Insurance Contracts and the Role of the Selling Agent: Empirical Evidence from Federal Crop Insurance

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Introduction

Over the past two decades crop insurance has evolved from a government program with nearly $1 billion in premiums in 1990 to $8.9 billion in 2009. Crop insurance has become the primary source of government offered risk management for producers, fulfilling a goal set by policy makers, partly in the hopes of reducing ad hoc disaster payments. To induce this growth, the Federal Crop Insurance Corporation (FCIC), who administers the crop insurance program for the Risk Management Agency (RMA), expanded available insurance policies, coverage levels, insured units and, perhaps most importantly, allowed private insurance agents to promote and sell insurance to producers.

The growth in crop insurance participation has been accompanied by increased program complexity. For example, producers in Iowa may choose from over 1,000 different combinations of insurance contracts. With unprecedented numbers of producers selecting from ever more complicated insurance options, the role of private insurance agents has increased. Presumably, the private insurance agents have their own motive, independent of either farmer or government. Hence, the private insurance agents' incentives may guide them to recommend insurance contracts to producers with impacts the FCIC never intended.

Unlike traditional insurance markets, crop insurance is a single-provider market in which the RMA determines the products offered and sets premium rates. No competition exists between agents over insurance products or premiums since all agents sell the same products at the same price (Babcock, 2009). Presumably, agent differentiation is over advice concerning the product mix for each farmer. Independent insurance agents make money by receiving a percentage of the premium paid for each policy from the RMA, and from selling policies with zero or low expected indemnity payments at a premium over polices with a higher expected indemnity to insurance companies.

Given the basic cost plus pricing mechanism, profit-maximizing agents prefer to sell as many policies as possible. Hence, they are happy to write contracts covering marginal production, which, in turn, are more likely to result in indemnity payments. Agents have a secondary objective. If they write contracts which yield no indemnity they can sell these contracts to crop insurance companies for the high prices. Neither the sales maximization nor the minimal indemnity objective may be in the best interests of either the FCIC or producers. Hence, this study focuses on identifying the effects agents have on the return from insurance for the FCIC and producers – a question which should be interesting to policymakers and producers.

Insurance agents operate in specific geographic areas and are typically very knowledgeable about the characteristics of the producer and the land on which the producer operates. Thus, the agent will have much more information than the FCIC about expected indemnities associated with any insurance contract. Since the agent has an incentive to write as many policies as possible, the agent may write contracts the FCIC would prefer not to carry. These contracts are more likely to exhibit higher indemnity payments due to adverse selection issues. Although the FCIC wants to encourage participation, they have no reason to suffer excess loss due to the insurance nemesis of adverse selection.

At the same time, the agents are usually significantly better informed about the characteristics of the insurance contracts than the producers. With all of the available insurance choices (introduction of revenue insurance, expanded coverage levels, expanded insured unit level), rules imposed by the FCIC (such as designation of high risk ground, final planting date, preventative planting provisions), and yearly changes, the complexity of the crop insurance industry may easily overwhelm producers. Increasingly, agricultural producers have come to rely on crop insurance agents to assist them in making insurance contract decisions. Yet, agents have an incentive to write contracts with the highest premium (since agent revenue is a percentage of sales) and lowest likelihood of indemnity payments (since low indemnity insurance can be sold in the insurance resale market) – neither of which may be in the best interest of producers.

Agents return associated with selling their books of business to the highest bidder is a result of "government mandated adverse selection." In the Standard Reinsurance Agreement (SRA) the government allows crop insurance companies to select the level of reinsurance for each insurance contract. More reinsurance means the government provides a larger return to that company, but the company takes on more risk. But in reality, companies "cherry pick" the best insurance contracts (ones with lowest indemnity history) to reinsure at the highest rate. Thus, the chance of these contracts having an indemnity is the lowest. Companies bid premiums to agents with these types of contracts. Agents have the incentive to write contracts with a low probability of indemnity in order to sell at the highest value to insurance companies.

Independent private insurance agents selling crop insurance represents an unusual example of the principal-agent problem. As a middleman, the insurance agent works as a selling agent for the FCIC and as a procurement agent for the agricultural producer. However, there is very little in the relationships between the agent and the two principals to ensure an efficient outcome. No incentives exist for the agent to maximize the combined profits of the agent and one or both of the principals. Additionally, no incentives exist for the agent to sell contracts that share risk optimally. Due to asymmetric information, the situation is a potential field of opportunities for the rational, profit-maximizing agent – with concomitant losses to the producers and decreases in program cost-effectiveness from the FCIC point-of-view.

