2020

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Received: 3 May 2019 | Revised: 12 January 2020 | Accepted: 24 March 2020

DOI: 10.1111/agec.12576

AGRICULTURAL ECONOMICS
The Journal of the International Association of Agricultural Economists

WILEY

ORIGINAL ARTICLE

The influence of crop insurance agents on coverage choices: The role of agent competition

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NO Data Appendix Available Online, but STATA codes are made available.

A data appendix to replicate the main results is available in the online version of this article. Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting information supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

Funding information
National Institute of Food and Agriculture, Grant/Award Numbers: 1019254, NEB-24-182

[Correction added on May 26, 2020 after first online publication: few math edits were implemented on page 3, 4, 5, 6, 7 and 10]

Abstract

We examine how competition among crop insurance agents affects coverage choice in the federal crop insurance program. Agents may influence producers' insurance decisions to maximize their total compensation. We develop a theoretical model of producer–agent interaction to examine how loss potential, agent compensation mechanisms, and market competition affect the coverage level selected. Using crop insurance unit-level datasets from five states, we find evidence that agent market concentration and agents' market share matter in the insurance coverage decisions of producers but that the economic significance of the influence is relatively small. Agent influence over coverage level, premium, and liability choice is generally positive but inconsistent across states, which may be attributable to differences in loss risk and agent compensation mechanisms.

KEYWORDS

crop insurance agents, federal crop insurance, market power

JEL CLASSIFICATION

Q12, Q13, Q18

1 | INTRODUCTION

The U.S. federal crop insurance program is the primary government provided risk management instrument for farmers, covering over 80% of all U.S. cropland. The United States Department of Agriculture Risk Management Agency (RMA) partners with private insurance companies to deliver the federal crop insurance program through agents who sell policies directly to producers. The government subsidizes producers in the form of premium discounts and reimburses private insurance companies for administrative and operating (A&O) costs. Producer premium subsidies average $5.9 billion per year, and A&O payments average $1.4 billion per year. The government provides further assistance to the industry by offering a cooperative reinsurance agreement that reduces loss exposure for insurance companies (Appel & Borba, 2009).[1] Total program costs average $7.1 billion per year but have been as high as $13.4 billion in a single year (USDA RMA, 2017).

Subsidization of private market players may facilitate rent-seeking behavior—efforts to capture larger shares of tax dollars devoted to the program—especially in the settings of asymmetric information, moral hazard, and adverse selection that typically characterize crop insurance markets (Glauber,2012; Lusk, 2016; Smith, Glauber, & Dismukes, 2016; Wu, Goodwin, & Coble, 2019). Although a considerable amount of work has identified producer rent-seeking behavior in crop insurance (Coble, Knight, Pope, & Williams, 1997; Just, Calvin, & Quiggin, 1999; Makki & Somwaru, 2001; Roberts, Key, & O'Donoghue, 2006; Skees & Reed, 1986; Smith & Goodwin, 1996; Walters, Shumway, Chouinard, & Wandschneider, 2015), little attention has been given to the behavior of other crop insurance participants. Smith et al. (2016) focus on the role of the insurance company and find that the commissions of crop insurance agents are affected by the level of competition among insurance companies. Ker and Ergun (2007) show that insurance companies can use private information in the reinsurance market to generate excess returns, which go uncaptured by the government's premium setting mechanism. Similarly, Coble, Dismukes, and Glauber (2007) show that crop insurance companies take individual policyholder characteristics into account when allocating policies to reinsurance funds—ceding high-risk policies to the government and retaining safe policies for themselves. Rejesus, Little, Lovell, Cross, and Shucking(2004) consider the role of the selling agent and find evidence of collusion between crop insurance agents, producers, and insurance adjusters. Our work extends the crop insurance literature by investigating the potential for selling agents to influence producers' choices of insurance coverage.

The Standard Reinsurance Agreement (SRA) establishes the guidelines under which the government, private insurance companies, and crop insurance agents operate and interact. Authorized private insurance companies sell and service insurance products and share underwriting gains and losses with the Federal Crop Insurance Corporation (FCIC). The government provided A&O reimbursement, calculated as a proportion of total premiums, covers agent commissions, adjustor costs, and regulatory compliance. Insurance companies allocate their total premiums net of A&O subsidies, or "net book premium," between two FCIC reinsurance funds: the Assigned Risk Fund, in which insurance companies cede most of their risk exposure to the government, and the Commercial Fund, where insurance companies retain more risk but enjoy a larger share of any underwriting gains.[2] Crop insurance agents act as intermediaries between farmers and insurance companies by procuring policies from producers and selling their portfolio of contracts, referred to as the book of business, to authorized insurance companies.

Agent compensation is proportional to the total amount of insurance transferred to insurance companies (total premiums), though the percentage of premium transferred (commission rate) may be influenced by the actuarial value of the book of business as determined by underwriting gains or losses (Rejesus et al., 2004; Walters, Chouinard, & Wandschneider, 2010).[3] Hence, the agents' incentives include the maximization of premiums collected from farmers and optimization of the actuarial performance of the policies they sell to insurance companies. We refer to these motivations as the *volume incentive* (premiums collected) and the *quality incentive* (actuarial performance).

The SRA restricts agent behavior in two important ways. First, neither agents nor insurance companies can influence the premium for a given policy type under penalty of being banned from the industry (Pearcy & Smith, 2015). Second, an agent operating in a state must sell any approved policy to a producer that requests it. Agents cannot compete with other agents on the basis of premium price or refuse the business of high-risk farmers (Glauber, 2004). However, agents may pursue rents by writing contracts for insurance products and coverage levels that maximize the agents' total compensation—premium commission (volume incentive) plus book of business value (quality incentive)—which may not maximize producer outcomes. In this context, we define agent rent-seeking as pursuing excess profit by selling coverage that would not be chosen by the producer in the absence of agent influence. This definition of agent rent-seeking does not specifically include the case of collusion between producers and insurance adjusters (Rejesus et al., 2004).

When choosing a crop insurance product, farmers select from a menu of options, including the coverage level, policy type (individual [revenue vs. yield] vs. area protection), unit structure, and price election. Insurance product characteristic combinations can easily number in the hundreds, making many producers reliant on agent expertise (Schnitkey & Sherrick, 2017). Agents with large market shares or few competitors may take advantage of these and other information asymmetries to maximize their compensation. More comprehensive insurance policies carry higher premiums, which

[1] The FCIC's Assigned Risk fund is used for policies identified as undesirable by companies. As a result, all producers, regardless of risk, can be insured.

[2] During the time period used in this study, the Development Fund was also available to insurance companies. The Development Fund offered an intermediate amount of risk sharing with the FCIC.

[3] In practice, final compensation depends upon the intricate rules outlined in the SRA (https://www.rma.usda.gov/pubs/ra/).

increase agent compensation.[4] Alternatively, if an agent expects an insurance customer to suffer large losses, the quality incentive may lead the agent to minimize the insurance company's exposure.

We examine how agent market share and the market concentration of agents influence the crop insurance contract decisions of producers. We model the interaction between a representative crop insurance agent and producer and examine how competition among agents impacts their selling behavior. We hypothesize that the effect of a decrease in agent competition on producers depends on the agent's beliefs about the producer's risk of loss and the agent compensation mechanism, which may vary by region.

We test these hypotheses using crop insurance contract-level data from five states with different growing conditions and crops: Iowa, Nebraska, Oklahoma, Montana, and Washington. For each state, we estimate the relationship between measures of agent market competition (market share and market concentration) and the insurance coverage choices of producers (policy coverage level, premium, and insured liability). Our results reveal small but positive relationships between insurance coverage and both the market share of individual agents and the overall concentration of agents in Iowa, Nebraska, and Montana—suggesting that agents are weakly motivated by the volume incentive. Results are most conclusive in Iowa where soil productivity is the most homogenous and actuarial risk is lowest. We find little empirical evidence to support the existence of a quality incentive for agents. In the following section, we develop a theoretical model describing the interaction between a producer buying a crop insurance policy and a representative selling agent. We then discuss the data and empirical model used in estimation, present results, and summarize our conclusions.

