AN ECONOMIC EVALUATION OF RISK MANAGEMENT STRATEGIES IN THE SOUTH AFRICAN AGRICULTURE

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ABSTRACT
The purpose in this research is to evaluate the economic viability of (a) a crop insurance programme for small scale farmers and (b) an Income Equalisation Deposit (IED) Scheme for commercial farmers. Hail insurance is provided by the private sector in South Africa but crop (drought insurance) programmes, after a promising start, failed to attract customers largely because of high premiums. An area insurance plan (farmers are insured as a group) is shown to be more appropriate especially for small scale farmers growing dryland field crops because risk is systemic (drought related) while adverse selection, moral hazard etc are overcome. Individual crop insurance will not be viable due to the cost of farm visits (verification of claims) and the non availability of information (information cost problem). An analysis of time series data shows that insurance premiums even for area insurance will be high because of the high variability in yields and the concomitant high expected claims. As a large part of the cost to government goes to administration of crop insurance it is recommended that an Income Equalisation Deposit (IED) scheme be considered. Under an IED scheme, farmers are permitted to deposit funds in good years and income tax is only paid on withdrawal in a bad year. An IED has been considered in the past in South Africa but rejected largely due to tax implications. Conditions have now changed while various countries (Australia, Canada and USA) are promoting this scheme. During 2000, tax consultants in rural areas in South Africa were interviewed about circumstances under which they will recommend an IED. An experimental design was used to draw a sample of consultants in order to allow for main and interaction effects in the statistical analysis. Discriminant and logit analysis (n=192) showed that consultants would recommend such a scheme to high risk farmers with low debt and farmers with higher net farm income. Interaction effects showed that the scheme will be particularly recommended to high risk maize (corn) farmers, a farming sector that has been devastated with droughts in the past. A policy recommendation is to make an IED scheme available to both small and large scale farmers with the government making also a contribution in the case of small scale farmers (as in Canada) which can be phased out as net farm income increases. These risk policy risk management strategies are seen as pro-active rather than the past reactive measures of substantial state assistance since droughts are common on the African continent.
1. INTRODUCTION
The purpose in this research is firstly to study the economic feasibility of a crop insurance programme for small scale commercial farmers who are not yet paying tax. Secondly, for commercial farmers already paying tax, an Income Equalisation Deposit (IED) scheme has been recommended as a risk management strategy. In this paper both risk management strategies will be evaluated.

Uncertainty of crop yields is one of the most basic risks farmers face. A great majority of farmers in most countries are unable to withstand such risks due to insufficient resources. The principal characteristic distinguishing agriculture from other industries is its dependence on nature. Providing farmers with risk protection is problematic. Failure of crop insurance markets has been primarily attributed to the problems of asymmetric information and systemic risk, both of which are found on such a large scale only in agriculture. Systemic risk undermines insurer attempts to provide affordable insurance to individual farmers as the cost of holding the reserves necessary to cope with widespread natural disaster is prohibitive. Asymmetric information raises insurer costs to the extent that the premiums necessary to cover these costs become unaffordable to individual farmers.

There are new developments in the USA crop insurance programme while this topic has received considerable attention in the literature in recent years. Given the problems associated with crop insurance and the recent developments in the crop insurance industry, the challenge in this study is whether this programme can be adapted to small scale farmers in South Africa. A major problem with crop insurance in the USA has been the high cost of administration which would be larger per hectare of land for small scale farmers. Special attention will thus be given in this study to the economic feasibility of an area insurance programme as a way to reduce costs associated with administration, asymmetric information and systemic risk.

In an effort to reduce the cost of government of risk management strategies in agriculture Income Equalisation Deposits (IED=s) will be studied. According to this proposal tax paying farmers deposit funds in good years and only pay tax on the amount when withdrawn. This is seen as a tax vehicle whereby better cash flow and risk management will be promoted. This Scheme has been suggested in South Africa in the past but rejected. Certain conditions in the mean time have changed which may have made such a scheme more attractive: (i) agricultural departments in both Australia and Canada are strongly promoting this scheme at present (ii) the South African government subsidized crop insurance programme for commercial farmers (Sentraoes) has ceased altogether (iii) deregulation in South African agriculture has exposed farmers to more risks and (iv) real interest rates have increased in recent years making an IED more attractive. In the light of these events the economic feasibility of introducing an IED in South Africa will be evaluated as a vehicle to promote self insurance by farmers.

