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AN EXAMINATION OF DIFFERENT TYPES OF ADVERSE SELECTION IN FEDERAL CROP INSURANCE

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ABSTRACT

Different types of adverse selection –type of insurance product, type of unit, type of coverage and number of actual yields reported in Federal crop insurance is examined utilizing binomial and ordered logit discrete choice models for all U.S. cotton producers, 1997-2000. The associated costs of adverse selection in U.S. cotton range from $32 Million to $359 Million for the four-year period.

AN EXAMINATION OF DIFFERENT TYPES OF ADVERSE SELECTION IN FEDERAL CROP INSURANCE

Asymmetric information has been the theme of economic analysis for more than half a century in the area of agriculture, finance, industrial organization, labor economics, development economics, income taxation, and resource allocation (see Stiglitz; Grossman and Stiglitz; Myers and Majluf; Spence; Basu; and Stiglitz and Dasgupta). Recognition of the importance of asymmetric information in economic theory is evident from the receipt of Nobel prizes in economic sciences by James Mirrlees and William Vickery in 1996 for their fundamental contributions to the theory of incentives under asymmetric information, and George Akerlof, Michael Spence and Joseph Stiglitz in 2001 for their contribution to the theory of markets with asymmetric information.

Akerlof and Spence have demonstrated the presence of adverse selection due to informational asymmetries with contradictory outcomes – only lemons remain in the market compared to hiring of low productivity workers with low wages due to signaling. Extending the above concept, Rothschild and Stiglitz show that their model has no pooling equilibrium (only separating equilibrium) since the insurance companies by offering different types of insurance can be profitable. Research on the incentives and market implications of asymmetric information to U.S. crop insurance markets has seen an increase in recent times. Asymmetric information due to adverse selection in crop insurance has been addressed using experimental or survey data, small samples of farm record data or yield data provided by Risk Management Agency (RMA). Recently

Atwood et al utilizing RMA's cotton yield and loss history from 1996-2000 have examined the presence of asymmetric information due to adverse selection as signaled by their choice of and level of insurance coverage. In this paper, we extend to examine the presence of different types of adverse selection in Federal crop insurance based on the choice of crop insurance policies employing all U.S. cotton producers who purchased federal crop insurance in the years 1997-2000.

Crop insurance has gained importance as USDA's primary policy instrument in protecting farmers against risk with the Freedom to Farm Act of 1996 and the Agricultural Risk Protection Act of 2000. Federal Crop Insurance Company through the Risk Management Agency offers several yield and revenue crop insurance policies relying on private companies for product delivery, service, and loss adjustment. Since the establishment of the Federal crop insurance program in 1938, the program has consistently experienced lower than desired participation and higher than desired loss ratios (indemnities divided by premiums). Various policy modifications like increased subsidization to all levels of coverage, expansion and development of crop insurance products for additional crops, regions and higher coverage levels have been made in an attempt to make the program a more effective risk management tool for producers (and thus increase participation) while simultaneously attempting to reduce excessive losses.

To a larger extent higher than desired loss ratio and loss cost ratio has been acknowledged and economists have examined numerous aspects of crop insurance including moral hazard (Chambers; Just and Calvin; Smith and Goodwin; Coble et al), adverse selection (Skees and Reed; Quiggin et al; Just and Calvin; Atwood, Shaik, and

Watts;), demand for crop insurance (Coble et al), and rating methodologies (Goodwin; Atwood et al; Skees, Black and Barnett; Goodwin and Ker; Olivier Mahul;).

Still current crop insurance policies are faced with different types of adverse selection within the RMA's insured pool of producers and the leading cause for low participation, and high loss ratio and loss cost ratio. Adverse selection is defined as asymmetric information in which a producer has more knowledge about his or her risk of loss than does the insurance provider in crop insurance. Under RMA's current procedures, producers have the choice to insure yield or revenue insurance product; basic or optional unit; number of actual yields reported, apart from the choice of and level of insurance coverage based on his/her perceived risk in order to maximize profits each crop year.

