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Screening, Competition and the Choice of the Cooperative as an Organisational Form

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Cooperatives are distinguished from investor-owned firms by different decision-making processes. A model is developed in which more cumbersome decision making by cooperatives may be compensated for by improved decision making. Conditions are derived under which cooperatives become efficient organisational forms. It is also shown that circumstances exist in which investor-owned firms and cooperatives can coexist in equilibrium. Finally, circumstances are identified in which competition results in a prisoners dilemma which comprises investor-owned firms only. Favourable public policy treatment of cooperatives may prevent this equilibrium outcome from occurring.

1. Introduction

Many agricultural and horticultural markets are inhabited by investor-owned firms as well as cooperatives. Table 1 illustrates this for a number of markets in the European Community (European Commission, 1994). These observations are not limited to Europe. Cook (1995) reports the coexistence of cooperatives and investor-owned firms in the USA. In 1993, the cooperatives market share was as follows: milk, 85 per cent; cotton, 35 per cent; grain/oilseeds, 42 per cent; fruits/vegetables, 21 per cent; and livestock, 10 per cent.

These observations raise a number of questions from the viewpoint of standard neo-classical theory. Are industry configurations with different types of organisations bound to disappear? If not, what mechanisms are sustaining such an industry structure? Is the equilibrium industry structure efficient? Is there scope for strategic organisational choice? These questions are addressed in this paper. A model is analysed in which the decision-making process used by a cooperative differs from that used by an investor-owned firm.

There are several indications and observations suggesting that decision making in cooperatives differs from decision making in investor-owned firms. CEO Cortopassi of the San Tomo Group in the United States observes that 'A cooperative cannot deal with the fundamental issue of current cost versus future benefit. Cooperatives fail in their ability to retain capital that's been earned and had taxes paid on it, because the farmer

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Table 1 Cooperatives Market Share in the Sale of Agricultural Products in 1991 (%) (European Commission, 1994)

	Pork	*Beef*	*Poultry*	*Eggs*	*Milk*	*Sugarbeet*	*Grain*	*Fruits*	*Vegetables*
Belgium	15	1	-	-	65	-	25-30	60-65	70-75
Denmark	97	53	0	60	92	0	50	90	90
Germany	23	25	-	-	56	-	-	20-40	55-65
Greece	3	2	20	3	20	0	49	51	12
Spain	5	6	8	18	16	20	16	30	15
France	80	30	30	25	50	16	70	45	35
Ireland	55	9	20	0	98	0	26	14	8
Italy	15	6	-	5	32	-	35	31	10
Luxembourg	35	25	-	-	81	-	79	10	-
Netherlands	24	16	21	18	84	63	65	78	69
Portugal	-	-	-	-	-	-	-	-	-
United Kingdom	19.9	5.1	0.2	18.0	4.1	0.4	21.1	29.6	19.4

says, I'd rather have that money to buy another piece of land or plant another orchard. Money left in the cooperative does not accrue to the future benefit of that farmer after he ceases being a member' (Fillip, 1994, p. 28). Professor Nilsson summarises several research findings regarding Scandinavian cooperatives thus (Bos *et al.*, 1995, p. 31): 'Tollin reports in her thesis about cooperatives in Sweden that they think less commercially, have more centralised power and adapt more slowly to consumer demand than investor owned firms.' Also 'Sfgaard finds that Danish cooperative slaughter houses are uniquely qualified to deliver bulk products, but that the production-specific pig-types which result in more expensive pork are problematic. Danish farmers are not willing to invest in products demanded by consumers with a strong preference for high quality. The short-term and individual interests dominate the long-term and collective interests of the farmers.' (Bos *et al.*, 1995).

Defining a cooperative and an investor-owned firm will never be done satisfactorily. Monks and Minow (1995, p. 7) write in this respect that definitions 'reflect the perspectives (and the biases) of the people writing the definitions. Anyone who tries to come with a definition is like the blind men who tried to describe an elephant, one feeling the tail and calling it a snake, one feeling the leg and calling it a tree, one feeling the side and calling it a wall.' This paper focuses on a decision-making or voting difference between a cooperative and an investor-owned firm and therefore ignores other important differences such as financial contributions, equity management, legal status, fiscal regime, member involvement, conflicts between decision makers, ethical attitudes and (diversification) strategy. A motivation for this representation of cooperatives and investor-owned firms is that the members of most agricultural and horticultural cooperatives are special in the sense that they are both suppliers of raw materials and capital, whereas shareholders of an investor-owned firm are only providers of capital. This gives members the incentive to structure the internal organisation of a cooperative in such a way that they have confidence that their substantial (financial)

stakes are protected and their interests are advanced. This manifests itself in more extensive decision-making power being allocated to the General Assembly of cooperatives than to the annual shareholders meeting of investor-owned firms.[1]

The model by Sah and Stiglitz (1986) is tailored to these observations regarding the relative conservative decision making by cooperatives.[2] A cooperative is characterised by two independent decision-making units with each unit having the power of veto, whereas an investor-owned firm consists of only one decision-making unit. This stylised distinction between a cooperative and an investor-owned firm has already considerable bite in the formulation of answers to the questions posed at the beginning of this section. It enables an analysis of the interaction between investor-owned firms and cooperatives. The main results consist of a characterisation of the circumstances in which

(i) the decision-making process in cooperatives is advantageous;

(ii) the coexistence of investor-owned firms and cooperatives is an equilibrium industry configuration;[3]

