Frontier studies in agricultural insurance

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Agricultural production is considered important in both developed and developing countries for its roles in food provision and rural employment. In a risky sector such as agriculture, insurance is the most effective risk mitigation tool widely available throughout the world and heavily subsidised by governments. The global agricultural insurance market is worth about USD 30 billion (AMR 2019). Agricultural insurance is also an active area of research, especially when new types of insurance mechanisms are being developed, when new crops, livestock and other natural resource products are being included, and also when new policies are being created to support it. This special issue of *The Geneva Papers on Risk and Insurance* is devoted to the topic of agricultural risks and insurance.

The nine papers in this special issue cover major grain crops, livestock, rangeland and forage, and forests, with cases from Asian, American and European countries. The methods used range from optimisation calibrated with published parameters, survey-based willingness-to-pay estimation and econometric analysis using field experiment data to actual market data. A brief overview of the papers is provided here.

Five papers focus on the demand for agricultural insurance. Although subsidised, producers are still influenced by many factors in their decision to participate, in the type and amount of coverage and how much they are willing to pay for them. Yi, Bryant and Richardson conduct an empirical analysis of the U.S. Federal Crop Insurance Program. Using per acre liability to measure demand, they estimate the elasticity of premium subsidies for corn insurance throughout the major U.S. corn producing regions. They find that demand is in general inelastic, with elasticity magnitudes

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smaller than 1. They also find evidence of extensive heterogeneity across regions, insurance types, and coverage levels; for example, their results indicate that farmers in higher risk regions are more sensitive to premium subsidies. These results provide new policy implications for the government when setting subsidy rates.

Goodrich, Yu and Vandever study rainfall index insurance, targeting pasture, rangeland and forage for U.S. livestock producers in Nebraska and Kansas. They use cluster analysis on actual insurance purchasing data to categorise insured farmers into similar groups, and their results show that, over time, proportionately more people with low risk aversion levels entered the Rainfall Index insurance programme. Compared to regular crop insurance that is based on a one-crop cycle often over several months, the Rainfall Index insurance unit period is 2 months and it can be bought all year round. The authors find that the large portions of premium subsidies and indemnities are paid in the non-growing season and that the insurance returns are higher during this season than during the growing season, which implies that the risk is also higher during this period.

Economic theories have shown that factors influencing insurance demand are the aforementioned subsidy levels, risk attitude and overall risk levels. However, these are not the only factors. Che, Feng and Hennessey use spatio-temporal models to identify another factor, the recent adverse risk realisation, which can influence insurance participation both directly and indirectly through the indemnity payouts. Many empirical studies show that insurance buyers are influenced by recent payments; however, the authors are the first to innovatively develop a theoretical model to include this factor in the insurance decision-making process. They use actual observed data and both parametric and non-parametric methods to estimate the direct and indirect effects, and they again find that participation increases most in the year when a high loss and a high indemnity occurred right before it.

Hypothetical experiments are often used to study demand for proposed insurance and/or insurance features that are not available in the market. Wang, Liu, Ortega, Jiang and Zheng examine Chinese farmers' demand for alternative types of crop insurance and higher coverage of such insurance than is currently available. As an emerging economy, their relatively new and heavily subsidised crop insurance programme has very low coverage options. Using labelled choice experiments, they survey corn growers and find that similar portions of farmers prefer yield and revenue insurance, followed by smaller portions preferring price-based and index-based insurance. Farmers are also willing to pay for higher coverage, but the current high level of subsidy is essential. The authors also find that the previous years' losses and indemnity experience influence current decisions.

Similarly, a hypothetical contingent valuation method is applied by Brunette, Couture, Foncel and Garcia to fire insurance in surveying French forest owners. Using the willingness-to-pay from the hypothetical survey, they estimate factors affecting demand for forest insurance. They also observe the actual insurance enrolment status for the same survey respondents and find that those who buy the insurance tend to show higher willingness-to-pay. Other interesting factors, including weather risks and ambiguity, tend to increase willingness-to-pay.

Another area of agricultural insurance study is the buyers' moral hazard behaviour, an action to claim more indemnity when insured than their normal

production practice would suggest. Two of the papers in this issue are devoted to this topic. Rao and Zhang conduct a two-year field experiment among Chinese hog farmers to investigate the effects of a government-subsidised insurance programme on production. Using an approach combining propensity score matching with difference-in-difference estimation, they find that the hog mortality rate is higher with insurance, but they note a positive externality in that farmers are more willing to report hog diseases. This, in turn, improves the government's ability to monitor animal epidemics.

In the second moral hazard paper, Park, Goodwin, Zheng and Rejesus study anomalous insurance claims among U.S. crop growers associated with contract elements and crop growing conditions. Using various econometric approaches, they find that the ability to insure individual fields, coverage level choice and total acres insured could affect such anomalous claims. Further, extreme weather occurrence and unfavourable economic conditions also lead to an increase in anomalous claims.

Two papers are in their own separate categories. Li, Shen, Harri, and Coble compare survey-based crop yield data from the National Agricultural Statistics Service and actual insurance reported yield data from the Risk Management Agency, both of which are agencies under the U.S. Department of Agriculture. They compare corn, soybean and wheat yields as well as current crop insurance payments calculated based on these yields by their means, variances, and disparity indices, and show the spatial distribution. Their results consistently show that the differences are very small, which gives the industry and government confidence to design and implement the insurance programmes.

The last paper by Liao, Zhou and Fan addresses the effect of agricultural insurance on poverty alleviation. China presents a unique situation with its fast developing economy and the government's willingness to subsidise poor farmers through crop insurance. It is crop insurance that mitigates agricultural risks and transfers income to farmers. The authors develop a multi-optima theoretical model to identify a possible poverty trap situation. Using a numerical optimisation based on the model calibrated with parameters from other published studies, they find that there is a capital threshold and that only farmers who go beyond that threshold can gain income benefit from crop insurance. The model also supports the idea that premium subsidies will help move more farmers beyond the threshold.

Overall, this collection of papers addresses some of the unique features of agricultural insurance and can help the insurance industry and governments to make better decisions in providing them. Specifically, agricultural insurance is often subsidised by governments; thus the demand behaviour of agricultural producers is influenced by special factors such as the subsidy in addition to the common factors such as risk levels. The empirical results of new products such as forestry insurance in France and crop insurance beyond material cost protection in China also generate new knowledge and contribute to the development of new insurance products.

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