W. L. NIEWUWOUDT AND J. B. BULLOCK

The Demand for Crop Insurance

INTRODUCTION

It is universally common that farmers receive some state support during natural disasters such as severe drought or floods. Disaster assistance is costly and it may encourage production in high risk areas if payments are made frequently. In the USA, disaster assistance was phased out in 1982 and the official view is that farmers must insure their crops (US Congress). Hail insurance is provided adequately by the private sector in many countries as the occurrence of hail is more random than droughts. Crop insurance, however, only enjoys sufficient acceptance by farmers in countries where it is highly subsidised such as in Canada or where it is compulsory as in Sweden. In the USA, only 16 per cent of potential cropland is insured in spite of a 25 per cent subsidy on premiums. In South Africa, crippling droughts during the past years (1983, 1984) again focused attention on crop insurance, while the Australian Bureau of Agricultural Economics is at present considering providing incentives to farmers to insure their crops. International interest is shown in crop insurance by the conference on agricultural risk, insurance and credit held in San José, Costa Rica, in February 1982 (Binswanger, Hogan Gardner and Kramer).

The demand for crop insurance, even at a subsidized level, appears low. The purpose of this paper is to measure empirically factors explaining farmer participation in a crop insurance programme with a view to assist policy-makers. Welfare redistributional impacts of insurance as simulated within a simultaneous equations model, are also presented.

THEORY

Crop insurance is a contingent contract, an agreement in which a farmer pays a price, the premium, after which his crop output determines a payout or indemnity. The contingency is that only certain (low) yields result in indemnities, and yield is a random variable whose value is unknown when the insurance contract is purchased. Due to lack of information the insurer cannot separate farmers into risk classes leading to adverse selection. The lower risk within each group will always opt out, raising the loss ratio (Binswanger 1982) and there may be no equilibrium in the insurance market (Rothschild and Stiglitz 1975).

The demand for crop insurance depends on (a) the farmer's utility function of income, (b) his current income, (c) his subjective frequency distribution of future income, (d) the change in the frequency distribution of future income generated by the contract and (e) the premium of the contract. Regarding (a), Friedman and Savage show that if marginal utility of income decreases as income increases then the maximum insurance premium an individual will pay depends on the extent that $U(\bar{I}) > \bar{u}$ where $\bar{I}$ = expected income and $\bar{u}$ = expected utility. Regarding (b), Arrow suggests that the cost an individual attaches to risk is a declining function of profit (wealth) i.e. decreasing absolute risk aversion. Items (c) and (d) determine the returns from insurance and (e) its cost.

Previous empirical research on the demand for crop insurance is limited. Gardner and Kramer, because they could not find empirical research on the demand for crop insurance, undertook a 'pilot' study of a cross-section of 57 counties (1982).

ANALYTICAL PROCEDURE

In the subsequent empirical estimates of the demand for crop insurance, percentage potential acreage insured for a specific crop in a given year was taken as the dependent variable while the price of insurance was derived from premiums paid and indemnities received. Other variables included are risk, crop diversification, farm size, part ownership, etc.

The demand for crop insurance was estimated from state data on insurance participation in major crops for the years 1960–81. More than 700 cross-section time series observations on participation rates are utilised. While probability distributions of yield vary significantly amongst farms, producers in an area essentially face the same price distribution. Thus, an aggregate demand function should provide a good estimate of the price parameter. A preliminary analysis indicated that substantial variation in regional data existed, for instance, during 1981, the percentage of wheat acreage insured varied from 4 per cent in Illinois to 48 per cent in Montana. Data on indemnities, premiums, liability and acreage insured were obtained from the Federal Crop Insurance Office in Kansas City, Missouri.

The insurance 'price' variable was specified in returns form. Two alternative price variables were used, namely the indemnity/premium ratio lagged one year and a variable slightly modified from the one suggested by Gardner and Kramer. The latter variable expresses the rate of return for year t as follows:

$$\left\{ \frac{\text{Indemnity/liability as moving average of recent period}}{\text{Premium/liability ratio for year t}} - 1.0 \right\} * 100 \qquad (1)$$

The denominator expresses the premium as a ratio of liability which is analogous to expressing the cost of a lottery ticket as a percentage of the maximum price (Gardner and Kramer 1982).