[1] The situation in the Netherlands may serve as an illustration. It is described because that is where the knowledge of the author resides. This will inevitably carry along some features which are specific to the Netherlands, but it is general enough for aspects of cooperatives in other countries to be captured as well. Ter Woorst (1989) describes several institutional differences between a cooperative and an investor-owned firm. The law in the Netherlands requires that the cooperative has a General Assembly, a Board of Directors and a Financial Control Committee. The General Assembly consists of the members/owners and is the most important, because ultimately it determines the policy of the cooperative and evaluates the execution of policy by the board of Directors. The General Assembly chooses and has the power to replace the members of the Board of Directors and the Financial Control Committee. Members of the Board of Directors and the Financial Control Committee are almost always members of the cooperative. The Board of Directors is ultimately responsible for the governance of the cooperative, culminating in the exclusive authority to determine the prices, dividends, or tariffs paid to or by the members. However, though the Board of Directors actively determines the strategic decisions and interferes with major organisational ones if necessary, a Directorate is appointed by the Board of Directors to run the company's day-to-day operations. In regular joint meetings, the Board of Directors monitors the Directorate, discusses possible options, decides on those and gives clear instructions to the Directorate.

There are three important differences between investor-owned firms and cooperatives regarding the Board of Directors. Cooperatives do not transfer the ultimate approval of the annual accounts to the Board of Directors. Secondly, they do not leave the right of appointing members of the Board of Directors to the Board of Directors itself. (A Board of Directors in a large corporation in the Netherlands is an in-group which selects its own successors. Shareholders can only not accept a candidate by a majority vote. They have no active rights to appoint or even to propose one.) The General Assembly takes care of these tasks. Finally, the law in the Netherlands allows a cooperative to write in its charter that up to two thirds of the members of the Board of Directors are to be appointed by the General Assembly. This secures member control. These differences make the Board of Directors in a cooperative a more independent decision-making unit than the Board of Directors in an investor-owned firm. This is summarised by assuming that a cooperative is characterised by two independent decision-making units, i.e., the General Assembly and the management (the Directorate), whereas an investor-owned firm has only one, i.e., the management.

[2] Cooperatives may have a slower and more cumbersome decision-making process than investor-owned firms, but once a decision is taken it is implemented rapidly due to the consensus which has grown up in the course of the process. This observation, together with the findings by Sfgaard in the previous paragraph, suggest that the conception of cooperatives in the current model is probably more applicable to consumer-oriented products with high value-added and rapidly changing consumer demand than to bulk product markets.

[3] There are several theoretical explanations for the coexistence of different types of organisations in an industry in equilibrium. Examples are supply assurance (Carlton, 1979), rationing (Hendrikse and Peters, 1989) and price discrimination (Perry, 1978). Explanations in the partial vertical integration literature; asymmetric information and incentives Hermalin (1994), stochastic cost differences Lippman and Rumelt (1982) and limited managerial attention Gifford (1992a). This paper differs because organisational structure is the main explanatory variable behind the coexistence of cooperatives and investor-owned firms in equilibrium. It reflects the view that on the one hand the way in which organisations are internally structured may have consequences for their behaviour in the market and on the other hand the market may discipline the choice of internal structure. The article by Tennbakk (1995) comes closest to this paper in the sense that a mixed duopoly of a cooperative and an investor-owned firm emerges as an equilibrium outcome. However, Tennbakk (1995) models the difference between these two organisations by different objective functions, whereas this paper focuses on the difference in the decision-making process.

(iii) cooperatives are a superior organisational form, but do not emerge in equilibrium because the choice of the investor-owned firm structure constitutes a prisoners dilemma.

The classification of this paper in the literature can be done by placing it in the scheme of Kreps (1990a). He classifies economic theories according to the assumptions made with respect to the degree of rationality and self-interest orientation (Table 2).[1] This paper assumes that there is no conflict of interest between decision makers, i.e. that all decision makers are assumed to maximise the same utility function. This paper can therefore also be classified as a contribution to team theory.[2]

Table 2 Behavioural Assumptions and Theories of the Investor-Owned Firm (Kreps, 1990a)

Degree of Rationality	*Opportunistic*	*Self-interested*	*Utopian*
Complete	Information economics	General equilibrium	Team theory
Bounded	Transaction cost economics	Temporary equilibrium	
Procedural		Evolutionary theories	

This paper is organised as follows. Section 2 develops the model. Section 3 derives the results. Finally, section 4 provides a summary and avenues for further research.

2. The Model

A model is developed in which three types of decision are identified. First, the organisational form is determined. This is done simultaneously and independently when there is more than one organisation. Second, nature chooses the type of the project.

[1] The well-known Arrow-Debreu theory of general equilibrium (Debreu, 1959) assumes that decision makers are self-interested and are completely rational. Drèze (1972) analyses cooperatives with these assumptions. There is nothing about decision-making processes in organisations in this approach. Information economics (Jensen and Meckling, 1976) analyses principal-agent problems. It is assumed that decision makers have an opportunistic orientation and are completely rational. Opportunistic orientation gives rise to interesting problems in this approach because there is an information asymmetry between the decision makers and they have a conflict of interest. Evolutionary approaches treat the investor-owned firm as a set of routines (Nelson and Winter, 1982). Decision makers have very limited cognitive capacities. Transaction cost economics, and its formal treatment in incomplete contracting theory assumes that individuals are opportunistic and boundedly rational (Coase, 1937; Simon, 1951; Grossman and Hart, 1986; and Kreps, 1990). There is a conflict of interest between the decision makers in this theory, as in information economics. Team theory assumes that decision-makers have a utopian orientation and are completely or boundedly rational. Decision makers in Marschak and Radner's (1972) team theory don't have a conflict of interest. They have different information at their disposal and this has to be coordinated. The investor-owned firm is viewed as a collection of individuals who process information. Gifford (1992b) adopts the same behavioural assumptions as in team theory literature, but focuses on the implications of limited managerial attention.

