Financial Management and Risk on Woolgrowing Properties

by

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Abstract

One widely accepted presumption is that financial deregulation has lead to a substantial increase in the risk associated with credit and has now made it a major component of the total risk environment of farm businesses. In this study, a stochastic budgeting model (RISKFARM) was used to simulate the financial and risk effects of a range of financial strategies under the contrasting conditions of uncertainty and perfect information regarding interest rates. Financial uncertainty was found to be a very important factor in the total risk environment of woolgrowing enterprises. However, as a general rule, the stochastically efficient strategies tended to be found under those conditions. This suggests that, for woolgrowers prepared to be proactive in financial management, deregulation appears to offer net benefits. These results are qualified by the case and context-sensitivity inherent in case study analyses.

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Introduction

Farm management in Australia is becoming an increasingly involved and complex task. Micro and macroeconomic reforms over the past decade and a half have seen agricultural businesses increasingly exposed to the vagaries of financial markets, world commodity markets and international economic forces (Milham and Hardaker 1990; Powell and Milham 1990). As a result, opportunities for farmers to concentrate their efforts purely on the production aspects of their enterprises are being increasingly curtailed. To maintain financial viability, farm managers now have to have, or have ready access to, substantial skills in financial management and commodity marketing, as well as traditional farming skills. In the study reported here[1], the focus was on farm financial management and the risk implications of various financial structures and finance conditions.

Financial Deregulation and Farm Financial Risk

In 1977, Anderson *et al.* stated: 'Agricultural firms typically are competitive, face known input prices but uncertain product prices, and face uncertainty in some of the factors that influence the quantity and quality of the output they produce.' (p.160) In their view the costs of farm inputs in a particular planning period, one of which is debt finance, were not subject to a significant degree of uncertainty. And, at that time, their conclusion may well have been a valid generalisation. However, since then, there have been substantial changes to the operating environment of Australian farm firms. One change in particular has been the extensive deregulation of finance markets.

The essence of any deregulation is the increased decision making responsibility given to individuals and firms. They also have to bear the consequences of those decisions. Some aspects of the 1980s farm crisis highlighted the failure of many lenders and farmer borrowers to adapt pre-deregulation strategies and financial structures to the new, more uncertain and risky, conditions. The deregulated financial sector provided no shelter from the effects on the monetary sector of macroeconomic trends and policy. Nominal interest rates rose to over 20 per cent and many farmers became insolvent. Some lenders also incurred large losses. It was apparent that many lenders and borrowers were inadequately prepared for operating in a deregulated economic environment (Brown 1987; Powell and Milham).

The deregulation of financial markets was expected to ensure that finance was provided as cheaply as possible and to improve efficiency in financial markets by increasing competition and stimulating innovation in finance products and packages. From the perspective of a decade

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[1]The paper is a summary of the results of a WRDC-funded project and the principal author's post-graduate research.

later, many such innovations have occurred and finance products now exist that have the potential to enable financial needs to be met more efficiently (Powell and Milham). However, the deregulation of financial markets also had serious implications relating to the pricing of financial services, financial risk and risk taking.

With the removal of restrictions on pricing, particularly interest rates, it was expected that price would become the mechanism for the rationing and allocation of available credit. Expectations were that, for lenders, varied pricing arrangements would be used to differentiate among borrowers for perceived differences in risk, while, for borrowers, the relative costs of the now wider and more available selection of alternative financial products would assume an important role in the financial planning process. There is evidence that, at least to some degree, financiers are now using interest rates to differentiate between clients and, for farmers, the most apparent outcomes of financial deregulation have been the rising cost of credit and increased uncertainty associated with that cost.

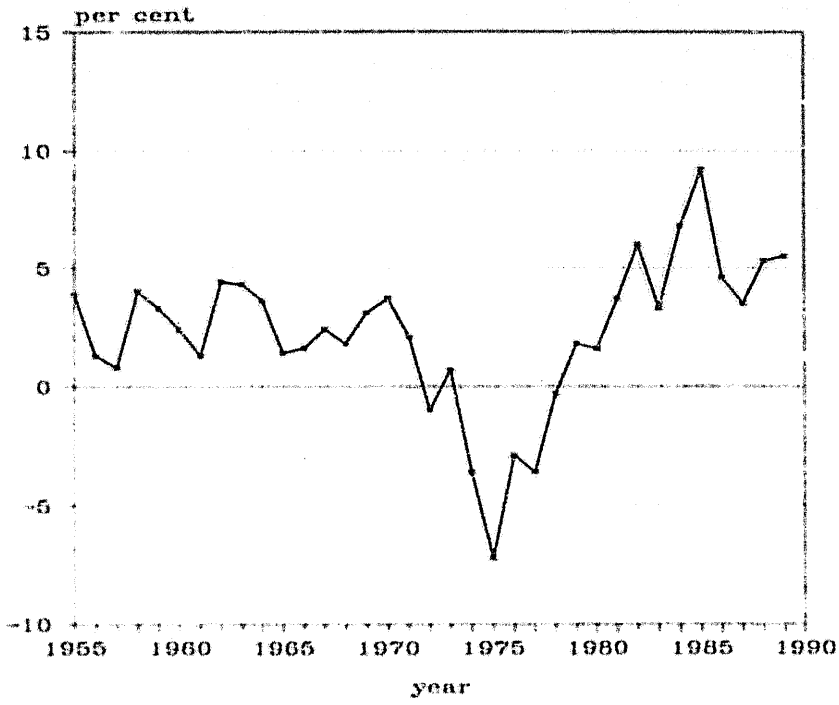
The stage has now been reached where almost all farm financing is undertaken by the private sector at market-determined interest rates, and during the past decade interest rates have fluctuated unpredictably and have maintained historically high levels (Figure 1). As a result, commentators have reported a rapid rise in the costs of servicing farm debt in the 1980s and highlighted the importance of sound financial management for the continued viability of farm businesses (Bowman 1985; Bowman and Powell 1986; Powell and Milham). Furthermore, much of the risk in financial transactions is now passed on from the lender to the borrower through variable interest rate lending. Thus, farm credit now has an uncertain component that was not so important in the former, more regulated, environment (LaDue and Leatham 1984; Powell and Wright 1987). Financial deregulation has changed the nature of financial risk and possibly made it a more important component of the total risk environment faced by farmers. At the same time, developments in the financial sector have provided farmers with some additional options in managing risks.