At the time when the farmer enters the insurance contract the premium rate and liability coverage (denominator) are known. Future indemnities are unknown. Thus the numerator reflects farmers' expectations of the proportional 'payout' of the contract.

The risk expectation variable, based on immediate past experiences of the farmer, was derived from yield per acre data as suggested by Ryan.

EMPIRICAL RESULTS

Findings presented in Table 1 indicate that both return variables (X_1 and X_2) were highly significant and positive implying that participation in crop insurance does respond to economic forces. The return variable X_1 was derived from Gardner and Kramer's specification (refer equation 1 text) while X_2 is a ratio of actual indemnity payments/premium payments, lagged one year.

Positive and highly significant coefficients for the risk variable (X_3) are in accordance with expectations because if producers are risk averse,

TABLE 1 *Demand functions for crop insurance. Dependent variable: percentage of acreage insured (t ratios)*

Independent Variable (Y)	(1)	(2)	(3)	(4)	(5)
Expected rate of return			0.0139	0.0194	0.0114
(Gardner) = X_1			(3.9)	(5.3)	(8.1)
Indemnity/Premium for	0.951	0.798			
year t−1 = X_2	(12.0)	(9.16)			
Expected risk = X_3	3.161	5.723	4.864	4.217	2.23
	(3.7)	(4.5)	(4.2)	(3.8)	(5.1)
Diversification				−10.30	
(Entropy index) = X_4				(−7.6)	
Diversification			22.11		
(Herfindahl index) = X_5			(7.1)		
Crop dominance = X_6			9.740	9.973	
			(9.1)	(9.5)	
Part owners = X_7			0.237	0.283	0.023
			(8.5)	(10.4)	(2.5)
Farm Size = X_8				−0.0355	
				(−5.8)	
Disaster payment dummy			−1.047		
1974–1981 = 1 X_9			(−2.1)		
Lag Y = X_{10}	1.032	1.031			0.998
	(91.1)	(91.3)			(70.1)
Constant = X_{11}	−0.972	−0771	−17.60	13.18	−0.84
	(−5.9)	(−6.1)	(−16.6)	(4.2)	(−2.0)
R^2	0.92	0.92	0.51	0.53	0.92
df	740	740	692	684	694

more insurance will be purchased the greater the risk experienced. The variance of returns from a portfolio of crops and insurance is reduced by the purchase of insurance. In model 1 (Table 1) risk (X_3) was measured as reflected in both shortfalls and increases in production while in models 2 to 5, only production shortfalls are considered.

The diversification indexes (X_4 and X_5) were highly significant with expected signs implying that producers insure more in specialised cropping areas. The entropy index of diversification (X_4) approaches zero when a farm is completely specialised while the Herfindahl index (X_5) approaches unity when a farm is specialised. The sign of the entropy index should thus be negative and that of the Herfindahl index positive as in Table 1. Crop specialisation is a dimension of risk as shown in portfolio theory and it is expected that in areas where farmers tend to specialize, for instance where a single crop has a clear comparative advantage, producers would insure more. This may explain why in intensive wheat areas included in the model such as Montana and North Dakota percentage acreage insurance in recent years reached between 40 and 50 per cent. As a contrast only 4 per cent of wheat acreage was insured in Illinois and Indiana during 1981.

The 'percentage of part owners variable' (X_7) was positive and significant. This may be due to a higher leverage position of part owners compared to full owners with creditors requiring crop insurance as a security on loans. Hogan showed that an increase in debt/equity ratio will increase the overall riskiness of the income stream if assets are held constant.

The negative sign on X_9 indicates that an increase in farm size was associated with a decline in percentage acreage insurance and that the risk premium declines as farm size increases. If large farmers are wealthier and can more readily secure loans they may have less incentive to insure their crops. The small farmer who does not own land may insure as a substitute for collateral due to the non-price rationing of credit (Binswanger 1982).

The R^2 in models could have been increased substantially by inclusion of regional dummies. Regional dummies account for regional differences captured by variables studied and were consequently not included.

Variable X_9 estimates that the Disaster Payment Program (DPP) of 1974–81 had a negative influence on participation in crop insurance. The DPP covering feedgrain, wheat and cotton paid indemnities but charged no premiums.