[2] Models classified as team theoretic may have either complete rationality or bounded rationality. It is not obvious how to classify Sah and Stiglitz (1986). Heiner (1988) provides various arguments in favour of complete rationality and other arguments in favour of bounded rationality. The title used by Sah and Stiglitz (1985) 'Human Fallibility and Economic Organization' being their interpretation of the probabilities in their model as 'reduced form parameters reflecting the limited abilities of homogeneous individuals' (Sah and Stiglitz, 1988, p. 452); their remarks about imperfect communication (Sah and Stiglitz, 1985, p. 293), and 'the information gathered by an individual ... processed into a single binary signal, and it is only these signals which are communicated' (Sah and Stiglitz, 1988, p. 452) indicate that they favour a bounded rationality classification.

Finally, decision units decide independently regarding the acceptance of the project. This game is solved for its subgame perfect Nash equilibrium by the method of backward induction. Working backwards, the section on 'screening' describes the third stage, the 'portfolio of projects' describes the second stage and the section on organisation choice describes the first stage. The final section of the model describes monopoly versus duopoly pay-offs.

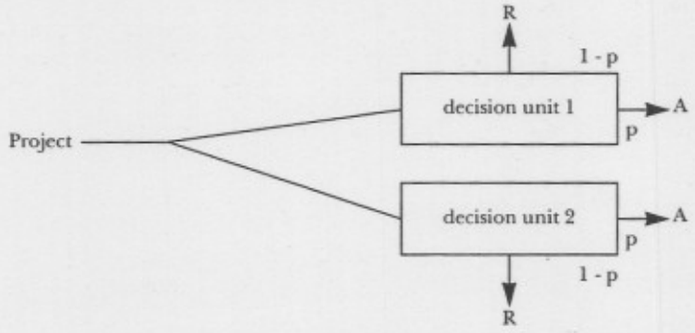
Screening

An organisation must try to distinguish between profitable and unprofitable projects according to Sah and Stiglitz (1986), but only has access to a noisy variable about a project's true profitability. An organisation is perceived as a collection of decision units. Units screen projects independently by sampling values of the noisy variable and make decisions about whether to accept or reject individual projects. The decisions of the units are aggregated into an organisation decision by an aggregation rule. Examples of aggregation rules are majority voting and unanimity.

Each decision unit evaluates/screens possible investment projects and decides to either accept (A) or reject (R) a project. It is assumed that the pool of projects faced by a decision unit consists of only two types of projects. A good project generates a positive pay-off, whereas a bad project has a negative pay-off. Screening entails errors of judgment. This is modelled by incorporating a probability that a bad project may be accepted and a probability that a good project may be rejected. The classical theory of statistical inference distinguishes four kinds of decision in this respect: a good (bad) project is either accepted or rejected. Failures are modelled as type-I and type-II errors, where the probability of rejecting a good project is a type-I error and the probability of accepting a bad project is a type-II error.

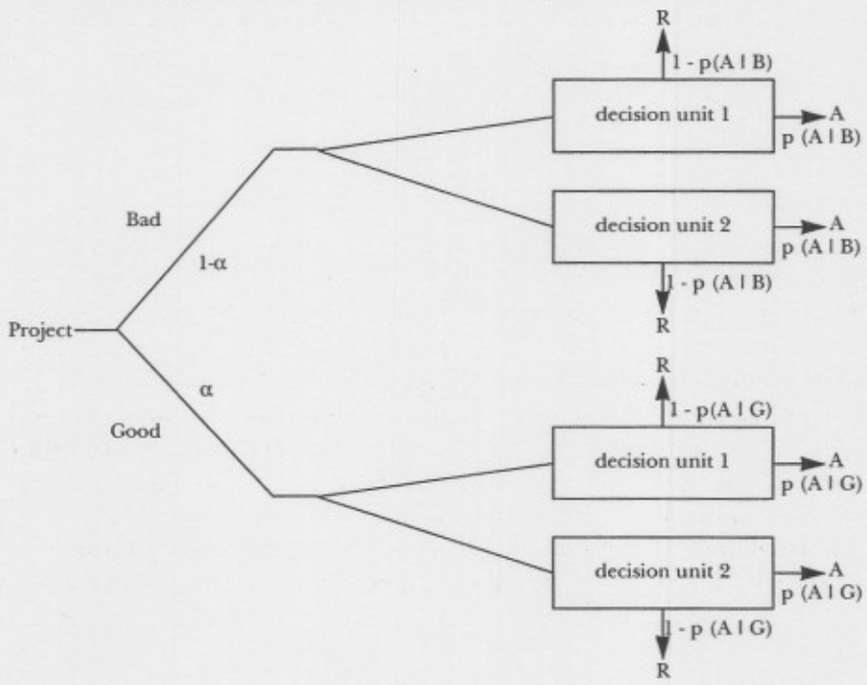
It is assumed that every individual (decision unit) is screening the same projects and that this is done independently.[1] Suppose that a decision unit accepts a project with probability p. Figure 1 represents this situation for an organisation consisting of two

Figure 1 Organisation as a Collection of Decision Units



[1] The assumption that screening is done independently can have various interpretations. It can be thought of as either deciding simultaneously in a game theoretic setting or as not knowing what the other will decide or not doing Bayesian updating in a situation where decisions are taken sequentially. All these interpretations are compatible with Sah and Stiglitz (1986).

