Farm-level choice of crop insurance coverage level: A preliminary assessment[1]

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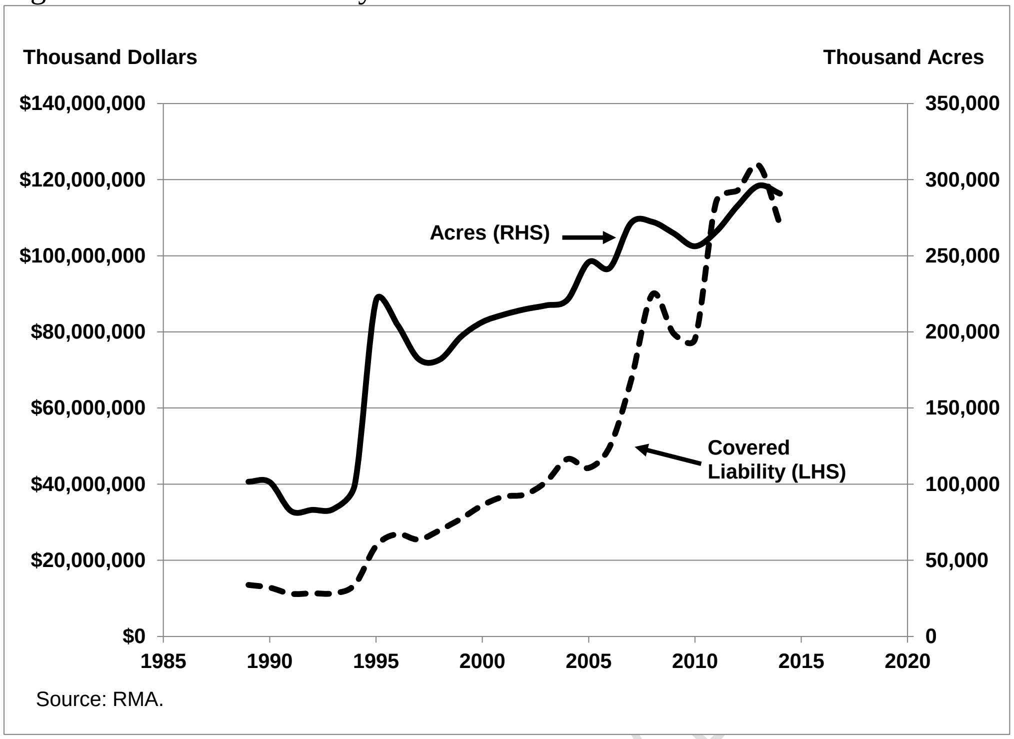
A preliminary assessment

The response of farmers to crop insurance incentives has been studied extensively. In particular, studies following the landmark ARPA legislation in 2000 have taken a close look at farmer participation changed with changes in the insurance subsidies. However, few if any studies have looked at the extent of farmer participation as measured in terms of their choice of coverage levels. This analysis uses farm-level observations of crop insurance choices to examine how changes to premium rates and subsidies may affect farmer choice of insurance coverage levels. Specifically we examine farmer choices of from a set of discrete coverage levels to changes in insurance premium subsidies that occurred in 2008 and 2009 while accounting for farm characteristics and market conditions. Some portion of the farmer choice of coverage levels were due to policy choices in the 2008 Farm Bill, whereas others were a result of significant price or other market changes between 2008 and 2009.

BACKGROUND

Many have noted how crop insurance as a risk management tool and a farm support program has been growing over time (Glauber, 2004, 2013; O'Donoghue 2014; RMA 2014). Figure 1 shows total liability and covered acres over time from 1989 to the current week of coverage for the 2014 crop. There has been an increasing desire to provide farm payments through insurance mechanisms; i.e., those programs provide payments to farmers in years when yields and/or prices are historically low, but not in years when they are high or normal. The new Farm Bill builds on that history. Congress recently included a raft of new insurance provisions. In some cases, new crop insurance programs would partially cover current crop insurance deductibles, possibly decreasing the returns to private dollars in purchasing higher levels of traditional crop insurance. Insurance programs are expected to cost more than $8 billion, for each of the next 10 years, which will provide coverage for more than $100 billion in crop value (CBO April 2014).