2 | PRODUCER–AGENT INTERACTION

For our analysis, we focus on the producer coverage-level choice as this decision directly influences the amount of liability transfer and therefore potential indemnities and premiums. A risk averse producer i chooses coverage level μ_i to maximize their expected utility from insurance.[5] As μ_i increases, both potential indemnities and producer premiums rise. We assume that producers cannot perfectly observe their optimal choice of insurance coverage, denoted by μ_i^*, and have some knowledge of their individual likelihood of experiencing a production loss. See Online Appendix A for a description of the producer's insurance decision problem.

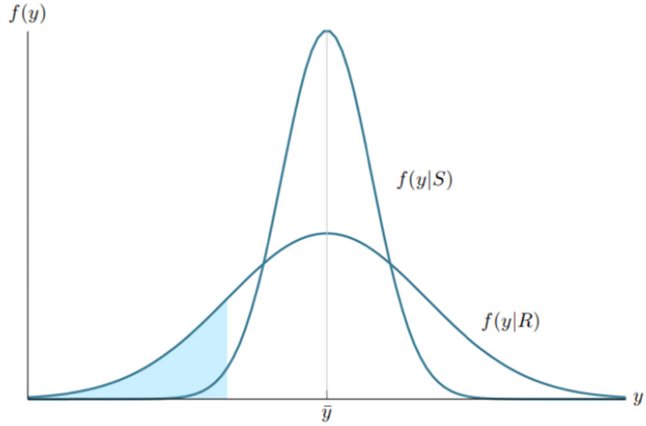

FIGURE 1 Producer loss probability types [Color figure can be viewed at wileyonlinelibrary.com]

The producer imperfectly observes their individual yield distribution $f(y_i)$, where y_i is output (bushels) per acre harvested. Producers estimate their expected production levels for the upcoming crop year and approximate their probability of loss. Although producers cannot perfectly anticipate losses, or exactly calculate their optimal coverage level, they may nevertheless exploit information asymmetries when purchasing crop insurance. Evidence for the existence of adverse selection is found throughout the federal crop insurance literature (Just et al., 1999; Knight & Coble, 1999; Skees & Reed, 1986; Walters et al., 2015). Due to imperfect knowledge, all producers rely on agent expertise to some degree when making crop insurance decisions.

We model producers as having either a high or low probability of loss, defined as actual yield falling below the yield level guaranteed by the insurance policy (coverage-level times average historical yield [i.e. APH]). High-loss probability producers (*risky*) are more likely to suffer a production loss and receive an indemnity payment for any chosen coverage level. The proportion of *risky* producers in the overall producer population is represented by p. High-loss probability *(risky)* and low-loss probability (*safe*) types have cumulative yield distributions $F(y|R)$ and $F(y|S)$, respectively. A *risky* producer and *safe* producer with identical historical average yields, denoted by $\bar{y}$, will differ in their respective likelihoods of loss, where $F(y|R)$ exceeds $F(y|S)$ for all yields below the historical average:

$$F(y|S) \leq F(y|R) \;\forall\; y < \bar{y}. \qquad (1)$$

In this way, $F(y|R)$ can be treated as a mean preserving spread of $F(y|S)$. Figure 1 depicts the two distributions where the *risky* type has the same historical yield average as the *safe* type but a wider variance around the historical average and greater semivariance (i.e., downside risk). Therefore,

[4] Note that the difference in commissions between revenue policies and all other is not linear in percent since the A&O subsidy rate is capped at 18.5% of premium for revenue policies versus 21.9% of premium for all other policies.

[5] We assume the producer maximizes their expected utility from crop insurance as described by Babcock (2012).

the likelihood of loss, or below average crop year, is always greater for the *risky* type than for the *safe* type. The producer's expected utility for a given insurance coverage level and loss probability type is:

$$E\left[U_i\left(\mu_i\right)|Risk\ Type\right]. \tag{2}$$

Prior to any interaction with the insurance agent, producers of either type use their private information to form an approximation of their optimal coverage level μ_i^*. Producer i communicates their approximated optimal coverage level, denoted by μ_i, to a representative crop insurance agent j who then recommends a coverage level μ_{ij} defined as follows:

$$\mu_{ij}\ \left(\mu_i, \alpha_j\right) = \mu_i\ + \alpha_j. \tag{3}$$

The term α_j captures the agent's influence over the producer's coverage choice, which may be positive or negative. The agent's recommendation depends on their beliefs about the producer's risk level and how agents are compensated by insurance companies. Note that, in reality, the value and magnitude of α_j is constrained by the available range of coverage levels, that is, 50–85% in 5% increments.

Crop insurance agents sell policies to maximize the total commission received from the insurance company that acquires the policy. This commission, equal to a commission rate times total premium transferred, can increase in two ways. First, the commission rate (percentage of total premium) may increase as the actuarial quality of the policy improves. Insurance companies may allocate policies between FCIC reinsurance funds in ways that maximize their overall returns (Ker & Ergun, 2007; Ker & McGowan, 2000). Insurance companies are then motivated to collect policies that generate underwriting gains, which can be assigned to the Commercial Fund where they enjoy a larger share of insurance profits. Insurance companies may, therefore, pay higher commission rates for policies perceived to be actuarially profitable. The incentive to maximize the commission rate, what we refer to as the "quality incentive," combined with the inability to turn away producers may lead the agent to recommend a negative α_j to a producer that is likely to suffer a production loss.[6] Reducing the coverage of a *risky* producer reduces exposure to large indemnity payments. Second, the agent can sell a policy with a high premium by convincing the producer to purchase a high coverage policy. The agent will recommend a positive α_j in response to this "volume incentive." If the agent's commission rate is not sensitive to actuarial quality, the volume incentive will be dominant. A full description of the agent's profit maximization problem can be found in Online Appendix B.

[6] Underwriting gains are a function of both premiums and indemnities, so the agent can increase underwriting gains by selling high premium policies. However, in the event of a production loss, indemnities rise faster than premiums as the policy coverage level increases.

The recommendation made by the agent may deviate too far from the producer's original approximation, causing the producer to seek out a different agent. Thus, agent competition may weaken an agent's ability to influence producers. A competing agent k may win over agent j's sale by offering a recommendation closer to the producer's approximated optimal coverage level. We assume that switching agents incurs some nontrivial transactions cost to the producer, such as time spent traveling to meet with new agents and processing paperwork. These costs fall as competition among agents rises—not only because greater choice and availability of agents reduces search costs but also because competition incentivizes agents to expend effort in service of their farmer customers (Pearcy & Smith, 2015). The producer will choose to purchase a policy from a competing agent k carrying coverage level $\mu_{ik} = \mu_i\ + \alpha_k$ if:

$$E\left[U_i\left(\mu_i + \alpha_k\right)\right] - t > E\left[U_i\left(\mu_i + \alpha_j\right)\right], \tag{4}$$

where t represents the transactions cost of switching agents. We denote the probability that the original agent j successfully sells the policy as $V(\alpha_j, t)$, which is increasing in α_j if α_j is negative and decreasing in α_j if α_j is positive. In other words, the probability of losing the sale to a competitor increases as the agent's recommendation deviates further from the producer's original approximation, μ_i, in either direction:

$$V_{\alpha_j}\left(\alpha_j, t\right)\begin{cases} < 0\ if\ \alpha_j > 0 \\ > 0\ if\ \alpha_j < 0. \end{cases} \tag{5}$$

Note that the distribution of $V(\alpha_j, t)$ across values of α_j is not necessarily symmetrical about zero and could depend on the producer's approximation μ_i. That is, there may be a bias toward thrift where producers perceive recommendations to increase coverage more skeptically than recommendations to lower coverage. In this case, $V(-\alpha_j, t) > V(\alpha_j, t)$.

The probability $V(\alpha_j, t)$ is also increasing in t, the cost to the producer of switching agents. A higher t raises the likelihood that the producer will accept the agent's recommendation at all levels of α_j, that is, $V_t(\alpha_j, t) > 0$. For tractability, we assume that the cross-partial derivatives are zero—a change in switching costs shifts the probability that the producer accepts a given recommendation but does not affect the producer's response to a marginal change in α_j.