EVALUATION

Actual data for 1982 on insurance participation were not incorporated into the model but will be used to test the predictive performance of model parameters. Rather than comparing model predictions with actual data, turning points (+ or −) in percentage acreage participation (Y) for 1982 compared to 1981 are studied which is a rigorous test. A comparison is made for each crop in each state studied.

Correct turning points in percentage acreage insured were correctly predicted in 32 out of 36 cases if returns variable X_2 and risk variable X_3 are used while 29 correct predictions were obtained if returns variable X_1 instead of X_2 is used. Risk and return variables were equally successful in predicting increases as well as decreases in percentage acreage insured; for instance 11 out of 13 changes were correctly predicted when insurance increased, while 21 out of 26 were correctly predicted when it declined. The exceptionally good results are attributed to economic rationality on the part of producers and strong annual signals emitted by the returns and risk variables. Insurance experts confirm this finding, that after a crop failure, such as 1980, acreage insured increases.

DISASTER PAYMENTS AND SUBSIDY ON PREMIUMS

Model 3 (Table 1) estimates that had the Disaster Payment Program (DPP) not existed, participation in crop insurance would have been 19.5 per cent more. This percentage appears small, given the magnitude of the DPP, but it agrees with Gardner and Kramer's observation that the DPP apparently did not discourage participation in crop insurance as much as expected.

Using the returns specification of Gardner and Kramer (Table 1) it is estimated that a 1 per cent subsidy on the premium rate would be expected to increase acreage insured by 0.429 per cent. This suggests that the percentage acreage insured is not very responsive to changes in the premium rate. The low 'price elasticity' indicates that some farmers will still insure at higher premium rates in situations of high risk arising from crop specialisation, yield related risks etc.

The question arises, what would be the impact on acreage insured if farmers pay the full cost of crop insurance? The farmer contribution to the total cost of crop insurance is estimated as 54.2 per cent. In this calculation, administration cost, the extent to which indemnities exceeded premiums in the past and the 25 per cent subsidy on premiums were considered. If the previously determined price elasticity of -0.429 is used, it is estimated that percentage acreage insurance will decline from the present 16 per cent (1983) level to 10.2 per cent if farmers pay the full cost of insurance.

While it is comforting that an estimated 10 to 11 per cent of farmers will insure even if they pay the full cost, one would have liked to see the subsidy having a greater expansionary effect on acreage insurance. It points out that a fairly large subsidy may be required to achieve the participation in crop insurance that the Federal Crop Insurance Corporation is aiming at and that the appropriate attention should rather be given to problem areas such as moral hazards or adverse selection.

WELFARE REDISTRIBUTIONAL EFFECT OF RISK REDUCTION

In a separate study the welfare effects of risk reduction were simulated by incorporating a risk specification in the corn and soybean supply functions of the simultaneous equation modelling system of the University of Missouri, Columbia. Since a variance-covariance risk specification was used, interrelationships between corn and soybean markets are recognised within the demand and supply system as well as in the risk specification. Variances and covariances were derived using Ryan's procedure. The risk averse coefficient was significant when included in supply functions of both soybeans and corn. Risk and no risk solutions were simulated by changing the variable cost of corn and soybeans in supply functions of the modelling system by a constant proportion. This adjustment in variable cost was derived from the risk aversion factors estimated. It was simulated that 'removal' of risk would lead to an expansion of corn and soybean acreage respectively of 0.453 million acres and 0.159 million acres. The social cost of risk as a percentage of the value of the crop was estimated for corn and soybeans respectively as 0.36 and 0.35 per cent.

In the case of the corn market a substantial welfare redistributional effect between consumers and producers was estimated. The gain in consumer surplus as a result of lower corn prices is estimated at $464 million while producer loss is $392 million. The redistribution in welfare is expected because the demand for corn, as incorporated in the modelling system was inelastic. For instance, elasticities of corn demand components included were; feed (−0.311), commercial export (−0.441) and food (−0.275). Welfare redistribution is estimated to be relatively smaller for soybean producers and consumers because the demand for soybeans, as incorporated in the model, is elastic. The gain in consumer surplus for soybeans is $54 million and the loss in producer surplus $11 million. A loss in producer surplus was simulated for soybeans, in spite of the elastic demand, because the demand for soybeans shifted backwards as a result of a decline in corn prices.

For this analysis risk removal had a greater impact on corn acreage planted than on soybeans. This agrees with expectations of extension specialists, since corn is considered as more 'risky' than soybeans. A subsidy on crop insurance could provide an incentive to expansion of more risky products and to expansion of production in 'riskier' areas.