In general the various choice of crop insurance policies available to the producers are: (1) type of insurance product[1] selected by the producer - standard multiple peril crop insurance (MPCI), a policy that insure producers against losses due to natural causes such as drought, excessive moisture, hail, wind, frost, insects, and disease, or the revenue[2] based crop revenue coverage (CRC) that provides revenue protection based on price and yield expectations by paying for losses below the guarantee at the higher of an early-season price or the harvest price; (2) type of unit insured – basic unit (BU) consist of all acreage of the crop in a county held by the insured under identical ownership or optional unit (OU), producers who farms satisfy certain spatial requirements are allowed to divided their farm into different insurable units and to report yields separately on each unit over time. The optional units provision is popular with producers due to its low

relative cost and the ability to indemnify losses on separate sections of land; (3) type and level of coverage - catastrophic coverage, a plan of insurance that provides coverage equal to 50 percent (50%) of the approved yield indemnified at 55 percent (55%) of the RMA's insurable market price or if the producers so choose, they can pay a higher premium for buyup coverage, i.e., 50-85 percent of the approved yield indemnified at 55-100 percent of the RMA's insurable market price; and finally (4) the number of actual yields reported by the producer compared to assigning a T-yield or other kinds of yields without yield history is an avenue of asymmetric information due to adverse selection.

Ideally a simultaneous decision making of the type of insurance product, type of unit, type of insurance coverage and number of actual yields reported is warranted in choosing a crop insurance policy. Empirically this can be addressed by objective nested decision-making process but is subjected to the bias of which crop insurance policy (insurance product, unit type, coverage or number of actual yields reported on each unit or farm) forms the prior and posterior nest. Hence we examine the presence of different types of adverse selection independently for insurance product, unit type, coverage or number of actual yields reported but conditional on other types of adverse selection variables.

A traditional model of asymmetric information is presented in the next section of the paper that examines the presence of different types of adverse selection in Federal crop insurance by the producer's risk as revealed by their choice of insurance product (MPCI vs CRC), unit type (BU vs OU), number of actual yields (< 4 versus >= 4) , and coverage levels (0.325% to 75% election) defined as a binary and ordered multiple

random variable respectively. Expected loss cost ratio (normalize indemnities over normalized liabilities) is used as proxy for risk, other variables include average farm yields, RMA's county-level base insurance premium rate used as a proxy for differences in county level risk, practice (irrigated versus dryland) dummy, state dummies and year dummies. Third section discusses the empirical binomial and ordered logit models to examine the presence of adverse selection along with the description of the data. The regression results and cost of adverse selection are presented in the next section followed by a conclusion section.

THEORETICAL MODEL OF ADVERSE SELECTION

Consider a stylized risk averse producer facing a potential loss of future output. Assume that the producer is initially endowed with a level of wealth W. At the end of the next time period the producer will realize one of the two possible states[3] of the world - State 1 with probability of loss p and State 2 with probability of no loss $(1-p)$. We assume that the producer's preferences over risky choices can be modeled using expected utility. The objective function can than be modeled as:

$$(1) \quad U = p\,u(W - L) + (1 - p)\,u(W)$$

Assume that producer purchase insurance for a premium Z payable in state 1, the utility objective function is:

$$(2) \quad U = p\ u(W - L + I - Z) + \ (1 - p)\ \ u(W - Z)$$

where W is the initial wealth, L is the loss, I is the indemnity and Z is the premium of insurance. Further the indemnity paid depends on the type of crop insurance policy opted by the individual producer as signaled by his or her choice of type of insurance product, type of unit, type of coverage, and number of actual yields reported within a farm policy. Under the assumption of no transaction cost, the premium is a function of type crop insurance policy, risk (α) associated with type of insurance policy and other observable characters (β).