Asymmetric information often occurs in insurance environments and generates opportunities generally labeled either adverse selection (the insured has greater risk than "underwriter" assumes to be the case) or moral hazard (the insured operates less prudently with insurance than without relative to the underwriter's expectations). The distinction between moral hazard and adverse selection is blurred in the present case, and, moreover, is not relevant. Agricultural producers have previously been shown to profit from crop insurance (Glauber, 2004) by making changes in land cropping patterns (Coble et. al., 1997) or from increasing or decreasing input usage (Goodwin, 1996; Horowitz and Lichtenberg, 1993). Specific contracts have shown evidence of adverse selection (Makki and Somwaru, 2001), as have yields (Skees and Reed, 1986; Roberts, Key, O'Donoghue, 2006). In some cases, these actions have exceeded the bounds of manipulation within the insurance system (always at risk of adverse selection and moral hazard). Previous research has identified patterns of fraud in the U.S. crop insurance industry (Atwood et. al (2006), and Rejesus et. al. (2004)).

While past research has explored producer behavior, to our knowledge, there has been no work on the effects of asymmetric information held by insurance agents. In this paper, we examine whether insurance agents write contracts to serve the interests of the FCIC, agricultural producers, neither or both. We model the agents' behavior in the next section. We then describe the empirical model and data used for the analysis. We then discuss the results. Conclusions and policy recommendations follow.

Insurance Agent Behavior

We assume that insurance agents work to maximize their profits. Agents receive a percentage, α, of the premium, P_i, for each policy written, denoted as i. The agent writes n policies. Agents are independent and can "reinsure" by selling their policies to any insurance company operating in their area. (To avoid confusion, we will label agent sales to farmers as sales, and agent sales of the policies to insurance companies as "resales.") Agents (re)sell the policies to the highest bidding insurance company for price, η_i. The price agents receive from the insurance companies depends on expected policy risk, which is identified by the expected indemnity payment, $E(I)$. Policies with lower expected indemnity payments resell for higher prices.

In order for a specific agent to sell a policy, agricultural producers must believe no better coverage exists at a lower price, which might be recommended by another agent. Therefore, agents must write each contract so that the producer expects the difference between the indemnity and premium for the contract to be greater than the difference they believe they could get from a contract recommended by another agent, A_p. This belief will vary by contract and producer, p. A producer will have only one contract per crop and county, likely encompassing many fields. Therefore, as agents write specific contracts to maximize their profits, their optimization problem can be written as,

(1) $$\underset{i}{Max}\ \pi = \sum_{i=1}^{n} \left[(\alpha P_i) + \eta_i (E(I_i)) \right]$$

$$s.t.\ E(I_i - P_i) \geq A_p \text{ for each } i.$$

Profit maximizing insurance agents faces several different incentives, which may influence the types of contracts written. First, agents want to sell as many policies as possible – or, more exactly, generate the highest possible total premiums, since their revenue is proportionate to premiums. However, in addition to the agents returns based on percentage of the premium, a policy sales creates the opportunity to resell the policy to an insurance company. Hence, agents may sell 'marginal' policies with a high likelihood of an indemnity payment, because more "marginal" land/production is insured. Second, agents prefer policies with higher premium rates. High premium policies generate larger transfers from the RMA to the agent. Therefore, agents may attempt to sell producers higher levels of coverage than needed to cover the risk producers want to insure against. Finally, agents prefer policies with little likelihood of indemnity payments since they can be resold to insurance companies for higher prices than polices with greater risk.

These incentives often lead to different types of contracts. A profit maximizing agent may prefer to write a portfolio of policies containing different combinations of high and low indemnities, and high or low premiums. If agents can sell a policy with a low premium and a small indemnity payment, they may be willing to forego the higher premium in order to profit from the resale. In this case, the agent "wins", while the government and producer may nearly breakeven. A high premium coupled with a low indemnity is the ideal outcome for agents. It is also the traditional best outcome for the primary insurer – in this case the government. However, in this case the producer loses. Agents may seek to write policies with high premiums and high indemnities in situations where the major or only source of income to the agent is the percentage of premium. The government and producer outcome will depend on the relative sizes of the premium and indemnity. Of course, producers prefer policies with low premiums relative to expected indemnities, but these are disliked by the government, and not preferred by agents. In the next section, we provide an empirical model to determine how agents affect the premiums and indemnities faced by producers and the “winners” and “losers” associated with the contracts written by various agents.