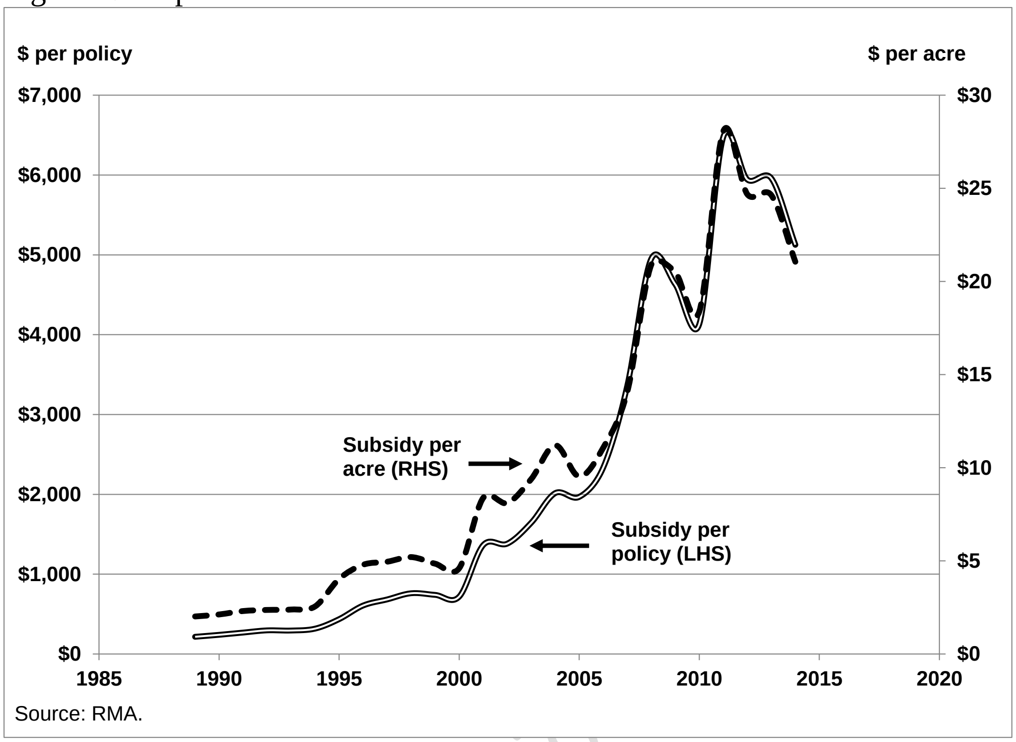
Figure 1. Acres and Liability



While the 2014 Farm Bill did generate expected savings relative to the 2008 Farm Bill programs, the actual amounts that will be paid out under the new programs will not be known until producers enroll in the farm programs and households apply for nutrition assistance. Certainly some have shown the potential for actual expenditures to be greater than expected outlays (FAPRI 2014). And while much is unknown at this point, it is clear that the federal budget will face continued pressure to limit unnecessary spending and to do more with less. If so, additional savings may again be sought from Farm Bill programs that are deemed to be too generous. Federal crop insurance is unlikely to be immune from such comparisons. With the new programs, some are questioning whether increased reliance on insurance has made the program inefficient in providing risk coverage to producers with taxpayers picking up the gains to producers and insurance companies (Babcock 2014).

Figure 2 shows how the rise of acres and liability covered by crop insurance has come at increasingly higher costs. Current subsidies per acre are more than $20 and more than $5000 per policy. In addition to offering higher subsidies following the 2000 ARPA legislation, higher commodity prices, particularly after 2005, have also driven those subsidies to the current high levels.

Figure 2. Crop insurance subsidies



Understanding how farmers respond to incentives to purchase crop insurance given the riskiness of their operations is fundamental to questions about expected federal outlays on those programs. Previous analyses have examined responsiveness of farmers to changes to the crop insurance program before and after the 2000 Agricultural Risk Protection Act (ARPA). At that point roughly 50 percent of corn acres were covered by crop insurance. And the product development for insurance plans were still undergoing significant change. Today, more than 85 percent of corn acres are covered by insurance plans.

Compared to the use and experience with crop insurance in 2000, today's changes to the program are more subtle than the large change experienced immediately after ARPA. And small changes to crop insurance programs in terms of rate adjustments, endorsements on existing products, or changes to subsidy levels will likely result in farmer changes in choice of coverage rather than in choice of participation as measured in terms of acres insured. Such behavior could be reinforced by the provision of shallow loss coverage, if a reduction in coverage levels can be accompanied by increased reliance on some of the new Farm Bill programs, such as the Supplemental Coverage Option (SCO). Previous analyses of crop insurance demand are useful for framing those issues, but they are limited for evaluating how more marginal changes to the crop insurance program may change producer behavior.

In addition, while examining pre- and post- ARPA period enrollment does capture how farmers may react to program changes, most previous studies were limited by having county-level data. Hence, these focused on aggregate measures of participation, such as the percentage of acres insured or the percentage of buy-up acres. Measures such as liability or premium at the county level are complicated by producer choices at the extensive margins (acres of buy-up) versus intensive margins (coverage level).[9]

This paper examines the relationship between subsidy levels and choice of coverage level at the farm level. To our knowledge there have been no studies thus far that have used database of farm-level data covering the whole nation to examine farmer choice of insurance coverage levels to changes in the cost of crop insurance. We use contracts for corn revenue policies in 2008 and 2009 for enterprise units to estimate the probability that corn producers will select difference coverage levels as a function policy variables, market variables, and farm characteristics..

ANALYSIS

The effect of premium rates and federal subsidies on farmer participation in crop insurance programs has been examined many times. However, the bulk of that literature examines the time period around the passage of the ARPA authorizing legislation. All recent analysis of the price elasticity of crop insurance purchases compare pre-ARPA crop insurance levels to post-ARPA crop insurance levels. A main objective ARPA was to encourage farmers to insure a larger percentage of their crop. That was accomplished by increasing the federal subsidy to insurance coverage. Since 2000, farmers have in general increased insured acres as well as increased the percentage level coverage (O'Donoghue, 2014).

[9] See for example O'Donoghue (2014): http://www.ers.usda.gov/publications/err-economic-research-report/err169.aspx#.VAnZ9VeM2JU.