2. ECONOMIC FEASIBILITY OF CROP INSURANCE FOR SMALL GROWERS

2.1 History of crop insurance in the USA and South Africa

The USA has the most the most well developed crop insurance programme in the world while South Africa=s experience with crop insurance has been brief.
South African Experience with Crop Insurance

South Africa's one attempt to broaden access to drought-inclusive crop insurance was not particularly successful. A scheme was launched in 1979 whereby the SA Government subsidised 25% of the crop insurance premiums for special comprehensive policies. In the 1980's the SA crop insurance initiative was hailed in Washington as one of the best examples of a scheme largely managed by private enterprise as the USA Federal Crop Insurance Corporation (FCIC) Programme at that time was largely managed by government. The SA scheme failed after ten years.

Jarvie and Nieuwoudt (1989) used discriminate analysis to study the factors why South African maize farmers insure/do not insure their crops. Results from 82 maize farmers indicated that those producers who insured their crops comprehensively had a low percentage of gross farm income from livestock, a relatively unfavourable liquidity position, substantial long-term debt, and a low gross farm income to assets ratio. These farmers also had a high risk index, tend to be older and more experienced. A risk index that take cognisance of individual farmer yield, crop specialization or diversification was used.

As very little research has been undertaken on crop insurance in South Africa, the discriminant function estimated by Jarvie and Nieuwoudt (1989) is shown below:

\[
\text{DISC} = -0.593 \text{LS} - 0.532 \text{LIQ} + 0.495 \text{DEBT} - 0.491 \text{GA} + 0.299 \text{RISK} + 0.294 \text{EXP}
\]

where DISC = 1.0 if insured, zero otherwise,

\[
\begin{align*}
\text{LS} &= \% \text{ income from livestock,} \\
\text{LIQ} &= \text{ principal component was extracted from three variables namely gross farm income, credit reserve, and the ratio of assets to liabilities,} \\
\text{DEBT} &= \text{ Long term debt,} \\
\text{GA} &= \text{ Ratio between gross farm income and assets,} \\
\text{RISK} &= \text{ Coefficient of variation of crop yields weighted by relative area under a crop} \\
\text{EXP} &= \text{ A principal component of years farming and age.}
\end{align*}
\]

All the variables were significant at the 1% level. As the function is in standardised form the importance of a variable is indicated by the magnitude of its discriminant function coefficient. For instance the livestock index was the most important variable (it had the highest standardised coefficient) in explaining the separation between the two groups (insured versus non insured). It was concluded that crop insurers should direct their efforts at cropping areas known to be specialized in their enterprise portfolio and that have relatively small herds of livestock, variable yields and fair amount of debt.

In the South African maize belt, farmers have little scope to diversify as all crops are affected by similar weather conditions. It is thus not surprising that the livestock variable was important as this is probably the only enterprise that could provide some stability to crop farming under the conditions where most of the income is derived from a single crop.

Experience with the USA Federal Crop Insurance Programme.

The Federal Crop Insurance Act was signed into law in the United States in 1980. The Act authorized the Federal Crop Insurance Corporation (FCIC) to subsidize producer premiums
payments and to reimburse participating private insurance companies for their administrative expenditures and part of their underwriting losses. Producers can purchase individualised coverage for either 50%, 65% or 75% of normal yield and one of three different price election levels. Normal yields are based on Actual Production Histories (APH). Price election levels are determined from FCIC forecasts of expected prices. Should the producer’s yield fall below the elected coverage level, he or she receives an indemnity equal to the yield shortfall times the elected price level. The program has expanded in recent years and about two-thirds of planted acreage of corn, soybeans, and wheat was covered by crop insurance in 1998 (Dismukes, 1999).

During 1998 US growers paid $900 million in crop insurance premiums while during 1995-98 the US government spent $1.2 billion per year on premium subsidies, administration and operating subsidies, and net underwriting losses (Dismukes, 1999). The US Treasury’s contribution to the Program is thus significant and greater than the farmers’ contribution while farmers receive twice as much in indemnities as they pay in premiums.

2.2. Problems inherent in crop insurance

Studies in recent years have concluded that market failure in crop insurance primarily results from asymmetric information problems, particularly adverse selection and moral hazard. The asymmetric information problem stems from the fact that the cost of obtaining accurate loss-risk information and the cost of monitoring farmer behaviour are prohibitively high (Miranda and Glauber, 1997). Recent scholars claim that systemic risk and not asymmetric information poses the more serious obstacle to the emergence of an independent private crop insurance industry. These problems are briefly evaluated.

(a) Adverse Selection

Adverse selection arises because producers are better informed about the distribution of their own yields and are thus better able to assess the actuarial fairness of their premiums than the insurer, who lacks access to reliable individual yield data and other relevant information. Producers who recognize that their expected indemnities exceed their premiums are more likely to purchase coverage than those whose premiums are actuarially high. As a result, the insurer’s expected indemnity outlays exceed total premium income, and, in the long run, the insurance operation loses money. Efforts by the insurer to avoid these losses by raising premiums only result in a smaller and more adversely selected pool of participants (Miranda, 1991).

