to explain and implement. In a decision context, the better-than-average effect simply says that most individuals perceive themselves to possess superior skills and ability to handle difficult situations which they think will translate into improved outcomes relative to the rest. Research has shown for example that more confident market participants trade more frequently even if their returns fail to beat the market average (Barber and Odean 2000). In agriculture, different signs of overconfidence have been observed. For example, both Eales at al. (1990) and Pease (1992) find that Illinois and Kentucky corn producers understated price and yield risks.

In a related context, several authors have investigated farmers' use of crop insurance and identified factors that influence participation rates (Goodwin 1993; Coble et al. 1996; Smith and Baquet 1996; Sherrick et al. 2004a). Among these factors, farm size and yield variability have been found to have a positive and significant impact on the decision to buy crop insurance. In contrast, behavioral characteristics such as overconfidence and risk attitude have received substantially less attention. Sherrick et al. (2004a), for example, measure producers' perspectives on the importance of risk management in a survey of Iowa, Illinois, and Indiana corn and soybean farmers. Their results show that the type of insurance (hail/revenue) depends on the importance producers assign to risk management. However, no research appears to exist on the impact of overconfidence on the use of crop insurance. This seems somewhat strange because subjective and objective yield distributions are at the heart of the crop insurance question. Objective yield distributions basically determine the fair market value of insurance premiums. But even if insurance premiums are actuarial fair, there is little motivation for producers to use insurance if their subjective yield distributions are not congruent with the fair market value of insurance, particularly if their distributions are more confident of high yields. An understanding of how perceptions and risk attitudes relate to the use of crop insurance is important not only for designing insurance and other risk management instruments that will be adopted with a high likelihood but also for extension personal who educate farmers in the use of these tools. The question that emerges from this brief literature is—Are agricultural producers overconfident about their yields? If overconfidence exists, does it influence agricultural producer behavior, particularly with regard to the use of crop of insurance?

Survey

Illinois corn farmers were surveyed to develop their subjective yield and yield risk perceptions at farm meetings in the first quarter of 2003 and 2004. Participation in the survey was voluntary and unassisted. The instrument included questions on the farm's primary farm location in the state (county), size of operation (acres), perceived historical yields, use of crop insurance, and seven Likert-scale measures of risk attitude. The complete survey instrument is displayed in the appendix.

The subjective yield information was elicited in several formats. Using a direct and open-ended question, producers' average corn yields were obtained by simply asking them to estimate their yield per acre in a typical year. The producers were then asked to compare their performance to other producers in the county by indicating whether their operation achieved higher, lower, or similar yields and experienced more, less, or similar yield variability. The survey also asked producers to describe their yield distribution by assigning probabilities into ten predefined yield categories (Figure 1). The procedure is similar to those used by Bessler (1980) and Eales et al. (1990), but does not restrict the size of the weights – here probabilities—allowing more flexibility. To obtain information about farmers' risk attitudes we use a seven-dimensional Likert-scale framework. With the exception of a few minor modifications in wording to reflect the context of this study, the questions are identical to those asked by Pennings and Garcia (2001) and who report significant factor loadings and good construct reliability. Finally, the survey asked producers whether they had purchased crop insurance.

Methods

Yields

The survey elicited two subjective measures of the producer's own yields, a directly-stated average corn yield in a typical year and an indirectly-stated yield based on the probability assignment task. The probability assignments were used to recover the farmer's subjective yield distribution which permitted us to infer its implied mean and standard deviation. By converting the discrete probabilities to a continuous distribution function, we allow for a greater degree of flexibility in determining the implied mean yield than by simply summing the weighted category mid-points.