Equation (2) can be re-written as:

$$(3)\quad U = p\ u(W - L + I(policy,\alpha) - Z(policy,\alpha,\beta)) + (1-p)\ u(W - Z(policy,\alpha,\beta))$$

which has first order conditions (FOC):

$$(4)\quad p\ u'(W - L + I(policy,\alpha) - Z(policy,\alpha,\beta))\ (I'(policy,\alpha) - Z'(policy,\alpha,\beta)\ -\ (1-p)\ \ u'(W - Z(policy,\alpha,\beta))\ Z'(policy,\alpha,\beta))$$

or

$$(5)\quad \frac{u'(W - L + I(policy,\alpha) - Z(policy,\alpha,\beta))}{u'(W - Z(policy,\alpha,\beta))} = \frac{(1-p)\ Z'(policy,\alpha,\beta)}{p\,(I'(policy,\alpha) - Z'(policy,\alpha,\beta))}$$

Sufficient second order conditions for a maximum are that producers be risk averse i.e., $u'' < 0$ over the relevant domain. Drawing upon the implicit function theorem if the first order conditions are satisfied, equation (5) can be rewritten with the crop insurance policy i.e., choice of the type of insurance product, type of unit, type of coverage, and number of actual yields reported expressed as:

(6) $Policy = f(\alpha, \beta)$

where (α) is the risk factor influencing the choice of crop insurance policy and (β) represents other observable characters.

Equation (6) can be employed to examine the presence of different types of adverse selection expressing individual producer's choice of crop insurance policy as a function of risk (α) -expected loss cost ratio is used as a proxy for farm level risk and other factors (β) -- average farm yields (farm productivity), RMA's county-level base insurance premium rate used as a proxy for differences in county level risk, practice (irrigated versus dryland) dummy, state dummies, year dummies and conditional adverse selection variables. The empirical model examines if RMA's insuree pool is conditionally adversely selected for different types of crop insurance policy. These results have important implications with respect to the RMA's ability to achieve the often-conflicting policy objectives of higher insurance participation, charging actuarially fair premiums, and avoiding excessive loss ratios. Results presented below provide strong evidence that the insured pool is indeed strongly adversely selected.

EMPIRICAL MODEL AND DATA

To examine for the presence of different types of adverse selection, ordered logit and binomial logit discrete choice models are estimated with the producer choice of crop insurance policy --type of insurance product, type of unit, coverage level, and number of actual yields as the dependent variable. The producer choice of the insurance product is

coded as 0,1 for the binomial logit model where 0 corresponds to revenue based crop insurance product, CRC and 1 corresponds to yield based crop insurance product, MPCI. Similarly producer choice of unit type (basic and optional unit) and number of actual yields reported by the producer $(=< 4 \text{ versus } > 4)$, defined as binary choice variable is coded as 0, 1 for the binomial logit model. The producer's choice of coverage (0.325 to 0.75) is modeled as the dependent variable and is coded as 0,1,..., 6 for the ordered logit model where 0 corresponds to the choice of a minimal catastrophic policy, 1 corresponds to 50 percent buyup coverage, etc.

In the following regressions, the individual producer choice of crop insurance policy is modeled as a function of (1) *expected loss cost ratio* (x_1) is defined as the ratio of annual 50% normalized indemnities divided by annual 50% normalized liabilities at the farm level and used as proxy for farm level risk, (2) *fybar* (x_2) defined as the average yield accounting for individual farm productivity, (3) *ctyrate* (x_3) defined as RMA's county-level base insurance premium rate used as a proxy for differences in county level risk, (4) *practice* dummy (D_prac)- irrigated versus dryland, (5) *state* dummy variables (D_states) and (6) *year* dummy for the years 1997 through 2000 (D_year). Other conditional variables included are the insurance product, unit type, buyup coverage election, and number of actual yields reported to account for other types of adverse selection. The general logit model – binary or ordered can be represented as:

$$(7)\ \text{Policy} = \alpha_0 + \sum_{i=1}^{3} \alpha_i x_i + \phi_1 \text{Conditional variables} + \beta_0 \text{D\_prac} + \sum_{j=1}^{15} \beta_i \text{D\_states}_j + \sum_{k=1}^{3} \gamma_k \text{D\_year}_k + \varepsilon$$