(b) Moral Hazard

Moral hazard results from asymmetric information. It occurs when, without the knowledge of the insurer, the insured changes behaviour after purchasing insurance in a manner that increases the probability of receiving an indemnity payment (Miranda and Glauber, 1997).

(c) High Administration Costs

Record keeping and other manpower requirements needed to verify individual production histories and to adjust individual yield-loss claims raise insurer expenditures and impose high transactions costs (Miranda, 1991).

(d) Inelastic Demand for Crop Insurance
Nieuwoudt and Bullock (1985 p 659) estimated the elasticity of demand for crop insurance in the USA at -0.43 implying that the area insured is not responsive to the premium rate or the level of subsidies. This low price elasticity of demand implies that significant subsidies are required to stimulate the demand for crop insurance. Goodwin (1993) estimated the demand for crop insurance in the USA at -0.32 for relative insured acres and -0.73 for liability per planted acre. Both studies indicate that the demand for crop insurance is inelastic.

(e) Systemic Risk
Systemic risk in agriculture stems primarily from the impact of geographically extensive unfavourable weather events, such as drought or extreme temperatures, which induce significant correlation among individual farm-level yields. Insurers of random events such as automobile insurance need not keep high reserves as claims can be paid by premiums received even over relatively short periods. Insurers of non random events such as drought need to keep large reserves which are costly. This lack of stochastic independence among individual yields defeats insurer efforts to pool crop loss risk across farms, causing crop insurers to bear substantially higher risk per unit of premium than other property liability and business insurers. Miranda and Glauber (1997) propose that systemic risk, and not asymmetric information, represents the primary cause of crop insurance market failure.

2.3 Area yield crop insurance
Area yield crop insurance has a short history in the USA. The US President’s 1994 budget strongly endorsed the Group Risk Plan (GRP) as a replacement for farm-based crop insurance. In response the US Congress did not eliminate farm-based crop insurance, but instead mandated that GRP be expanded to the extent practicable. Sweden implemented a similar programme at an earlier date (1961) while the Canadian province of Quebec introduced a programme in 1977 (Skees et al, 1997).

Under an area-yield plan, the producer receives an indemnity equal to the difference, if positive, between the area yield and some predetermined critical yield level. Each participating producer receives the same indemnity, per insured acre, regardless of his or her own crop yield, and would therefore pay the same premium rate.

Area yield crop insurance offers advantages over individual yield crop insurance by increasing the actuarial fairness of premiums. Adverse selection would be mitigated as information on area yields is readily available and reliable. Moral hazard would essentially be eliminated as a producer could not significantly increase his or her indemnity by altering production practices. Administrative costs would also be substantially reduced as claims would not have to be adjusted individually and verification of individual production histories would not be required (Miranda, 1991 and Mahul, 1999). No fieldwork is required to adjust losses (Dismukes, 1999). These features are important for small scale farmers where the cost of farm visits will be high per hectare of land and information on yields be lacking.

Miranda (1991) decomposes individual yield variation into a systemic component, perfectly correlated with area yield, and a non-systemic component, uncorrelated with area yield. He defines a variable, $\beta$, that measures the sensitivity of the producer’s individual yield to the systemic factors that affect the area yield. The more highly correlated a producer’s yield is to
area-yield, the greater the risk reduction from area-yield insurance. Producers with the highest
\[ \beta_i = s \]
enjoy the greatest risk reduction under an area-yield plan (AYP), while producers with the
highest yield variances obtain the best risk reduction under and individual yield plan (IYP).
Area-yield crop insurance covers only systemic individual yield risk. There are areas where yield
risks are not systemic for instance the problem of freeze in a fruit growing area. Non systemic
risks such as hail are generally well provided by private insurance companies.

Area-yield reinsurance could be provided by government at low cost given that historical yield
levels for various crops and regions have been compiled for years. No additional information
beyond what is currently being collected would be required to settle reinsurance claims. Area
yields could not be manipulated by the insurer. Government area-yield reinsurance contracts
could therefore significantly reduce potential moral hazard and adverse selection problems
between the government and the insurer. Rate setting responsibilities for individual policies
could be shifted to the insurance company, which would assume some underwriting gains and
losses from individual crop insurance contracts at the margin. This would restore incentives for
crop insurance companies to improve their actuarial performance by closely monitoring the
adverse selection and moral hazard problems between the insurance company and the individual
farmer.