Much has changed since that time. Insurance products, expected yields, and expected prices today are very different from the early 2000's. Farmers today primarily choose crop revenue products as opposed to crop yield insurance products. Today, farmers are more familiar with crop insurance plans and rely on revenue protection plans in particular. The average federal subsidy per acre insured has tripled from $8 per acre to more than $20 per acre over the past 10 years (Figure 2). Given changes in the program and farmers relatively familiarity with today's insurance program, the response of growers to changes in the cost of crop insurance may be different today than when ARPA was implemented.

The number of acres covered by insurance policies has approached 300 million acres and is assumed to remain relatively constant over the next 10 years (CBO 2014). We assume farmers have adjusted to a relatively steady-state level of reliance on crop insurance to manage risk. Therefore, the impact of minor rate changes on choices will likely occur at the relatively intensive margin (i.e., insurance level) rather than at the extensive margin (i.e., acres enrolled or type of policy).

For example, in 2012 the premium rates for corn in Minnesota were adjusted downward by approximately 12 percent on average. The largest number of policies in 2011 for revenue protection on corn was at the 75% level. Following the rate adjustment, 71% of those policies selected 75% coverage again, but 21% selected coverage at a higher rate (80% or 85%). In some cases, farmers selected lower coverage rates following the premium rate revisions, but on net, coverage levels increased. More than 80% of the policies that were insured at the 80% or 85% level in 2011 chose to re-insure at the same or higher level in 2012. By comparison, premium rates increased in North Dakota by about 7%. In 2011, the largest number of policies for revenue insurance on corn acres also insured at the 75% level. Following the rate adjustment, only 8% of policies chose to insure at a higher level, whereas 19% selected lower insurance levels. More than half of the policies that were insured at the 80% or 85% level in 2011 chose to re-insure at lower level in 2012.

There are a number of potential questions that could be asked at the intensive margin, as opposed to the extensive margin. While farmers balance crop insurance with other management decisions, such as fertilizer applications or investments in new equipment; it may be that small changes to premium rates for example do not induce significant switching to other coverage levels due to inertia. However, in other cases larger changes to insurance costs may induce farmers to switch insurance levels or adopt new products. Also, how might producers respond to changing subsidy rates may depend on farm specific characteristics and on their expectation of first and higher moments of prices and yields and/or their combination in the form of revenues and costs.

This paper will be one of the first since Coble, knight, Pope and Williams (1996) to use farm-level data rather than county-level data in order to focus more closely on how marginal changes in premium rates effect farmer choice of crop insurance.

DATA

Since 2001, after ARPA was implemented, premium subsidy rates and average coverage levels remained relatively stable until 2009 (2010 for winter wheat) when the premium subsidy rates for enterprise units were increased. As shown in Table 1, average coverage levels for revenue coverage (which allowed for enterprise units) increased at the same time as the average subsidy rate increased.

Table 1. Coverage and Premium Subsidy

Crop	**Year**	2001	2002	2003	2004	2005	2006	
Wheat	Average Coverage Level	70%	70%	71%	70%	70%	70%	
	Average Premium Subsidy Rate	57%	57%	60%	60%	60%	60%	
Corn	Average Coverage Level	72%	73%	73%	72%	72%	73%	
	Average Premium Subsidy Rate	55%	54%	55%	55%	55%	55%	
Soybeans	Average Coverage Level	73%	74%	74%	72%	73%	73%	
	Average Premium Subsidy Rate	54%	53%	54%	55%	55%	55%	
Crop	Year	2007	2008	2009	2010	2011	2012	2013
Wheat	Average Coverage Level	70%	69%	70%	71%	71%	72%	72%
	Average Premium Subsidy Rate	61%	61%	63%	65%	67%	66%	65%
Corn	Average Coverage Level	72%	72%	75%	75%	76%	76%	77%
	Average Premium Subsidy Rate	55%	56%	61%	62%	62%	63%	61%
Soybeans	Average Coverage Level	72%	72%	75%	75%	75%	75%	76%
	Average Premium Subsidy Rate	55%	56%	61%	62%	62%	63%	62%

Note, levels are for Revenue Protection, Crop Revenue Coverage, and Revenue Assurance products (source RMA).

Between 2008 and 2009 the premium subsidy offered by USDA on enterprise units was increased to encourage adoption of enterprise units relative to basic and optional units. In 2008 the subsidy rate for enterprise units (EU'08) was the same as for optional and basic units. However in 2009, the enterprise unit subsidy (EU'09) was increased by more than 20 percentage points in some cases.

Table 2. Subsidy rates for enterprise units in 2008 and 2009.

	Coverage Level							
	50%	**55%**	**60%**	**65%**	**70%**	**75%**	**80%**	**85%**
EU'08	67%	64%	64%	59%	59%	55%	48%	38%
EU'09	80%	80%	80%	80%	80%	77%	68%	53%

Enterprise units encompass all of the insured acres of a crop in a county. In contrast, basic units creates separate insurance coverage according to farm ownership, and may be further broken down into optional units. Until 2009, optional units accounted for acres. Enterprise units tend to have less frequent loss than other unit types, because they diversify risk over a larger geographic area. There is a greater possibility for higher yields in one area to offset low yields in another. RMA provides an enterprise unit discount that reflects this reduction in risk.