Financial Risk and Total Risk in Farming

Financial risks express the cost and availability of credit and are reflected partly in interest rates and partly through non-price sources such as differing loan

Figure 1

Real Long-Term Interest Rates, Australia: 1955 - 1989



Source: Powell and Milham (1990, p.225)

limits, security requirements, loan maturities and loan supervision and documentation (Barry 1983; Cumming and Parton 1990).

Following Barry (1983) and Barry and Baker (1984), the contribution of uncertain finance costs to the total risk faced by farmers can be expressed as follows:

$$(1) \qquad TR = [s_a/\bar{r}_a].[\bar{r}_a P_a/(\bar{r}_a P_a - i_d P_d)] \quad ,$$

where TR is total risk, s_a and $\bar{r}_a$ are the standard deviation and expected return to equity of the portfolio of risky farm assets; P_a and P_d are the respective proportions of risky and risk-free assets in the portfolio; and, i_d is the interest rate on risk-free assets.

The first term on the right hand side of this equation represents business risk and the second term is the financial leverage multiplier, which is the index for financial risk (Barry; Barry and Baker; Collins 1985). When risky finance is obtained from external sources, the leverage effect is to increase the second term and multiply business risk. That is, if interest rate uncertainty exists, debt finance increases total risk (assuming there is no positive correlation between interest rates and business returns) relative to a situation of predictable interest rates (Barry and Baker). This means that financial gearing, i.e., the relative level of debt to equity finance used, has the potential to magnify the riskiness of return on equity outcomes arising from farm activities.

Research Objectives and Hypotheses

In recent years, considerable public and academic pressure has been exerted on farmers to increase the resources allocated to financial management. [As examples, see Australian Bankers Association 1987, Barry and Baker, Brown, and Milham and Hardaker.] However, farm management resources are scarce and need to be allocated efficiently in order to maximise profitability and the prospects for long-run financial viability. Only if the benefits of increasing financial management resources outweigh the opportunity costs of alternative uses of those resources will this be an effective strategy. These benefits and costs must be measured in terms of risk.

The optimal management of risk requires awareness of, and action in, all the areas in which uncertainty arises. That is, it requires recognition that '... a portfolio of risks exists alongside a portfolio of risk management strategies, and that optimising will involve determining both the level of risk taken and the most cost-effective strategies in achieving that level.' (Powell and Milham, p.237)

A primary objective of this research was to examine the effectiveness, in terms of reducing risk and improving financial viability, of selected farm-level financial risk management strategies for Australian woolgrowers. Alternatives in this area include asset insurance, maintaining liquid asset reserves, manipulating financial structure, and taxation provisions related to income smoothing, such as income equalisation deposits. A secondary objective was to investigate the contribution to total risk for woolgrowers of financial uncertainty. In this context, a model was constructed and experiments designed to test the following hypotheses:

(1) That, under a given and fixed production plan, use of fixed price (interest rate) credit facilities will reduce total risk in net cash flow and wealth outcomes for a woolgrowing business.

(2) That, under a given and fixed production plan, manipulating financial structure so as to reduce debt will reduce total risk in net cash flow and wealth outcomes for a woolgrowing business.

(3) That, under a given and fixed production plan, utilising income equalisation deposits to smooth the taxable income of a woolgrowing business will reduce total risk in net cash flow and wealth outcomes.

(4) That financial uncertainty contributes significantly to total risk in net cash flow and wealth outcomes on woolgrowing properties.

Analytical Approach

To achieve a predictive understanding of farmers' decisions will often require an intimate study of the realities of farm production and of farmers' attitudes. It is thus appropriate to carry out empirical investigations into risk management in agricultural firms at the level of the individual farm. It is particularly appropriate in Australia where most farms are owner-operated and almost all management decisions are made at the farm-level.[2]

> 'The case study approach involves intensive, detailed study of only one or a few farms. The objective of this study is to learn, not only what is happening on the study farms, but why, i.e., to elucidate the cause and effect relationships that operate. This process of elucidation is often facilitated by studying more than one case. Two or three contrasting cases, by way of their very differences, may make it easier to identify important factors leading to the results observed'. (Dillon and Hardaker 1980, p.30)

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[2]Some management decisions may be forced upon individual farmers as conditions of financial arrangements or as requirements for receipt of rural assistance.