Figure 2 Portfolio Composition and Conditional Acceptance/Rejection Probabilities



decision units. An investment project is being considered by both decision units. Each decision unit decides independently whether to accept (A) or reject (R) the project.

The present value of costs associated with accepting a bad project is defined to be W, whereas a good project generates a pay-off of V.[1] It is assumed that there is some filtering or screening i.e., the probability that a bad (B) project is judged to be good is smaller than the probability that a good (G) project is accepted. A simple model of this screening process (Sah and Stiglitz, 1986) is that the estimated return of a good project is equal to the sum of the future return V and a stochastic term ε, which is defined as the noise in the current observation. Assume that ε has a normal distribution with mean 0 and variance σ2. Similarly, the sampling/screening/evaluating of a bad project indicates that the future return will be -W + ε. The evaluator/decision unit/screener does not know of course whether the project is good or bad. A decision rule has to be used therefore, which is independent of the nature of the project, e.g., a project should be accepted when the realisation of the stochastic variable is not negative.

Portfolio of Projects

The composition of the portfolio of projects is characterised by α, which is defined as the proportion of good projects in the pool of available projects. A particular project is either good or bad, which must be reflected in the acceptance probability p. This is done

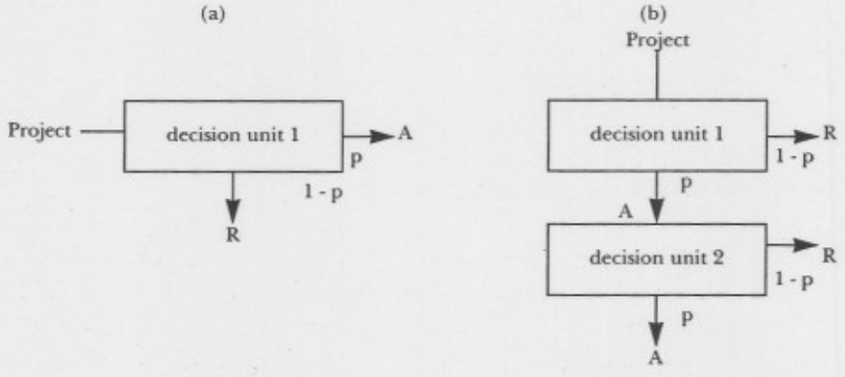
[1] It is assumed implicitly that a cooperative as well as an investor-owned firm face the same product demand and factor supply (cost) curve.

by formulating conditional probabilities. Define p(A | B) as the probability that a project is accepted, given that it is bad and p(A | G) as the probability that a project is accepted, given that it is good. Figure 2 illustrates the relationship between these various probabilities and is an extension of Figure 1. The previous section assumed that there is some screening, i.e., p(A | B) < p(A | G).[1]

Organisation Choice

A cooperative and an investor-owned firm differ with respect to the probability of accepting good and bad projects. A cooperative is defined by two features. It is an organisation consisting of two decision units, and it aggregates the decisions of the decision units into an approval decision of the whole organisation only when both decision units accept the project. An investor-owned firm is defined as consisting of only one decision-making unit.[2] Figure 3(a) presents an investor-owned firm as a collection of decision units. Figure 3(b) shows the aggregation rule of a cooperative by the feature that the decision of the second decision-making unit has only to be taken into account when the first decision-making unit approves the project. Notice that independent screening by decision-making units is reflected by the acceptance and rejection probability of the decision-making unit 2 being the same and independent of the decision of the decision-making unit 1.

Figure 3 (a) Investor-Owned Firm (b) Cooperative



An investor-owned firm accepts a particular project with probability p, whereas the probability of acceptance is p^2 for a cooperative. An investor-owned firm accepts a larger percentage of projects than a cooperative, because $p > p^2$. This is true for good as well as bad projects. An investor-owned firm has therefore a relative advantage in accepting good projects, whereas a cooperative is preferred when the rejecting of bad projects is of primary importance. These probabilities can be made more explicit by using the portfolio composition parameter and the conditional probabilities. The acceptance

[1] Perfect screening for a good project entails that p(A | G) = 1 and p(R | G) = 0 and for a bad project that p(A | B) = 0 and p(R | B) = 1.

[2] Notice that investor-owned firms may also be characterised by a sequential decision-making process involving more than one decision-making unit. However, the purpose of this paper is served by presenting the difference between the two organisations that are as stylised as possible.

probability of a bad project by a cooperative with two decision units is $(1 - \alpha)p(A \mid B)^2$. It accepts a good project with probability $\alpha p(A \mid G)^2$. Similarly, an investor-owned firm accepts a bad project with probability $(1 - \alpha)P(A \mid B)$, whereas a good project is accepted with probability $\alpha p(A \mid G)$.

It is sufficient for our purposes to deal with the probabilities of accepting good and bad projects for the organisation as a whole. In order to simplify notation define $f_C(,f_F)$ as the probability that a cooperative (investor-owned firm) accepts a project, given that it is good, and $g_C(,g_F)$ as the probability that a cooperative (investor-owned firm) accepts a project, given that it is bad. So, $f_C = p(A \mid G)^2$, $g_C = p(A \mid B)^2$, $f_F = p(A \mid G)$ and $g_F = p(A \mid B)$. It follows immediately that

$$f_C < f_F$$

and

$$g_C < g_F,$$

i.e., an investor-owned firm accepts a larger proportion of good as well as bad projects compared to a cooperative. The feature $p(A \mid B) < p(A \mid G)$ implies that