The lower risk of enterprise units results in lower premiums and less premium subsidy per acre, which made them a relatively infrequent choice among producers before 2009. For 2009 and later, the 2008 Farm Bill required the enterprise unit subsidy rates to be increased such that, on average, the number of dollars of subsidy per acre would be equalized with basic and optional units. Aside from reducing risk for the crop insurance program, enterprise units offer other benefits. Grouping all of a grower's insured acreage under a single unit reduces complexity. It makes the measurement of production and losses easier to measure and report, which reduces administrative costs and enhances program integrity (Babcock and Hart, 2005).

Contract data for revenue insurance in 2008 and 2009 were used to test the relationship between subsidy level and coverage choice. Furthermore, to keep the comparison as independent as possible, we constrain the data first to look at corn production for those producers that enrolled enterprise units in revenue insurance in either 2008, 2009, or both. Looking at the farm-level data, we can see that the number of enterprise units increased relative to the number of optional or basic units. However, we are interested in how the level of coverage changes in response to an increase in subsidy rates, so the data used is constrained to be those producers selecting enterprise units in 2008 and in 2009 (Table 3).

Table 3. Descriptive statistics for corn policies

Variable	Mean	Std.Dev.	Min	Max
Caverage	77.33	6.00	50.00	85.00
Acres	393.63	408.42	1.54	10,023.72
Liability	574.96	126.83	124.75	1,026.21
Liability per acre	3.34	5.57	0.06	322.99
Producer premium	7,668.64	10,037.00	29.00	299,822.00
Producer premium per acre	19.38	10.43	1.02	183.24
Subsidy	10,542.48	12,127.12	44.00	261,734.00
Subsidy per acre	27.35	9.30	3.65	180.66
Total premium	18,211.12	21,125.27	74.00	545,286.00
Total premium per acre	46.73	16.30	5.12	295.55
APH	158.35	24.03	11.94	232.00
Crop value	743.54	154.08	171.16	1,209.08
Subsidy rate	0.60	0.12	0.38	0.80
Observations 2008	13,502			
Observations 2009	14,540			

Data: RMA.

MODEL

Uncertainty is ubiquitous in agriculture and can stem from a variety of sources that range from systemic down to idiosyncratic in nature. For example, price shocks impact revenues and weather shocks impact crop yields and revenues. Economic research suggests that farmers tend to be risk averse, meaning that uncertainty affects their farm management decisions. Farmers have developed risk management strategies to cope with unforeseen events and have many options available to reduce their risk exposure. Risk management involves technologies that reduce risk exposure, farm and non-farm diversification, borrowing, saving, investment, hedging, and of course, federal crop insurance. The farmer’s true farm decision model may be to choose inputs to maximize expected utility or some other function such as survival model (Egan) or hired-manager model. For the purposes of this paper, we seek to capture a local approximation to the farmer’s management decisions, focusing on the federal crop insurance coverage decision.

Consider a simple EU framework (e.g. Chavas and Holt; Serra and Zilberman). Prices and yields are stochastic in our model and, if the farmer is not risk neutral, optimal input choices will be sensitive to price and yield distributions. Yields are denoted by Y_j, output prices ($/bu.) by P_j, planted acres by A_j, the insurance indemnity payment by I_j , the insurance coverage rate by $\boldsymbol{\theta}_j$ (in theory, bounded between 0 and 1), the insurance premium by ρ_j, and non-federal crop insurance cost per acre by C_j, for crop ***j***, and setting aside for the time being the farm specific subscript ***i***. Assume that the constraints on the farm household's input decisions (due to a budget constraint) are represented by $f(\boldsymbol{A},\boldsymbol{\theta}) = 0$, where $\boldsymbol{A} = (A_1,\ldots,A_n)$ and $\boldsymbol{\theta} = (\boldsymbol{\theta}_1,\ldots,\boldsymbol{\theta}_n)$. A simple *EU* framework for modeling acreage decisions, with the insurance choice added, can serve as a basis for discussion leading to our empirical nested model. We abstract to the simplest model here, assuming two choice variables, *A* and $\boldsymbol{\theta}$. In this model, the farmer maximizes a concave expected utility function (such as an expected utility function) over wealth:

(1)

$$\max_{A,\theta} \left\{\Psi\left[\frac{w_i}{q} + \sum_{j=1}^{n} \frac{1}{q}\left(P_j Y_{ij} + I_{ij}\left[Y_{ij}^b, P_j, Y_j, \theta_{ij}\right] - \rho_{ij}\left[P_j^b, Y_{ij}^b, P_j, \theta_{ij}, s_{\theta_{ij}}, G_{ij}\right] - C_{ij}\right) A_{ij}\,,\;\; \varphi_i\right]\right\}$$

s.t. $f(\boldsymbol{A},\boldsymbol{\theta}) = 0$,

where $s_{\theta_{ij}}$ is the premium subsidy rate (ranging between 0 and 1) associated with Θ_{ij}, G_{ij} is a vector of farm, county, crop, and farm specific coefficients that impact the actuarial rating, Y_{ij}^b is the expected yield for insurance ratings purposes (while we assume that the producer's yield expectation can differ from Y_{ij}^b, we assume no distinction between the producer's price expectation and the base insurance price, being simply the futures price at planting time), w_j is exogenous wealth, φ is a vector expressing the farmer's risk preferences, and *q* is a price index for household goods. [10]

[10] We have little reason to believe farmers preferences for crop insurance can generally be expressed by a static von Neumann Morgenstern utility function where the farmer's risk preference is expressed by one coefficient. The only reason that this model would return an interior solution for the insurance coverage rate is due to discontinuities in the revenue distribution induced by the non-continuous subsidy schedule associated with the federal crop insurance coverage rates.