2.4 Area insurance for small-scale farmers in South Africa

There are about 140 000 emerging farmers who earn money by farming as well as other means
and who are trying to become established full time farmers. Dryland maize will be an important
crop in such a programme. Area insurance as discussed in this document is proposed where risks
are systemic as in the case of dryland crop farming. Vegetable crops are also important in small
scale farming but the risks that affect the latter are not of a systemic nature as these crops are
under irrigation. Consideration should be given to individual yield insurance in the latter case.
According to van Rooyen (2000) individual yield insurance for vegetables may also not be viable
as risks differ between vegetable crops while individual crops are grown in small patches.
Maize and wheat are grown on a larger scale but even in this instance farms may be small as most
small scale farms in KwaZulu-Natal are less than two ha.

In this section the annual cost of small holder crop insurance to the South African Government
will be estimated based on estimated value of small holder production in South Africa and
relative cost data for the USA. Using data on the cost of the USA programme, an information
of the value of small scale production in South Africa the subsidy cost to the South African
treasury is estimated at R 40 million and the premium cost to growers at R 30 million. The
information requirements of an insurance programme for vegetable crops will be high if
individual farms are insured.

Clover and Nieuwoudt (2001) analysed time series data for small scale farmers in several sugar
mill areas assuming an area yield plan. It was concluded that premium rates will be high because
of the great possibility of claims.

Insurance schemes are most effective in reducing producer risk when contracts are written by the
private sector while government subsidises part of the underwriting losses and administration
costs. The private sector would also perform the initial farm level examinations, conduct claim
assessments and bear a share of the risk. Private sector reinsurers would help form the pricing strategy and also bear a share of the risk. It is essential that schemes be structured in a way which provides incentive to farmers to reduce risk exposure by adopting risk-reducing practices or investing in risk-reducing improvements.

Along with insurance, risk management strategies should be considered such as low risk technologies (McGregor and Hudson, 1999). Incorporation of a livestock factor in high risk crop areas may provide the farmer with better liquidity (Jarvie and Nieuwoudt, 1989).

2.5 Crop insurance as a risk management vehicle for small scale farmers

The following lessons are drawn from this study.

1. Subsidised crop insurance for individual small-scale vegetable growers under irrigation will be more appropriate than area insurance. The reason is that risk faced by these growers is not of a systemic nature (correlation between yields for different farmers is low if drought is eliminated) and different farmers may experience different risks. It may, however, not be economically viable to insure vegetable crops of small holders under irrigation as crops are grown in small patches.

2. An area insurance plan (farmers are insured as a group) is proposed for dryland field crops such as maize because risk is systemic (drought related). In this Report the Group Risk Plan (GRP) whereby a farmer takes out insurance on a crop loss of the area is shown to be more cost effective especially for small scale farmers. The GRP has lower administration cost as individual farm yields are not required, and verification of individual farm losses is not needed. Further adverse selection and moral hazard are not issues.

3. A problem with crop insurance is that a large part of the cost to government goes to administration of the scheme and thus does not reach the target group (farmers). Due to the high cost of crop insurance to the government other strategies of risk management for small growers should be considered such an Income Equalisation Deposit (IED) scheme. This scheme will be discussed in the next section.

3 ECONOMIC FEASIBILITY OF INCOME EQUALISATION DEPOSITS (IED)

3.1 History
The IED proposal is that a farmer be allowed to build up a tax-free fund in good (high income) years and that he be assessed for income tax purposes on the income deposited in this fund only in the (bad or low income) years when it is withdrawn. According to Lamont (1990, pp 406-410) this proposal has been discussed at different times during the past 50 years but rejected every time in spite of attractive features. A main concern is that farmers may misuse the scheme. This criticism will be further discussed and a solution is offered.

3.2 Misuse of an IED
If an IED is used along with an averaging scheme which has an In/Out provision, then farmers may obtain tax benefits from destabilizing their income (Lamont, 1990, p369, 410). This possibility will be further explained. Current averaging schemes in South Africa (paragraphs 15
(3) and 19 (2)) have an automatic In/Out provision (Huxham and Haupt, 2000). That is, a farmer pays tax on his current income but he can elect that the tax rate be derived from a five year moving average of his farming income (paragraph 19 (2)). A further concession is that in a year when current farm income is below its moving average, he is taxed on current farm income at the rate that corresponds to that income. When current farm income is below average income, the farmer will be taxed at a rate lower than the rate that corresponds to the moving average income. The tax rate thus falls in a bad year, providing the farmer some relief in adverse conditions.

If an IED is used in conjunction with an averaging (In/Out) scheme then the farmer may derive benefit from deliberating destabilizing his income. The following example will illustrate this procedure. Assume that a farmer has a constant annual income of R50 000 per year. Assuming no other income, then his tax rate will be the rate that corresponds to an income of R50 000 per year. Assume now that he withdraws and deposits funds so that in some years his income is low and other years it is high. In years when his income is low, his tax rate will be zero (if income is below minimum scale), or at least lower than the rate that corresponds to approximate R50 000 per year income. In years when his income is high, he pays tax at a rate that corresponds to a R50 000 income.