This approach enables the simultaneous collection of the production and financial data required for the analysis, and the elicitation of subjective probabilities for uncertain decision variables. These data and probabilities provide a unique combination that reflect the actual situation, expectations and responses of a particular agricultural producer. The analysis and the results obtained thus have a realism and immediate applicability that can be difficult to achieve with a 'representative' or 'average' farm approach. For this study, a sample of four contrasting woolgrowing enterprises in eastern Australia was selected.

Dynamic stochastic budgeting experiments based on the case study data were conducted using the RISKFARM model (Milham 1992; Milham, Hardaker and Powell 1992; 1993). Maximisation of subjective expected utility, determined by applying the technique of stochastic dominance with respect to a function, was the criterion used to rank the strategies. This ranking provided the basis for judgements as to whether or not to reject the stated hypotheses.

Stochastic Dominance with Respect to a Function

Given the complexity of the real world, it is unlikely that it will be possible immediately to distinguish between, and thus order, all risky prospects. The task for the analyst is to find a means of reducing the size of the choice set down to a smaller subset, ideally with one or very few elements, that contains the prospect with the highest expected utility.

The case for stochastic dominance arises when either there is no single identifiable decision maker, or when it is not feasible to derive a utility function for the identified decision maker. However, if something is known about the risk attitudes of the decision maker, the methods of stochastic efficiency analysis can be used to partition risky prospects. In the field of agricultural economics, stochastic dominance with respect to a function (Meyer 1977a, 1977b) - also referred to as the Meyer criterion, generalised stochastic dominance and generalised stochastic efficiency analysis - has been widely used for this purpose. (See, for example, da Cruz and da Fonseca Porto 1988, King and Robison 1981 and Kramer and Pope 1981.)

The basis of stochastic dominance with respect to a function (SDRF) lies in the expected utility theorem, and it operates in a fashion that allows the ranking of risky prospects consistent with the maximisation of expected utility. It is a criterion which establishes necessary and sufficient conditions for the distribution of outcomes defined by the cumulative distribution function $F(w)$ to be preferred to the function $G(w)$ by all agents whose absolute risk aversion functions lie everywhere between lower and upper bounds $r_1(w)$ and $r_2(w)$. [For first degree stochastic dominance the range is $\infty \leq r_A(w) \leq \infty$, while for second degree stochastic dominance the range is $0 \leq r_A(w) \leq \infty$, i.e., all risk averters.] Thus, SDRF is demonstrated when the utility function which minimises

$$(2) \qquad \int_{-\infty}^{\infty} [G(w) - F(w)].U(w)\,dw$$

subject to

$$(3) \qquad r_1(w) < -U''(w)/U(w)' < r_2(w)$$

is found and the integral is still positive. This corresponds to the identification of the utility function in the admissible class which is least likely to result in the expected utility of risky prospect F being greater than that of risky prospect G. If it can be shown that F is preferred to G for that function, then it is known that the result will hold for the entire class of admissible functions.

The Generalized Stochastic Dominance software program developed in the Department of Agricultural Economics and Rural Sociology at the University of Arkansas (Raskin and Cochran 1986) provides a useful pre-fabricated means of applying SDRF analysis to simulation results

Design of the Experiments

Dumsday and Edwards (1990) identify two objectives that characterise the behaviour of Australian farmers. The first is that of wealth maximisation and the second is that of maximisation of short-run cash flow. They argue the first objective is the most pervasive, with the second objective primarily being a temporary phenomenon describing '...the behaviour of farmers with very low incomes together with substantial debts' (p.97). These conclusions were supported by the results of a small informal survey of woolgrowers carried out prior to the development of the RISKFARM model. Hence, from the wide range of annual financial performance measures produced by RISKFARM, only net worth and net cash flow[3] were selected for analysis.

Under the first hypothesis it was postulated that the use of fixed interest rate credit facilities, as opposed to variable interest rate facilities, could significantly reduce total risk in financial outcomes for a woolgrowing business. To test this hypothesis, a simulation experiment was designed involving refinancing variable interest loans into a fixed interest, interest-only, liability at the beginning of the 1992 financial year. The magnitude of this liability was determined as the sum of existing loans, including overdraft debt, and any forecast cash

[3]Whether net cash flow evidences the inverse relationship with risk aversion strictly required for application of stochastic efficiency analysis (Pratt 1964) has not been empirically determined. However, since this relationship can be demonstrated for income (Anderson 1970) it seems a reasonable intuitive assumption that it would also exist for net cash flow, which is closely related to income.

operating deficit in 1992 (see Table 1). The fixed interest rate was assumed to be 14 per cent per annum, the (then) current market rate for these types of loans.

Under hypothesis 2 it was postulated that manipulating financial structure so as to reduce debt would lead to a significant reduction in total risk. Management action in this regard was assumed to involve the sale of assets to enable accelerated repayment of debt. Discussions with the co-operating graziers indicated that only off-farm assets, particularly financial assets, would be considered for this purpose. Furthermore, if debt reduction took place, it was deemed most likely that it would also involve refinancing into a fixed interest facility. Hence, experiments involving the redemption of financial assets, reducing debt and locking-in an interest cost were designed for Cases A and B, the only ones with substantial off-farm assets (see Table 1). It should be noted that selling financial assets to reduce debt involves a number of adjustments to farm financial structure and cash flow. First, there is the direct reduction in business assets with an associated equivalent, but probably not proportional, reduction in liabilities. Second, there is the reduction in investment income and, third, there is the reduction in interest expenses.