Using equation (1),

$$(1)\ \min_{\theta_i}\left[\left(p_{i1}-D(U_1\,|\,\theta_i)\right)^2+\sum_{j=2}^{9}\left(p_{ij}-\left[D(U_j\,|\,\theta_i)-D(U_{j-1}\,|\,\theta_i)\right]\right)^2+\left(p_{i10}-\left[1-D(U_9\,|\,\theta_i)\right]\right)^2\right]$$

each producer's yield distribution is recovered separately by minimizing the sum of squared differences between the stated probabilities and the fitted probabilities across all ten yield intervals. Here, p_{ij} denotes the stated probability of producer i for interval j, U_j refers to the upper bound of the interval, and *D(.)* is the cumulative distribution of farm-level yields. *D(.)* is assumed to be the same for all producers. Following Pichon (2002) and Sherrick et al. (2004b) who conducted extensive analyses of alternative distributions, its functional form is specified in equation (2) as a Weibull distribution,

$$(2)\qquad D(x)=1-e^{-(x/\beta_i)^{\alpha_i}}, \qquad 0\le x<\infty,\ \alpha_i,\beta_i>0.$$

Solving (1) for θ_i provides a set of i two-dimensional parameter vectors (α_i, β_i), one for each participant, which is then used in equation (3),

(3) $\mu_i = \beta_i \Gamma\left(1+\alpha_i^{-1}\right)$,

to obtain producer *i*'s implied mean yield μ_i.

The objective yield, i.e. the yield of a typical farm in a respondent's county, is computed as the average yield in that county. To calculate objective yields, historic yields are first de-trended to remove the effect of systematic increases due to changes in technology. Following Pease (1992) and Sherrick et al. (2004b), a linear trend model in equation (4) is used. Because yields have not increased in similar fashion throughout the state, each county's yield data are de-trended separately to 2002 and 2003 levels using

(4) $Y_{adj,ct} = Y_{org,ct} + \gamma_c \left(year - t \right), \quad year = 2002, 2003$

where, $Y_{adj,ct}$ is county *c*'s yield in year *t* adjusted to 2002 (2003) levels and γ_c, is the slope coefficient from regressing county *c*'s original yields $Y_{org,ct}$ on a linear time trend, *t* = 1972, …, 2002 (2003).

Risk

A producer's complete risk profile is characterized by both risk perception and risk attitude. Risk attitude is measured by the responses to the seven Likert-scale questions. In order to ensure that larger values consistently correspond to greater risk aversion, the scores assigned to questions 2-4 are reversed (see appendix). Each participant's degree of risk aversion is then computed as a single value by averaging individual scores from questions 7.1-7.7.

For the same respondent *i* a corresponding measure of risk perception (σ_i) is obtained as the implied standard deviation of the fitted distribution using the parameter vector (α_i, β_i) from equations (1) and (2), and (5),

$$(5) \qquad \sigma_i = \sqrt{\beta_i^2 \left[\Gamma\left(1 + 2\alpha_i^{-1}\right) - \left[\Gamma\left(1 + \alpha_i^{-1}\right) \right]^2 \right]}$$

where Γ is the gamma function. Finally, county risk is computed as the standard deviation of the de-trended county yields.[1]

Incongruent subjective and objective distributions

We are concerned with identifying the relationship between subjective and objective yield distributions and the possible effects on crop insurance decisions. To measure these differences we use producer perceptions/statements to identify how their corn yield and its variability compared to other producers in the county. We also examine the relationship between their stated perceptions of yields, indirectly-stated yields, and county yields. Previous agricultural research suggests that indirectly-stated yields will differ from directly-stated yields and will be close to county yields (Egelkraut, et al. 2006; Pease 1992). We then relate the perceptions to insurance use.

Crop insurance use

The influence of overconfidence, producer risk attitudes, and their characteristics on the use of crop insurance is examined using equations (6) and (7). Equation (6) is specified

[1] The standard deviation is used to reflect variability because it is easier to interpret than variance and consistent with Pease's (1992) use of coefficients of variation.

in the most conventional context of overconfidence which suggests that an agent's actions are influenced by the perception that their outcomes are better than average in mean and variability. However, in equation (7) since we are looking at the producers buying crop insurance for protection against adverse weather events, we examine the effect of underconfidence as well. This context suggests that producers in search of protection will purchase of insurance when expected yields are less than average and manifest higher variability. In both equations we include producer risk attitude, actual county yield variability, and farm size.

