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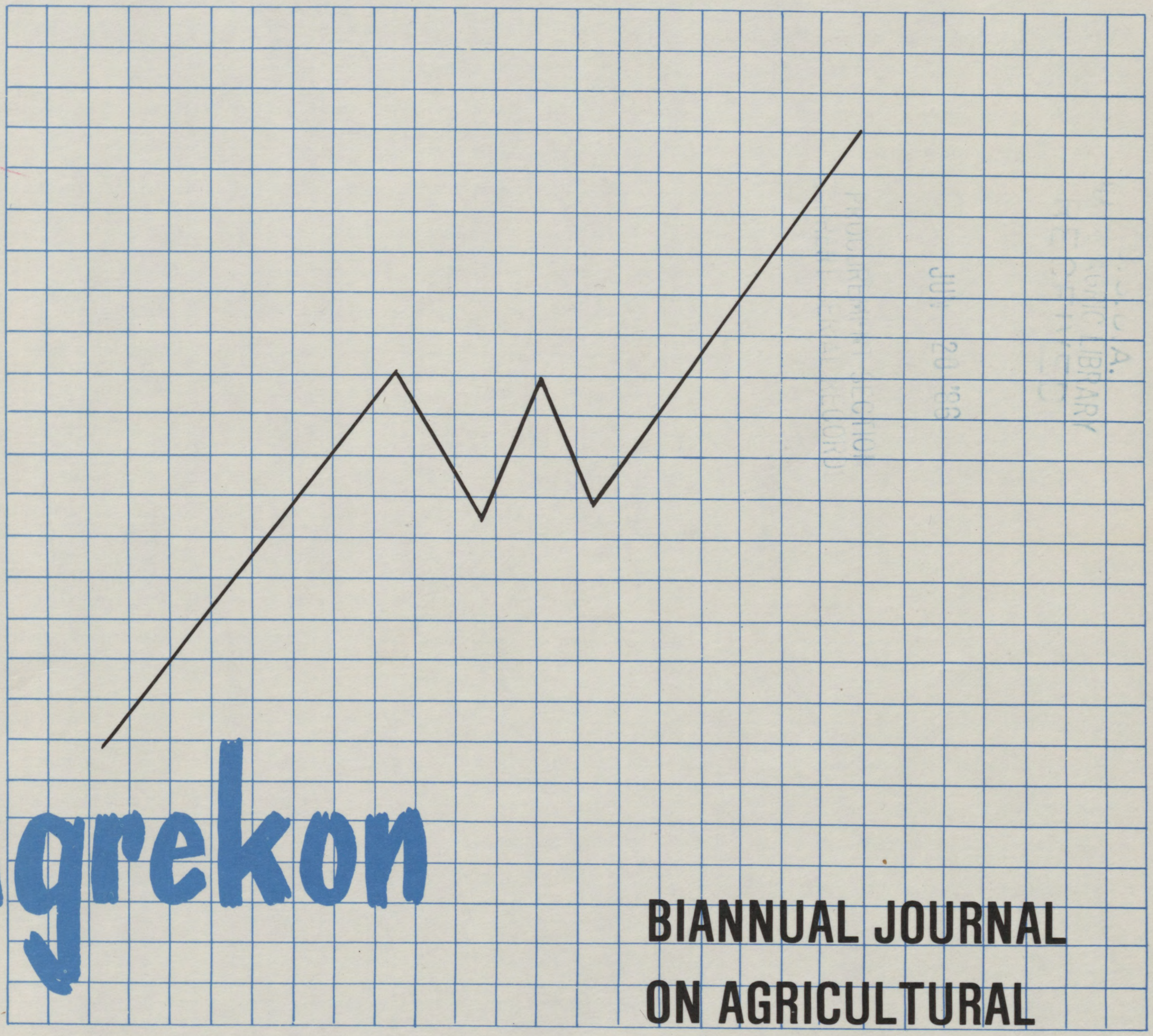

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THE VIABILITY OF AN AGRICULTURAL CROP INSURANCE PROGRAMME - A POLICY ISSUE

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INTRODUCTION

Farming is risky owing to its dependence on weather. The massive State aid granted to South African farmers in drought-stricken areas in 1983 reflects the official concern of the State about the vulnerability of agriculture to forces outside the control of the farmer, such as drought. In order to reduce the impact of risk arising from drought and other natural hazards, the United States Department of Agriculture is promoting Federal crop insurance.