The experiments for testing Hypothesis 3, relating to the use of IEDs, involved using the same scenarios formulated for testing Hypothesis 1, with the additional decision rule that if net taxable income in any year was positive (negative) then, if possible, an income equalisation deposit would be made (redeemed) This strategy focuses on reducing intertemporal variations in taxable income

Table 1
Simulation Experiments

	Case A	Case B	Case C	Case D
	$	$	$	$
Hypothesis 1				
Loans refinanced and locked-in at 14%				
- amount	200000	100000[a]	240000	250000
- fee	4000	2000	4800	5000
Hypothesis 2				
Assets sold and debt reduced and locked-in at 14%				
- sales amount	150000	100000	na	na
- debt refinanced	50000	0	na	na
- fee	1000	0	na	na
Hypothesis 3				
Lock-in interest rates as for Hypothesis 1 and invest in IEDs if taxable income would otherwise be > 0				
- IED amount determined during simulation	?	?	?	?
- loan amount	200000	100000	240000	250000
- fee	4000	2000	4800	5000
Hypothesis 4				
Degenerate stochastic interest rates to their mean values and simulate each of the above scenarios again				

[a]Case B already has a debt of $300,000 with a fixed interest rate of 14.3% per annum;
na = not applicable.

Under the fourth hypothesis it was postulated that uncertainty in financial variables contributes significantly to total risk in financial outcomes on woolgrowing properties. This hypothesis is closely related to Hypothesis 1 but is more general in nature and was tested in a quite different way. The approach taken was to degenerate all of the stochastic interest rates to their mean values[4] and conduct simulation experiments using those values. Unlike simply locking-in a fixed interest rate on some borrowing's (Hypothesis 1), this degeneration procedure removed the uncertainty associated with those costs without removing the predicted variation through time. Further, this procedure also removed uncertainty from overdraft interest rates and yields on financial investments. That is, all interest rates were still allowed to vary through time, but in a known way.

Results

The five per cent percentile values of the cumulative distribution functions generated for the net worth and net cash flow outcomes, together with the mean and variance for each distribution, for each farm for each experiment are reported in Milham (1992). Table 2 contains a summary of the final results of the stochastic dominance analysis of those distributions

In these tables, the suffix "L" on the strategy code indicates that these results were generated under conditions of financial certainty. Where strategies are grouped together, this indicates that the assumed utility function and risk attributes used in the SDRF analysis did not provide sufficient information to rank them.

Case Study A

Eight simulation experiments were conducted in Case A in order to identify the manner in which the four strategies outlined in Table 1 influenced business performance under the contrasting conditions of financial certainty and financial uncertainty. In summary, the mean net cash flow outcomes for all the strategies trended downward from the end of the 1991 financial year and were at their lowest levels at the end of 1995. The mean net worth, or wealth, outcomes across the four strategies all declined until 1993 and then trended upward to be at their highest levels in 1995. The lowest generated mean value for net worth in the 1993 financial year still exceeded $1.8 million.

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[4]This procedure is a menu option in @RISK , the software used for the stochastic budgeting, and is thus straightforward to carry out.

Table 2

SDRF Ranking of Net Worth and Net Cash Flow Outcomes

	Net Worth Outcome	Net Cash Flow Outcome
Case A		
Most Preferred	FANOTHL	FA200L
	FANOTH	FA200
	FAIED	FAIED
	FA200; FA200L	FAIEDL
	FAIEDL	FAASSL
	FAASS; FAASSL	FANOTHL
		FAASS
Least Preferred		FANOTH
Case B		
Most Preferred	FBIED	FBIED
	FB100; FB100L	FB100
	FBASS; FBASSL FBNOTH	FBIEDL
	FBIEDL	FB100L
	FBNOTHL	FBASSL
		FBNOTH
		FBASS
Least Preferred		FBNOTHL
Case C		
Most Preferred	FC240; FCIED; FCIEDL;	
	FCNOTH; FCNOTHL[a]	FCIEDL
	FC240L	FC240
		FCIED
		FC240L
		FCNOTH
Least Preferred		FCNOTHL
Case D		
Most Preferred	FD250; FD250L	FD250; FD250L
	FDIEDL	FDIED
	FDIED	FDIEDL
	FDNOTHL	FDNOTH
Least Preferred	FDNOTH	FDNOTHL

[a]Complete ordering of the net worth outcomes was obtained with the coefficient of relative risk aversion set in the range of unity to two. For this interval, the preferred strategy under conditions of financial uncertainty was to do nothing. Under financial certainty, the dominant strategy was to invest in IEDs. Note: $r_A = r_R/w$.

The results of the stochastic dominance ranking of the net worth and net cash flow outcomes from these experiments for the 1995 financial year are shown in Table 2. The legend in this table is interpreted as follows:

- FA200 is the strategy involving locking-in a debt of $200000 at 14 per cent;
- FAASS refers to the strategy of liquidating financial assets and locking-in a debt of $50000 at 14 per cent;
- FAIED represents the strategy in which income equalisation deposits are used in conjunction with a locked-in debt of $200000; and,
- FANOTH is the strategy of maintaining existing financial structure and arrangements, i.e., doing nothing.

The SDRF analysis indicates that, under both financial uncertainty and financial certainty, the FANOTH strategy lies most to the right and would be the most efficient strategy in terms of maximising expected utility from wealth. One unexpected and surprising feature of these results is the high ranking of many of the strategies under conditions of financial uncertainty. *A priori* expectations were that, for a particular strategy, the outcome distributions under perfect financial information would dominate those obtained under financial uncertainty. In fact, this is frequently not the case. Results of this nature were obtained in all four case studies. Some discussion, and an intuitive explanation, of this aspect of the results is provided later in the paper.