3 | AGENT PROFIT FUNCTION

To see how a change in the level of competition among agents affects agent influence, we examine the agent's objective function. The agent's expected profit given the producer's approximated coverage level μ_i is:

$$\max_{\alpha_j} \mathbb{E}\left[\Pi_j\left(\alpha_j|\mu_i\right)\right] = V\left(\alpha_j, t\right)\cdot\left\{P\left(R|\mu_i\right)\cdot\mathbb{E}\left[\Pi_j\left(\mu_i+\alpha_j\right)|R\right] + \left(1-P\left(R|\mu_i\right)\right)\cdot\mathbb{E}\left[\Pi_j\left(\mu_i+\alpha_j\right)|S\right]\right\} \tag{6}$$

After producer i communicates μ_i to the agent, the agent chooses a recommendation, $\mu_i+\alpha_j$, to maximize expected profit and economic rents. Producers use private—albeit imperfect—information about their loss potential when approximating their optimal coverage level. Therefore, after observing μ_i, the agent attempts to infer information about the producer's risk profile. The term $P(R|\mu_i)$ is the conditional probability that the producer is a *risky* type with a high probability of incurring a loss given the observed coverage approximation μ_i. If adverse selection is present within the insurance pool, *risky* producers will be more likely to overinsure (approximate a higher coverage level), while *safe* producers will underinsure (approximate a lower coverage level), making the derivative of $P(R|\mu_i)$ with respect to μ_i positive.

The agent's profit from selling a policy with coverage level $\mu_i+\alpha_j$ is expressed as $\Pi_j(\mu_i+\alpha_j)$, which represents the product of the commission rate paid by the insurance company, $c(\cdot)$, and the total policy premium collected, $\rho(\cdot)$.[7] Commission rates act as a form of profit-sharing mechanism, where the insurance company offers a base rate and then allocates a portion of any underwriting gains to agents as a bonus.[8] Commission rates may also depend on the actuarial performance of the agent's individual book of business. These agreements are entered into prior to the crop year and are effective for 2–3 years, providing agents with a reasonable expectation of their compensation under different scenarios.

Because insurance companies only pay commissions at the end of the crop year after underwriting gains or losses have been realized, the commission rate is expressed as an expectation (See Online Appendix B).

$$E\left[\Pi_j\left(\mu_i+\alpha_j\right)\right] = E\left[c\left(\mu_i+\alpha_j\right)\right]\cdot\rho\left(\mu_i+\alpha_j\right). \tag{7}$$

Two forces can influence the agent's commission rate. First, the individual policy may affect the agent's commission by making their book of business more or less attractive to insurance companies. The insurance company may pay a lower commission rate if the producer suffers a loss and the indemnities incurred outweigh the premiums collected, that is, the policy's loss ratio is greater than 1. The second effect is through the agent's contribution to the insurance company's overall underwriting gains or losses. Large loss ratios for any one policy will reduce the probability of exceeding their base commission rate. Potential indemnity payments increase with the elected coverage level, so the change in the agent's expected profit due to an increase in the producer's coverage level, denoted by $\mathbb{E}[\Pi_j'(\cdot)]$, depends on the likelihood of loss and the sensitivity of commission rates to actuarial performance.

The probability that the producer accepts the agent's recommendation, $\mu_i+\alpha_j$, and the agent successfully sells insurance to the producer is $\mathrm{V}(\alpha_j, t)$, while the probability of the producer buying from a competing agent is $1-\mathrm{V}(\alpha_j, t)$.[9] A decline in competition among agents—resulting either from an increase in the individual agent's market share or a reduction in the total number of agents—raises the transactions costs t associated with searching out a new agent. This in turn makes the producer more likely to accept the agent's recommendation, raising $\mathrm{V}(\cdot)$ for all levels of α_j.

Taking the first-order condition of the agent's expected profit function and applying the implicit function theorem, the following comparative static describing the effect of competition on the agent's recommendation emerges:

$$\frac{\partial\alpha_j}{\partial t}\begin{cases} > 0\ if\ P\left(R|\mu_i\right) < \left[1-\frac{\mathbb{E}[\Pi_j'(\cdot)|R]}{\mathbb{E}[\Pi_j'(\cdot)|S]}\right]^{-1} \equiv \Omega\left(\Lambda\right) \\ < 0\ if\ P\left(R|\mu_i\right) > \left[1-\frac{\mathbb{E}[\Pi_j'(\cdot)|R]}{\mathbb{E}[\Pi_j'(\cdot)|S]}\right]^{-1} \equiv \Omega\left(\Lambda\right) \end{cases} \tag{8}$$

where $\Lambda \equiv \frac{\mathbb{E}[\Pi_j'(\cdot)|R]}{\mathbb{E}[\Pi_j'(\cdot)|S]} \le 1$.

The above conditions state that the agent's response to reduced competition depends on two factors: the conditional probability that the producer is a *risky* type, $P(R|\mu_i)$, and the threshold $\Omega(\Lambda)$, which is a function of how agents are compensated by insurance companies. If, given the producer's approximated coverage level μ_i, the probability that the producer is *risky* exceeds $\Omega(\Lambda)$, the agent will attempt to lower the producer's coverage level. Conversely, if $P(R|\mu_i)$ falls below the threshold defined by $\Omega(\Lambda)$, the agent will seek to increase the producer's coverage.

The threshold $\Omega(\Lambda)$ captures the importance of the quality incentive to the agent's compensation. It establishes the tradeoff between increasing the producer's coverage, thereby increasing premiums, and the risk of large indemnities which may affect the agent's commission rate. The term

[7] As stated, the expected profit function is technically an expected revenue function, as we do not include costs to the agent. We assume that selling costs are negligible with respect to the policy coverage outcome and therefore do not influence the agent's selling behavior.

[8] Though capped under the current SRA, profit-sharing agreements during the period of our analysis were often very lucrative for agents (Babcock, 2009).

[9] The full expected profit function shown in Equation (6) would add the term $(1-\mathrm{V}(\alpha_j, t))\cdot 0$ to represent the probability weighted outcome of losing the sale to a competitor and earning a profit of zero.

$\Lambda \equiv \frac{\mathbb{E}[\Pi_j{}'(\cdot)|R]}{\mathbb{E}[\Pi_j{}'(\cdot)|S]}$ is the agent's expected marginal profit from increasing a *risky* producer's coverage level divided by the expected marginal profit from increasing a *safe* producer's coverage level.

If commissions are highly sensitive to actuarial performance, that is, if insurance companies provide a sufficient quality incentive for agents, then increasing the coverage of *risky* types will decrease the agent's expected compensation, while increasing the coverage of *safe* types will boost their expected compensation, making the ratio Λ negative. If agent commissions are not tied to policy performance, that is, only the volume incentive matters, the ratio Λ will be positive and agents will attempt to increase the coverage of all producers regardless of risk type.[10] As the quality incentive becomes more important, Λ becomes a larger negative number and the threshold $\Omega(\Lambda)$ falls. A lower $\Omega(\Lambda)$ means that the likelihood that the producer is a *risky* type must be small for the agent to attempt to increase the producer's chosen coverage level. Therefore, given their conditional belief about the producer's risk type and the insurance company's compensation mechanism, the agent balances the volume and quality incentives to maximize their expected total compensation.

The conditional probability that the agent is selling to a *risky* producer, $P(R|\mu_i)$, likely varies by region. Areas with a high degree of basis risk or regions with a large presence of marginal cropland, such as the arid West, will have a higher presence of *risky* producers and therefore a higher $P(R|\mu_i)$. Homogeneous areas with productive soils and predictable growing conditions, such as the Corn Belt, will have a low $P(R|\mu_i)$. The threshold $\Omega(\Lambda)$ implies that regional differences may influence the relationship between agent competition and agent influence. *Risky* types pose an adverse selection problem to insurers as these producers are more likely to purchase insurance than *safe* producers. The latter, knowing they are less likely to receive a return on their insurance investment, may forgo insurance entirely, provided that a significant premium subsidy does not exist.[11] If the quality incentive is large, the most common outcome of a decline in agent competition will involve the agent recommending lower coverage levels to *risky* producers and higher coverage to *safe* producers.

[10] Note that the ratioΛcannot exceed 1 as we assume the denominator will always be at least as large as the numerator. High coverage policies sold to *safe* producers are at least as attractive to insurance companies as high coverage policies sold to *risky* producers.