Information on each insuree who purchased cotton insurance for the years 1997-2000 was extracted from RMA's yield history and loss history data files[4]. The expected loss cost ratio used as a proxy for farm level risk is computed as the ratio of indemnities received over liabilities. Since the loss cost ratio is expected to increase with increase in coverage, OU compared to BU, CRC compared to MPCI, and less than four actual yields compared to more than four actual yields, we computed the expected indemnities and liability for all the producers as if they have insured at 50% coverage level. This would address the inherent correlation between higher coverage and higher loss cost ratio and the use of normalized loss cost ratio would truly reflect the farm level risk. Average yield computed as the arithmetic mean farm level yield over the last ten years is used to account for the individual farm productivity. RMA's county-level base insurance premium rate used as a proxy for differences in county level risk is computed as the mean of all individual farm level premium rates for 50% coverage within each county.

The number of insured cotton farms, the total acres insured, average farm yield, county rate and the expected loss cost ratio for different crop insurance policies are presented in Table 1. It is evident from Table 1 that the more number of insured producers (farms) elected MPCI, basic unit, buyup 65% election, and more than four actual yields compared to CRC, optional unit, other buyup percent election, and less than four actual yields respectively. Average farm yields reported a similar pattern with higher average farm yields reported by MPCI (629.95 lbs compared to 617.84lbs for CRC), basic unit (965.63 lbs compared to 580.84 lbs for optional unit), buyup 75% election (779.39 lbs compared to 464.75 lbs for 50% election), and more than four actual

yields reported (650.13 lbs compare to 601.73 lbs for less than four actual yields). However higher normalized loss cost ratio was shown by CRC, optional unit, other buyup percent election, and less than four actual yields (0.214, 0.177, 0.228 and 0.155) compared to MPCI, basic unit, buyup 75% election, and more than four actual yields (0.115, 0.070, 0.154 and 0.121).

REGRESSION RESULTS OF ADVERSE SELECTION

Tables 2 present the results of the binomial and ordered logit regression models as estimated using qualitative and limited dependent variable model of SAS[5]. The results of all four discrete choice regression models support the presence of adverse selection as multiple peril crop insurance (MPCI) relative to crop revenue coverage (CRC), more than four reported actual yield relative to less than reported actual yields (optional unit (OU) relative to basic unit (BU), higher buyup coverage levels relative to lower buyup coverage level and catastrophic coverage) are negative (positive) and significantly correlated with higher risk defined as normalized loss cost ratio. This supports the notion of the presence of adverse selection in RMA's pool of cotton producers in U.S. for the years 1997-2000. Average farm yield, a measure of individual farm productivity was negative (positive) and significantly correlated with insurance product and unit type (coverage level and reported actual yields). This demonstrates that high average yielding (irrigated) producers choose CRC, basic unit, lower (higher) coverage level, and report more than four actual yields.

As expected, the signs on conditional variables -insurance product, unit type, coverage level, and number of actual yields reported included were appropriate and correct. For example the sign on the unit type in the insurance product regression is negative and significant indicating the producer with optional units choose CRC insurance product. The same result is demonstrated in the unit type regression model with the sign on the insurance product variable is negative and significant indicating producer with MPCI choose basic unit. Similar and consistent results are demonstrated by other conditional variables.

Analogous to the r-square in linear regression models, McFadden suggested a likelihood ratio index defined as:

$$(8)\quad R^2 = 1 - \frac{\ln L}{\ln L_0}$$

where L is the value of the maximum likelihood function at the maximum and L_0 is a likelihood function when regression coefficients except an intercept term are zero. The McFadden's likelihood ratio index is bound between 0 and 1.

Other goodness-of-fit measures developed by Veall and Zimmermann R^2_{VZ}, and Mckelvey and Zavoina R^2_{MZ} reported in Table 2 are

$$(9)\qquad R^2_{VZ} = \frac{2(\ln L - \ln L_0)}{2(\ln L - \ln L_0) + N} \frac{2\ln L_0 - N}{2\ln L_0}$$

$$(10)\quad R^2_{MZ} = \frac{\sum_{i=1}^{N} (\hat{y}_i - \bar{\hat{y}}_i)^2}{N + \sum_{i=1}^{N} (\hat{y}_i - \bar{\hat{y}}_i)^2}$$

where $\ln L_0$ is computed with null slope parameter values, N is the number of observations, $\hat{y}_i = x_i'\hat{\beta}$ and $\bar{\hat{y}} = \sum_{i=1}^{N} \hat{y}_i / N$.