$$g_C < f_C$$

and

$$g_F < f_F.$$

Monopoly Versus Duopoly Pay-Offs

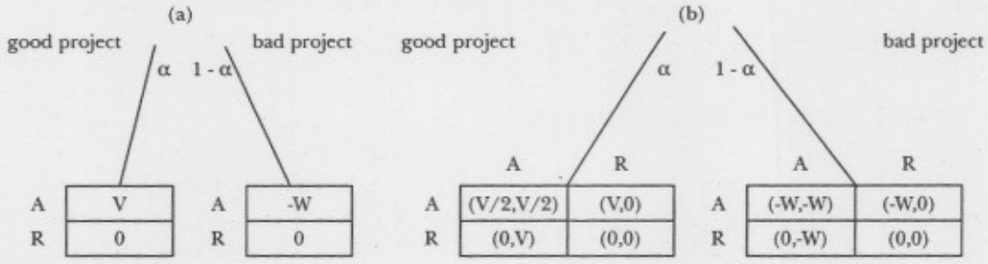
The derivation of the implications of screening within and competition between different organisational forms requires the formulation of the expected profits of an organisation in a monopoly as well as a duopoly situation. The monopoly profits will be used to evaluate whether a strategy of entry deterrence by the monopolist of a potential entrant is profitable and how it may influence the choice of organisational form. The expected profits of a monopolist having organisation form i are

$$Y_i = \alpha f_i V - (1 - \alpha) g_i W \qquad (1)$$

where i is either C or F. Figure 4(a) summarises the pay-off structure for the monopolist.

The duopoly case involves two values for the acceptance of a good project. The decision whether the market has to be shared or not depends on a rival. We assume that the gains associated with a good project are split equally when both organisational forms accept the project. The loss associated with accepting a bad project is assumed to be independent of

Figure 4 (a) Monopoly Pay-Offs and (b) Duopoly Pay-Offs



market structure.[1] Figure 4(b) summarises these assumptions. It reflects the pay-offs of the two organisations in duopoly. The first number in brackets is the pay-off of one organisation and the second number the pay-off of the other organisation. These pay-offs depend on the decisions of both organisations. For example, if one organisation chooses R(eject) and the other A(ccept), then the first organisation receives 0 and the second organisation -W when the project is bad.

The expected profits of an organisation having organisational form i and facing a competitor with organisational form j are Y_{ij}. We have therefore

$$Y_{ij} = \alpha f_i(f_j V/2 + (1 - f_j)V) - (1 - \alpha)g_i W = \alpha f_i(1 - f_j/2)V - (1 - \alpha)g_i W \qquad (2)$$

3. Results

The results of the model are derived and explained in this section. We examine first the monopoly case and subsequently the competition between two organisations.

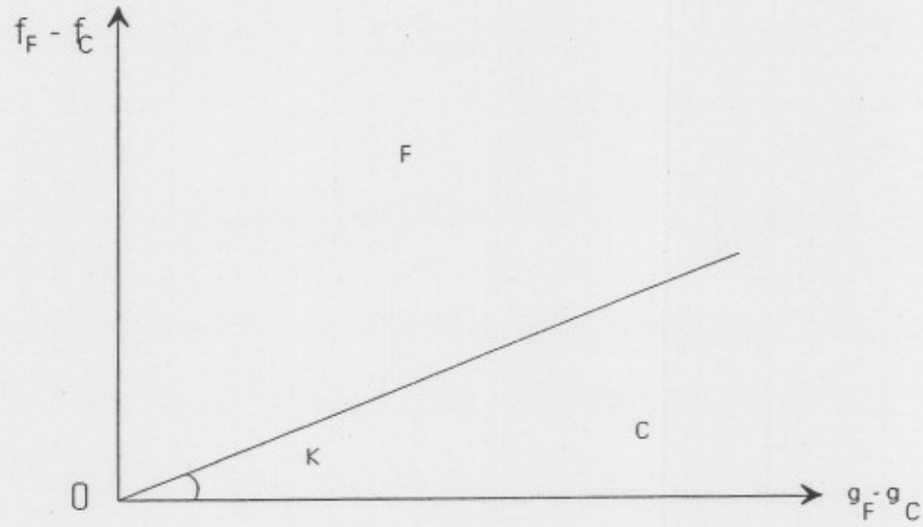
It is straightforward to show in the monopoly case with expression (1) that

$$\begin{aligned} & Y_F > Y_C \\ \Leftrightarrow\ & \alpha f_F V - (1 - \alpha)g_F W > \alpha f_C V - (1 - \alpha)g_C W \qquad (3) \\ \Leftrightarrow\ & \frac{f_F - f_C}{g_F - g_C} > K \end{aligned}$$

where $K \equiv (1 - \alpha)W/\alpha V$. If inequality (3) holds then the investor-owned firm is preferred to a cooperative as an organisational form. The choice of an investor-owned firm is indicated by 'F' in Figure 5 above the separating line because that is where $f_F - f_C > K(g_F - g_C)$. The separating line indicates combinations of $f_F - f_C$ and $g_F - g_C$ for which an

[1] A richer model might make these costs dependent on market structure, as in Loury (1979), and on the internal organisation's choices. One way of including costs as well as the demand effects of competition in general is to specify βV with $\beta \in [0,.5]$ instead of $V/2$ and $-\gamma W$ with $\gamma \in [0,1]$ instead of $-W$. A decrease in costs reduces the importance of preventing type-II errors, i.e., it increases the attractiveness of the investor-owned firm.

Figure 5 Organisational Form Choice by a Monopolist



organisation is indifferent between an investor-owned firm and a cooperative as an organisational form. Finally, the area below the separating line contains the values of $f_F - f_C$ and $g_F - g_C$ in which a cooperative is preferred to an investor-owned firm. This is indicated by 'C'.