Reading from Table 2, in order of dominance, the strategies under (i) financial uncertainty are: FANOTH, FAIED, FA200 and FAASS; and (ii) financial certainty are: FANOTH, FA200, FAIED and FAASS. In comparing the strategies across the two states of financial information, the strategy of taking no action under financial certainty was found to be dominant (FANOTHL) in terms of the net worth outcome.

The stochastic efficiency ordering of the strategies is somewhat different when determined in the context of maximising expected utility from net cash flow. Under financial uncertainty, the strategies are ordered preferentially from FA200 to FAIED then FAASS and, finally, FANOTH. The ordering is the same under financial certainty. In comparing the strategies across the two financial states, the strategy of locking-in $200000 at 14 per cent under financial certainty (FA200L) was found to be dominant for the net cash flow outcome.

Case Study B

Eight simulation experiments were conducted in Case B. In all cases, the wealth outcome showed a continuous upward trend and the net cash flow outcome, conversely, demonstrated a

continuous downward trend over the model period. Net cash flow and wealth were thus at their lowest and highest levels respectively, at the end of the 1995 financial year.

The codes for the experiments on this property are interpreted as follows:

- FB100 is the strategy involving locking-in a debt of $100000 at 14 per cent;
- FBASS refers to the strategy of liquidating financial assets to provide operating finance (and thus avoiding the necessity of obtaining credit);
- FBIED represents the strategy in which income equalisation deposits are used in conjunction with a locked-in debt of $100000; and,
- FBNOTH is the strategy of maintaining existing financial structure and arrangements, i.e., doing nothing.

The results of the SDRF analysis for the experiments in Case B are summarised in Table 2. As shown, the income equalisation deposit strategy (FBIED) is the dominant strategy for maximising expected utility from net worth under conditions of financial uncertainty. Strategy FB100 is next preferred, followed by FBIED and FBASS, which cannot be ordered. Under financial certainty the dominant strategy is FB100L, i.e., borrowing $100000 at a fixed rate of 14 per cent. The remaining strategies in order of declining preference are FBASSL, FBIEDL and FBNOTHL. The strategy of locking-in a debt of $100000 and utilising IEDs (FBIED) was found to be dominant in terms of maximising expected utility from wealth when comparing the strategies across the two financial states.

The SDRF analysis also revealed strategy FBIED as the dominant strategy for net cash flow under both financial uncertainty and certainty. Further, this strategy was most efficient under financial certainty. Within the financial uncertainty category, the ordering from the most to least efficient strategy is FBIED, FB100, FBNOTH and FBASS. Under conditions of financial certainty the ranking is FBIEDL, FB100L, FBASSL and, lastly, FBNOTHL.

Case Study C

Six simulation experiments were conducted in Case C. Both the net worth and net cash flow outcomes for all strategies evidenced downward trends over the model horizon for this farm business. They were thus both at their lowest levels at the end of 1995.

The codes for the experiments shown in Table 2 are interpreted as follows:

- FC240 is the strategy involving locking-in a debt of $240000 at 14 per cent;
- FCIED represents the strategy in which income equalisation deposits are used in conjunction with a locked-in debt of $240000; and,

- FCNOTH is the strategy of maintaining existing financial structure and arrangements, i.e., doing nothing.

With the range of the coefficient of relative risk aversion r_R set at unity to three, no dominant strategy could be determined in terms of maximising expected utility from net worth. When the upper bound on r_R is reduced to from three to two, FCNOTH proves to be the most efficient strategy under conditions of financial uncertainty. The income equalisation deposit strategy (FCIEDL) is dominant under conditions of financial certainty with $1 <= r_R <= 2$.

The stochastic efficiency ordering of the strategies is somewhat different when determined in the context of maximising expected utility from net cash flow. From Table 2, the most efficient strategy under financial uncertainty is FC240, followed by FCIED and then FCNOTH. The ordering under financial certainty is from FCIEDL to FC240L then FCNOTHL. In comparing the strategies across the two financial states, the joint strategy involving use of IEDs under financial certainty (FCIEDL) was found to be dominant for the net cash flow outcome.

Case Study D

Six simulation experiments were conducted on Property D. Both the net worth and net cash flow outcomes for all strategies evidenced upward trends over the model horizon for this farm business. They were thus both at their highest levels at the end of 1995.

The codes for the strategies investigated are as follows:

- FD250 is the strategy involving locking-in a debt of $250000 at 14 per cent;
- FDIED represents the strategy in which income equalisation deposits are used in conjunction with a locked-in debt of $250000; and,
- FDNOTH is the strategy of maintaining existing financial structure and arrangements, i.e., doing nothing.

As shown in Table 2, the strategy involving locking-in a debt of $250000 at 14 per cent (FD250) is the dominant strategy for maximising expected utility from net worth under both of financial states. Strategy FDIED is the next most efficient, followed by FDNOTH. FD250, i.e., locking-in $250000 at 14 per cent under financial uncertainty, was found to be dominant in terms of maximising expected utility from wealth when comparing the strategies across the two financial states. The results of the SDRF analysis show FD250 to be dominant under conditions of both financial certainty and uncertainty. The complete ordering of the strategies is the same under both states of financial information: FD250 then FDIED then FDNOTH.