Empirical Model, Data, and Analysis to Examine Agent Behavior

Recall that insurance agents hold asymmetric information relative to both producers and government. They have more information about each producer’s characteristics than the FCIC and more knowledge of the FCIC insurance policies than the producers. The agents assist the producers to select a specific insurance contract as they write contracts for the FCIC. The agents know the premiums associated with each contract and the expected indemnity. As stated earlier, the agents face several incentives that may cause the agent to guide a producer to a specific contract with high or low indemnities and high or low premiums. Therefore, the agents influence the overall portfolio -- the premiums, indemnities and indemnity/premium ratio associated with the contracts they write. The empirical model will shed light on who “wins” and who “loses” due to agent influence.

In order to determine if the agents are directing producers to select contracts with systematically higher or lower premiums we examine agent impacts on premiums. We model premiums, P , as a function of the crop year, CY , individual producer characteristics, PC, and agent effects, A. We write the empirical model for premiums as

$$P = Constant + \beta * CY + \lambda * PC + \gamma * A + \varepsilon. \quad (2)$$

We consider premiums as the premium producers actually pay (not including the subsidy paid by the FCIC) divided by the total planted acres. This normalizes the premium to be dollars per acres. The constant is a vector of ones, crop year is a matrix of dummy variables which equal one for September through August of the year and zero otherwise, producer characteristics is a matrix of producer dummy variables which equal one for a specific producer and zero otherwise, and the agent effects is a matrix of dummy variables which equal one for contracts written by a specific agent and zero otherwise. Here, β, λ, γ are parameters to be estimated, and ε represents the error term.

We also want to determine if agents are associated with policies that yield systematically higher or lower indemnity payments. Agents may write contracts for production on "marginal" land in order to receive a portion of the premium, which will result in higher indemnities. Agents may also want to resell the policy to an insurance company for a higher price, which will result in lower indemnities. We model indemnities per acre insured, I, as a function of the same variables as the premium,

$$(3) \qquad I = Constant + \beta * CY + \lambda * PC + \gamma * A + \varepsilon.$$

The parameters and error term will be different between equations.

Finally, in order to understand the extent of the difference between the premiums and indemnities we examine the ratio of indemnities to producer paid premiums, I/P. We assume this ratio is a function of the same variables, and write it as

$$(4) \qquad I/P = Constant + \beta * CY + \lambda * PC + \gamma * A + \varepsilon.$$

Again, the parameters and error term will be unique.

The data we use is at the individual policy level. The summary statistics are given in Table 1. We examine all crop insurance contracts written for corn for grain in Cerro Gordo

County in the northeast part of Iowa during the crop years 2002 – 2009. Over this time period there are 823 producers with a crop insurance policy during at least one of these years. The premiums we examine are the amounts paid by the producers not including the FCIC subsidy. The average per acre premiums nears $24 with a standard deviation of 18.87. The minimum premium is $.53 and the maximum is $112.87. Clearly, there is a large range of premiums paid in this county. Given that corn for grain production in this county is relatively homogeneous, this may suggest that agents are guiding similar producers to different insurance contracts.

The average per acre indemnity paid during our sample period is $9.91 with a relatively large standard deviation of 40.62. Some producers receive no indemnity, while the largest payment was $676.35. Again, there is a wide range of payments and may be evidence of heterogeneous production or insurance contracts.

The loss ratio, indemnity divided by the premium, equals .52 on average. A standard deviation of 2.30 makes it unclear if most producers make more in indemnity payments than they pay in premiums. The maximum ratio over 91 suggests some producers are receiving significantly more than they pay. For policy reasons, the FCIC may be particularly interested in policies where the indemnity far outweighs the premium – that is situations in the “disaster” tail of the distribution.

The contracts we examine are nearly equally distributed between the various crop years. Crop year 2009 has fewer observations because producers utilized the enterprise option unit where they combined previously independently insured units into one large insured unit. Enterprise options have been available for years but in 2009 the RMA significantly changed subsidy rates to incentivize their use.

We examine fourteen different insurance agents who have written thirty or more contracts. We combine the agents with fewer than thirty contracts, and compare the other agents to this group. We perform this comparison because we consider the agents with few contracts to be less likely to engage in opportunistic behavior. Agents with more than 30 contracts represent 55% of the total number of contracts. The range of contracts written by these agents is nearly 1% to 17%, with the most agents writing about 3% of the total contracts.