Equation (6) specifies crop insurance use in a logit framework,

$$(6)\log\left(\frac{\Pr\left[ci(i)=1\right]}{\Pr\left[ci(i)=0\right]}\right)=\beta_0+\beta_1 RA+\beta_2 CSTD+\beta_3 SIZE+\beta_4 LV+\beta_5 HY+\beta_6 LV\times HY+\varepsilon\ ,$$

where *ci(i)* is a binary variable that takes the value of 1 if a producer purchased crop insurance and 0 otherwise, *RA* is the producer's risk attitude measure, *CSTD* the standard deviation of the de-trended county yields, and *SIZE* is farm size. The remaining three (binary) variables are designed to capture producer's overconfidence. *LV* takes a value of 1 if a producer perceives his yield variability to be less than other farms in the county and 0 otherwise, and *HY* is assigned a value of 1 if the producer viewed his yield as higher than the county average and 0 otherwise. $LV\times HY$ is an interaction term which allows for a differential effect for more confident, better than average producers.

To examine the underconfidence framework, the crop insurance use is specified as

$$(7)\log\left(\frac{\Pr\left[ci(i)=1\right]}{\Pr\left[ci(i)=0\right]}\right)=\beta_0+\beta_1 RA+\beta_2 CSTD+\beta_3 SIZE+\beta_4 MV+\beta_5 LY+\beta_6 MV\times LY+\varepsilon\ .$$

Here, MV is a binary variable takes a value of 1 if a producer perceived his yield as more variable than typical in his county and 0 otherwise, and LY is a binary variable that takes a value of 1 if the producer thought his yields are lower than those of others in the county. $MV \times LY$ is an interaction term which allows for a differential effect for less confident, less than average producers.

Survey Data, Results and Discussion

Survey data

The farm meetings yielded 134 and 194 completed surveys in 2003 and 2004, corresponding to a response rate of about 50% of the participants present. Excluding non-farmers (e.g. bankers), out-of-state responses and incomplete or inconsistent[2] questionnaires, the final sample was 112 surveys in 2003 and 146 in 2004 (table 1). The producers operated relatively large farms with an average of approximately 1211 (2003) and 1347 (2004) acres which is representative of commercial scale farms in the Corn Belt. No spatial concentration was detected among the responses. The participating producers represented 69 different Illinois counties and no county accounted for more than 16 surveys (6.2%) in the final sample.

Based on equation (3) and (5), producer's implied mean yield and implied standard deviation are computed. The objective county measures that correspond to these subjective yield and yield risk estimates are obtained by first de-trending the NASS county yields over the 1972-2002 (2003) period (equation 4) and then computing the arithmetic averages of the adjusted yields $Y_{adj,ct}$, t = 1972, …, 2002 (2003), for each

[2] Surveys with rounding or summing errors that were 10% or less were retained in the sample and rescaled (e.g. if the assigned probabilities summed to 102%, then divide each individual entry by 102%).

county *c*. Examining independence of subjective yield and yield risk in a regression framework, we detect no significant relationships (results not displayed). Finally, testing for construct reliability, i.e. the degree to which questions 7.1-7.7 can be considered as measuring the single latent variable, risk attitude, we find that the risk scores display good reliability (Cronbach's α =0.726) and hence are aggregated into a single score.

Relative and absolute yield and yield risk perceptions

Producer's assessments of their individual yields and yield variability relative to those of a typical farm in their county are summarized in table 2. The majority of the participants perceived their yields to be higher (46.1%) or similar (42.3%) to those of other farms in their county and only 11.6% thought they experienced lower yields. Similarly, most producers viewed their yields as less variable (41.5%), or similar (38.4%) and only 20.1% indicated that they experienced greater yield variability than typical in their county. Hence farmers seem confident regarding their yields, with a "better-than-average" perception, and yield risk.