Hypothesis Tests and Discussion

The criterion for non-rejection of each hypothesis is that the outcome of the decision scenario reflecting the hypothesis statement be dominant over the outcome of the null (i.e., the "do nothing" scenario) in the sense of SDRF. That is, rejection or non-rejection of the hypothesis is a function of the position and dispersion of the outcome distributions and the risk attitude of the grazier.

Hypothesis 1

In Case Study A, in the case of the wealth outcome, the strategy involving the fixed price credit facility did not dominate the existing management strategy. Nor did it do so in Case C, where these strategies could not be ordered. However, for net worth in cases B and D and for the net cash flow outcomes on all four case study properties, this strategy was dominant in terms of SDRF. Determination of whether or not this hypothesis should be rejected thus appears to depend on the primary management objective of the grazier.

If management attention is focused on short-run cash flow, the results of this study indicate that Hypothesis 1 should not be rejected. That is, use of fixed interest credit appears to improve performance and reduce risk in net cash flows sufficiently for stochastic dominance to emerge over a wide range of relative risk aversion. Furthermore, under conditions of uncertainty regarding the values of financial variables, this strategy dominated all the alternative financial risk management strategies investigated.

The situation is not so clear when the management objective is to maximise expected utility from wealth. The results from case studies B and D indicate that, under this objective also, Hypothesis 1 should not be rejected. However, the result from Case A, and even Case C where dominance was indeterminate, indicate the reverse.

It is difficult to determine exactly why a strategy that is dominant in terms of its net cash flow consequences should not also be dominant in terms of its wealth consequences. One possible explanation lies in the temporal nature of the cash deficits that occur and the way the RISKFARM model works.

RISKFARM is an annual model and any cash deficit at the end of the financial year appears as an overdraft debt in the annual accounts. And this is the amount that, at the end of 1991, contributed to determining the magnitude of the debt to lock-in for these experiments. If the actual cash deficit was intermittent, or of only very short duration, the interest charges on the fixed interest facility could be considerably larger than those on the overdraft debt. This difference could be large enough to cause a sufficient discrepancy in wealth for stochastic dominance to accrue to the "do nothing" outcome. Meanwhile, due to the large contribution of

interest payments to net cash flow, the reduction in risk in net cash flows arising from certainty in the interest commitment could be sufficient for the "lock-in" strategy to dominate the "do nothing" strategy with respect to that outcome. Although there would also be a reduction in risk in the wealth outcome, the relative contribution of the annual cash operating surplus or deficit to net worth may be small enough that the desirable, variability-reducing, effects are outweighed by the undesirable, magnitude-reducing, effects.

In summary, for three out of the four cases examined, the strategy of arranging a fixed interest loan facility to cover existing variable interest facilities and provide operating finance, produced net cash flow and wealth consequences that dominated, or were indistinguishable from[5], those obtained from the existing financial arrangements. In the fourth case, the net cash flow outcome arising from this strategy was preferred but the wealth outcome was not. The weight of evidence thus suggests that this strategy will generally have desirable consequences and that Hypothesis 1 should not be rejected. For the special case where cash operating deficits are very intermittent and highly irregular in magnitude, the preferred strategy will depend on whether the management objective is to maximise expected utility from wealth or net cash flow.

Hypothesis 2

With respect to maximising expected utility from wealth in Case A, the strategy of liquidating financial assets and locking-in a fixed interest rate on a reduced debt burden (FAASS) was dominated by the "do nothing" strategy (FANOTH). In Case B, no dominance between the two strategies could be determined.[6] It thus appears that these results provide little, if any, support for this hypothesis. For the net cash flow objective, strategy FAASS dominates strategy FANOTH in Case A, but dominance is reversed for the equivalent strategies in Case B. At first glance, these results are also inconclusive and Hypothesis 2 cannot be authoritatively stated as being not rejected in the case of maximising expected utility from net cash flow. However, closer inspection of the particular cases provides some further insights.

The difference between the outcomes for the two case studies probably lies in the nature of the respective financial assets owned by the businesses. The financial assets in Case A consist of market securities and interest-bearing investments with variable yields. The capital values of the market securities are subject to market forces and were forecast by the grazier to increase substantially over the five years modelled. That is, the margin between the value of

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[5]If the actual utility function for each grazier were known, then complete ordering could be obtained

[6]Reducing the range of r_R to $1 \leq r_R \leq 2$ and $2 \leq r_R \leq 3$ still did not allow preference between these strategies to be determined.

total assets under strategies FAASS and FANGTH is not just the face value of the financial assets but also the capital gains foregone. With reduced interest receipts and reduced interest payments acting in some degree as counter effects on the cash balance, this margin is sufficient for FANOTH to dominate FAASS with respect to wealth. Other results obtained (not reported here) indicate that the reduction in interest payments is generally less than the reduction in interest earnings. The net result, in combination with certainty in credit costs, is such that FAASS is preferred in terms of maximising expected utility from net cash flow.

In Case B, where there is no capital gain on financial assets, the primary adjustments under the "sell assets" strategy are the respective reductions in interest earnings and expenses, and the reduction in the risk associated with the cost of credit. Here, there are no foregone capital gains to increase the margin between the value of total assets under the two strategies in question. The net effect on the wealth outcome of the FBASS strategy is such that, for a wide range of risk aversion, the decision maker is indifferent between this and the FBNOTH strategy.