[11] In actuality, crop insurance subsidies are high and have risen several times throughout the 1990s and early 2000s to increase participation and reduce adverse selection. However, 100% participation has not been achieved, possibly suggesting the existence of *safe* types.

4 | DATA

Data were obtained from the USDA RMA at the individual crop insurance unit level. Units are separate parcels of land within a producer's landholdings that are insured under individual contracts.[12] Each insured unit has its own production history against which actual yields and revenues are compared to determine if an indemnity payment is triggered.[13] The producer chooses what policy type to purchase and the coverage level which, when multiplied by the number of acres planted, determines the policy premium cost and liability.[14] More comprehensive policies come with higher premiums, lower subsidy rates, and potentially larger liabilities.

For each producer-unit level contract, we observe the insured crop type, crop year, county location, total premiums paid (producer out-of-pocket expense and government subsidy), total dollar amount of liability insured, coverage level, number of acres insured, farm practice used on the unit (e.g., irrigated vs. nonirrigated), whether transitional yields (T-yields) are used to calculate the average yield, the insured's share in any crop-sharing agreement, and indemnities paid. We observe the agent who sold the policy and approved insurance company that ultimately acquires the contract.[15]

The data span selected counties in five states (Iowa, Nebraska, Oklahoma, Montana, and Washington) from 1995 to 2009.[16] Iowa, Oklahoma, and Washington datasets contain counties from across the growing regions in their respective states, while Nebraska and Montana are regionally focused.[17] The counties in Nebraska we observe are like Iowa in terms of land heterogeneity and crop mix (both primarily grow corn and soybeans and have relatively low yield variability) but are more reliant on irrigation. Oklahoma, Montana, and Washington exhibit greater within-county variation in growing conditions compared to the more homogenous states of Iowa and Nebraska (Walters et al., 2015).[18] We restrict the data to the main crops grown in each state (corn and soybeans in

[12] There are four types of crop insurance units: basic, optional, enterprise, and whole farm. Whole farm and enterprise are the largest and most aggregated unit types, while basic and optional units allow for smaller tracts of land to be insured individually.

[13] When insuring enterprise units, an indemnity will be paid on the combined outcome of all units in the enterprise.

[14] Coverage levels range from 50% to 85% in 5% increments. Over time, high coverage "buy-up" policies have become more popular as subsidies for them have risen.

[15] A small number of policies denote multiple selling agents. We drop these as we are unable to award the sale to a unique agent.

[16] The dataset is highly confidential due to the individual farm-level detail. As such, sharing of the dataset has been strictly limited.

[17] Nebraska coverage is limited to five counties in the west, while Montana is limited to four counties in the north-central part of the state.

[18] The dataset used in this paper comes from Walters, Shumway, Chouinard, and Wandschneider (2015). See their work for more details.

Iowa; corn, soybeans, and wheat in Nebraska; corn, soybeans, wheat, sorghum, and cotton in Oklahoma; wheat and barley in Montana and Washington).

We construct two measures to characterize agent market competition: individual agent market shares and a Herfindahl index of overall agent market concentration. We determine each agent's yearly market share by dividing the number of producers who purchase at least one contract from the agent by the total number of producers who purchased a contract within the county that year. Each agent's market share is then:

$$\mathrm{MS}_{jnt} = \frac{\sum_{i=1}^{I} \mathrm{A}_{ijnt}}{\sum_{j=1}^{J}\sum_{i=1}^{I} \mathrm{A}_{ijnt}} . \tag{9}$$

The term A_{ijnt} equals 1, if producer i operating in county n purchases at least one contract from agent j for crop year t. We treat all policies sold to a single producer by a single agent as one sale as opposed to calculating market shares based on the number of individually insured units. Because optional units carry higher premiums, calculating market shares based on units sold may introduce endogeneity into the estimated relationships between agent competition and policy coverage. An agent selling multiple optional units to a single producer will naturally raise both their own market share and policy premiums.[19]

We square and sum the individual market shares across all agents in the same county to create a Herfindahl index of agent market concentration.

$$\mathrm{HI}_{nt} = \sum_{j=1}^{J} \left(\mathrm{MS}_{jnt}\right)^2 \in (0, 1) . \tag{10}$$

The Herfindahl index is normalized to be between zero, denoting perfect competition among agents, and one, representing monopoly by a single seller.

Many of the observed contracts do not identify the agent selling the policy. Missing agents are concentrated to the Nebraska, Oklahoma, Montana, and Washington datasets for which 35%, 41%, 26%, and 39%, respectively, of all contracts do not report an agent. Only 6% of Iowa contracts are missing this information making it the most complete dataset for agent information. Iowa presents the best case for testing for the influence of crop insurance agents and we interpret our results with this in mind. The preponderance of missing agents outside of Iowa raises two important issues. First, contracts with no reported agent may differ systematically from those with an agent. We find that whether the policy paid an indemnity for the year insured is highly correlated with whether the agent is listed.[20] Using only contracts with listed agents could introduce selection bias into estimation results. The second challenge is the construction of individual market shares and Herfindahl indices for agents when not all market information is available. To make use of these missing agent contracts, we would have to assume that agents are randomly left off contracts and each agent stands the same chance of being unobserved for market shares and Herfindahl indices to be accurate and unbiased. This is a strong assumption that is unlikely to hold.

We, therefore, limit our data to only county-years in which more than 90% of contracts report a selling agent. This ensures that any effects of nonrandom missing agents are minimized while maintaining sufficiently large sample sizes.[21] To correct for any selection bias introduced by excluding contracts nonrandomly, we include a dummy variable for whether the policy indemnified the policyholder in our main regressions and perform a Heckman two-step correction model as a robustness check (see Online Appendix C).

After dropping county-years that did not meet the minimum requirement for reporting agents, we have a total of 423,388 observations across all states. Iowa contributes close to half of the total observations. This is due to both the completeness of the Iowa data and favorable agro-climatic conditions, resulting in a high density of farms.

Table 1 displays summary statistics by state. Regional differences in insurance preferences clearly emerge. Total premiums per acre (producer-paid plus subsidies) range from an average of 2 dollars per acre in Washington to almost 9 dollars per acre in Iowa. Insured liability, the amount a policy would pay out in the event of a total loss, is equally variable across states. Iowa stands out as having the highest premiums and insured liabilities per acre. This reflects high crop values, higher chosen coverage levels, and higher APH yields (the historical average yield used to set policy guarantees). Iowa producers appear to prefer more comprehensive coverage. This is consistent with the findings of Du, Hennessy,

[19] This strategy is also the most consistent with our theoretical framework where market competition is modeled as the probability that a single producer receives recommendations from multiple agents. In this way, an agent's market share can be thought of as the percentage of crop insurance customers an agent sells to out of all crop insurance consumers in the market.

[20] The correlation between reported agents and policy losses is generally positive and is likely the result of increased scrutiny placed on policies that incur indemnity payments by reporting agencies. However, we find that selection into our estimation sample (counties with greater than 90% of contracts reporting the agent) and estimated individual market shares are generally negatively correlated with whether the contract reports a loss, that is, agents are not missing-at-random but missing in a way systematically related to measures of market competition. The exception is Oklahoma, where selection into our estimation sample is positively related to policy losses, making its estimation sample more risky than the overall sample.

[21] We change the threshold for missing agent contracts and test the robustness of our results. Results for Iowa—our most complete dataset—are found to be highly robust to changes in this threshold (see Online Appendix C). We still use contracts that do not report the agent for specifications involving Herfindahl indices, subject to the 90% reporting threshold, but models using individual agent market shares drop these observations.