THE COSTS OF ADVERSE SELECTION IN U.S. COTTON INDUSTY

The results of the regression models support the hypothesis that RMA's insured pool is adversely selected with lower risk producers electing lower crop insurance policy (multiple peril crop insurance, basic unit, lower coverage level, and reporting more than four actual yields) and higher risk producers selecting higher crop insurance policy (crop revenue coverage, optional unit, higher coverage level, and reporting less than four actual yields). In this section we attempt to estimate the costs due to different types of adverse selection over the time period 1997-2000.

To examine the different types of adverse selection costs in US cotton, cotton indemnification information from RMA's loss history data-base was aggregated by the type of insurance (CRC and MPCI), type of unit (BU and OU), type and level of coverage (catastrophic, 50% to 75%) and less than four and more four number of actual yields reported. Table 3 presents summary statistics aggregated over the four-year period. Table 3 lists the number of farms, acreage insured, net acres (acres that received indemnity payments), the actual indemnities and the average 50% normalized loss cost ratio of all producers by the type of insurance, type of unit, type and level of coverage and number of actual yields reported during the period 1997-2000.

The 50% normalized loss cost ratio values in the fifth column were computed as the ratio of total indemnities normalized to 50% over total liabilities normalized to 50%

across all producers in the given category. To estimate the adverse selection cost, we first compute the actual indemnities (column 4). The values in column 5 are computed as the difference in the LCR's of the crop revenue coverage and multiple peril crop insurance, optional unit and basic unit, 75% buyup and 50% buyup coverage, and more than four actual yields and less than four actual yields multiplied by the amount of actual indemnities of the crop revenue coverage, optional unit, 75% buyup coverage, and less than four actual yields respectively. For example the LCR of the CRC was (0.214) while the LCR of the MPCI was (0.115). The actual indemnity of all the producers who choose CRC was $71,172,553. The estimated cost of adverse selection due to type of coverage is thus (0.214-0.115) x $71,172,553 = $32,930,635. Similarly the cost of adverse selection due to type of unit, type and level of coverage and the number of actual yields reported is $359,154,161, $39,326,038 and $73,274,705 respectively in U.S. cotton industry for the period, 1997-2000.

CONCLUSIONS

The results presented in this paper support the hypothesis that RMA's current insuree pool is adversely selected and that producers signal information with respect to their risk by their choice of crop insurance policy. These results have several implications with respect to congressional policy objectives of higher participation, low cost, and equity across producers. One implication is that the effectiveness of using partial subsidies in an attempt to increase participation will be limited and potentially

quite costly if the current practice of charging a common premium price to all producers with similar first and/or second moment of yields is retained. The current practice essentially ignores differences in producer risks. A more effective, efficient, and equitable insurance program requires that a given producer's premium rate must somehow include an adjustment for the level of the producer's risk as signaled by his choice of crop insurance policy and also the risk aversion (which is seldom available). An obvious approach to account for differences in producer risk would be to incorporate information about the producer's past indemnification, choice of crop insurance policy into current rates or incorporate the simultaneously effect of choice of crop insurance policy – type of insurance product, type of and level of coverage, type of unit and number of actual yields reported, and normalized loss cost ratio in the estimation of the rates.

Specifically from the estimation perspective, the choice of type of insurance product and type of and level of coverage needs to be simultaneously estimated. So does the choice of type of unit and number of actual yields reported by the producer. Both reflect the examination of asymmetric information in crop insurance.

REFERENCES:

Akerlof, George A. "The Market of Lemons: Qualitative Uncertaininty and the Market Mechanisms." *Quarterly Journal of Economics.* 113(1970): 79-119.

Atwood, J.A., A.B. Baquet, and M.J. Watts. "Income Protection" Staff Paper 97-9, Montana State University, Department of Agricultural Economics and Economics. 1997.