CONCLUSIONS

Several countries are presently looking at crop insurances as a programme for protecting farmers against yield and income losses. The demand for crop insurance, however, appears low even at a subsidized level.

The following factors were significant in explaining the demand for crop insurance; expected rate of return in insurance, expected risk, crop specialisation, part ownership, disaster payments and farm size. The risk and returns variables were found to be excellent short-run predictors of turning points in acreage insured, as in 32 out of 36 state/crop comparisons the change (positive or negative) in percentage acreage insured between 1981 and 1982 was correctly predicted by these variables. A better understanding of these economic forces may aid programme administrators in understanding why certain areas will always have lower participation rates and why participation in some years may decline.

The welfare distributional impact of risk reduction was simulated in a separate study by including a risk variable in the corn and soybean supply functions of the University of Missouri, Columbia simultaneous equation modelling system. The social cost of risk was estimated as 0.36 and 0.35 per cent of the corn and soybean crops. Risk reduction was estimated to lead to a loss in producer surplus but gain in consumer surplus. Simulations indicate a loss in producer surplus for soybean producers, in spite of an elastic demand. The reason being that demand for soybeans shifted backward as a result of decline in corn prices.

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DISCUSSION OPENING I – R. J. HILDRETH

This session deals with risk aspects of decision-making. Such a focus is appropriate as risks are pervasive in farming and the intellectual concepts and methods of dealing with risk are complex, confusing and difficult. To the degree that agricultural economics can make use of theory and add to the development of theory of decision-making with risk, farmers, policy-makers and consumers will benefit.

The Anderson, Dillon and Hardaker paper sketches, criticises, reviews ongoing developments and supports the use of the paradigm of subjective expected utility. The approaches of the other two papers are not in conflict with subjective expected utility but do not use the approach directly. One reports research measuring production risks and the other measures empirical factors explaining farmer participation in a crop insurance programme. My assigned function is to place before the conference some issues and questions that could be discussed. I now proceed to state some issues and questions which you may wish to explore further.

At a July 1985 conference on ethics and economics in the United States, serious questions were raised about the logical fundamentals of utility identification and measurement. If it is not possible usefully to measure or identify utility, much less subjective expected utility, then the usefulness of models which optimise utility for explanation, prediction, or prescription is in doubt.

The Anderson, Dillon and Hardaker paper points out difficulties with the subjective expected utility model. Clearly models and paradigms which do not incorporate risk are not very useful. But are there alternatives to the subjective expected utility model in dealing with risk? Schoemaker lists nine variants of expected utility models in his 1982 *Journal of Economic Literature* article. If we were to apply a subjective utility analysis to an issue involving risk for economists, using subjective utility analysis, would we focus on subjective utility analysis, other expected utility models, or explore other paradigms such as mean-variance models?

The valuable papers on measuring production risk and the demand for crop insurance do not add greatly to a better understanding of the subjective utility analysis paradigm. Should research in this area focus on the development of the theory as an end in itself, or deal with questions of use to individual farmers or policy-makers as the measuring production risk and the demand for crop insurance papers do? In other words, will we move ahead further by dealing with problems perceived as important by the users of our efforts, or problems perceived to be important by the profession of agricultural economics itself? Perhaps the situation to be desired is to deal with questions and problems perceived to be important by the users of our work and at the same time add to the theoretical development.

A less significant issue, but one that causes confusion, is the use of the words 'normative' and 'positive'. It seems to me to be more useful to use the word 'prescriptive' rather than 'normative' and to use the word 'predictive' rather than 'positive'. An alternative is to use prescriptive and normative together and predictive and positive together. Misunderstanding of the use and meanings of words may impede progress in understanding.

The elegant paper on measuring production risk reports that by holding other inputs at their mean level and varying the level of fertilizer input, output variability increases exponentially for a village in India. Hazel reports increased variability in world cereal production and suggests that increased use of improved seed fertilizer-intensive technologies may have been an important factor. He suggests that price effects rather than higher sensitivity of new technologies to environment stress may be the cause of variability at the world level. But the evidence reported in the Kerr–Kalirajan paper is strong, for a much smaller area. Are these situations for farms where increased fertilizer use will reduce yield variability, say by increasing moisture efficiency? More analysis in measuring production risk would be valuable.