TABLE 1 Summary statistics 1995–2009

Variables	Iowa		Nebraska		Oklahoma		Montana		Washington	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Total premium per acre	8.94	9.53	6.59	4.82	6.80	5.60	3.83	2.81	2.00	2.08
Liability per acre	156.87	103.36	86.67	63.74	43.85	32.25	39.52	26.09	42.55	37.55
Coverage level	0.68	0.09	0.64	0.06	0.62	0.08	0.66	0.07	0.63	0.11
APH	99.29	50.14	68.98	45.29	48.14	87.68	29.39	8.84	52.26	18.63
Acres insured	85.52	89.98	82.95	69.25	113.36	83.19	156.15	158.49	245.47	266.12
T-yield	0.09	0.28	0.65	0.48	0.29	0.45	0.45	0.50	0.72	0.45
T-yield new	0.03	0.17	0.05	0.21	0.04	0.19	0.01	0.12	0.02	0.15
Producer–operator	0.71	0.45	0.64	0.48	0.58	0.49	0.63	0.48	0.47	0.50
Loss	0.04	0.19	0.07	0.25	0.50	0.50	0.21	0.41	0.04	0.20
Indemnity per acre	1.91	18.06	2.34	12.86	29.89	85.24	5.68	17.29	0.93	9.22
Underwriting gains per acre	7.09	16.04	4.34	12.67	–11.74	32.67	–1.28	13.21	1.31	7.21
Agents per county	58.86	31.25	77.79	28.86	30.87	32.58	58.63	19.21	18.49	18.46
Agent market share	0.06	0.07	0.08	0.10	0.13	0.16	0.09	0.10	0.11	0.11
Agent Herfindahl	0.05	0.03	0.07	0.06	0.12	0.10	0.10	0.05	0.11	0.07
Crops										
Corn	0.58	0.49	0.46	0.50	0.04	0.19		_		_
Soybeans	0.42	0.49	0.15	0.36	0.02	0.15		_		_
Wheat	_	_	0.38	0.49	0.81	0.39	0.89	0.31	0.83	0.38
Barley	_	_	_	_	_	_	0.11	0.31	0.17	0.38
Sorghum	_	_	_	_	0.09	0.29	_	_	_	_
Cotton	_	_	_	_	0.04	0.20	_	_	_	_
Counties observed	34		5		53		4		26	
Producers observed	29,638		3,282		14,691		4,213		7,496	
Observations	210,935		34,956		64,525		50,160		62,812	

and Feng (2014), who show that producers growing crops on high-quality land and with advantageous weather conditions are more likely to choose high coverage insurance, though it may also be driven by lower average premium rates per dollar of liability, increasing the demand for comprehensive policies relative to other states.

Agent competition varies moderately from state to state. The Nebraska counties included in our sample have the greatest number of agents with an average of 78 per county. Iowa and Montana have about 59 agents operating per county. An average of 31 agents sell policies in Oklahoma, while 18 agents operate in Washington. Differences in agent location may reflect differences in population densities (both farm and nonfarm) as well as differences in county size. For example, Montana counties have far fewer people per square mile than in Iowa but have a comparable number of crop insurance agents per county—possibly because the typical Montana county covers a much larger land mass. The number of selling agents also varies within states. The boxplots in Figure 2 show that agents per county vary from as few as 1 to over 170 in the case of Iowa. Note that agents per county observed in our dataset do not necessarily imply the number of agents physically located in a county but rather the number of agents reported to have sold at least one policy in each of the observed counties.[22]

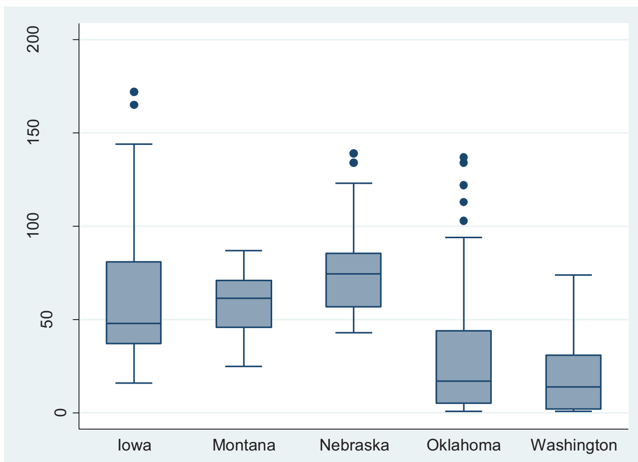

FIGURE 2 Crop insurance agents per county by state [Color figure can be viewed at wileyonlinelibrary.com]

[22] Because we do not observe all counties within each state completely, we cannot fully track an agent's full selling territory nor can we identify an agent's "home county" with certainty.

Agents operating in Iowa have the lowest average market share at 6% per agent. The market concentration Herfindahl index in Iowa is also the lowest of the five states at 0.05. This could be explained in part by the high average premiums paid by Iowa producers. Oklahoma appears to be the least competitive with an average market share and Herfindahl index of 13% and 0.12, respectively. Although total premiums paid in Oklahoma are moderate, persistent underwriting losses could explain the relatively low level of agent competition.[23] All five states are considered unconcentrated by the criteria of the United States Federal Trade Commission.

The five states we observe differ significantly across several dimensions, most notably in terms of land heterogeneity, loss risk, and the potential for underwriting gains. They also represent different reinsurance arrangements between crop insurance companies and the FCIC. The SRA defines three state groups based on overall actuarial risk, which establish the amount of risk that insurance companies can cede to the federal government. Insurance companies operating in group 1 states (including Iowa and Nebraska) bear a larger share of underwriting losses and enjoy a smaller share of underwriting gains than those operating in group 2 states (which include Oklahoma, Montana, and Washington).[24] The inclusion of these states allows us to compare agent relationships in different production settings and under different reinsurance institutions, which may influence the way agents are compensated.

5 | EMPIRICAL MODEL OF THE RELATIONSHIPS BETWEEN AGENT MARKET COMPETITION AND INSURANCE COVERAGE

Our theoretical framework establishes the policy coverage selected by a producer as the sum of the producer's initially estimated optimal coverage choice, μ_i, and the agent's influence factor, α_j, as shown in Equation (3). We update (3) to incorporate determinants of each component, dynamics, and a random (unobserved) error term. A producer i, operating in county n, insures an individual unit s for crop year t.[25] The policy is sold by an agent j who transfers the policy to an insurance company q. The producer's elected coverage is expressed as follows:

$$\mu_{isjqnt} = \mu_{isnt}\ \left(\mathbf{X}_{ist}, \mathbf{\Gamma}_{ist}, \sigma_i, \eta_n, \tau_t, \zeta_{nt}\right) + \alpha_j\left(V_{jnt}, \lambda_q\right) + e_{isjqnt}. \quad (11)$$

We estimate the above for three measures of insurance policy coverage: the policy coverage level, total premium per acre insured, and guaranteed liability per acre insured.[26] Using coverage-level tests for agent influences over a narrowly defined policy choice as modeled in our theoretical framework, while premiums and liabilities may capture other channels of agent influence (e.g., policy type and unit structure).[27] Both premiums and liabilities increase as producers elect more comprehensive insurance plans.

Equation (11) states that producer i's baseline coverage for a unit s, μ_{isnt}, depends on: a vector of time varying unit-producer specific control variables, $\mathbf{X}_{ist}$, including the type of crop insured, acres insured, farm practice (e.g., irrigated vs. nonirrigated), actual production history (APH), use of transitional yields, and whether the insured is a producer–operator or landlord in a crop share agreement;[28] a vector $\mathbf{\Gamma}_{ist}$ capturing the producer's loss risk, measured with an indicator variable for whether the contract triggers an indemnity for the insured crop year[29] and an indicator for whether the producer received an indemnity during the previous crop year;[30] a

[23] Note that due to our selection criteria, the Oklahoma sample is significantly more risky than the overall sample.

[24] A third state group includes several states in the Mountain West and Northeast. Differences in risk sharing across state groups are limited to the Commercial Fund. The Assigned Risk fund defines the same (low) risk sharing arrangement for all states nationwide.

[25] A single producer may purchase multiple contracts in the same year for separately insurable units (i.e., crop–practice combinations). On average, producers in our datasets insure between 3 and 5 individual units per year.

[26] Total premium represents the sum of the producer's out-of-pocket costs and premium subsidies paid by the government.

[27] We use total premium and liability in addition to coverage level as dependent variables because a producer makes several decisions for each insurance unit that are not captured in the coverage level alone (e.g., revenue insurance or unit structure selection). Two different policy types with the same coverage level may differ in premium by tens of dollars per acre. Using coverage level as a single choice variable is the most tractable for modeling purposes but incomplete for empirically estimating the influence of agents.

[28] We identify producer–operators as those with a greater than 50% share in a crop share agreement and those with less than 50% as landlords.