The purpose of this paper is *inter alia* to study the viability of the U.S. crop insurance programme with a view to drawing some policy conclusions as far as the feasibility of such a scheme for South Africa is concerned. It is concluded that South African policy-makers should not rush into a comprehensive state-supported crop insurance programme such as that in the U.S.A., since it could soak up millions of rand in state subsidies. Crop insurance initiated through private channels in South Africa, such as farmers' co-operatives, must be welcomed since it promotes greater stability in agriculture and more rational decision-making. These organisations should, however, be aware of the complexities and take a cautious attitude since many similar schemes in the U.S.A. have run into financial difficulties in the past.

U.S.A. CROP INSURANCE - A POLICY ISSUE

Official concern regarding the viability of the U.S.A. crop insurance programme is evidenced by recent (1983) congressional hearings and correspondence between senators and the General Accounting Office[1]. Major issues are the high administrative cost of providing crop insurance and the question whether the programme will enjoy sufficient acceptance to provide farmers with protection against the adverse effects of weather. In spite of a subsidy of 25% on premiums, only 16% of the potential U.S. acreage was covered by the programme in 1982[2]. This means that the intended objectives of the programme of protecting farmers against natural disasters were not achieved and that the demand for crop insurance is low even at the subsidised level.

The purpose of this paper is furthermore to measure empirically factors explaining farmer participation in the crop insurance programme with a view to analysing policy implications. More than 700 cross-section, time series observations on participation rates for major crops in various states are utilised to study the effects of factors such as risk, return from insurance and crop specialisation on the demand for crop insurance. Attention is focussed on the low farmer participation in the programme and on the relation between crop insurance and other government support and stabilisation programmes such as the Disasters Payment Programme (1974-1981).

ANALYTICAL PROCEDURE

The demand for crop insurance was estimated from state data on insurance participation in major crops for the years 1960 to 1981. 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 there was substantial variation in regional data; for instance, during 1981 the percentage of wheat acreage insured varied from 4% in Illinois to 48% in Montana.

Data on indemnities (payments to farmers if crops fail), premiums, liability (insured value of crops) and acreage insured were obtained from the Federal Crop Insurance office in Kansas City, Missouri. Attention was focussed on the insured acreage of corn, soybeans, wheat and cotton. A north-south slice of centrally located states were selected for analysis in an effort to capture the diversity in agriculture.

EMPIRICAL RESULTS

A regression model explaining the demand for crop insurance indicated that farmer participation in crop insurance does respond to economic forces. The following factors were found to be significant: expected rate of return from insurance, expected risk, crop diversification, crop dominance, part-ownership, farm size and payments on disaster assistance.

A rate of returns variable specified as the ratio of indemnities paid to farmers to premiums paid by farmers in the previous year was an important factor explaining crop insurance participation in the current year.

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At the time when the farmer enters into the insurance contract the premium rate and liability coverage are known but future indemnities are unknown. An alternative return expectation variable was thus specified, i.e. indemnity/liability ratio as a moving average for the past three years divided by the premium/liability ratio of the current year. The numerator reflects the farmers' expectation of the proportional payout of the contract, while the denominator is akin to the cost of a lottery ticket as a percentage of the maximum prize.

The risk in agriculture arising from the adverse effects of the weather was captured from past yield data on a time series cross-sectional basis for the crops studied. Estimates indicate that farmers are averse to risk in the sense that acreage insured increase following years of adverse weather.

Crop diversification indices (Herfindahl and entropy) indicated that producers insure more in specialised cropping areas. Crop specialisation is a dimension of risk as shown in portfolio theory[3] and it is expected that in areas where farmers tend to specialise, for instance where a single crop has a clear comparative advantage, producers would insure more. This explains why in intensive wheat areas included in the model such as Montana and North Dakota the percentage of the acreage insured in recent years reached between 40% and 50%. In contrast, only 4% of the wheat acreage was insured in Illinois and Indiana during 1981. In Montana and North Dakota almost no corn and soybeans are grown and wheat is produced very much as a specialised crop, although some barley and oats are grown. Illinois and Indiana, on the other hand, are important corn and soybean states.

The "percentage of part-owners variable" was positive and significant. This may be due to the higher leverage position of part-owners in comparison with sale owners, with creditors requiring crop insurance as security for loans. Hogan[4] showed that if assets remain constant an increase in debt equity ratio will increase the overall riskiness of the income stream.

An increase in farm size was associated with a decline in the percentage of acreage insured. If large farmers are wealthier and can more readily secure loans they may have less incentive to insure their crops.