Solving for planted acres and the insurance coverage rates in equation 1 leads to the optimal acreages and insurance coverage rates expressed as exogenous variables, or $A^*(w, \boldsymbol{P}, \boldsymbol{Y}, \boldsymbol{C}, \boldsymbol{Y^b}, \boldsymbol{s}, \boldsymbol{G}\ \ , \boldsymbol{\varphi}\ \ , \boldsymbol{\sigma})$ and $\theta^*(w, \boldsymbol{P}, \boldsymbol{Y}, \boldsymbol{C}, \boldsymbol{Y^b}, \boldsymbol{s}, \boldsymbol{G}\ \ , \boldsymbol{\varphi}\ \ , \boldsymbol{\sigma})$, where $\boldsymbol{\sigma}$ represents the covariance matrix of crop revenues and stochastic costs, or some other measure of variance and perhaps their higher moments. For simplicity, and perhaps without too much loss of realism given that all farmers in our data have chosen to insure at the enterprise level, we assume that if $\theta_j > 0$, i.e., insurance is purchased, and the farmer purchases it for all acreage in crop j.

By design, $\frac{\partial \rho}{\partial s} < 0$. We expect that the demand for insurance in the form of the coverage rate is decreasing in the premium, or $\frac{\partial \theta}{\partial \rho} < 0$. Hence, $\frac{\partial \theta}{\partial \rho}\frac{\partial \rho}{\partial s} > 0$, i.e. the coverage rate is increasing in the premium subsidy rate. Since $\frac{\partial \theta}{\partial s} > 0$, increasing the premium subsidy rate increase the probability that $\theta_j > 0$, and consequently, the probability that A^* is insured. In principle, increases in *s* may cause shifts in acreage between crops and expansion in total planted acreage, although little evidence exists to date for significant insurance-induced acreage expansion in most regions (e.g., Goodwin, Vandeveer, and Deal 2004). We presume little regarding the relationship between the farmer's maximization function Ψ and θ except that there is a unique solution for θ and that it can include interior points. For the purposes of this study, we do not presume that in equation (1) insurance affects yields.

In equation (1), the farmer's choice of coverage rate θ is continuous between the allowable limits on this variable. However, in practice, the farmer cannot express a continuous choice. As shown in Table 1, the FCI coverage rate is available only over up to eight increments, and 0, where 0 indicates that insurance is not selected, or $\theta_g \in \{0, 0.50, 0.55, 0.60, 0.65. 0.70, 0.75, 0.80, 0.85\}$. We assume that decision function is concave in θ, allowing for a unique optimal θ choice for each crop.

The producer can use RMA's online premium calculator or an insurance agent to examine the relationship between choices of θ and its impacts on the liability and the premium rate given his APH yield and other farm characteristics (we ignore choices of basic versus optional units and the like for the time being). The online calculator shows the levels of θ, the liabilities, and premiums in the form of a schedule (i.e., table). The farmer chooses the one coverage rate that most closely matches his true, unobserved choice for θ given his preferred liability level – premium tradeoff.

In general concept, this selection process is much like a conjoint study (e.g., Louviere, 2006; Louviere et al. 2008; Green and Srinivasan, 1978, 1990; Green and Srinivasan, 1978, 1990; Green and Rao; Luce and Tukey, 1964), in which the respondent makes a choice from among a discrete set of alternatives, the characteristics of which differ by alternative-specific variables. The standard econometric approach to analysis of conjoint data is a discrete choice multinomial model such as the additive multinomial logit or probit or a random coefficients logit (see for example, McFadden and Train, 2000), which uses a random utility framework to model the probability of making a specific choice from among a set of choices. As outlined in Cameron and Trevidi (2010) and applied to our application, in the additional random-utility specification, for farmer *i* and coverage rate *θg*, we assume that utility *Uig* is the sum of a deterministic component *Vig* that is a function of explanatory variables and their associated unknown parameter values, and an unobserved component ϵ_{ig}:

$$U_{ig} = V_{ig} + \epsilon_{ig} .$$

With this additive random utility model (ARUM), we observe the outcome *yi* = *θg* if coverage rate alternative *θg* has the highest utility among the coverage rate choices. That is,

$$\Pr(y_i = \theta_g) = \Pr(U_{ig} \geq U_{ik}), \text{ for all } k$$

$$= \Pr(U_{ik} - U_{ig} \leq 0), \text{ all } k$$

$$= \Pr(\epsilon_{ig} - \epsilon_{ig} \leq V_{ig} - V_{ik}), \text{ all } k$$

The standard multinomial model (e.g., Cameron and Trevidi, 2010) specifies that $V_{ij} = x'_{ig}\beta + z'_i\gamma_g$, where $\boldsymbol{x}_{ig}$ are the coverage rate alternative specific variables (including the subsidy rate, the liability, and the premium) and $\boldsymbol{z}_i$ are the farmer specific variables (e.g., yield). Assumptions about the distribution of the error term ϵ_{ig} lead to models with different specifications for the cumulative density function of V_{ij} . For this analysis, we use the conditional multinomial logit for computation tractability due to the relatively large sample size and number of alternative coverage rate choices. In the conditional multinomial logit, the probability of coverage choice θig is

$$p_{ig} = \frac{\exp\left(x_{ig}'\beta + z_i'\gamma_g\right)}{\sum_{l=1}^{m}(x_{il}'\beta + z_i'\gamma_l)}, \quad g = 1,\ldots,m \text{ choices of coverage rate.}$$