[29] Including current losses raises a reverse causality issue, as higher coverage plans are more likely to trigger indemnities. However, we find that contracts reporting indemnified losses are generally more likely to identify the selling agent, which affects our calculations of agent market shares and agent Herfindahl indices. Specifically, we find that policies with a loss are more likely to report a low-market share agent than policies without a loss, implying that agents are not missing-at-random but missing in a way that is systematically related to measures of agent competition. Therefore, not controlling for contemporaneous losses amounts to an omitted variable that biases the agent competition effects downward. Addressing this omitted variable bias is more important to the variables of interest than avoiding endogeneity in a control variable. The negative omitted variable bias introduced by not controlling for losses is most pronounced in Nebraska, Oklahoma, Montana, and Washington, where a large number of contracts do not report the selling agent.

[30] We identify whether any of a given producer's contracts report an indemnified loss in the previous crop year because the data do not allow us to track the loss history of individually insured units over time.

producer fixed effect, σ_i; unobserved regional characteristics, η_n;[31] unobserved temporal heterogeneity, τ_t; and county-by-year fixed effects, ζ_{nt}, that captures all unobservable local factors that vary over time, such as weather and price shocks.[32]

As shown in Equation (8), agent j's influence over the producer's coverage decision is a function of the level of competition among insurance agents in the area, represented by V_{jnt}. In estimation, we use two measures of agent competition: first, the individual market share of agent j during year t in county n, and second, the Herfindahl index of overall agent market concentration in county n during crop year t. Equation (8) predicts that the direction of the agent's influence depends on the incentives provided by insurance companies. To control for the agent compensation mechanism, we include an indicator variable, λ_q, for the insurance company that acquires the policy.[33]

Assuming the functions in (11) are linear in parameters, we establish the following equation to be estimated via fixed effects regression:

$$\mu_{isjqnt} = \mathbf{X}_{ist}\,\beta + \mathbf{\Gamma}_{ist}\gamma + \phi V_{jnt} + \lambda_q + \sigma_i + \eta_n + \tau_t + \zeta_{nt} + e_{isjqnt}. \qquad (12)$$

The parameter ϕ represents the relationship between the market share of the individual agent or the market concentration of agents and the chosen insurance coverage of producers. The sign and size of $\hat{\phi}$ will vary regionally depending on the risk profile of producers in the area and agent compensation arrangements (see the discussion following Equation 8).

Agent competition within a county is likely influenced by regional production and actuarial characteristics. For example, the number of farms and average farm size in a county may be positively related to the number of agents, while counties with persistently high loss ratios may attract fewer agents. If these regional characteristics are also correlated with producer insurance choices, our measures of agent competition will be endogenous, biasing our estimates of ϕ. We correct for this possibility in two ways. First, the inclusion of region-specific fixed effects control for all time invariant characteristics that may influence the general level of competition among agents within a county. Second, county-by-year fixed effects (district-by-year fixed effects in market concentration models) capture changes in unobservable region-specific characteristics that may invite or dispel crop insurance agents over time.

Note that because individual insurance units cannot be tracked across time in our dataset, individual unit fixed effects cannot be accommodated. Any bias produced by this omission will be negligible in the presence of farm fixed effects as agent market competition variables do not vary across units for a given producer. Nevertheless, we estimate an alternative farm-level specification as a robustness check, finding our results to be largely unchanged (see Online Appendix C).

Because we use three measures of the dependent variable (coverage level, premium cost, and insured liability) and two measures of insurance agent competition (individual agent market share and overall market concentration), we estimate six regressions. To accommodate data size and compare regional outcomes, we estimate regressions separately by state (Iowa, Nebraska, Oklahoma, Montana, and Washington). Regression estimation is performed with STATA's XTREG command, which accommodates both producer fixed effects and clustering of standard errors at the producer level.[34]

6 | RESULTS

We report the estimated relationships between agent market share, agent market concentration, and policy coverage choice in Tables 2–4. Results indicate that individual agent market share is positively related to coverage levels chosen by producers in Iowa, Nebraska, and Montana. In Table 2, the estimated coefficient of 0.08 for Iowa means that a 10-percentage point increase in an agent's market share—roughly one standard deviation—is associated with a 0.008 increase in coverage level on average. Recall that the choice of coverage level is discontinuous in increments of 0.05—an increase that would require a 63-percentage points rise in the selling agent's market share. The relationships between agent market share and coverage level in Nebraska and Montana are similarly small in magnitude. A 10-percentage point increase in the market share of the selling agent is associated with a coverage level increase of 0.002 in Nebraska and 0.005 in Montana. The computed elasticities for Iowa, Nebraska, and Montana are less than 0.01 in all cases.

[31] Although we use producer fixed effects, county fixed effects are included because a small number of producers insure fields in multiple counties.

[32] County-by-year fixed effects are especially important in specifications, where the dependent variable is premiums as the USDA RMA sets premiums by county and year to reflect local risk conditions. In models, where the agent Herfindahl index is the independent variable measuring competition, we replace county-by-year fixed effects with crop reporting district-by-year fixed effects as the Herfindahl index is calculated at the county-year level.

[33] The dataset uses anonymous codes for insurance companies, preventing us from identifying individual AIPs or their characteristics. More AIP codes appear in the datasets than companies approved to operate in each state (typically 10–15)—likely the result of miscoding. To correct for this, we use fixed effects for insurance companies with 1,000 or more policies (5,000 or more in Oklahoma) for all years observed and grouping together AIP codes below the threshold into one group. This produces the generally expected number of AIPs. Results are robust to using fixed effects for each (ungrouped) AIP code.

[34] Our results for Iowa are robust to clustering at higher levels of aggregation, such as the county and crop reporting district levels.

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TABLE 2 The influence of the selling agent on crop insurance coverage level

	Dependent variable: policy coverage level									
	Iowa		Nebraska		Oklahoma		Montana		Washington	
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
APH	−0.00	−0.00	0.00***	0.00***	0.00***	0.00***	0.00*	0.00*	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Acres (100s of acres)	−0.00***	−0.00***	−0.00***	−0.00***	−0.00	−0.00*	−0.00***	−0.00***	−0.00**	−0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
T-yield	−0.02***	−0.02***	−0.00*	−0.00**	0.00*	0.00**	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
T-yield new	−0.00	−0.00	0.00	0.00	0.01***	0.01***	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Producer–operator	−0.00	−0.00	0.00	0.00	0.01***	0.01***	0.00	0.00	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Loss lag	0.01***	0.01***	0.00***	0.00***	0.01***	0.01***	0.00*	0.00**	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Loss	0.02***	0.02***	0.01***	0.00**	0.01***	0.01***	0.00***	0.00***	0.03***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Agent market share	0.08***		0.02**		−0.01		0.05***		−0.02	
	(0.01)		(0.01)		(0.01)		(0.02)		(0.01)	
Agent market concentration		0.17***		−0.12		0.00		−0.18**		−0.16**
		(0.04)		(0.11)		(0.02)		(0.08)		(0.07)
Policy characteristics	Yes		Yes		Yes		Yes		Yes	
Producer FE	Yes		Yes		Yes		Yes		Yes	
Insurance company FE	Yes		Yes		Yes		Yes		Yes	
County FE	Yes		Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes		Yes	
County by year FE[a]	Yes		Yes		Yes		Yes		Yes	
Observations	185,871	190,430	33,530	34,956	60,778	64,410	40,576	41,359	61,919	62,807
Producers	23,939	24,157	3,146	3,282	13,895	14,968	3,916	3,977	7,355	7,439
Within panel R^2	0.28	0.27	0.16	0.16	0.07	0.06	0.12	0.12	0.13	0.12

Notes: *** $p < .01$, ** $p < .05$, * $p < .1$. Errors corrected for clustering at the producer level in parentheses.

[a]District by year fixed effects are used for regressions (2), (4), (6), (8), and (10) as the agent market concentration variable is the same for all observations within the same county-year.