To avoid misusing of an IED, a rule is required that no funds may be deposited in an IED if current taxable income is below the moving average taxable income. If this rule is applied no tax sheltering is possible. SARS (2000) at present require information on a farmers current income and his moving average income in terms of the income averaging rule.

3.3 Averaging farm income measures in South Africa

**Drought relief provision (Paragraph 13A of the South African income tax)**

If a farmer sells livestock because of drought and deposits the proceed with the Land and Agricultural Bank of South Africa, this deposit will not be included in his gross income. If he withdraws the money he will be taxed on the withdrawal (Huxham and Haupt, 2000, p192). The total amount invested under this provision on 31/12/1999 was R227.2 million (Marais, 2000) which is not an insignificant.

This drought relief provision is similar to an IED, the difference is that this provision only applies to the sale of livestock under drought conditions.

**Averaging of Taxable Income (Paragraph 19)**

This concession applies to all farmers and allows them to be taxed at a tax rate that corresponds to a moving average income. This concession is widely used by farmers. Average farming income is calculated as follows. The sum of the current year plus previous 4 year taxable income from farming is divided by 5. Tax is paid on actual (current) income at a rate based on his average income. If actual farming income is lower than the average farming income, tax will be paid on actual income. In the latter case the tax rate is based on actual income and not on average income.
The South African averaging scheme includes the In/Out provision as farmers automatically exit the average scheme when farm income is below the average. The latter provision was introduced because one of the serious drawbacks of a moving average scheme is that taxpayers are subject to a burdensome tax liability in years when they have little or no income. The In/Out provision meant that farmers are favoured by the taxation system in the sense that the tax rate is reduced below that of the tax rate of a moving average income. However, as a risk management strategy this provision provides the farmer with some tax relief in a bad year as his tax rate is calculated on his actual income in that year and not on his moving average income (which is higher).

3.4 Over capitalization in good years

The de Swardt Study Group recommended the introduction of IED=s in 1960 (Lamont, 1990, p406) to counter excessive capital expenditure in good years. Over capitalisation may be encouraged by generous tax depreciation allowances on the cash cost of any machinery, implements or utensils or articles (SARS, 2000);

The farmer can thus bring down his income tax in a good year by buying capital items. The farmer=s disposable income is higher with these high depreciation rates. In the absence of these high depreciation rates he/she may have postponed purchase. However, since the farmer can elect to be taxed on an average income, his income tax rate will not be higher in a good year. Most of the tax advantages from over-capitalization in good years thus may disappear as he/she does not face high marginal tax rates in such a year.

However, the instability in farm income may create instability in the Agri-support industries such in the input demand sector. If agricultural cash flow can be improved through risk management strategies (IED=s) then the rural sector and its support activities may benefit. In the following section the impact of farm income variations on the purchase of a durable capital asset namely farm tractors and machinery is studied (using data for 1976 to 1999) in order to determine whether there is a significant relation between farm income and purchases of capital items. The hypothesis is that purchases increase in good years because of better liquidity and also because of tax considerations.

The economic model used is that the demand for farm inputs is derived from the demand for the product (product produced by the inputs), the production function (the technical relationship between inputs and output) and the supply conditions of other inputs (other inputs that can replace input in question).

In the statistical model single equation investment functions are used as it is believed that current prices are predetermined in the non-farm sector. It is thus assumed that the supply of farm tractors and machinery is highly elastic and that the supply and demand functions of tractors and machinery need not be estimated simultaneously.

A demand model for farm tractors and machinery for the period 1976 to 1999 is specified in equation 1 where the original variables were transformed to logarithms (base 10).
\[ \log \left( \frac{Y_t}{CPI} \right) = -7.67 - 1.656 \log \left( \frac{P_t}{CPI} \right) + 1.729 \log \left( \frac{I_t}{CPI} \right) \]

\( (t = -3.04) \quad (t = 4.41) \) (1)

Where
- \( Y_t \) = annual purchases of tractors and machinery in million rand for year \( t \) (NDA, 2000).
- \( CPI \) = consumer price index (1995 = 100) (STATSSA, 2000)
- \( P_t \) = Price of tractors and machinery, year \( t \) (1990 = 100) (NDA, 2000)
- \( I_t \) = gross value of field crops and horticultural products in thousand rand (NDA, 2000)

\[ R^2 = 0.681 \]
\[ DW = 1.51 \]

According to model 1, the t values are highly significant while the adjusted \( R^2 \) is good. Of the total variation in the dependent variable, 68% is explained by the model. The conclusion is that the real purchases of tractors and machinery are negatively related to real prices of this item and positively related to gross income of crops and horticultural products.