The financial assets liquidated under FBASS are yielding a guaranteed annual percentage return. Thus, while cash costs decline and become less uncertain under this strategy, cash income also declines and loses a stable component (interest receipts). That is, cash income falls and becomes relatively more uncertain and this, in turn, contributes to a decline and increased uncertainty in aggregate net cash flow. The net effect is to worsen the "worst case" net cash flow result and make the entire distribution more disperse. Consequently, for net cash flow, the FBNOTH strategy is preferred over the FBASS strategy in the sense of SDRF.

The ranking of the wealth outcomes changed from the "debt reduction" strategy being dominated by the "do nothing" strategy to indifference between them as the adverse effects of selling assets were reduced. That is, in Case A, capital gains and interest earnings were foregone and FAASS was dominated. In Case B, only interest earnings were foregone and dominance could not be determined. It is therefore possible, though unconfirmed, that financing debt reduction by means other than by selling income-earning assets, i.e., foregoing neither investment income nor capital gains, could provide a dominant risk management strategy in terms of wealth.

Furthermore, if it true that the net cash flow outcome of strategy FBASS is dominated by that of strategy FBNOTH due only to the adverse effects on the magnitude of interest earnings and the stability of total cash income, then some extrapolation of these results is also warranted. [Support for this conclusion is provided by the fact that on both case study properties the net cash flow outcome of the pure lock-in strategy FA200 (FB100) dominates that of the mixed, sell assets and lock-in strategy FAASS (FBASS).] As argued above, it is plausible that financing debt reduction by means other than by selling income-earning assets

would be a dominant strategy in the context of maximising expected utility from net cash flow. Further experimentation would be required to confirm these intuitive conclusions.

On the basis of these considerations, Hypothesis 2 is neither rejected nor not rejected but, rather, is left open for more detailed testing.

Hypothesis 3

In three of the four cases examined, the wealth outcome of the income equalisation deposit strategy dominates or is indistinguishable from that of taking no additional action in financial risk management. In the fourth case (Case A), the FANOTH strategy is preferred over FAIED in terms of maximising expected utility from wealth. For the objective of maximising expected utility from net cash flow, the result for all four farm businesses was that the strategy involving IEDs was preferred

It is notable that, as it was for the wealth outcome of the pure lock-in strategy (Hypothesis 1), Case A is once again the contradictory case. Indeed, the existing financial arrangements on that property dominate all of the alternatives investigated (FANOTH). A possible explanation for the discrepancy between the conclusions drawn from Farm A and the results of other case studies was provided in the discussion of Hypothesis 1.

Under most circumstances, the combined strategy of arranging a fixed interest loar facility to cover existing variable interest facilities and provide operating finance together with utilising IEDs to smooth taxable income, appears to generate measurably preferred wealth and net cash flow consequences. The weight of evidence thus suggests that Hypothesis 3 should not be rejected. Once again, in the special case where cash operating deficits are very intermittent and highly irregular in magnitude, the preferred strategy will depend on whether the management objective is to maximise expected utility from wealth or net cash flow.

Hypothesis 4

The decision criterion for this hypothesis was that the distributions of the selected outcomes under conditions of perfect financial information should dominate those obtained under uncertainty in the sense of SDRF. The results of the stochastic dominance analyses are rearranged in Table 3 to show more plainly the ranking of the outcomes of the experiments designed to test this hypothesis.

The only clear pattern to emerge is that, with regard to wealth, the strategies involving locking-in debt at a fixed interest rate under financial uncertainty dominate or are

indistinguishable from the same strategies under financial certainty.[7] As noted earlier, this is the reverse of the expected result that the outcome of a particular strategy under financial uncertainty would be dominated by the outcome under full information. For a given strategy, the only difference between the two states of financial information is that, under financial certainty, interest rates on both assets and liabilities vary in a known way. Thus, for a strategy involving a fixed interest rate debt, the difference between the outcomes under financial certainty and uncertainty can lie only in the margin between the fixed and variable interest costs and the risk reducing effects of removing uncertainty in interest yields.

[7]The only exception is that of the income equalisation deposit strategy in Case D.

Table 3

Stochastic Dominance Results for Hypothesis 4

Case and Strategy	Wealth		Net Cash Flow	
	Financial Uncertainty	Financial Certainty	Financial Uncertainty	Financial Certainty
Case Study A				
* pure lock-in	dominant	-	-	dominant
* sell assets and lock-in	indifferent		-	dominant
* lock-in and use IEDs	dominant	-	dominant	-
* do nothing	-	dominant	-	dominant
Case Study B				
* pure lock-in	indifferent		dominant	-
* sell assets and lock-in	indifferent		-	dominant
* lock-in and use IEDs	dominant	-	dominant	-
* do nothing	dominant	-	-	dominant
Case Study C				
* pure lock-in	dominant	-	dominant	-
* lock-in and use IEDs	indifferent		-	dominant
* do nothing	indifferent		dominant	-
Case Study D				
* pure lock-in	indifferent		indifferent	
* lock-in and use IEDs	-	dominant	dominant	-
* do nothing	-	dominant	dominant	-

Note. Indifference arises only because the utility function and risk attribute assumptions applied do not provide sufficient information for dominance to be determined.

The simulation results suggest that, once risk in interest costs is removed (by locking-in), the potential windfall gains from interest yield increases outweigh the benefits obtained from introducing financial certainty.