TABLE 3 The influence of the selling agent on crop insurance premiums

	Dependent variable: total premium per acre insured									
	Iowa		Nebraska		Oklahoma		Montana		Washington	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
APH	0.00**	0.00**	0.01***	0.01***	−0.00**	−0.00***	0.03***	0.03***	−0.01***	−0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Acres (100s of acres)	−0.53***	−0.52***	−0.50***	−0.49***	−0.14***	−0.15***	−0.05***	−0.05***	−0.02***	−0.02***
	(0.07)	(0.07)	(0.05)	(0.05)	(0.02)	(0.02)	(0.01)	(0.01)	(0.00)	(0.00)
T-yield	−0.52***	−0.53***	−0.17***	−0.19***	−0.01	−0.01	−0.02	−0.01	−0.14***	−0.13***
	(0.05)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	(0.02)	(0.02)	(0.02)	(0.02)
T-yield new	−0.40***	−0.40***	0.37**	0.41**	0.53***	0.51***	−0.05	−0.07	0.15	0.17*
	(0.08)	(0.08)	(0.18)	(0.17)	(0.16)	(0.16)	(0.10)	(0.09)	(0.10)	(0.10)
Producer–operator	2.97***	2.96***	3.42***	3.43***	4.11***	4.06***	2.67***	2.68***	2.17***	2.18***
	(0.05)	(0.05)	(0.13)	(0.13)	(0.12)	(0.12)	(0.13)	(0.13)	(0.08)	(0.08)
Loss lag	0.41***	0.48***	0.24***	0.23**	0.14	0.13	0.06	0.08**	0.17***	0.21***
	(0.06)	(0.06)	(0.09)	(0.09)	(0.14)	(0.14)	(0.04)	(0.04)	(0.04)	(0.04)
Loss	1.07***	0.91***	0.20*	0.11	0.85***	0.82***	0.27***	0.21***	0.64***	0.67***
	(0.08)	(0.07)	(0.11)	(0.09)	(0.07)	(0.07)	(0.04)	(0.04)	(0.06)	(0.05)
Agent market share	3.93***		0.97*		0.18		1.15***		−0.14	
	(0.64)		(0.56)		(0.35)		(0.42)		(0.22)	
Agent market concentration		9.40***		5.49		−0.34		−3.64		−1.93
		(1.82)		(5.39)		(0.77)		(2.51)		(1.20)
Policy characteristics	Yes		Yes		Yes		Yes		Yes	
Producer FE	Yes		Yes		Yes		Yes		Yes	
Insurance company FE	Yes		Yes		Yes		Yes		Yes	
County FE	Yes		Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes		Yes	
County by year FE[a]	Yes		Yes		Yes		Yes		Yes	
Observations	185,871	190,430	33,530	34,956	60,778	64,410	40,576	41,359	61,919	62,807
Producers	23,939	24,157	3,146	3,282	13,895	14,968	3,916	3,977	7,355	7,439
Within panel R^2	0.44	0.43	0.34	0.33	0.33	0.33	0.20	0.19	0.18	0.17

Notes: *** $p < .01$, ** $p < .05$, * $p < .1$. Errors corrected for clustering at the producer level in parentheses.

[a]District by year fixed effects are used for regressions (2), (4), (6), (8), and (10) as the agent market concentration variable is the same for all observations within the same county-year.

TABLE 4 The influence of the selling agent on crop insurance liability

Variables	Dependent variable: liability per acre insured									
	Iowa		Nebraska		Oklahoma		Montana		Washington	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
APH	1.02***	1.02***	1.12***	1.12***	0.07***	0.07***	1.26***	1.26***	0.80***	0.80***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.00)	(0.00)	(0.07)	(0.07)	(0.02)	(0.02)
Acres (100s of acres)	−9.47***	−9.41***	−5.82***	−5.72***	−0.46***	−0.47***	−0.41***	−0.40***	−0.29***	−0.30***
	(1.23)	(1.19)	(0.61)	(0.59)	(0.12)	(0.12)	(0.08)	(0.07)	(0.06)	(0.06)
T-yield	−12.03***	−12.04***	−1.12*	−1.27**	−1.11***	−1.15***	0.37	0.43	0.54*	0.57**
	(0.66)	(0.64)	(0.58)	(0.58)	(0.33)	(0.32)	(0.30)	(0.29)	(0.28)	(0.28)
T-yield new	−5.92***	−6.04***	−0.55	−0.34	3.76***	4.03***	0.85	0.85	1.83	2.00
	(1.05)	(1.05)	(1.28)	(1.24)	(0.99)	(0.98)	(0.79)	(0.76)	(1.34)	(1.34)
Producer–operator	60.13***	59.93***	46.28***	45.96***	27.39***	27.35***	28.98***	28.98***	45.89***	46.02***
	(0.88)	(0.87)	(1.67)	(1.66)	(0.68)	(0.66)	(1.21)	(1.20)	(1.30)	(1.30)
Loss lag	0.76	0.70	0.07	0.06	−1.09*	−1.07*	0.08	0.13	0.89**	1.12***
	(0.57)	(0.57)	(0.62)	(0.60)	(0.66)	(0.61)	(0.27)	(0.26)	(0.41)	(0.40)
Loss	9.09***	7.93***	1.43	0.79	2.97***	3.61***	0.84***	0.59**	5.93***	5.94***
	(0.72)	(0.62)	(0.92)	(0.77)	(0.37)	(0.35)	(0.29)	(0.24)	(0.68)	(0.54)
Agent market share	37.40***		4.68		−1.14		6.03**		−1.87	
	(7.32)		(4.47)		(1.52)		(2.54)		(3.11)	
Agent market concentration		94.29***		217.67***		−6.01		3.62		−5.39
		(20.47)		(42.38)		(3.78)		(15.50)		(11.63)
Policy characteristics	Yes		Yes		Yes		Yes		Yes	
Producer FE	Yes		Yes		Yes		Yes		Yes	
Insurance company FE	Yes		Yes		Yes		Yes		Yes	
County FE	Yes		Yes		Yes		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes		Yes	
County by year FE[a]	Yes		Yes		Yes		Yes		Yes	
Observations	185,871	190,430	33,530	34,956	60,778	64,410	40,576	41,359	61,919	62,807
Producers	23,939	24,157	3,146	3,282	13,895	14,968	3,916	3,977	7,355	7,439
Within panel R^2	0.46	0.45	0.61	0.61	0.41	0.41	0.59	0.59	0.48	0.48

Notes: *** $p < .01$, ** $p < .05$, * $p < .1$. Errors corrected for clustering at the producer level in parentheses.

[a]District by year fixed effects are used for regressions (2), (4), (6), (8), and (10) as the agent market concentration variable is the same for all observations within the same county-year.

Overall agent market concentration and coverage levels are positively related in Iowa but negatively related in Montana and Washington. A 1% increase in the agent Herfindahl index raises coverage levels by 0.01% in Iowa and reduces coverage levels by 0.03% in both Montana and Washington. Table 2 results for Montana imply a positive relationship between individual agent market share and coverage levels but a negative relationship between agent market concentration and coverage levels. This seemingly contradictory result implies that agents in Montana have two different motivations regarding producers' coverage-level choice. However, the negative result for agent concentration in Montana is limited to policy coverage levels, while agent market share is positively associated with total premiums and liability insured. Therefore, the volume incentive for agents is more apparent in Montana than the quality incentive.

The influence of agent competition on contract premiums is presented in Table 3. Premiums appear to be positively influenced by the agent's market share in Iowa where a 10-percentage point increase in market share raises policy premiums by an average of \$0.39 per acre—a 4% change for the typical Iowa farm. Small but statistically significant estimates are also identified in Nebraska and Montana. The same 10-percentage point increase in agent market share is associated with a \$0.10 per acre increase in premiums for Nebraska producers (1.5% for the average farm) and a \$0.12 per acre increase in premiums for Montana producers (3% increase for the average farm). In terms of total farm premiums, our estimates suggest that a typical Iowa farm pays \$87 more in premium when their agent's market share rises by 10-percentage points, a modest increase given total farm premiums in our sample average nearly \$2,000 per year. Even a shift in market share from the 5th to the 95th percentile (a 22-percentage point change) is only associated with an increase of \$190.75, or 10% for the average operation in Iowa.[35]

We find a positive link between agent market concentration and premium choice in Iowa. A 1% increase in the county-level Herfindahl index is associated with a 0.06% increase in total premiums per acre insured. Again, the relationship may be more useful in terms of whole farm expense. Total farm premiums are \$234 (12% on average) higher at the 95th percentile of the Herfindahl index than at the 5th percentile. The sign on the agent market concentration variable is negative in wheat-producing states (Oklahoma, Montana, and Washington) though none are statistically significant at the 10% level.