The above model was estimated in two stages. In the first stage, autocorrelation was serious. The Theil-Nager estimate of the autocorrelation coefficient \( \rho \) was used (Gujarati, 1988, p 392) as the sample is relatively small. The estimated \( \rho \) was lagged out of the original variables and the model was re-estimated in the second stage and expressed in terms of its original variables. After the second stage the Durbin-Watson = 1.51 which is near the upper bound of the indecision stage (\( d_L = 1.188 \), \( d_u = 1.546 \)).

As model 1 is expressed in logarithms, coefficients are elasticities. Model 1 indicates that a 1% increase in real gross income from crops and horticultural products is estimated to increase real purchases of tractors and machinery by 1.73% in the same year. A 1% increase in real prices of tractors and machinery is expected to depress real purchases of the durable item by 1.66%. In both cases, the impact on purchases is more than proportionate to the change in the exogenous variable (\( P_t/CPI \) and \( I_t/CPI \)).

As fluctuating farm incomes appear to have a disproportionate impact on purchases it indicates that the instability of agricultural incomes may have ripple effects on the agric-support sectors such as the farm input supply sectors.

The reasons why farmers buy more inputs in good years could be (a) better liquidity in a good year and (b) possible tax advantages. Case (b) implies that under an IED, agricultural income taxes will increase. It is concluded that improving the cash flow of farmers, may have income stabilising impacts on the Agri-support sectors.

### 3.5 Income equalisation deposits in other countries

The features and tax implications of income averaging schemes will be discussed in selected countries.
Australia

The present IED scheme in Australia is called Farm Management deposits (FMD=s). FMD=s have the same purpose as IED=s namely to encourage farmers to save money in good times for use in bad times. A tax deduction is allowed when an amount is invested while it is taxed when it is redeemed. FMD=s provide a tax linked savings tool for farmers which can complement other risk management strategies such as developing fodder and water reserves, financial planning, diversification of production systems, forward selling and future contracts. The purpose is to improve the viability and sustainability of farm businesses (Petrolati, 2000).

Most Australian farmers are taxed on an averaging system. They pay tax on their current (present year) primary production income and limited non-primary production income at the rate applicable to their average taxable income for the past five years. This is identical to the current South African income averaging provision except that Australian farmers do not have the advantage of the South African In/Out system. That is Australian farmers pay tax based on the rate calculated for a moving average income whether taxable income is above or below the moving average income. As farmers do not have the In/Out provision of the averaging scheme, they can not misuse an FMD by deliberately destabilizing income in order to obtain tax advantage.

Canada

Canada instituted a programme to help producers achieve long-term farm income stability on an individual basis, referred to as the Net Income Stabilization Account (NISA). Producers can make deposits in their NISA accounts and receive matching contributions from the government. In lower income years, producers can make withdrawals from the funds. The NISA account operates as an IED. The main difference is that under NISA, Canadian farmers receive significant matching contributions from the State.

3.6 Conclusions regarding adopting an IED in South Africa

Possible capital bunching in good years was studied. Research conducted in this study for the period 1976-1999, indicates that purchases of tractors and machinery are positively associated with gross income from crops and horticultural crops. The income (proxy for liquidity) elasticity was estimated at 1.7 indicating that a 1% increase in real gross income is estimated to lead to a 1.7% increase in real purchases of these capital items. The increase in farm income has a greater than proportional impact on capital purchases. If farmers have access to an IED then this bunching of capital purchase may be less which will also have a stabilizing impact on the non farm sector.

Disastrous droughts are common in Southern Africa which have lead to massive state support in the past. These droughts affect the whole Agri support sectors with implications on employment. Droughts are recurring and risk management strategies should be pro-active and not reactive. Most disaster assistance goes to high risk areas which promotes crop intensification in marginal areas. It is unlikely that the SA Government will consider disaster assistance in a favourable light in future.
An IED will promote better cash flow over time and risk management and it is shown that an IED could be feasible in the South African situation. A very desirable feature of an IED is that it is a >self help= scheme.

The main recommendations are:

(i) That an IED be adopted in SA on the lines of the Australian FMD. An IED comes at little cost to the state as especially administration cost is not an issue.

(ii) To avoid the situation that an IED be used to destabilize income for tax benefit using the South African in/out provision it is recommended that a tax rule be adopted that funds not be deposited in a year if actual income in that year (current) is below the moving average income.

(iii) It may be possible to replace the livestock scheme (Paragraph 13A) with an IED, and have one scheme (IED) that caters for both crops and livestock while the above rule applies to both enterprises.