With regard to the strategies involving maintaining existing financial structure and arrangements, i.e., the null hypothesis or "do nothing" strategies, there was only one exception to the rule that the stochastically efficient wealth outcomes were generated under financial certainty. This implies that existing financial arrangements on woolgrowing properties are commonly not optimal for operating in a deregulated financial environment. Thus, as would be expected, unless the wealth-seeking grazier is prepared to take active measures to reduce financial risks, financial certainty is preferred.

There are no clear patterns in the results of the stochastic efficiency comparisons of the generated distributions of net cash flow. In Case A, it is the pure "lock-in" strategy under financial certainty that is dominant, in Case B it is the "IED" strategy under financial uncertainty, in Case C the "IED" strategy under financial certainty, while in Case D, no preference can be determined between the pure "lock-in" strategies under the two alternative financial conditions

In case studies B, C and D, financial uncertainty appears to offer most opportunity for deriving maximum expected utility from net cash flow A deciding factor here could be the magnitude of the fees involved in refinancing the respective loan liabilities. The only exceptions are the strategies involving selling assets in Case B and utilising IEDs in Case C.

Once again, Case A provides contradictory results On that farm, financial certainty seems to be the preferred operating environment, with three out of the four strategies yielding their dominant net cash flow outcomes under those conditions. The exception is the "IED" strategy. Given the presumed extreme volatility in cash operating deficits experienced on this farm (see the discussions of Hypotheses 1 and 2), it is plausible to argue that the risk-reducing effects of eliminating financial uncertainty overwhelm any adverse magnitude effects to ensure that this condition is preferred under almost all strategies. Conversely, the effect of smoothing taxable income, and hence tax, associated with the "IED" strategy, when combined with the positive aspects of financial uncertainty (e.g., windfall gains in interest earnings), appear to be sufficient to make this the preferred state when focusing on short-run cash flow.

On the basis of the above results and considerations, Hypothesis 4 is not rejected.

Conclusions

The experimental strategies involving maintaining existing financial arrangements and structures were not, as a general rule, included in the efficient set under conditions of financial

uncertainty. This implies that the existing financial arrangements on the case study properties were not the most appropriate for operating in a deregulated financial environment. It is plausible that the same assessment could apply to many other woolproducing farms in Australia.

Farm managers, rural consultants, financiers, industry bodies and policy makers alike should take note of this observation. Although the various "rural crises" of the 1980s occasioned considerable adjustment in the wool industry, it appears that these adjustments may not have extended to addressing adequately the problem of managing increased financial uncertainty. Unless continued efforts are made to encourage appropriate financial structures and arrangements for farm businesses, the incidence of financial stress in this industry is not likely to decline.

On a brighter note, there is evidence of some positive moves in this regard. There are initiatives under the new Farm Financial Management Skills Program of the Commonwealth Department of Primary Industry and Energy to improve the information-base and financial management skills of agriculturalists and rural accountants. Also, in recent years, farm financial advisers have been active in promoting use of medium-term, fixed-interest loans to finance even what has been traditionally regarded as long-term credit (e.g., land purchase); and this risk management strategy is an increasing phenomenon (Ross Turvey, R.J. Turvey & Assoc., pers. comm., 1990). Originally selected on the basis of intuition and management acumen, this study has shown empirically that, as a general rule, this strategy is likely one of the best possible.

An important outcome of this study was the demonstrated usefulness of income equalisation deposits as a risk management option. For the cases examined, use of IEDs was found to rank highly in terms of stochastic efficiency for both the wealth and net cash flow outcomes. It seems, however, that the effectiveness of IEDs is significantly reduced under conditions of financial certainty. This is not unexpected: a taxation instrument designed to smooth fluctuating incomes will naturally be most effective when incomes are most volatile. These results provide support to the recent work by Douglas and Davenport (1992) and Kaine *et al.* (1992), both of whom argue in favour of IEDs as a strategic financial management instrument.

Although Hypothesis 4 could not be rejected, i.e., financial risk was indeed found to contribute significantly to total risk on woolgrowing properties, interpretation of the results led to a somewhat surprising inference. This was that, if maximising expected utility from wealth were the primary objective, those producers who were prepared to undertake proactive financial risk management could actually prefer conditions of financial uncertainty. This inference was based on the demonstrated dominance of the "lock-in", "sell assets" and "IED"

strategies under conditions of uncertainty as against full financial information. Thus, it seems that financial risk management strategies can be designed for most farm businesses that will provide potential wealth benefits under financial uncertainty such that the adverse risk effects are more than offset. While the results are not so conclusive with regard to maximising expected utility from net cash flow, it is arguable that the same can be said for this objective.

This last comment raises the critical requirement of defining the primary management objective before attempting to design and implement a strategic adjustment to farm financial structure. It is necessary to appraise alternatives on the basis of their relative impacts on the prospects of satisfying this primary goal. The results of this study have highlighted the differences in the ranking of the alternative strategies that can arise when considering disparate objectives. Opportunities to make further strategic changes may be severely limited due to cost or the contractual nature of the arrangements entered into, so it is vital to select initially the appropriate strategy to meet the primary objective.

A further implication is that, with increasing opportunities for farmers to obtain credit under arrangements tailored to their requirements, financial deregulation appears to have benefited the wool industry. The results obtained support the proposition that a return to a more regulated financial environment would not be preferred except by those woolgrowers who are constrained by circumstance, ignorance or preference to maintain inappropriate financial strategies.

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