Under this model, the coefficients are be interpreted as

$$\frac{\partial p_g}{\partial x_k} = \begin{cases} p_g\left(1 - p_g\right)\beta & g = k \\ -p_g p_k \beta & g \neq k \end{cases}$$

where the farmer specific subscript is dropped to remove clutter. Hence, a positive coefficient on the subsidy rate means that if the subsidy rate specially associated with coverage choice θg increases, then, then the probability that θg is chosen increases, and the probability of the other coverage rates being chosen decreases.

The conditional multinomial logit does have the characteristic of independence of irrelevant alternatives (IIA), i.e., that the ratio of the probabilities of two coverage rate choices, p_g / p_k, are independent of the other choices in the set, which may be a strong assumption here. A nested logit can relax the IIA assumption, but we see no obvious nesting structure, particularly given that the available data is conditional on the farmer already having chosen to insure. The multinomial probit relaxes IIA, but is particularly computationally demanding given our large sample size and choice set. The random coefficients logit also relaxes IIA and is an approach that we will pursue in future research.

While the coverage rates themselves are clearly ordered ordinally (if not cardinally due to associated declining subsidy schedule), an ordered probit or logit model seems too restrictive for our analysis in that it does not explicitly model the liability-premium trade-offs the farmer is facing across the coverage rate choices; in its standard form at least, the ordered probit or logit does not allow for the alternative specific variables (subsidy rate, premium, liability). As an aside, note that a producer's preferences for θ are not necessarily ordered ordinally (or cardinally for that matter). For example, a producer that has a preference for a coverage rate of 70 percent may be indifferent between choices of 65 or 75 percent coverage rates.

Our goal is to assess how the coverage rate θ the farmer chooses is changing in the subsidy rate s. It could be tempting to estimate this relationship as a continuous dependent variable model with θ itself as the dependent variable, but perhaps subject to bounds, as in a Tobit model. However, the nature of the coverage selection process and the design of the insurance program limit the applicability of a continuous model, denoted in stylized form as $\theta = \mathbf{w}'\boldsymbol{\delta} + \varepsilon$, where $\mathbf{w}$ is a vector of explanatory variables and ε is an additive error.

First, for policy relevance, we need to model the choice of θ as a function of the premium and/or the premium, liability, and subsidy rate s. By design however, these explanatory variables are endogenous with respect to the dependent variable θ. Endogeneity in s could be eliminated by specifying an instrument for s, but what such an instrument might be is not evident given that the instrument would have to model a political-economy process. Alternatively, endogeneity in s could be eliminated by specifying the dependent variable as θ/s and using partial instruments for liability and full-premium such as expected price and yield, variance of yield, etc. In such a specification, $d\theta/ds = \mathbf{w}'\boldsymbol{\delta}$, which is rather uninteresting from the perspective of our policy needs. Furthermore, the continuous model specification cannot account for how a change in the subsidy rate for one coverage rate will affect the demand for the other coverage rate choices.

To the best of our knowledge, this is the first paper to apply the multinomial model to the choice of insurance coverage rate. Saleem et al (2008) use multinomial logit is utilized to model the choice of whether to purchase yield or revenue insurance. Sherrick et al (2004) utilize a multinomial model farmers choices between general types of insurance (hail, yield, revenue), and consequently, without the need for alternative-specific variables. Hojjati and Bockstael (1988) use a multinomial model to examine choices between insured and non-insured acreage. Velandia et al 2009) use a multivariate probit to analyze risk management choices. A multivariate probit approach would be less demanding in terms of estimation than a multinomial approach but is inapplicable here as the former does not account for the farmer being able to make only one choice of coverage rate from the available set.

Faced with this new schedule of subsidy rates prior to the 2009 crop year, a farmer could increase, decrease, or leave unchanged the coverage rate chosen for their crop. Conceivably, a producer with a coverage level at 85 percent in 2008 could drop coverage rates in 2009 to 70 percent to take advantage of a much higher subsidy rate (i.e., 80 percent relative to 38 percent) and a lower premium (i.e., 70 percent coverage relative to 85 percent coverage). That same producer could remain at 85 percent coverage and just pay less due to the higher subsidy level (i.e., 53 percent relative to 38 percent). Lastly, a producer with 2008 coverage levels less than 85 percent has the option of using the savings from the increased in subsidy rates to increase their coverage level for 2009.