(iv) An IED for small growers should receive serious consideration with the government making a contribution as for example in Canada. Instead of the government paying R133 for every R100 that a grower pays for crop insurance the government could make a matching contribution to small growers, with the contribution being gradually phased out when the grower=s turnover say reaches R50 000. If an IED for large scale commercial farms is accepted then this will provide a logical link between the drought assistance provided to small and large scale farming. An IED for small growers can include all enterprises namely crops, horticultural crops and livestock. It will thus be of a more inclusive strategy than crop insurance. In addition an IED does not have the problems that are inherent in crop insurance (asymmetric information etc). A main issue in South Africa is the high cost of delivery of crop insurance to very small growers while information is not readily available.

4. ANALYSIS OF FACTORS AFFECTING THE ADOPTION OF AN IED

Twenty-four consultants (tax experts) in South African production areas were asked during 2000 under what conditions they will recommend an IED to a farmer. (For more information see Lishman and Nieuwoudt, 2001). Areas were selected to obtain the views of consultants that dealt with tax matters for a range of farm situations, from relatively low risk livestock and diversified farmers in KZN (less variable net farm incomes), to relatively high risk maize farmers (more variable net farm incomes) in the Maize Triangle and adjacent regions.

Each consultant was asked to review nine scenarios of typical farms in the study regions and to decide whether they would recommend an IED scheme for each scenario. These farms were depicted using four variables that showed different levels of farm business leverage (debt/asset ratio), net farm income, business risk (index of net farm income variability), and off-farm income, based on representative farm record data supplied by the National Department of Agriculture. An experimental design was used in constructing the scenarios (Cochran and Cox, 1957 p235) that will allow for the study of main effects and interactions. Debt/asset ratios ranged from under 15 percent to over 40 percent, while net farm income ranged from a low of less than R50 000 per annum to a high of over R300 000 per annum. The index of net farm income
variability was shown for each year during 1995-1999 by expressing annual net farm income in each year as a percentage of the average net farm income over the five-year period. In this way, the index for high risk maize farmers (ranging from -30 to 276 around a mean of 100) showed far more net farm income variability than the index for low risk livestock farmers (ranging from 58 to 124 around a mean of 100). Annual off-farm incomes typically ranged from zero to a high of over R20 000 on the study area farms.

Discriminant analysis using standardised coefficients was used to estimate which of the four variables best distinguished between scenario farms that the consultants would and would not consider as likely users of an IED scheme. The research hypothesis was firstly, that more highly leveraged (higher debt/asset ratio) farmers would less readily invest in an IED as they had more pressing debt commitments. Secondly, farmers with higher net farm incomes would more likely use an IED, as they had the means to make deposits. Thirdly, IEDs would suit farms having a higher index of net farm income variability as they are exposed to more business risk. Finally, higher levels of off-farm income may indicate clients that have diversified investments and so are less likely to need an IED. The appropriate Discriminant model, therefore, to separate potential users and non-users of an IED scheme was

\[ D_i = -\alpha_1 DA + \alpha_2 NFI + \alpha_3 RISK - \alpha_4 OFI \] ..........(1)

where \( D_i \) gives the discriminant score of the \( i \)th farm scenario; \( \alpha_1 \ldots \alpha_4 \) are the standardised coefficients; \( DA \) is the debt/asset ratio; \( NFI \) is net farm income; \( RISK \) defines the index of net farm income variability; and \( OFI \) is off-farm income. Results are presented in Table 1.

The research hypothesis implies that potential users of an IED would have higher estimated discriminant scores than non-users for equation (1). Two discriminant models are presented in Table 1. Model 1 consists of the main effects and Model 2 consists of the main effects with an interaction effect. The overall Chi-square value (significant at the 1% level of probability) in both models indicates that, collectively, the explanatory variables in each model distinguish significantly between adopters and non-adopters of an IED scheme. The Wilks’ Lambda in both models indicates a high level of discriminating power. In addition, the Eigenvalue (ratio of between-groups to within-groups sum of squares) and the Canonical correlation (measure of degree of association between the discriminant scores and group membership) indicate good predictive models. Both models correctly classified 94% of overall cases. Due to the restrictions imposed by the statistical model, no hold-out sample was used in determining classification rates. The relationships (coefficient signs) between dependent and independent variables were in accordance with \textit{a priori} expectations. In Model 1, the debt/asset ratio (DA) was found to be the most important variable (highest standardised coefficient) distinguishing between adopters and non-adopters. The negative sign of the variable indicates that, \textit{ceteris paribus}, farmers with lower debt/asset ratios are more likely to make use of an IED scheme. The second most important distinguishing variable was net farm income (NFI). The sign was positive which confirms that, \textit{ceteris paribus}, farmers with high net farm incomes are more likely to invest in an IED scheme. The third most important variable was that of the index of variation in net farm income (RISK). The sign was positive indicating that, \textit{ceteris paribus}, maize farmers with high variation in net farm income are more likely to invest in an IED scheme than livestock farmers with low variation in net farm income. This indicates that the scheme could act as a potential risk management strategy. The fourth distinguishing variable listed was that of off-farm income (OI). Even though
the standardised coefficient was found to be non-significant, it was retained in the model as the sign of the coefficient and its magnitude are of significance to the adoption of an IED scheme. The non-significant sign of the coefficient indicates that, ceteris paribus, off-farm income will not be invested in an IED. This implies there are no gains to be made in the misuse of the scheme as a tax shelter.