Atwood, Joseph A., Saleem, Shaik and Myles J. Watts. "An Examination of Adverse Selection in Crop Insurance." *Staff Paper* 2001-2, *Montana State University, Department of Agricultural Economics and Economics*, Dec 2001.

Basu K. "*Analytical Development Economics*". MIT Press, Cambridge, MA, 1997.

Borch K. H. "*Economics of Insurance*". North-Holland, New York, 1990.

Chambers, R.G. "Insurability and Moral Hazard in Agricultural Insurance Markets." *American Journal of Agricultural Economics*. 71(1989): 604-16.

Coble, Keith., T.O. Knight, R.D.Pope, and J.R.Williams. "An Expected Indemnity Approach to the Measurement of Moral Hazard in Crop Insurance." *American Journal of Agricultural Economics*. 79(1997): 216-226.

Coble, K. H., T. O. Knight, R. D. Pope, and J. R.Williams. "Modeling Farm-Level Crop Insurance Demand with Panel Data." *American Journal of Agricultural Economics*. 78(1996): 439-47.

Goodwin, Barry K., A. P. Ker. "Nonparamatric Estimation of Crop Yield Distributions: Implications for Rating Group-Risk Crop Insurance Contracts." *American Journal of Agricultural Economics*. 80(1998): 139-153.

Goodwin, Barry K. "An Empirical Analysis of the Demand for Multiple-Peril Crop Insurance." *American Journal of Agricultural Economics*. 75(1993): 425-34.

Grossman S. and J. Stiglitz J. "On the Impossibility of Informationally Efficient Markets." *American Economic Review.* 70 (1980): 393-408.

Horowitz, J.K., and E. Lichtenberg. "Insurance, Moral Hazard and Chemical Use in Agriculture." *American Journal of Agricultural Economics*. 75(1993): 926-35.

Just, Richard E., and Linda Calvin. "Moral Hazard in U.S. Crop Insurance: An Empirical Investigation." Unpublished manuscript. College Park: University of Maryland, College of Agriculture and Natural Resources, Oct 1993.

Just, Richard E., and Linda Calvin. "Adverse Selection in U.S. Crop Insurance: The Relationship of Farm Characteristics to Premiums." Unpublished manuscript. College Park: University of Maryland, College of Agriculture and Natural Resources, Nov 1995.

Makki, Shiva S., and Agapi Somwaru. "Asymmetric Information in the Market for Yield and Revenue Insurance." *ERS Technical Bulletin* No. 1892, April 2001.

McKelvey, R. M. and W. Zaviona. A Statistical Model for the Analysis of Ordered Level Dependent Variables. *Journal of Mathematical Sociology.* 4 (1975): 103-22.

Myers, Stewart C and Nicholas Majluf. "Corporate Financing and Investment Decisions when Firms have Information that Investors do not have." *Journal of Financial Economics.* 13(1984): 187-221.

Quiggin, J., G. Karagiannis, and J. Stanton. "Crop Insurance and Crop Production: An Empirical Study of Moral Hazard and Adverse Selection." In *Economics of Agricultural Crop Insurance: Theory and Evidence*. Ed. Darrell L. Hueth and Willian H. Furtan. Norwell, MA: Kluwer Academic Publishers, 1994, pp. 253-272.

Skees, J., and M. Reed. "Rate Making for Farm Level Crop Insurance: Implications for Adverse Selection." *American Journal of Agricultural Economics.* 68(1986): 653-659.

Spence, A. M. "Job Market Signalling." *Quarterly Journal of Economics.* 87 (1973): 355-374.

Stiglitz J. "Incentives and Risk Sharing in Sharecropping." *Review of Economic Studies.* 41 (1974): 219-255.

Stiglitz J. and P. Dasgupta. "Differential Taxation, Public Goods and Economics Studies." *Review of Economic Studies.* 38 (1971): 151-174.

Veall, M. R. and K. F. Zimmermann. Pseudo-R2 Measures for some common Limited Dependent Variable Models. *Journal of Economic Surveys.* 10 (1996): 241-59.