We also have dummy variables to control for producer effects, but due to the large number of producers, 843 we do not include their parameter estimates in the tables. The number of producer insured fields ranged from a minimum of one through the study period to a maximum of 63.

Because contracts are selected by producer and applied to many fields we do not assume independent and identically distributed (IID) sampling errors within a producer. We do assume IID errors between producers. To account for this sampling structure we cluster on producer which adjusts the variance for within-cluster correlation (Woolridge 2002). We used Stata 10.0 to perform the estimation.

Results

We examine the result describing the effects of various agents on premiums in Table 2 and on indemnities in Table 3. We want to compare the two effects simultaneously in order to identify which incentive, the high premium or low indemnity, may be driving each agent to write policies with these characteristics, if either. We find three positive parameter estimates on premium from agents significant at the 5% level (agents 3, 11, 14). The size of the significant effects ranges from a low of $5.81 per acre to a maximum of $8.21 per acre.   This provides evidence to suggest that some agents guide producers' to select contracts with higher premiums. Of the three agents with significantly higher premiums, none had low indemnities, the outcome where agents can make the most money. These agents seem to be maximizing premium while sacrificing indemnities. With high premiums agents win while the outcome for producers and the government depend upon relationship between indemnity and premium.

We find four significantly negative parameter estimates from agents with respect to indemnities (agents 2, 9, 10, 12). The size of the effect ranged from -$55.87 to -$4.40 per acre. Of the four negatively significant agents on indemnity one had a significantly lower premium and the other three were insignificant. These agents are maximizing the value of their books of business to resell to the highest bidding crop insurance company while sacrificing premium -- a case where the agent wins from selling the policy at a premium, the outcome for producers is unknown, and the outcome for the government is likely to be bad because they are paying higher reinsurance rates. There were four agents with either a significantly negative premium or a significantly high indemnity (agents 5, 6, 7, 8). Agents with this combination may be writing contracts for savvy producers who understand the intricacies of the FCIC options – that is the producer is "outsmarting" the agent, or government, or both. Paying the lowest premium relative to indemnity is what the producer is attempting to achieve. In this case, producers win, agents prefer a different outcome, but settle for the opportunity to write the contract, and the government again loses (more than desired) because they are paying the indemnity to the producer. Two agents (4, 13) did not significantly affect either the premium or the indemnity. We identified no agents who were able to maximize both premium and indemnity. It appears agents face trading off high premiums for low indemnities while keeping their policy holders business.

Table 4 contains results for the impact of agents on the loss ratio. A loss ratio less than one indicates that the producer paid more in premium than received in indemnity. At the 10% significance level two agents (2, 13) had a significantly lower loss ratio. Producers lose in this case as the amount paid becomes larger than the amount received. One agent (7) significantly increases the loss ratio. This is good for producers, but the government loses – it pays more in indemnities than it receives in premiums.

Conclusions

We analyze the effect on crop insurance from the incentives faced by crop insurance agents. Agents make money by selling more insurance "volume" (i.e., total premium). They can also make money by writing contracts with producers with a low probability of receiving an indemnity. Contracts with little chance of indemnification are resold to insurance companies at a premium over contracts with higher chance of indemnification. Our results indicate that 50 % (7 of 14) of the large agents can significantly impact premiums or indemnities, thereby increasing their profits.

Agents win when they can affect premiums. As the sole source primary insurer, the government benefits from additional premium. However, the net outcome for the government depends upon the indemnity relative to premium paid (and to their other policy objectives such as avoiding disaster payments). The final outcome for producers depends upon the resulting indemnity relative to premium paid (and to gains/losses from production). Agents win due to program complexity and their knowledge of the region they work in. In summary, we find some evidence that some agents can use their "middleman" position to increase their net incomes at the expense of the producer and government. This suggests there should be an opportunity to ‘tweak’ the insurance program to improve outcomes for government and/or producers, if policymakers desire.