It was estimated that the disaster payment programme (DPP) of 1974 to 1981 had a negative influence on participation in the crop insurance programme. The DPP covering feed grain, wheat and cotton paid indemnities but charged no premiums.

EVALUATION

Actual data for 1982 insurance participation became available only during the final stages of the project. These data were not incorporated into the model but were used to test the predictive performance of model parameters.

Rather than comparing model prediction with actual data, turning points in acreage participation (Y) for 1982 are studied, which is a rigorous test. The rate of return from crop insurance and risk change significantly from year to year and should provide insight as short-run predictors of participation in crop insurance. Other variables measured, such as crop specialisation, capture either regional differences or long run adjustments and would thus not be suitable as short-run predictors.

Model parameters correctly predicted turning points (increase or decrease) in acreage insured in 32 out of 36 comparisons. The effect of crop losses in one year on acreage insured in the following year is known to crop insurance experts. For instance the record increase in the acreage insured of 81% in 1981 is partly attributed by these experts to the crop failure of 1980. The model confirms this relationship.

DISASTER PAYMENT AND SUBSIDY ON PREMIUMS

During the period 1974 to 1981, an annual average of $476 million was spent on disaster assistance (DPP) in the feed grain, wheat, rice and cotton programmes. During the same period indemnity payments under Federal Crop Insurance (FCIC) amounted to $161 million annually. Since the DPP charged no premiums it is expected that the programme would have had a depressing effect on participation in the FCIC programme.

It is estimated that had the DPP not existed, participation in crop insurance would have been 19,5% more. This percentage appears small, given the magnitude of the DPP, but it agrees with Gardner and Kramer's[5] observation.

The question arises, what would be the impact on acreage insured if farmers had to pay the full cost of crop insurance? Total indemnities for the U.S.A. during the period 1948 to 1982 amounted to $2,440 billion and premiums to $2,193 billion, giving a "loss ratio" (indemnities/premiums) of 1,11. If administration costs of $597 million (1948 to 1982) are added to indemnities then the farmer contribution to the total cost of the programme was $(2,193)/(0,597 + 2,440) = 72,2\%$. With the current 25% actual subsidy on premiums the farmer's contribution to crop insurance is estimated at 54,2%[8]. Thus current premiums need to increase by 84,6% if farmers are to pay the full cost of crop insurance. If the price elasticity of the returns variable of -0,429 is used, then it is estimated that percentage of the acreage insured will decline from the present 16% level to 10,2%.

CO-ORDINATION OF PROGRAMMES

Some government programmes, such as those for the promotion of price stability may increase the demand for crop insurance while others, such as the provision of disaster assistance and low interest loans, are risk management substitutes.

The impact that price stability has on the demand for crop insurance can be studied if the variance of revenue is partitioned into the variance of price, variance of yield and co-variance of price and yield[6]. If the co-variance between price and the individual farmers'/yield is negative then crop insurance would be less effective in reducing income stability because if yield variability is reduced to zero, the negative co-variance term is also reduced to zero. Price stability thus increases the demand for insurance because in such a case the co-variance would be zero and the variance in return would vary directly with the variance in yield. Price stabilisation policies and crop insurance should thus be co-ordinated[7].

The FCIC Contract (1980) Act specifies three yield levels and three price levels so that in effect the farmer buys some income protection in addition to yield stability. It is possible that including price options in the contract enhances the demand for insurance since it reduces the co-variance term to zero. The FCIC Contract, however, does not provide price protection, since indemnities are paid only when yields fall below the insured coverage level. A lesson from the PIK (Payment in Kind) programme is that price stabilisation policies are expensive and that price stabilisation should be left to other devices such as the futures market.

INFORMATION COST

The lack of demand for crop insurance in the past has been attributed to complaints that insurance is a good buy for high risk and inefficient farmers [8] because indemnity payments were based on county average yields, which were lower than the yields of the better farmers. Under the individual yield coverage programme (IYC) launched in 1982 farmers can increase their liability coverage for the same premiums if they have proven yields for three years. Fewer than 1% of the farmers with acreage insurance participated in the IYC programme in 1982. A complication is that farmers often do not keep records that would satisfy insurance agents and therefore do not qualify for the IYC scheme.