The comparative statics results regarding the choice of organisational form by the monopolist follow immediately from this figure. An increase in the difference between the acceptance probabilities of good projects of an investor-owned firm versus a cooperative favours the choice of an investor-owned firm. The same result emerges when the difference between acceptance probabilities of bad projects decreases. The reason is that an investor-owned firm is relatively good at accepting projects, whereas a cooperative is better at rejecting projects. The comparative statics results with respect to the benefits of a good project, the cost associated with selecting a bad project and the portfolio composition are similar. An increase in the benefits associated with a good project (V), an improvement in the portfolio (α) and a decrease in the costs associated with a bad project (W) increase the range of parameters for which an investor-owned firm is chosen. Finally, the effect of an increase in $p(A \mid G)$ depends on the value of this parameter. If $p(A \mid G)$ increases and is smaller than .5, $f_F - f_C$ (and therefore the attractiveness of the investor-owned firm) increases. The reverse holds when $p(A \mid G) > .5$.[1]

The profit-maximising organisational form choice in duopoly is determined by the calculation of the Nash equilibrium. Table 3 presents the strategic/normal form regarding organisational choice in a duopoly. The pay-offs associated with each entry are formulated in expression (2).

Situations are now identified such that a particular combination of strategies is a Nash equilibrium. Two organisational forms constitute a Nash equilibrium when the choice of organisational form in each organisation maximises its pay-off, given the choice of

[1] A referee has pointed out this comparative statics result.

Table 3 Strategic Form of Organisational Choice Game

	Organisation 2	
Organisation 1	*C*	*F*
C	(Y_{CC}, Y_{CC})	(Y_{CF}, Y_{FC})
F	(Y_{FC}, Y_{CF})	(Y_{FF}, Y_{FF})

organisational form of the other organisation. For example, an industry consisting of the choice of cooperative (C) by organisation 1 and the choice of investor-owned firm (F) by organisation 2 is an equilibrium industry structure when $Y_{FC} > Y_{CC}$ and $Y_{CF} > Y_{FF}$. The first inequality entails that

$$\begin{aligned} &\alpha f_F(1 - f_C/2)V - (1 - \alpha)g_F W > \alpha f_C(1 - f_C/2)V - (1 - \alpha)g_C W \\ &\Leftrightarrow \alpha(f_F - f_C)\ (1 - f_C/2)V > (1 - \alpha)(g_F - g_C)W \\ &\Leftrightarrow (f_F - f_C)/(g_F - g_C) > (1 - \alpha)W/\alpha(1 - f_C/2)V \end{aligned} \tag{4}$$

The second inequality entails that

$$\begin{aligned} &\alpha f_C(1 - f_F/2)V - (1 - \alpha)g_C W > \alpha f_F(1 - f_F/2)V - (1 - \alpha)g_F W \\ &\Leftrightarrow \alpha(f_C - f_F)\ (1 - f_F/2)V > (1 - \alpha)(g_C - g_F)W \\ &\Leftrightarrow (f_F - f_C)/(g_F - g_C) < (1 - \alpha)W/\alpha(1 - f_F/2)V \end{aligned} \tag{5}$$

Both organisations adopt the cooperative structure when $Y_{CC} > Y_{FC}$ and $Y_{CF} > Y_{FF}$. Both organisations choose the investor-owned firm as organisational structure when $Y_{FF} > Y_{CF}$ and $Y_{FC} > Y_{CC}$. These three pairs of inequalities reduce to and are summarised by

(C,C) - equilibrium emerges when $$\frac{f_F - f_C}{g_F - g_C} < L \tag{6}$$

(C,F) - equilibrium emerges when $L < \frac{f_F - f_C}{g_F - g_C} < M$ (7)

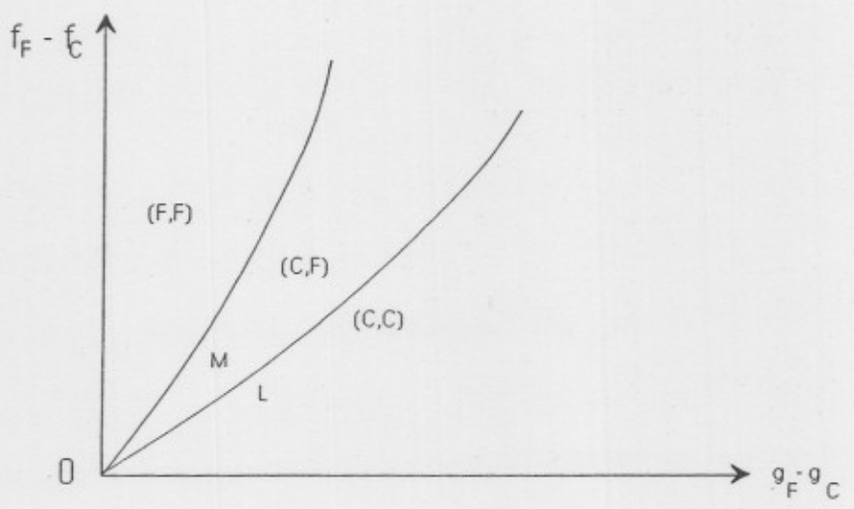
(F,F) - equilibrium emerges when $M < \frac{f_F - f_C}{g_F - g_C}$ (8)

where $L \equiv (1 - \alpha)W/\alpha(1 - f_C/2)V$ and $M \equiv (1 - \alpha)W/\alpha(1 - f_F/2)V$. The duopoly results are presented in Figure 6. Three segments of the parameter space are distinguished. The symbols L and M determine the demarcation of the segments. The duopoly choices in each segment are indicated. For example, (C, F) indicates that the duopoly will consist in equilibrium of one cooperative and one investor-owned firm.