This "better-than-average" effect is also reflected in producer's direct yield statements (table 3). Their directly-stated average yield is 153.43 bu/ac, 7.18 bu/ac higher than the NASS county average and 7.75 bu/ac higher than the average producer implied mean yield. When examined with the Wilcoxon signed rank test, a paired non-parametric test that does not require assumptions about the form of the distribution of observations, both differences are significant (p<0.001 and p<0.001). In contrast, no significant difference (p=0.838) is found between the Weibull implied mean yield (145.68 bu/ac) and the county average yield (146.25 bu/ac). These findings are robust when the 2003 and 2004 surveys are examined separately and when county yields are computed based on only the more recent yield observations of the post-1988 period. Upward-biases of the direct open-ended question format have also been reported by Champ and Bishop (2001) and Ready et al. (2001) in contingent valuation analyses. The results also agree with Bessler (1980) and Eales et al. (1990), who find that aggregate elicited probabilities provide reasonably accurate descriptions of objective mean yields and prices.

Overconfidence is also observed in producers' implied standard deviation. For the entire sample the average farmer perceived standard deviation (19.12 bu/ac) is significantly smaller than the average county standard deviation (20.31 bu/ac) when examined with the Wilcoxon signed rank test (p=0.012). To assess the sensitivity of this finding to decreases in yield variability post-1988—a period characterized by fewer adverse weather events—and to examine the notion that perceptions are often based on more recent information (Wyer and Srull 1981; Kahnemann, Slovic and Tversky 1982), we evaluate the same hypothesis using the observed variability during the most recent period. We find that the post-1988 county standard deviation decreases to 17.75 bu/ac which is smaller than the Weibull implied risk, but the difference is not significant (p=0.197). Because positive and negative deviations from the county mean yield should at least partially offset each other within the county, individual farm-level variability is expected to exceed the variability of average county yields. Our results suggest that the surveyed producers seem to understate actual yield variability, a finding consistent with Eales et al. (1990) and Pease (1992).

Crop insurance use

The results from different specifications of equations (6) and (7) appear in tables 4 and 5. The pseudo R^2s (McFadden's R^2s) are low across all of the specifications, but the likelihood ratio tests are significant at conventional levels. Across all specifications risk attitude and the standard deviation of county yields have a positive and significant effect on the use of crop insurance. Their estimated coefficients and levels of statistical significance appear to be quite stable. For example, in table 4 greater risk aversion increases a farmer's probability of buying crop insurance (*RA*=0.052, *p*=0.013), and producers in counties with greater yield variability are also more likely to buy insurance (*CSTD*=0.033, *p*=0.000). Larger farm size also had a positive impact on the use of crop insurance (*SIZE*=0.002), but the effect was not statistically significant (*p* = 0.164).

The effects of the over-and underconfidence variables are not symmetric in the two formulations. In the overconfidence specification, larger than average perceived yields have a negative effect on the use of crop insurance. In the underconfidence specification, larger than average perceived variability increases the use of crop insurance. However, in both cases, the marginal probabilities are small and quite similar in size but opposite in sign (*HY*=-0.134 (A) and -0.088 (B); *MV*=0.110 (A) and 0.120 (B)). In contrast, the other over- and underconfidence variables never enter significantly.

The results suggest that producers who viewed their yields as better than average are also less likely to buy crop insurance, while producers who perceive their variability to be larger than average are more likely to buy insurance. This last result also seems quite compatible with a more traditional risk perspective and is highly consistent with the significant risk preference and county yield variables in both specifications. To investigate whether the magnitude of producers' larger-than-average yield (variability) perceptions influenced their likelihood of using crop insurance, we multiplied in the overconfidence specification the binary mean variable by the difference between producers' directly-stated and county mean yields, and in the underconfidence specification the binary variance variable by the implied standard deviation from the Weibull. Eliminating variables with non-significant coefficients, we find only a marginal change in the results (compare B to C in both table 4 and 5).