Table 1. Summary Statistics of the all US Cotton Producers, 1997-2000

Crop Insurance Policy or Contract	No:of Farms	Insured Acres	Net Acres	MEAN		
				Farm Yield	Ctyrate	LCRatio50
CRC	6,921	1,375,881	633,733	617.84	0.132	0.214
MPCI	217,595	35,498,095	13,197,859	629.95	0.147	0.115
Basic	169,339	24,378,690	6,834,453	695.63	0.117	0.070
Optional	64,189	12,499,311	6,568,200	580.84	0.170	0.177
Catastrophic	81,486	17,219,890	1,814,635	780.65	0.086	0.020
Buyup 50%	41,347	7,738,824	3,871,627	464.75	0.220	0.154
Buyup 55%	6,780	1,416,921	814,345	417.29	0.258	0.193
Buyup 60%	2,465	489,920	243,871	503.12	0.194	0.153
Buyup 65%	114,865	17,953,073	10,696,575	508.47	0.185	0.187
Buyup 70%	6,885	1,511,365	729,677	598.81	0.129	0.176
Buyup 75%	2,674	791,692	498,439	779.39	0.093	0.228
<4 Actual yields	69,330	10,554,207	3,579,261	601.73	0.130	0.155
>=4 Actual yields	201,740	39,185,073	15,970,335	650.13	0.138	0.121

Table 2. Binomial and Ordered Logit Results Examining Types of Adverse Selection, US Cotton States, 1997-200

Parameters	Insurance Product (CRC vs MPCI)		Unit Type (BU vs OU)		Coverage Level (0.325 to 0.75)		Actual Yields (<4 vs >=4)	
	coefficient	**t-ratio**	**coefficient**	**t-ratio**	**coefficient**	**t-ratio**	**coefficient**	**t-ratio**
Intercept	4.856	41.82	-0.990	-9.58	4.919	51.36	-0.045	-0.39
LCRatio50	-0.351	-7.34	0.195	10.68	0.518	32.93	-0.080	-3.85
Fybar	-0.00029	-3.75	-0.00076	-22.78	-0.00032	-11.60	0.002	56.66
Ctyrate	6.349	24.42	1.576	23.48	-1.912	-34.53	1.299	15.79
D_prac (Irrigated=1)	-0.084	-2.21	-1.045	-66.70	0.030	2.26	0.203	12.60
Insurance Product			-0.159	-5.02	-1.465	-48.70	0.125	3.51
Unit type	-0.054	-4.94			0.374	100.29	-0.069	-13.96
Coverage level	-0.505	-45.54	0.348	95.47			0.082	21.38
Actuals	0.099	2.76	-0.186	-12.53	0.283	22.63		
Alabama	0.896	12.22	0.486	16.50	0.932	33.57	-0.827	-25.86
Arizona	1.869	7.32	-0.049	-0.62	-1.763	-27.67	-2.127	-33.29
Arkansas	0.689	5.33	-2.701	-22.96	-4.434	-80.91	-1.050	-33.74
California	1.553	7.85	-1.464	-15.98	-3.010	-56.66	-1.451	-29.00
Florida	-0.953	-7.24	1.581	21.52	-0.976	-15.14	-1.674	-23.70
Georgia	-0.425	-8.90	1.364	59.03	-0.939	-47.28	-2.048	-89.62
Louisiana	0.618	5.57	-1.111	-16.95	-2.869	-80.93	-1.043	-30.74
Missouri	0.472	4.83	-0.346	-6.52	-2.663	-77.28	-0.777	-20.84
Mississippi	0.326	2.20	-2.493	-15.91	-4.297	-61.26	-1.375	-37.03
North Carolina	-0.517	-3.30	-0.501	-5.77	-1.339	-20.84	-1.156	-15.87
New Mexico	0.454	5.57	0.795	22.57	-1.370	-47.41	-1.612	-51.05
Oklahoma	0.214	2.43	-0.361	-8.92	0.790	22.11	-0.060	-1.26
South Carolina	1.233	4.96	0.830	14.13	-2.060	-42.31	-1.718	-34.82
Tennessee	-0.365	-3.26	-0.708	-8.15	-2.747	-58.78	-0.760	-16.14
Virginia	0.854	3.48	0.367	3.73	-1.761	-25.60	-1.847	-26.34
D_98	0.808	12.82	0.060	3.30	-0.405	-27.77	0.075	4.18
D_99	-0.522	-11.88	0.120	7.06	0.304	22.00	0.236	13.63
D_00	-0.457	-10.43	0.231	13.64	0.518	36.77	0.186	10.71
LIMIT2					0.968	181.14		
LIMIT3					1.096	196.32		
LIMIT4					1.142	201.67		
LIMIT5					4.886	325.51		
LIMIT6					6.254	243.46		
R-square								
McFadden's LRI	0.138		0.160		0.178		0.079	
Veall-Zimmermann	0.167		0.291		0.436		0.150	
McKelvey-Zavoina	0.626		0.679		0.734		0.326	