RESULTS

The true model is likely dynamic, but due to lack of data, we examine, as typical in the agricultural risk management literature, the static. Using the 2008 and 2009 contract data for enterprise units on corn acres, we model the choice of a producer to 8 discrete coverage levels as a function of subsidy rate, unit size, expected yield, and we include a year dummy to pick up the change in prices between 2008 and 2009 using conditional multinomial logit regression analysis. Furthermore, while the farmer paid premium imbeds the subsidy rate, it may be useful to retain the subsidy rate as a separate explanatory variable as farmers may be explicitly considering it in making their coverage rate choice. We can also examine liability and the premium as explanatory variables in the farmer choice.

Table 4. Mean subsidy per acre and observations

	2008		2009		Total	
Coverage	**Mean**	**Count**	**Mean**	**Count**	**Mean**	**Count**
50	15.58	73	12.00	45	14.22	118
55	17.78	21	19.74	10	18.41	31
60	19.39	88	24.26	16	20.14	104
65	17.69	1,170	21.30	326	18.48	1,496
70	24.50	2,668	28.71	1,091	25.72	3,759
75	26.64	3,925	31.71	3,559	29.05	7,484
80	26.43	3,501	31.19	5,779	29.40	9,280
85	23.68	2,056	26.78	3,714	25.67	5,770
Total	24.82	13,502	29.71	14,540	27.35	28,042

Data: RMA.

Comparing results by year and by coverage level, we should our empirical results to confirm that produces selected towards higher coverage levels in 2009 due to the higher subsidy rate offered on those contracts (Table 4). Between 2008 and 2009, producers on average moved away from the middle coverage levels towards the higher levels, particularly 80 percent coverage and 85 percent coverage levels. In addition, the overall number of corn acres covered by enterprise unit revenue policies, increased slightly.

While the results presented here are preliminary, we can see that the general result we expected is confirmed by the multinomial logit model (Table 5).

Table 5. Preliminary MNL results

		Model 1		**Model 2**		**Model 3**		**Model 4**	
Coverage Choice	Variable	Coefficent	P>|z|	Coefficent	P>|z|	Coefficent	P>|z|	Coefficent	P>|z|
ALL	subrate	28.7513	0.0000	29.6173	0.0000	10.9124	0.0000	17.8838	0.0000
	suba			0.0191	0.0010				
	pprema					-0.0839	0.0000		
	tprema							-0.0417	0.0000
50 percent	**---------- base alternative ----------**								
55 percent	acre	0.0000	0.9480	0.0000	0.9450	-0.0001	0.8610	-0.0001	0.9010
	aph	-0.0029	0.1630	-0.0030	0.1480	-0.0051	0.0140	-0.0036	0.0850
	year	-1.1932	0.0030	-1.2381	0.0020	-0.8352	0.0360	-0.8956	0.0230
60 percent	acre	-0.0004	0.3780	-0.0004	0.3600	-0.0005	0.2250	-0.0004	0.2850
	aph	0.0074	0.0000	0.0068	0.0000	0.0068	0.0000	0.0089	0.0000
	year	-1.7952	0.0000	-1.8631	0.0000	-1.5244	0.0000	-1.4762	0.0000
65 percent	acre	0.0004	0.1220	0.0004	0.1340	0.0001	0.6010	0.0003	0.3250
	aph	0.0344	0.0000	0.0336	0.0000	0.0306	0.0000	0.0346	0.0000
	year	-2.5780	0.0000	-2.7427	0.0000	-1.7304	0.0000	-1.7395	0.0000
70 percent	acre	0.0007	0.0120	0.0006	0.0140	0.0004	0.1330	0.0005	0.0500
	aph	0.0390	0.0000	0.0376	0.0000	0.0371	0.0000	0.0415	0.0000
	year	-2.1169	0.0000	-2.3028	0.0000	-1.4245	0.0000	-1.2974	0.0000
75 percent	acre	0.0007	0.0110	0.0007	0.0120	0.0004	0.1490	0.0005	0.0560
	aph	0.0488	0.0000	0.0472	0.0000	0.0457	0.0000	0.0513	0.0000
	year	-1.5572	0.0000	-1.7831	0.0000	-0.9590	0.0000	-0.6917	0.0000
80 percent	acre	0.0009	0.0010	0.0009	0.0010	0.0006	0.0250	0.0007	0.0070
	aph	0.0601	0.0000	0.0586	0.0000	0.0542	0.0000	0.0609	0.0000
	year	-0.3548	0.0500	-0.5755	0.0030	-0.3484	0.0550	0.2015	0.2730
85 percent	acre	0.0011	0.0000	0.0011	0.0000	0.0007	0.0070	0.0008	0.0010
	aph	0.0741	0.0000	0.0731	0.0000	0.0642	0.0000	0.0718	0.0000
	year	1.1547	0.0000	0.9941	0.0000	0.1272	0.4900	1.0533	0.0000

For any given coverage rate choice all else equal, a higher subsidy rate, or alternatively, a higher subsidy per acre, typically generates a higher probability that coverage rate is selected (relative to the base coverage rate of 50 percent). A higher producer paid premium or total premium associated with a given coverage rate generally result in a lower probability of that particular coverage level being chosen.[12] With respect to farm-specific variables, producers insuring larger enterprise units are likely to select higher coverage levels. Producers with higher expected yields are more likely to choose higher coverage levels. Coverage levels, all else equal, would have been expected to decline in 2009 relative to coverage level 50 except for 85 percent coverage. Based on summary statistics we would have expected coverage level 80 percent to also show a significant increase in 2009 relative to 2008.