Overall, the empirical estimates suggest that the use of crop insurance is affected by the combined effect of risk preferences, the yield risk across counties, and producer perceptions of larger-than-average yields and variability. The effect of yield risk across counties is consistent with previous literature, but our findings represent the first evidence of significant risk preferences effects and producer over- or underconfidence on insurance use. While the findings appear rather stable and statistically significant, it is important to note that the magnitudes of the effects are not large.

Conclusion and Discussion

Using survey data from 258 Illinois corn farmers in 2003 and 2004, we investigate the relationship between subjective and objective yield measures and their effect on the use of crop insurance. Based on the answers of Illinois corn producers to questions about their farm-level yields and their perceived relative performance compared to others, we find that producers think of themselves as better-than-average with respect to yields and in terms of their variability. A difference between directly-stated yields and average county yields exists, but when probabilistic yield distributions are elicited the difference between producer and average county yields practically disappears. These findings are consistent with Egelkraut et al (2006), and with Bessler (1981) and Eales et al (1991) who report that probabilistic elicitation of random variables provides a good representation of the objective means. With regards to the variability, we find that producers' yield standard deviations generally understate the actual yield variability in the county.

Crop insurance use is affected by risk preferences, county yield variability, and measures of over- and underconfidence. The effects of the risk preferences and county yield variability are highly stable across various specifications, while the effects of the over- and underconfidence variables are not symmetric. The effect of overconfidence is primarily reflected in the larger-than-average yield, while the effect of underconfidence emerges mainly in the larger-than-average variability. The underconfidence effect seems quite compatible with a more traditional risk perspective and is highly consistent with the significant risk preference and county yield variables. On balance, the statistical findings appear rather robust, but the magnitudes of the probability effects do not appear large. The magnitude of the marginal effects may have been somewhat limited by the large number of producers in the sample who already use crop insurance perhaps as a function of other factors including high government subsidies. We therefore encourage future researchers to investigate the impact of overconfidence on other producer decisions and for crop insurance use in different contexts.

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Table 1. Number of Usable Survey Responses and Producer Farm Size

Survey year	Usable surveys	Number of counties represented	Usable surveys from most represented county	Farm size	
				Average *acre*	Median *acre*
2003	112	48	8	1211	925
2004	146	59	10	1347	1000
All	258	69	16	1288	1000

Table 2. Producers' Perceived Average Yield and Yield Variability Relative to a Typical Farm in Their County

Survey year	Average yield			Yield variability		
	Higher yield %	About the same yield %	Lower yield %	More stable yield %	Same yield variability %	More variable yield %
2003	42.0	47.3	10.7	41.1	38.4	20.5
2004	49.3	38.4	12.3	41.8	38.4	19.9
All	46.1	42.3	11.6	41.5	38.4	20.1

Table 3. Producers' Perceived Average Yield, Weibull Implied Mean Yield and Yield of a Typical Farm in Their County

Survey year	Directly-stated average yield *bu/ac*	Simple implied mean yield *bu/ac*	Weibull implied mean yield *bu/ac*	County average yield *bu/ac*	Directly-stated minus typical yield[a] *bu/ac*	Directly-stated minus Weibull implied yield[a] *bu/ac*
2003	151.45	141.95	143.66	143.60	7.84***	7.78***
2004	154.95	146.22	147.23	148.28	6.67***	7.72***
All	153.43	144.37	145.68	146.25	7.18***	7.75***

[a] Significantly greater than zero at p<0.050 (*), p<0.010 (**) and p<0.001 (***).

Table 4. Overconfidence and crop insurance use (2003 and 2004, *n*=258).