The duopoly choices deserve some comments. Several comparative statics results are similar to the monopoly situation. An increase in the difference between the acceptance probabilities of good projects of investor-owned firms and cooperatives favours the acceptance of an investor-owned firm in both a monopoly and a duopoly. The same result emerges when the difference between the acceptance probabilities of bad projects of investor-owned firms and cooperatives decreases. This is because an investor-owned firm is relatively good at accepting projects, whereas a cooperative is better at rejecting projects. The comparative statics results with respect to the size of the three segments is determined by the characteristics of the portfolio of projects. The prize of winning (V), the costs associated with selecting a bad project (W) and the portfolio composition (α) have similar effects. A higher prize (lower costs, improved portfolio) will increase the expected pay-off of a project and therefore increases the range of parameter values for which an investor-owned firm is chosen. For example, a reduction in costs when there are two investor-owned firms in the market (instead of one) will reduce L and M. Type-II errors are less expensive and an investor-owned firm will be chosen for a larger set of parameter values.

A duopoly consisting of two cooperatives is predicted for a larger set of parameter values (Figure 6) than the choice of a cooperative by a monopolist (Figure 5), because it is straightforward to show that K (in Figure 5) is smaller than L (in Figure 6). The economics behind this result is that competition reduces the probability of being the only one executing the project in the market, i.e., it reduces from f_i in the situation without a

Figure 6 Organisational Form Choice by a Duopoly Market



rival (equation (1)) to $f_i(1 - f_j)$ in the duopoly situation (equation (2)).[1] Another way of formulating this result is that an organisation executes a good project alone with probability one in a monopoly, given that it has accepted the project. This probability is only $1 - f_j$ in a duopoly because the rival organisation accepts the project with probability f_j, i.e., the probability of getting all the benefits from a good project decreases because the market has to be shared with a rival once in a while. This decreases the expected value of a good project. It becomes more important therefore to reduce type-II errors and cooperatives are relatively good at preventing these errors. More competition results therefore in more centralised decision structures.

Two different organisational structures may coexist in equilibrium. An investor-owned firm is sustained in such an equilibrium because it faces a higher expected revenue of good projects in either a monopoly or duopoly. This is due to the investor-owned firm having a higher probability of selecting a good project. This effect compensates for being more often on the wrong track. One cooperative is sustained because the lower expected costs of accepting bad projects outweighs the reduction in the expected revenue of accepting a good project in either a monopoly or duopoly.

Parameter values can be determined such that two investor-owned firms form a prisoners dilemma. Table 4 presents this situation with parameter values $f_C = .36$, $f_F = .6$, $g_C = .16$, $g_F = .4$, $\alpha = .5$, $V = 100$ and $W = 60$. It illustrates that the two organisations each choosing the cooperative form maximise their joint pay-off, i.e., $9.96 + 9.96 = 19.92$ is the maximum amount of profit which can be achieved by the two organisations in this industry. However, deviating from the (C,C) - choices is attractive because the expected revenue of good projects is increased by the increase of f_i from .36 to .6. This effect compensates for the costs of accepting bad projects more often. The profits of the remaining cooperative are decreased by the switch of the competitor, because the probability of being the only one executing the project is reduced. This cooperative will be abandoned for the same reasons as the other organisation changed from a cooperative to an investor-owned firm.[2]

Public policy towards cooperatives is often favourable. Examples are beneficial tax treatment, limited immunity from anti-trust laws, access to favourable credit and technical assistance (Cook, 1995a). One motivation for this policy stand is that cooperatives perform a 'competition yardstick' role (Nourse, 1922; Sexton, 1990). The

[1] The number of organisations adopting a project is a stochastic variable. There are either zero or one organisations actively engaged with a project in the monopoly situation. The probability that a project is not adopted is $1 - f_i$ $(1 - g_i)$, given that the project is good (bad). Similarly, the probability that the organisation is adopting a project is f_i (g_i), given that the project is a good (bad) project. There are either zero, one or two organisations adopting a project in a duopoly situation. If the project is good, then the probability that neither organisation i nor organisation j adopts the project is $(1 - f_i)(1 - f_j)$. One organisation adopts the project when either organisation i rejects the project and organisation j accepts it or organisation i accepts the project and organisation j rejects it. The probability that one organisation accepts the project is therefore $(1 - f_i)f_j + f_i(1 - f_j)$. The probability that both organisations adopt the project is $f_i f_j$.

[2] There are no parameter values for which two cooperatives form a prisoners dilemma in the model. There are also no parameter values such that a monopolist chooses a cooperative in the absence of an entry threat, whereas an investor-owned firm is chosen as the organisational form when there *is* such a threat, in order to deter entry. This strategic choice is only attractive when the profits of a cooperative in a duopoly consisting of two cooperatives are lower than the profits of an investor-owned firm as a monopolist. Such a situation would require that inequality (6) holds, inequality (3) does not hold, and $Y_F > Y_{CC} > 0 > Y_{FC}$. It is not possible to satisfy all these inequalities together.

Table 4 Organisational Choice and Prisoners Dilemma

	C	*F*
C	(9.96, 9.96)	(7.8, 12.6)
F	(12.6, 7.8)	(9, 9)

idea is that the competition with cooperatives improves the market performance of investor-owned firms. The model is able to identify circumstances in which cooperatives improve the performance of investor owned firms. (It is an industry equilibrium consisting of an investor-owned firm and a cooperative and in addition $Y_{FC} > Y_{FF}$).