CONCLUSIONS

Insurance policy designs and associated costs of insurance programs has been a discussion of debate and contention in the United States over the past 5 years. Certainly policymakers have argued that federally-supported insurance can lower overall government outlays. Private provision of insurance is often limited by adverse selection; whereby the riskiest individuals cannot afford insurance coverage and so are left to fend for themselves or rely on catastrophic government assistance in the occurrence of damage. That limits the pool of participants for sharing risk broadly and leads to higher premia. Government policymakers have argued that such an ex-post reliance on government assistance in bad times is less efficient than encouraging (or requiring) use of insurance products to provide that safety net. That is because, according to this argument, requiring participants to undertake some level of cost to purchase that insurance will lead to more responsible behavior, which in turn will lower the risk of future damages. Understanding how federally subsidies for insurance affect the level of private participation in those programs is important for government policymakers to understand. It may be that optimal insurance coverage can be achieved by targeting subsidy rates differently or at different levels.

For traditional multi-peril crop insurance, there has been a motivation to provide subsidies to encourage producers to purchase those products to smooth their income over the distribution of yields and prices that may transpire through time. The primary motivation for subsidizing crop

[12] Many of these variables are correlated, and so the regression is inefficient, meaning that bootstrap approaches are necessary to calculate measures of fit for the explanatory variables. STATA offers several methods for calculating standard errors that correct for covariates being correlated with the error term (Guan 2003). We plan to use a bootstrap method for estimating the variance-covariance matrix for an updated draft.

insurance is that risk management (i.e., an ex ante policy mechanism) with the producer as an active participant is more efficient than leaving insurance to *ad hoc* government disaster assistance (an ex post policy mechanism).[13] By charging a premium for more coverage, producers balance risk management options in the most optimal manner for them. However, producers do not pay the full amount for insurance. Federal crop insurance subsidies are used to encourage higher levels of participation across producers and regions and participation at higher levels (cite USDA study stats here). The same logic provides a basis for proposals seeking to generate farm program savings, but with the new shallow-loss programs in place, it is unclear if simply reducing subsidy rates will generate much savings, since farmers could simply lower traditional coverage levels (and receive higher subsidy rates) and backfill with shallow-loss coverage.

For example, will farmers insure fewer acres under buy-up coverage, or might farmers simply opt to cover their revenue at lower coverage levels, and perhaps supplement that coverage with the new Supplemental Coverage Option. The Supplemental Coverage Option (SCO) insurance product enacted with the Farm Bill provides area crop insurance from 86 percent coverage to whatever the individual coverage choice is for that unit at a relatively high subsidy level.[14] It may be that farmers will scale back on the level of traditional coverage they select, taking advantage of the higher subsidy rates (65 percent) available under SCO. On the other hand the new program may not result in any changes to the crop insurance decisions a producer would have made anyway. In either case, the provision of highly subsidized crop insurance up to 86 percent of expected revenue is expected to increase federal outlays on the crop insurance program. The Congressional Budget Office projects outlays on crop insurance programs under the 2014 Farm Bill are expected to be greater than under then 2008 Farm Bill provisions by about $500 million by 2020. However the increase is less than the $700 million expected outlays in SCO and STAX, indicating that producers might be expected to lower coverage levels when shallow loss programs are available. That is also consistent with analysis of the early proposals for supplemental coverage (see Dismukes, Coble, Miller and O'Donoghue, 2013; Bulut and Collins 2013).

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[13] http://www.choicesmagazine.org/choices-magazine/theme-articles/current-issues-in-risk-management-and-us-agricultural-policy/ten-considerations-regarding-the-role-of-crop-insurance-in-the-agricultural-safety-net

[14] STAX provides a similar shallow loss coverage option for cotton.

Previous proposals to generate savings from the crop insurance program have often looked at lowering the subsidy offered to producers on those products. For example, the Office of Management and Budget proposed lowering subsidy rates on federal crop insurance during the run up to the 2014 Farm Bill by 2 percent on all buy-up policies (OMB 2013). Others from the Government Accountability Office (GAO 2012) and from the American Enterprise Institute (Smith, Goodwin, and Babcock 2012) to the Environmental Working Group (Babcock 2013) have all pointed to crop insurance subsidies as one place to find savings from farm programs. Analyzing how farmers might respond to changing incentives and hence how much savings might be achieved is a complicated undertaking.

This paper is an initial attempt to model the discrete choice insurance coverage decision, instead of examining more aggregate measures of participation at the county or state levels. We find that as might be expected increasing subsidy rates will increase the likelihood of farmers to choose higher levels of crop insurance. That is consistent with studies that posit farmers will indeed try to harvest subsidy dollars through crop insurance programs. However, by looking at the crop coverage decision we can see that under some specifications farmers will opt for lower coverage levels and incur lower farmer paid premia. The time variable indicates that when prices are higher (and expected revenues) it is likely that producers will insure at the highest coverage rates. Lastly we find that farmers insuring larger areas under enterprise units are more apt to insurance at higher coverage levels. These results will form the basis for determining the elasticity of farmer response to changes in subsidy rates across coverage levels.

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