The application of risk models to macroeconomic phenomena, such as international trade or agricultural policy, is relatively new. This issue is mentioned or implied in all three papers. It would appear that we will require improvement in our ability to measure values (welfare) in an interpersonally valid way in order to make progress. Can the understanding in the macroeconomic area be increased at the same time as understanding is increased in the micro area? Or does the micro understanding have to come first before progress can be made in the macro area? Where should the relative emphasis be placed?

Many challenges and opportunities exist for economists in the area of risk analysis. The papers presented here are suggestive for further work.

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DISCUSSION OPENING II – JEAN-MARC BOUSSARD

We have just heard three very interesting and stimulating papers, although the scope of each is quite different.

I shall begin with the Kerr and Kalirajan paper, on which my own contribution will be poor, because, in fact, I am not very qualified to discuss a sharp econometric matter. I shall make only three points:

1 In some cases, this paper uses a restricted vocabulary, which makes its understanding for the non-initiated difficult (e.g. the three stages of the production function).

2 This is a pity, because this contribution is important, on an important subject. Another paper in this conference tackled the same subject, with apparently quite different conclusions (the paper by Antle, on *Technology and Uncertainty: evidence from Egypt*). It would be very useful to compare both in detail.

3 Why are these estimates measured in absolute rather than in relative values (i.e., 'per ha')? It would have made the estimation easier, without loss of generality.

The paper by Nieuwuwoudt and Bullock is also a pioneering one. Few studies have been undertaken to elicit the determinants of crop insurance. This one is therefore specially welcomed, the more so as it is two papers in one, with the measurement of crop insurance elasticity on the one hand, and the effects of risk reduction on the other.

On this second point, the paper is perhaps rather too short. The question of the welfare effects of output variability is intricate. For instance, the conclusions may differ widely if the risk is additive:

$$\text{i.e.: } y = \bar{y} + \varepsilon, \quad E(\varepsilon) = 0, \quad E(\varepsilon^2) = \sigma^2$$

or multiplicative:

$$y = \varepsilon\bar{y}, \quad E(\varepsilon) = 1, \quad E[(\varepsilon - 1)^2] = \sigma^2.$$

Since nobody knows which of these alternative models holds, one should be careful with firm conclusions in this field.

On the crop insurance market, on the contrary, the paper is new and informative. It is interesting to know that the price demand elasticity of crop insurance is small: this makes highly questionable the policy of subsidizing it, a classical example of an inefficient 'structural' measure. I would have appreciated also a comment on the difference in the values of the R^2 between models 4 and 5, and the others. This is a consequence of the omission of the lagged variable, but why?

Nevertheless, I am not in full agreement with the authors when they say that the ability of their model to react to changes in the rate of return on insurance is a good mark. In fact, when the return on insurance is high, it is because of a large number of crop failures which induces many farmers to revise their expectations when they should not. Thus, this factor means essentially that expectations are not free of contingent considerations. This is an illustration of the irrationality of the decision to subsidize an insurance contract, as shown by various authors, including Kunreuther. And this leads me to the discussion of the paper by Anderson et al.

This is, of course, a superb piece of literature, devoted to what could be called the classical theory of farmers and risk. In particular, they give a useful bibliography which will occupy my thoughts and my leisure time this winter. But I am a heretic, and I do not think this theory is really useful.

From a normative point of view, its usefulness is a matter of faith, we all agree, and the faith is far from being widely spread. Therefore, the real potential of the theory is descriptive. It gives a better understanding of farmers' behaviour, in their choices of techniques and, of course, this is essential.

Nevertheless, it seems to me that two major problems are ignored by this theory:

1 *The expectation problem*. Expectations are often inconsistent, and, in any case, seldom expressed in terms of probability. This is the sense of my previous remark. It is therefore important to set up a theory of

expectations pertaining to random events. This is a challenging task, that Marc Ne Love could perhaps undertake.

2 *The risk aversion coefficient problem*. Of course, the pure theory of expected utility does not *require* that the risk aversion coefficient be constant, and a permanent characteristic of each farmer. But all practical applications admit it. Now, it is simply wrong to say that 'within a reasonable range of values for wealth', the risk aversion coefficient may be approximately constant, especially when wealth can be negative as well as positive. An immediate proof of what I say is that many people buy at the same time fire insurances and horse-race betting tickets: such behaviour would be perfectly inconsistent with a constant risk aversion coefficient.

