Crop Insurance's Role in Farm Solvency

Todd H. Kuethe, University of Illinois
tkuethe@illinois.edu

Nicholas Paulson, University of Illinois
npaulson@illinois.edu

Gary Schnitkey, University of Illinois
schnitke@illinois.edu

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Over the past decade, crop insurance program participation and the intensity of use (i.e. elected coverage level) have greatly increased. Between 2002 and 2012, the share of US corn acreage enrolled in crop insurance increased from 28% to 84% and premium subsidies grew from $1.74 billion to $6.96 billion (Ifft, Kuethe, and Morehart, 2015). Crop insurance has become the primary component of the farm safety net, and its role in farm risk management will only increase following the implementation of the Agricultural Act of 2014.

By design, crop insurance is well suited to cover temporary or short-term adverse financial conditions for America's farms. Farmers purchase crop insurance annually to cover losses as a result of either adverse growing conditions or price declines. This study examines the degree to which crop insurance may support farmers' ability to meet long-term financial obligations. We explore the link between crop insurance coverage and farm solvency using a panel of farm records from 1995 – 2014.

Methodology

Following the USDA Economic Research Service, a farm's solvency position is determined by the combination of net farm income and debt/asset ratio. The classification follows:

- Favorable: net farm income > 0, debt-to-asset ratio ≤ 40%

- Marginal income: net farm income < 0, debt-to-asset ratio ≤ 40%

- Marginal solvency: net farm income > 0, debt-to-asset ratio > 40%

- Vulnerable: net farm income < 0, debt-to-asset ratio $> 40\%$

The simple classification expresses the degree to which a farm is able to meet long-term financial commitments (debt-to-asset ratio) based on its current income (net farm income). USDA data suggests that the share of US farms classified as vulnerable has consistently fallen since the 1980s farm financial crisis with a similar increase in the share of farms classified as favorable (Park, et al, 2011). The aggregate data may provide an accurate snapshot of the solvency position of US farms in a given year, but it is difficult to track an individual farm's solvency position from year to year using USDA surveys. As a result, we employ data from Illinois Farm Business Farm Management Association (FBFM). Our panel database includes farm-level financial records and data on crop insurance use. The panel spans the period 1995 – 2013.

The relationship between crop insurance coverage and each farm's financial solvency will be captured by a multi-state Markov model (Figure 1). The multi-state Markov model was developed in the context of disease modeling in which patients may advance into or recover from various stages of disease. Similarly, a farm with solvency state $S(t)$ at t may change solvency position as a result of changes in farm income, asset values, or borrowing activity. The next state to which the farm moves, and the time of the change, are governed by a set of transition intensities $q_{rs}(t, z(t))$ for each pair of states r and s. The intensities also depend on a set of farm-specific or time varying explanatory variables, including crop insurance coverage, $z(t)$. The risk of moving from state r to state s

$$(1) \qquad q_{rs}\big(t, z(t)\big) = \lim_{\delta t \to 0} P(S(t + \delta t) = s | S(t) = r) / \delta t$$
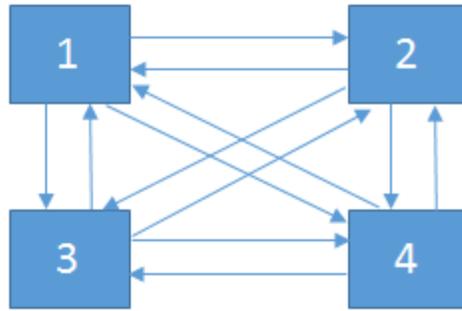
$$Q = \begin{pmatrix} q_{11} & q_{12} & q_{13} & q_{14} \\ q_{21} & q_{22} & q_{23} & q_{24} \\ q_{31} & q_{32} & q_{33} & q_{34} \\ q_{41} & q_{42} & q_{43} & q_{44} \end{pmatrix}$$

Figure 1 General Multi-state Model

Equation (1) is estimated via maximum likelihood. It is important to note that the flexible functional form of the multi-state Markov model allows for farms to transition to and from any combinations of solvency classification (Figure 1). The transition probabilities are estimated by observed financial conditions of farms within the dataset. Preliminary analysis shows movements across each possible combination of states.

Data

The data were obtained from the Illinois Farm Business Farm Management Association (IL FBFM), and the Risk Management Agency (RMA) and National Agricultural Statistics Service (NASS) of the USDA. The IL FBFM data includes farm-level financial records from commercial grain operations located throughout the state of Illinois. Records used in the analysis come from the accrual based income statements and balance sheets which are certified by the field staff who work with the farmers in putting the records together for tax, credit, and budgeting purposes.