Table 1 Results of the discriminant models identifying adopter and non-adopter characteristics of an IED scheme, sample of SA consultants, 2000 (n=192)

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standardised coefficient</td>
<td></td>
</tr>
<tr>
<td>DA</td>
<td>-0.955*</td>
<td>-0.956*</td>
</tr>
<tr>
<td>NFI</td>
<td>0.879*</td>
<td>0.880*</td>
</tr>
<tr>
<td>RISK</td>
<td>0.756*</td>
<td>0.756*</td>
</tr>
<tr>
<td>OI</td>
<td>-0.111</td>
<td>-0.111</td>
</tr>
<tr>
<td>RISK_DA</td>
<td></td>
<td>-0.067</td>
</tr>
</tbody>
</table>

| Discriminant function statistics | Statistic | |
|----------------------------------|-----------|
| Chi-square                       | 203.871*  | 203.878* |
| Wilks= Lambda                    | 0.338     | 0.338    |
| Canonical correlation            | 0.814     | 0.814    |
| Eigenvalue                       | 1.958     | 1.966    |

<table>
<thead>
<tr>
<th>Overall classification</th>
<th>Adopters</th>
<th>Non-adopters</th>
<th>Adopters</th>
<th>Non-adopters</th>
</tr>
</thead>
<tbody>
<tr>
<td>% correctly classified</td>
<td>100.0</td>
<td>89.7</td>
<td>100.0</td>
<td>89</td>
</tr>
<tr>
<td>Overall % correctly classified</td>
<td>94.3</td>
<td>94.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * signifies statistical significance at the 1% level of probability

In Model 2, an interaction variable was tested with the main variables. The main variables were all in accordance with the results obtained in Model 1. The standardised coefficient of the interaction variable (RISK_DA) was found to be non-significant but retained in the model to reveal its contribution to the adoption of an IED scheme. The negative sign of the variable indicates that, ceteris paribus, maize farmers with a high index of variation in net farm income carrying high debt are less likely to invest in an IED. In the consultants= views, high variability in net farm income (business risk) coupled with high debt (financial risk) may increase a farmers total risk but the farmer should first redeem the debt before investing in an IED.
The discriminant function, obtained from Model 1, using unstandardised coefficients that separates potential users and non-users of an IED scheme is presented below. In Model 1, high risk maize farmers (high income variability) were compared to low risk livestock farmers with (low income variability). By substituting the standard deviations for the (RISK) variable in the discriminant function, all possible combinations of income variability with farming type could be exploited. Specific samples from the scenarios were selected depicting different combinations and levels of the explanatory variables. With the use of the discriminant function, the potential membership of a specific case (sample) could be predicted based on the discriminant score. The off-farm income variable (OI) in Model 1 was statistically non-significant and was therefore retained with a low score (0) as it had no influence on the outcome of the discriminant scores. As the interaction effect in Model 2 was also statistically non-significant, no discriminant function was presented for Model 2.

\[ D_i = 1.65 - 2.249DA + 1.984NFI + 0.009RISK - 0.22OI \ldots (2) \]

The results indicated that maize, livestock and diversified farmers carrying large amounts of debt (>40%) are less likely to invest in an IED scheme. Only maize farmers with high income variability and high net farm incomes are most likely to make use of an IED scheme. The positive effect of the net farm income and risk variable was enough to offset the negative effect of the debt/asset variable in this particular sample. The relative contribution of the debt variable in the analyses indicated the importance of this variable in distinguishing between adopters and non-adopters of an IED scheme.

In the consultants’ view, farmers with higher net farm incomes (>R300 000), lower debt/asset ratios (<15%), more variable net farm incomes, and less off-farm income would more likely use an IED scheme. In terms of ranking, high risk maize farmers, intermediate risk maize farmers and high risk livestock farmers are more likely to use an IED than are low risk maize farmers, livestock farmers and diversified farmers. Since maize farmers have been the main beneficiaries of past government drought aid, this could mean reduced demands on government drought relief funds in future if an IED scheme is introduced.
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