The model provides a new reason for favourable public policy towards cooperatives. Public policy in circumstances in which a prisoners dilemma emerges may change the pay-offs to such an extent that the prisoners dilemma disappears. For example, Table 4 has provided a numerical example which illustrates that an industry consisting of two cooperatives is the Pareto-optimal industry configuration.[1] However, competition between the two organisations cannot sustain this outcome as an equilibrium. Public policy might use taxes/subsidies in order to change the pay-off 9.96 above 12.6 and pay-off 9 below 7.8 This establishes the desired organisational choices.

4. Summary and Further Research

The introduction section posed a number of questions about the supply side of agricultural and horticultural markets. These questions are addressed in this paper by focussing on decision theoretic as well as strategic considerations. Decision theoretic aspects are reflected by the probabilities of accepting and rejecting projects and the costs and benefits associated with bad and good projects. Strategic considerations also play a role, i.e., decisions made by rivals affect the environment/pay-offs an organisation is facing and will influence therefore its choice of organisational form. Circumstances have been identified in which a cooperative is an efficient organisational form and is chosen in equilibrium. There are other circumstances in which the cooperative as an organisational form is not chosen in equilibrium even when it is efficient, i.e., investor-owned firms emerge as a prisoners dilemma outcome. This provides a new rationale/justification for favourable tax treatment of cooperatives. Situations have also been characterised in which cooperatives and investor-owned firms coexist. The model provides an explanation in this respect for the figures in Table 1. The implications of the model in the form of testable hypotheses are captured by the comparative statics results. The main hypothesis which emerges is that a switch from a cooperative to an investor-owned firm doesn't occur when the attractiveness of the industry is reduced. The normative implications qualify the criticisms levelled at cooperatives that they are conservative and show a lack of innovation. The model has identified situations in which this is good policy and the cooperative as organisational form is recommended.

The model can be extended in a number of directions such that other interesting issues can be addressed. First, the acceptance probabilities are exogenous in the model. They

[1] Whether or not this outcome also improves aggregate societal welfare depends on the effect on consumer prices.

can be endogenised by having decision units choose their acceptance/rejection probabilities. A way to incorporate this aspect is to introduce a fourth stage into the model. This stage should come after the choice of organisational form and before the stage in which the type of product is determined by nature. Second, the decision units in a cooperative are modelled as deciding simultaneously and independently regarding the acceptance of a project. Sequential decision making raises new issues because it creates the possibility for enhancing the performance of the organisation by having the second decision-making unit taking into account the information generated by the decision of the first decision-making unit. An acceptance of a decision-making unit in a cooperative might change the acceptance/rejection probability choice of the other decision-making unit (Meyer, 1991).

This paper has dealt with only one aspect of cooperatives. There are many other aspects of organisations which have to be taken into account when the choice of organisational form is considered. (The fourth paragraph of the first section has identified some of these other aspects.) Some additional avenues for research which are not close to the earlier model will be mentioned briefly in order to provide an indication of the rich menu of issues associated with marketing cooperatives. Third, this paper treats only one type of cooperative, because the emphasis is on the competition between different organisational forms. A rich analysis allows for different types of cooperatives and investor-owned firms. Fulton and King (1993) focus on the choice between two different organisational forms of a cooperative from a perspective which is similar to the one adopted here. Fourth, sociological accounts of cooperatives (Zusman, 1993) emphasise the importance of member commitment, culture, ethical attitudes and consensus decision making. These aspects are related to the preferences/pay-offs of a hierarchy and can in principle be accounted for by making the choice of the second decision-making unit dependent on the decision of the first decision-making unit. Herd behaviour issues may become prominent in such an analysis (Scharfstein and Stein, 1990). Finally, incentive considerations are not dealt with in this paper, but this is done elsewhere (Hendrikse and Veerman, 1995).

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The Diversity of Farmers' Risk Management Strategies in a Deregulated New Zealand Environment

S Martin and F. McLeay

In this paper, the results of a nation-wide survey of New Zealand sheep and beef farmers are presented. Multivariate statistical techniques are used to identify groups of farmers who differ in their risk management practices. Five groups are identified. They are labelled income risk reducers, capital managers, part-timers, debt and market risk managers, and production managers. These groups differ in their perceptions of risk sources and in some farm and farmer characteristics. Reasons for these differences are identified and discussed in the context of deregulation.

1. Introduction

Risk and uncertainty are of great importance in agriculture world-wide. As a consequence, numerous mathematical and econometric techniques have evolved which allow risky decision making to be analysed. Such techniques include, econometric models subjective expected utility models, mathematical quadratic programming models, and specific linear alternatives such as MOTAD (Hazell, 1971), marginal risk constrained linear programming (Chen and Baker, 1974) or separable linear programming (Thomas *et al.*, 1972). In general, these models aid the identification of risk-efficient farm plans from a range of alternatives with specific resource constraints. Individual risk preferences are incorporated through a risk aversion parameter.

While these risk programming approaches can help identify risk-efficient outcomes at the farm level, concern has been expressed that the solutions may be very sensitive for both MOTAD and quadratic programming (Mapp and Helmers, 1984). A failure to specify completely the resource situation and constraint set may contribute to solution sensitivity. This may occur because farmers operate in a multi-attribute environment in which many forces, choices, preferences and events influence behaviour and performance (Mapp and Helmers, 1984). Such complexities are increasing as farming systems in many countries face a wider range of external forces (Eidman, 1994; Tyler and Lattimore, 1990) and are likely to make it increasingly difficult to model farmer behaviour.

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