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Table 1, Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Premium	23.98	18.87	0.53	112.87
Loss Ratio	0.53	2.28	0.00	91.03
Indemnity	9.91	40.62	0.00	676.35
Crop Year 2002	0.15	0.36	0	1
Crop Year 2003	0.14	0.34	0	1
Crop Year 2004	0.12	0.33	0	1
Crop Year 2005	0.12	0.32	0	1
Crop Year 2006	0.12	0.33	0	1
Crop Year 2007	0.13	0.34	0	1
Crop Year 2008	0.13	0.33	0	1
Crop Year 2009	0.08	0.28	0	1
Agent 1*	0.44	0.50	0	1
Agent 2	0.08	0.27	0	1
Agent 3	0.03	0.18	0	1
Agent 4	0.01	0.10	0	1
Agent 5	0.02	0.15	0	1
Agent 6	0.03	0.16	0	1
Agent 7	0.04	0.20	0	1
Agent 8	0.17	0.37	0	1
Agent 9	0.03	0.18	0	1
Agent 10	0.02	0.15	0	1
Agent 11	0.02	0.14	0	1
Agent 12	0.02	0.15	0	1
Agent 13	0.03	0.17	0	1
Agent 14	0.04	0.20	0	1

*Represents all agents with less than 30 insurance contracts.

Table 2, Insurance Agent Effects on the Premium Paid by Producers (Dollars per Acre)[a]

Variable	**Parameter Estimate**	**P-value**
Agent 2	-3.52	0.018
Agent 3	5.85	0.048
Agent 4	-2.23	0.311
Agent 5	-2.02	0.232
Agent 6	-8.37	0.088
Agent 7	-2.20	0.737
Agent 8	-4.43	0.004
Agent 9	-11.74	0.147
Agent 10	-0.46	0.736
Agent 11	8.21	0.004
Agent 12	2.68	0.744
Agent 13	-2.06	0.299
Agent 14	6.25	0.012
Crop Year 2002	-27.31	0.000
Crop Year 2003	-26.21	0.000
Crop Year 2004	-20.72	0.000
Crop Year 2005	-24.20	0.000
Crop Year 2006	-22.27	0.000
Crop Year 2007	-8.59	0.000
Crop Year 2008	6.32	0.000
Constant[b]	41.54	0.000

[a] Producer effects were estimated but suppressed in the output.

[b] Constant includes Crop year 2009 and Agent 1 who is defined as all agents with less than 30 different insured policies.

Table 3, Insurance Agent Effects on the Indemnity Payment (Dollars per Acre)[a]

Variable	**Parameter Estimate**	**P-value**
Agent 2	-4.40	0.051
Agent 3	7.80	0.321
Agent 4	6.53	0.248
Agent 5	5.45	0.097
Agent 6	4.17	0.783
Agent 7	19.11	0.059
Agent 8	3.02	0.271
Agent 9	-55.87	0.000
Agent 10	-16.16	0.081
Agent 11	14.51	0.060
Agent 12	-38.20	0.018
Agent 13	-0.96	0.730
Agent 14	12.81	0.069
Crop Year 2002	3.55	0.082
Crop Year 2003	6.78	0.001
Crop Year 2004	11.02	0.000
Crop Year 2005	4.78	0.011
Crop Year 2006	6.02	0.004
Crop Year 2007	6.27	0.001
Crop Year 2008	62.67	0.000
Constant[b]	-2.15	0.393

[a] Units are in dollars per acre. Producer effects were estimated but suppressed in the output. [b] Constant includes Crop year 2009 and Agent 1 who is defined as all agents with less than 30 different insured policies.

Table 4, Insurance Agent Effects on the Loss Ratio (Dollars per Acre)[a]

Variable	**Parameter Estimate**	**P-value**
Agent 2	-0.34	0.074
Agent 3	-0.12	0.781
Agent 4	-0.25	0.423
Agent 5	0.53	0.171
Agent 6	0.79	0.262
Agent 7	0.76	0.092
Agent 8	0.19	0.208
Agent 9	-0.57	0.473
Agent 10	-0.77	0.143
Agent 11	-0.09	0.838
Agent 12	-0.53	0.527
Agent 13	-0.34	0.066
Agent 14	0.24	0.563
Crop Year 2002	0.05	0.455
Crop Year 2003	0.42	0.001
Crop Year 2004	0.72	0.000
Crop Year 2005	0.10	0.065
Crop Year 2006	0.24	0.002
Crop Year 2007	0.24	0.001
Crop Year 2008	2.65	0.000
Constant[b]	-0.05	0.634

[a] Producer effects were estimated but suppressed in the output.

[b] Constant includes Crop year 2009 and Agent 1 who is defined as all agents with less than 30 different insured policies.