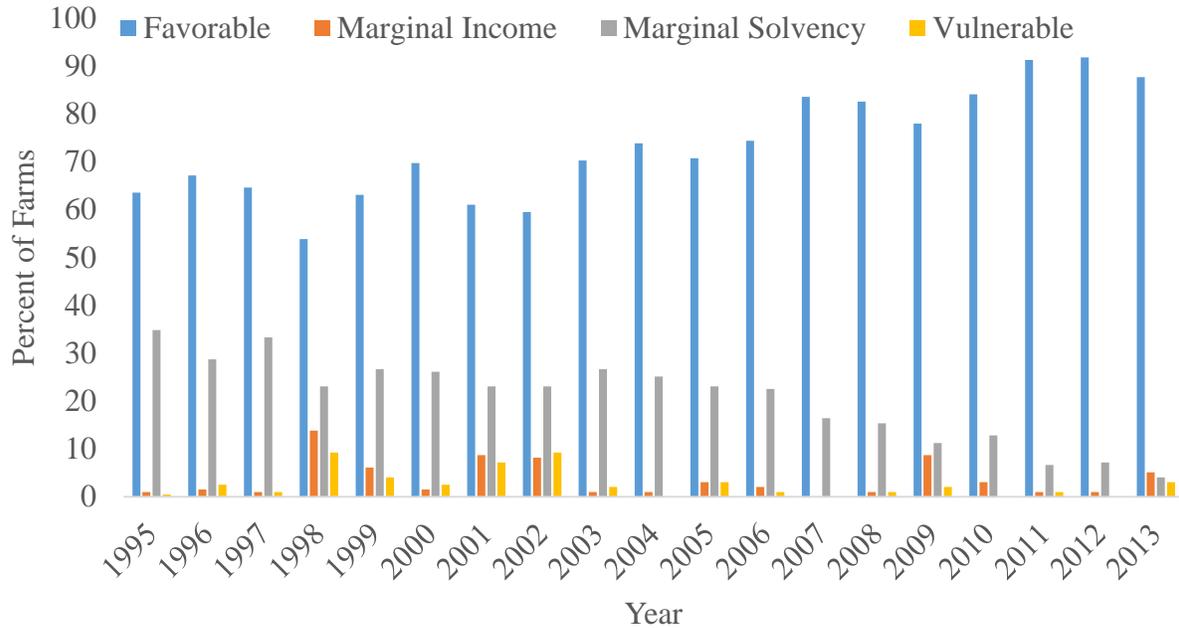The share of farms according farm solvency condition are depicted in Figure 2.

Figure 2 FBFM Farms by Solvency Classification

The observed transition of all individuals between each combination of states is captured by the

transition table.

		To:			
		Favorable	*Marginal Income*	*Marginal Solvency*	*Vulnerable*
	Favorable	2,346	110	75	10
	Marginal Income	100	16	8	1
From:	*Marginal Solvency*	135	6	553	59
	Vulnerable	7	1	57	26

The covariate of interest for the multi-state Markov model is the insurance coverage index. Data

on the farm's insurance expenditure was used to create the index such that larger values indicate

a greater level of insurance coverage for the farm, where more insurance coverage could be driven by a higher coverage level for a given plan of insurance (i.e. 85% revenue protection instead of 70% revenue protection) or a more comprehensive insurance plan at the same coverage level (i.e. revenue protection instead of yield protection). Specifically, we use the farmer-paid insurance premium observed in the FBFM data along with premium rate data from the RMA and historical insurance base prices to construct the insurance coverage index:

$$Insurance_{i,t} = \frac{FarmPremium_{i,t}}{BaseRate_{c,t} * Price_t * TrendYield_{c,t}}$$

The insurance index is the ratio of the farmer-paid premium by farm i in year t to the base insurance rate in county c and year t, the base insurance price in year t, and the county trend yield in county c and year t. This index accounts for the variation in premiums paid by farms due to regional variation in base rates, and variation across time and space due to the liability effects associated with adjustments in insurance base prices and farm-level yield guarantees. Note that for the results provided in this paper, the base rate, insurance prices, and trend yields were based on corn production. Results were also generated where the insurance index was constructed with soybean base rates, insurance prices, and trend yields and the results are qualitatively similar to those presented here.

Results

Conclusions

References

Ifft, J., T.H. Kuethe, and M. Morehart. (2015) "Does Federal Crop Insurance Lead to Higher

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