Model	Producer characteristics			Subjective perceptions					
	RA[a] (*p*-value)[b]	*CSTD* (*p*-value)	*SIZE* (*p*-value)	*LV* (*p*-value)	*HY* (*p*-value)	*LV×HY* (*p*-value)	Correctly classified %	McFadden's R^2	Likelihood ratio[c] (*p*-value)
A	0.052	0.033	0.002	-0.065	-0.134	0.087	82.17	0.114	26.79
	(*0.013*)	(*0.000*)	(*0.164*)	(*0.384)*	(*0.031)*	(*0.216)*			(*0.000*)
B	0.053	0.034			-0.088		82.56	0.101	23.76
	(*0.012*)	(*0.000*)			(*0.046*)				(*0.000*)
C	0.059	0.035			-0.005[d]		83.33	0.098	22.97
	(*0.005*)	(*0.000*)			(*0.057*)				(*0.000*)

[a] The values displayed are the marginal effects at the means of the independent variables.
[b] The values in parentheses are the *p*-values of the estimated coefficients.
[c] The likelihood ratio test follows a Chi-square distribution with *k* degrees of freedom, where *k* corresponds to the number of independent variables in the regression. The test examines the hypothesis that all of the slope coefficients are not significantly different from zero.
[d] Here, the variable takes a value equal to the difference between producers' directly-stated and county mean yields for those respondents who stated their yields were higher than average when compared to others, and zero for respondents who viewed their yields as lower than average or about the same.

Table 5. Underconfidence and crop insurance use (2003 and 2004, *n*=258).

Model	Producer characteristics			Subjective perceptions					
	RA (*p*-value)	*CSTD* (*p*-value)	*SIZE* (*p*-value)	*MV* (*p*-value)	*LY* (*p*-value)	*MV*×*LY* (*p*-value)	Correctly classified %	McFadden's R^2	Likelihood ratio[c] (*p*-value)
A	0.053 (*0.011*)	0.031 (*0.001*)	0.002 (*0.216*)	0.110 (*0.028*)	0.043 (*0.572*)	0.002 (*0.991*)	83.33	0.118	27.79 (*0.000*)
B	0.054 (*0.009*)	0.032 (*0.001*)		0.120 (*0.002*)			82.95	0.110	25.94 (*0.000*)
C	0.053 (*0.009*)	0.031 (*0.001*)		0.008[d] (*0.017*)			82.95	0.116	27.38 (*0.000*)

[a] The values displayed are the marginal effects at the means of the independent variables.
[b] The values in parentheses are the *p*-values of the estimated coefficients.
[c] The likelihood ratio test follows a Chi-square distribution with *k* degrees of freedom, where *k* corresponds to the number of independent variables in the regression. The test examines the hypothesis that all of the slope coefficients are not significantly different from zero.
[d] Here, the variable takes a value equal to the producers' Weibull implied standard deviation for those respondents who stated their yield variability was greater than average when compared to others, and zero for respondents who viewed their yield variability as lower than average or about the same.