Table 4 reports the estimated relationships between agent competition and producer liability. Again, Iowa demonstrates the strongest relationship between agent competition measures and coverage choice. The coefficient of 37.40 translates to an elasticity of 0.01. When buying a policy from an agent at the 95th percentile for market share, producers in Iowa insure \$20.93 more per acre than when purchasing from an agent at the 5th percentile. For the average Iowa farm, this represents an increase of \$4,618 (13%) in the total amount insured by the operation. The estimated relationship between contract liability and agent market share is also positive and statistically significant in Montana at 6.03. Though smaller, the coefficient translates to an elasticity equal to that of Iowa (0.01) due to the relatively low average liability insured by Montana producers.

Table 4 suggests that greater market concentration among agents is associated with higher insured liability in Iowa and Nebraska. In Iowa, a 1% increase in the agent Herfindahl index raises average liabilities insured per acre by 0.03%. The relationship becomes significantly larger in Nebraska. There, the estimated coefficient of 217.67 suggests that liabilities rise by 0.18% for every 1% increase in the agent Herfindahl index. For the average Nebraska farm, a one standard deviation increase in the concentration of agents is associated with a nearly 15% rise in the total dollar amount insured by the operation. The estimated coefficients for both agent market share and agent market concentration are negative in Oklahoma and Washington, though none rises to the level of statistical significance.

Though small in magnitude, the overall direction of our estimates lends support to the existence of a volume incentive for crop insurance agents. The results in Iowa in particular are positive and statistically significant across all models. Crop insurance agents in Iowa with large market shares or in uncompetitive markets attempt to increase the premiums chosen by all producers, regardless of their loss risk, though their ability to do so on a large scale appears limited. Results from Montana and Washington provide some support to the hypothesis that agent market concentration acts to reduce the coverage level chosen by producers. However, consistent evidence that agents are motivated by a quality incentive is weak. A quality incentive would be most likely to emerge in Oklahoma where loss risk is the highest—half of all contracts in the Oklahoma sample report a loss and indemnities average nearly \$30 per acre.

We apply several robustness checks to our main results shown in Tables 2–4, including agent fixed effects, sample selection correction, and farm-level estimation (see Online Appendix C). The main findings for Iowa are consistent and robust to multiple specifications, implying a causal relationship between agent competition and policy coverage choices in that state. However, results for Nebraska, Montana, and Washington appear to be sensitive to our empirical approach. Consequently, we cannot confidently interpret the relationships estimated in these states as direct causal links. Rather, these associations may reflect the effects of unobserved agent characteristics, for example, affiliation with a large,

[35] We compute percentage changes at the farm level by multiplying the change in per acre premiums by the average number of acres insured per farm in Iowa (220.62) and dividing by average farm-level premiums (\$1,972).

established agency or years of selling experience, that correlate with measures of agent competition. Nevertheless, our results lead us to reject the null hypothesis that agents with market power exert no influence over the crop insurance decisions of their farmer customers.

7 | DISCUSSION AND IMPLICATIONS

Given the "rules of the game" stipulated in the SRA, crop insurance agents may pursue one of two incentives: maximizing total premiums (volume incentive) or contributing to the actuarial gains of insurance companies (quality incentive). We explore how agents respond to these incentives in the presence of market power. Using a comprehensive, unit-level dataset spanning five states, we test the impact of agent market share and agent market concentration on the coverage choices of producers. We hypothesize that market competition affects an agent's ability to influence the insurance decisions of producers and that the direction of the effect depends on the producer's risk level and the importance of the quality incentive for agents.

In general, we find that both agent market share and market concentration are associated with higher coverage levels, policy premiums, and insured liability but the economic magnitude of these effects are small, suggesting limited market influence by agents. Small positive relationships between insurance coverage and agent market shares and concentrations point to the existence of a weak volume incentive for insurance agents. Evidence that agents distinguish between high- and low-risk producers, and therefore that the quality incentive matters for agents, is limited and not consistent across locations.

Iowa demonstrates the clearest relationship between agent competition and producer insurance decisions. This is likely a result of two factors. First, Iowa is the most homogenous of the states observed in terms of crop mix and land quality. As a result, losses are infrequent and the opportunity for adverse selection is limited. Agents with market influence operating in Iowa may safely pursue a strategy of increasing producers' coverage without fear of transferring losses to insurance companies. In states with substantial land and climate heterogeneity, such as Oklahoma, Montana, and Washington, agents may attempt to influence producers on a case-by-case basis according to the producer's individual risk profile. Clear relationships between agent competition measures and insurance coverage are unlikely to emerge in such cases. Second, our Iowa dataset is the most complete of the five states observed. The lack of conclusive evidence found outside of Iowa may be driven in part by measurement error. Further analysis with more comprehensive data should be pursued.

The relative power of crop insurance agents to crop insurance companies may partially explain the weak influence of agents over producers found in this paper. Agents—particularly those with loyal customers—can shop around their books of business to insurance companies that attract agents with profit-sharing agreements. Given that insurance companies' underwriting gains or losses are calculated at the state level, as well as the reinsurance channels and A&O cost-reimbursements made available to crop insurance companies, the actuarial performance of any one agent's book of business may not be a significant factor in their compensation. Moreover, production shocks, such as drought or excess precipitation, are typically experienced on a large scale. Variation in risk between agents' books of business in a single time period will be less important than year-to-year variation in a company's statewide underwriting gains.

In such an environment, agents will have little incentive to influence the policy decisions of producers. Rather, they may simply try to maximize the number of farmer customers in their book of business by providing better service. The marginal benefit of increasing a given producer's chosen coverage level is likely outweighed by the benefits of signing up a new client—especially if the new client remains loyal to the agent, ensuing a guaranteed revenue stream over multiple years. Our theoretical model predicts that the influence agents wield over producers is constrained by transaction costs associated with switching agents. If true, our results imply that search costs are generally low and agents' time is better spent attracting new clients than attempting (and potentially failing) to upsell their existing clients. Moreover, agents may become captured by their farmer customers, selling policies that maximize producers' net return on insurance over time. The presence of these "farmer-friendly" agents could limit the market power of crop insurance agents more broadly.

Our analysis does not test for agent influence on the extensive margin, that is, efforts to gain market share. Instead, our results suggest that the ability of crop insurance agents to influence producers on the intensive (policy coverage decision) margin depends to a limited extent on the level of competition among agents. Agents operating in highly competitive markets could be under greater pressure to sell coverage that satisfies producers' ex-ante preferences for fear of losing clients. This may raise producer welfare but may not benefit insurance companies or the taxpayers that reinsure them.

Although agent commission rates grew only slightly throughout the 2000s, total commission payments per policy more than tripled from 2001 to 2008 due to increased subsidization of high premium policies (Babcock, 2009). This suggests that maximizing premium volume has been the primary motivation for agents—though this can be hard to identify as farmers insured more during this period as familiarity with the program grew and subsidies rose. In response to excessive agent commission payments, the 2010 SRA capped commission rates at 80% of a company's A&O reimbursement if the company suffers underwriting losses for the crop year. Companies that achieve underwriting gains can pay up to 100% of their A&O reimbursement to agents as a profit share reward. Policymakers could further modify the SRA to tie commission rates directly to loss ratios (claims paid relative to premiums collected) on a policy-by-policy basis. This would align the incentives of agents with those of insurance companies and taxpayers but may leave certain producers underinsured. Alternatively, total commissions could be capped at a set dollar amount per policy to protect the interests of producers.

The policy implications drawn from our findings can be summarized as follows: the influence of crop insurance agents over the decisions of producers is driven both by the incentives provided by insurance companies and policymakers and in small part by the level of competition among agents. Policymakers wishing to improve the performance of the federal crop insurance program for various stakeholders should consider both forces.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: DeLay ND, Chouinard HH, Walters CG, Wandschneider PR. The influence of crop insurance agents on coverage choices: The role of agent competition. *Agricultural Economics*. 2020;51:623–638. https://doi.org/10.1111/agec.12576