The adverse selection problem still arises because even if farmers can be separated according to mean yields achieved, they are not being separated into risk classes. If insurance is voluntary, the lower risks within each group will always opt out, raising the loss ratio[9] and there may be no equilibrium in the insurance market[10]. The very nature of the lack of information implies that premiums of the more risky farmers are subsidised by the less risky producers which is an incentive (price) distortion. Although producers are not currently separated into risk classes initially, premiums will be adjusted annually (new programme) depending on whether the producer received indemnity payments or not. This is a step in the right direction as it will increase (decrease) the cost of insurance to high (low) risk producers as is the case with automobile insurance.

The adverse selection problem can be tackled by (1) obtaining better information on individual farm risk, which is costly, (2) subsidising premiums and (3) making insurance compulsory. Compulsory insurance would leave those who would not willingly buy insurance worse off. A subsidy makes insurance attractive to those who would drop out of the programme owing to adverse selection. The subsidy may also make insurance attractive to risk neutral farmers and risk preferrers. There is no welfare benefit if a risk neutral person insures, since risk does not distort the prices he perceives. A risk preferrer may, however, take on more risk in order to reachieve the level of riskiness he enjoyed before insurance. The latter consequence may not be too serious, since most studies indicate some risk behaviour on the part of producers.

Reliable and objective insurance data are costly to obtain since they vary between geographic areas, between fields on the same farm and between levels of management. More information is also required to ascertain individual farm losses and verify claims than for example in the case of life insurance, where death has to be established only once. The high cost of obtaining information must be an important component of the high administration cost of the current programme. Administration and operating expenses of the FCIC were estimated at $236 million or $5,36 per insured acre for 1982[11]. Whereas the risk diffusing benefits of crop insurance are important, the cost of providing the service is high.

SOME IMPACTS OF CROP INSURANCE

Although the research was focussed on preconditions that promote the acceptability of crop insurance, some information is provided on the impact of insurance.

Given a trade-off between risk and profit, the removal of some risk through insurance will induce farmers to undertake riskier enterprises with greater profit. Insurance and diversification are risk management tools and the availability of insurance is expected to promote further crop specialisation.

During the period 1948 to 1980, the loss ratio (indemnity/premium) averaged 1,09 for the US for all programmes[12]. The premium was thus slightly better than actuarially 'fair'. Loss ratios (1948 to 1980), however, differ for major crops as follows: wheat 1,04, cotton 1,55, corn 1,12, and soybeans 0,84 (1955 to 1980) (Federal Crop Insurance Corporation). The economic justification for crop insurance is that it promotes a more optimum use of resources by removing the price-distorting effect of risk. With indemnities exceeding premiums by as much as 55% in the case of cotton it appears that the programme introduced price distortions of its own. Soybeans are generally considered a lower risk crop than, for instance, corn, which is grown in similar states. The crop insurance programme may have been open to the same criticism as the DPP, namely that it encouraged production in higher risk situations.

Loss ratios were generally low in corn belt and wheat states while they were high for cotton in all states. Low participation rates in Illinois and Indiana are partly attributed to low loss ratios. The consistently low loss ratios in some areas and high ratios in others indicate that premiums in the past were not adjusted sufficiently to reflect expected indemnities. The loss ratio for soybeans in Iowa was

0,44 (1960 to 1981) and the standard error indicates that the probability of a loss ratio greater than 1,0 was only 1%. In the case of cotton in Texas, indemnities exceeded premiums (loss ratio > 1,0), for instance, for 10 years during 11 consecutive years (1966 to 1976).

The crop insurance scheme not only introduced price distortions between crops but also between regions but also favoured the risky producer, causing adverse selection. It is hard to justify the existence of an insurance programme on efficiency grounds if it creates price distortions by rewarding risk taking. It is thus imperative that the actuarial soundness of premium rates be reviewed and that these rates be adjusted for each farmer so that they will be as nearly as possible proportional, to expected indemnities for the individual.

Crop insurance shifts the risk from the farmer to the insurance agency. Owing to the non-random nature of weather only some of these risks can be diffused to other areas, crops, and sectors and over time. Arrow[13], however, states that risks publicly borne, as in the case of crop insurance, are spread amongst so many taxpayers that the total cost is insignificant. If society regards the compensation of victims of natural disasters as a public good, then insurance may be of additional benefit[14].

CONCLUDING COMMENTS

Econometric models indicated that the extent of farmer participation in crop insurance depends on the riskiness of agriculture in a particular area, the amount paid to farmers in indemnities in the previous year, the premium rate, whether the area is diversified or specialised (Herfindahl index) part-ownership, farm size and the existence of other programmes.