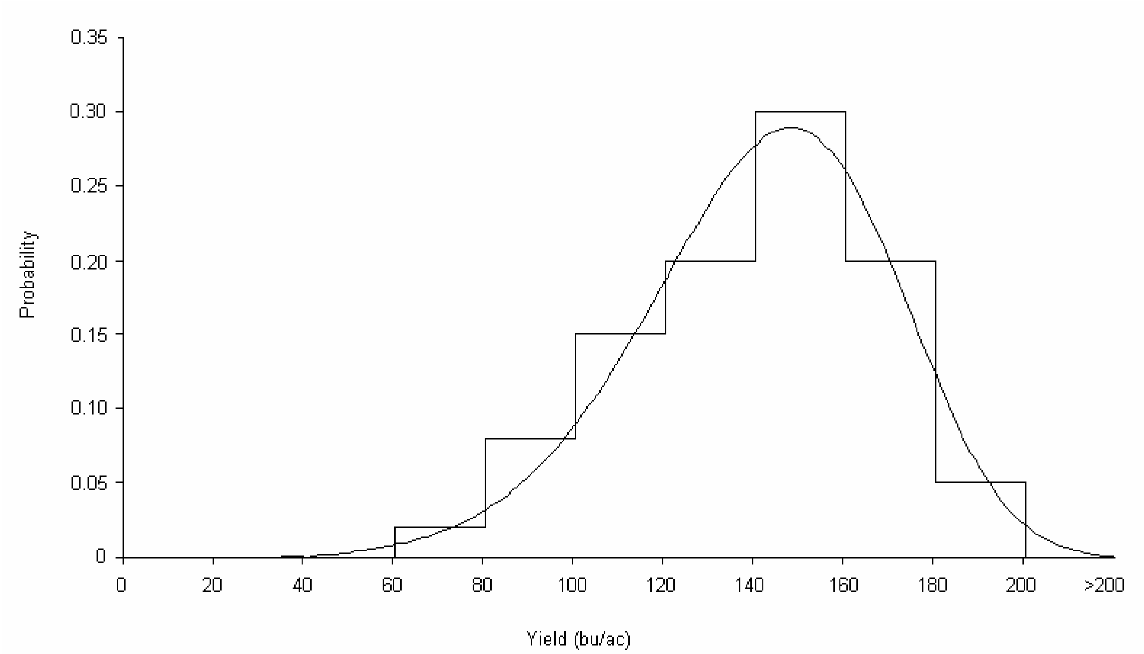

Figure 1. Assigned producer yield probabilities and their fitted Weibull yield distribution.

Appendix

farmdoc
Crop Yield Risk Survey
(estimated time to complete = 4 minutes)

1. Primary location: ________________ (enter county)

2. Number of acres farmed ______________ (acres)

3. Enter your average corn yield in a typical year _____ (bu/acre)

4. We are interested in your corn yields **relative to a typical farm** in your county.

   Compared to a typical farm in your country, your average corn yield is: (*Check box, fill in blank*)

   ☐ a. higher, by _____ bu/acres

   ☐ b. lower, by _____ bu/acres

   ☐ c. about the same

   Thinking about yield risk, compared to a typical farm in your county, would you say your average corn yield is: (*check box*)

   ☐ a. more stable

   ☐ b. more variable

   ☐ c. same degree of variability

5. Do you buy any form of Crop insurance? Why or why not? (Use back if necessary) If yes, which products?

   ____
   ____
   ____
   ____

6. Please fill in the table with your best estimates of the probability of your yield being in the intervals listed (*for example, 15 times out of 100 is a 15% probability*).

	Corn-Yield Range	Probability
a.	Less than 40 b/acre	________
b.	41 to 60 bu/acre	________
c.	61 to 80 bu/acre	________
d.	81 to 100 bu/acre	________
e.	101 to 120 bu/acre	________
f.	121 to 140 bu/acre	________
g.	141 to 160 bu/acre	________
h.	161 to 180 bu/acre	________
i.	181 to 200 bu/acre	________
j.	More than 200 bu/acre	________
	Total	**100%**

7. On a scale from 1 to 9, where 1 is strongly disagree and 9 is strongly agree, to what extent do you agree or disagree with the following statements?

	Strongly disagree			Neutral			Strongly agree		
1. When selling my crop, I prefer financial certainty to financial uncertainty.	1	2	3	4	5	6	7	8	9
2. I am willing to take higher financial risks in order to realize higher average returns.	1	2	3	4	5	6	7	8	9
3. I like taking financial risks.	1	2	3	4	5	6	7	8	9
4. When selling my crops, I am willing to take higher financial risks in order to realize higher average returns.	1	2	3	4	5	6	7	8	9
5. I like "playing it safe."	1	2	3	4	5	6	7	8	9
6. With respect to the conduct of business, I am risk averse.	1	2	3	4	5	6	7	8	9
7. With respect to the conduct of business, I prefer certainty to uncertainty.	1	2	3	4	5	6	7	8	9