where, MPCI= multiple peril crop insurance, CRC=crop revenue coverage, BU=basic unit, OU=optional unit

Table 3. Conditional Cost due to Types of Adverse Selection in US Cotton Industry, 1997-2000

Crop Insurance Policy or Contract	No:of Farms	Insured Acres	Net Acres	Actual Indemnities	Loss Cost Ratio 50%	Cost of Adverse Selection
CRC	6,921	1,375,881	633,733	71,172,553	0.214	
MPCI	217,595	35,498,095	13,197,859	899,264,588	0.115	**32,930,635**
Basic	169,339	24,378,690	6,834,453	323,664,282	0.070	
Optional	64,189	12,499,311	6,568,200	595,609,620	0.177	**359,154,161**
Catastrophic	81,486	17,219,890	1,814,635	41,321,961	0.020	
Buyup 50%	41,347	7,738,824	3,871,627	188,317,627	0.154	
Buyup 55%	6,780	1,416,921	814,345	45,849,267	0.193	
Buyup 60%	2,465	489,920	243,871	16,386,685	0.153	
Buyup 65%	114,865	17,953,073	10,696,575	816,134,968	0.187	
Buyup 70%	6,885	1,511,365	729,677	90,880,677	0.176	
Buyup 75%	2,674	791,692	498,439	82,146,560	0.228	**39,326,038**
<4 Actual yields	69,330	10,554,207	3,579,261	336,134,198	0.155	
>=4 Actual yields	201,740	39,185,073	15,970,335	1,039,059,960	0.121	**73,274,705**

FOOTNOTES

[1] Definitions of the types of insurance products are based on RMA web page.

[2] In the current data set, MPCI and CRC insurance product accounts for 99% of the crop insurance. Other revenue crop insurance products include Group revenue insurance policy (GRIP) --makes indemnity payments only when the average county revenue for the insured crop falls below the revenue chosen by the farmer. While the adjusted gross revenue (AGR) --insures the revenue of the entire farm rather than an individual crop by guaranteeing a percentage of average gross farm revenue, including a small amount of livestock revenue. The plan uses information from a producer's Schedule F tax forms to calculate the policy revenue guarantee. Crop Revenue Coverage (CRC) --provides revenue protection based on price and yield expectations by paying for losses below the guarantee at the higher of an early-season price or the harvest price. Income Protection (IP) --protects producers against reductions in gross income when either a crop's price or yield declines from early-season expectations. Revenue Assurance (RA) --provides dollar-denominated coverage by the producer selecting a dollar amount of target revenue from a range defined by 65-75 percent of expected revenue.

[3]While this example is a highly simplified two-state model, these results can be generalized to a continuous distribution using methods similar to those presented in Borch.

[4] RMA's database consists of a number of different databases containing information with respect to insurance companies, agents, adjusters, and producers. RMA's yield history data set contains producers' reported historical yields used in establishing an average or "approved" yield at the beginning of the insurance year. RMA's loss history data set records indemnities paid at the end of the insurance year.

[5] Based on as smaller sample size, comparison of parameter estimates of the discrete choice models estimated from LIMDEP, SHAZAM and SAS results in similar values.