Therefore, the main problem, when building a descriptive model of farmers' behaviour, is precisely to determine the relevant values of the risk aversion coefficient in each element of the set of feasible actions. The debt equity ratio, which varies considerably over this set, plays an important part here. Elsewhere I had occasion to explain how to incorporate the previous considerations in actual models, by expressing the consequences of risk through a set of constraints, rather than by choosing a different utility function. I suspect Jock Anderson will not agree with me, although I do not understand why. Thus, it is better to stop here, and let him explain.

GENERAL DISCUSSION – RAPPORTEUR: S. C. THOMPSON

The question was asked whether decision analysis, as described in the Anderson et al. paper, could be applied on small as well as on large farms. Another question on this paper concerned the period between a decision and its payoff – does a gap exist between *ex ante* and *ex post* risk parameters? It is assumed that probabilities of states of nature are independent of the size of rewards; but is this a fair assumption when we know that the high prizes in life are rarely won? Does the model link risk aversion with money flexibility of consumption income well enough to allow analysis of farmer welfare?

A participant in the discussion on the same paper noted that even in multi-attribute utility models of the type referred to, the final index of utility was unidimensional – is risk itself multidimensional? For example, is survival risk different from the risk of losing social prestige? Another speaker felt that it might be more profitable to study aggregate group behaviour under risk in order to draw policy implications, rather than developing more detailed theoretical models.

A question was asked about the best dependent variable to use in empirical studies of demand for crop insurance – does income level or wealth influence demand; can wealthier farmers bear more risk? It was suggested that crop dominance and diversification should be included in measures of risk associated with crop insurance. A further question asked how subjective mean and variance should be assessed in supply response analysis and how is it possible to distinguish between a quadratic price response and a linear response plus a quadratic variance term? Another question concerned the use of climatic variables and the importance of cyclical effects. It was also wondered if the crop insurance model could incorporate political and administrative changes over time.

Dr Anderson was then asked if he would accept that there were limitations to the concept of probability in forming expectations. Can the Subjective Expected Utility model be expressed in a dynamic rather than a static formulation?

Dr J. R. Anderson replied as follows:

I think there is something circular about Dr Hildreth's suggestion to use Utility Theory to select among competing utility models. Surely some external viewpoint would be needed. I. M. Boussard and I differ in our views on utility functions, which I view as concave rather than sigmoid. In response to Mr Agrawal I have stated in my paper that the model has application for both small and large farms. George Jones expressed a head-on confrontation with the very notion of subjective probability. Certainly if preferences are not independent, then the model will fall apart. He is right that estimating subjective probabilities for rare or calamitous events remains a most challenging task.

I agree with Burger that econometric models which use only mean and variance effects to represent risk can be very limited in their application – but does a better methodology yet exist? I agree also with Parton that our model does not do justice to combining different dimensions of risk in one analysis. In response to Michel Petit, the SEU model is not explicitly static and can be as dynamic as the imagination of the analyst. The use of probabilities is a great simplification of our risky environment, but what I do not see is why you cannot believe in them more readily! Lastly, I hope I have demonstrated my pragmatism to Alexander Sarris. I too am interested in robust results applicable over groups of farmers.

Dr Niewuwoudt replied:

J. M. Boussard asks whether risk is additive or not, and I agree we do not yet know. In response to his question on R-squared values, there are substantial regional differences and using a log term, like bringing in regional constant terms, will dramatically increase R-squared. In answer to Agrawal, we captured risk in the model from past yield data in each region. Kada asked what was the best dependent variable. We looked at past indemnity and premium values. I agree with him that the merit of crops insurance will change as income level changes. In answer to Burger's question, we did include crop dominance measures. Farmers tend to insure the crops from which they earn most income, regardless of whether it is dominant or not.

We dealt with Lumayag's question in our model by taking a

North-South slice in order to maximise diversity in our data. Sonka's observation on political influences on crop insurance is quite accurate. Different payments in different states actually create distortion rather than stability!

Participants in the discussion included R. C. Agrawal, G. T. Jones, R. Kada, K. Burger, K. Parton, M. Petit, S. Sonka, E. Lumayag and A. Sarris.