It was estimated that if farmers were to pay the full cost of the programme, participation in crop insurance would only fall from 16% to 10 to 12% in the U.S.A. The low and disappointing participation in crop insurance for instance in the corn belt was attributed to the availability of risk management alternatives such as diversification.

A major problem with crop insurance (in contrast with life insurance) is the inability of the insurer to separate high-risk from low-risk producers (information cost problem). Crop insurance data (information) are costly to obtain owing to the diversity in agriculture, for instance the administration cost of the U.S.A. programme is R5 per acre insured. The evidence indicates that insurance promotes risk-taking such as crop specialisation and other risk-taking activities. Since insurance removes the price-distortionary effect of risk, some risk-taking is expected and desirable from an efficiency point of view. However, past average (1948 to 1980) loss ratios (indemnities/premiums) range from a high of 1,55 for cotton to a low of 0,84 for soybeans. Loss ratios were generally low in corn belt states and high in cotton in all states. This implies that the programme introduces price distortions and rewards risk taking by subsidising the riskier crops and taxing the less risky crops.

Some Co-operatives in South Africa have shown an interest in crop insurance. Crop insurance initiated through private channels in South Africa, for example by farmers' co-operatives, must be welcomed since it promotes greater stability in agriculture and better and more rational decision-making. The Co-operatives may also be in a better position than the Government (Department of Agriculture) to assess the risk on a specific farm.

The Federal Crop Insurance Scheme in the U.S.A. has become a financial headache and a similar state-supported scheme is not recommended for South Africa. Private agencies (co-operatives) would be well advised to familiarise themselves with the complexity of the issues, such as adverse selection, the moral hazard and the information cost problem, since agricultural hazards such as droughts effect vast areas at the same time.

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APPENDIX - Demand functions for crop insurance dependent variable: Percentage of acreage insured (t ratios)

Independent variable (Y)	(1)	(2)	(3)	(4)	(5)	(6)	(7)*	(8)	(9)
Expected rate of return (Gardner) = X_1					0,0139 (3,9)	0,0194 (5,3)		0,0198 (5,7)	,0114 (8,1)
Indemnity/premium for year t-1 = X_2	0,951 (12,0)	0,798 (9,16)	0,821 (9,4)	0,845 (10,3)			1,575 (8,2)		
Expected risk = X_3***	3,161** (3,7)	5,723 (4,5)	5,10 (3,9)	1,987 (4,8)	4,864 (4,2)	4,217 (3,8)	2,661 (3,1)	3,01 (2,8)	2,23 (5,1)
Diversification (Entropy index) = X_4						-10,30 (-7,6)	-17,048 (-15,1)	-7,99 (-6,0)	
Diversification (Herfindahl index) = X_5					22,11 (7,1)				
Crop dominance = X_6					9,740 (9,1)	9,973 (9,5)	4,943 (5,4)	9,46 (9,4)	
Availability of acreage = X_7								7,48 (8,0)	
Part-owners = X_8			0,017 (2,0)	0,020 (2,4)	0,237 (8,5)	0,283 (10,4)	0,061 (2,3)	0,313 (11,8)	,023 (2,5)
Farm size = X_9						-0,0355 (-5,8)		-0,059 (-8,1)	
Disaster payment dummy 1974-1981 = 1 X_{10}					-1,047 (-2,1)				
Lag Y = X_{11}	1,032 (91,1)	1,031 (91,3)	1,017 (76,1)	1,000 (73,6)					0,998 (70,1)
Constant = X_{12}	-0,972 (-5,9)	-,0771 (-6,1)	-1,49 (-3,8)	-1,56 (-4,1)	-17,60 (-16,6)	13,18 (4,2)	19,49 (8,3)	12,19 (3,7)	-0,84 (-2,0)
R^2	,92	,92	,92	,92	,51	,53	,74	,57	,92
df	740	740	739	739	692	684	690	691	694

*Coefficients for regional dummies are: corn and beans in Illinois and Indiana -4,1, wheat in Montana, North Dakota and Nebraska +5,7, corn and beans in Iowa 2,0, beans and cotton in Louisiana -7,4 corn in North Dakato -12,6, beans in North Dakota and Nebraska +4,0 and beans in Kansas -1,9

**In model 1 both increases and decreases in yield per acre are used in the risk specification. In all other models only decreases are included

***In models 1, 2 and 3 it was assumed that standard deviation of individual yield = standard deviation of aggregate yield (P = 1). In all other models P = 0