Collaborative Alliances in Agriculture Under Distrust

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Abstract

Goyal and Joshi (2003) proved that when firms form collaborative alliances with the objective of reducing production costs, the unique stable architecture of collaboration is the complete network (i.e. a network in which all firms have a collaborative alliance with one another). This article shows that this result does not hold when firms face distrust among potential partners. Since researches have identified distrust as an important feature in agriculture, this finding suggests that the formation of beneficial collaborative alliances in this sector requires political intervention.

Key words: Collaborative alliances; networks of collaboration; distrust.

1. Introduction

Goyal and Joshi (2003) showed that when firms collaborate with the objective of reducing production costs, they always have an incentive to form collaborative alliances. The authors obtained this result from a social network model and showed that under some specific conditions (*i.e.* firms have market power and firms' marginal cost is linearly declining in the number of collaborative alliances), the unique stable network is the complete network (*i.e.* a network in which all firms have a collaborative alliance with one another).

These type of alliances have been named in agriculture as farm supply cooperatives (Ortmann and King, 2007). They correspond to alliances in which farmers group their resources (land, capital or/and labour) to jointly

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make decisions based on these resources, and then they divide the gains of collaboration in a fair way (Gerichhausen *et al.,* 2009). Cooperation helps farmers to save costs by purchasing in terms of volume and also by sharing inputs including seeds, fertilizer and farm equipments, among others. It also allows them to reduce information asymmetries, minimise transaction and production costs, reduce transport and communication costs as well as enable them to coordinate their policies (Gall and Schroder, 2006, and Lapar *et al*., 2006). However, there is an important characteristic of farm supply cooperatives that have not been considered by the original model of Goyal and Joshi (2006). That is, it has been argued that lack of trust among potential partners can negatively affect the formation of these alliances (Gerichhausen *et al*., 2009; and Banaskar, 2008). In order to determine whether this argument holds in the UK, a pilot survey was conducted with a sample of ex-sugar beet farmers of the West Midlands region of this country. The survey revealed that these farmers were only willing to form alliances with no more than two partners. These farmers argued that the formation of large collaborative alliances is coupled with costs arising from distrust between partners, and that these costs increase at an increasing rate as the number of alliances increase.

The objective of the present article is to determine whether farmers deviated from the complete network architecture when there is distrust among their potential partners. For this purpose, the network model developed by Goyal and Joshi (2003) was extended by means of the introduction of a distrust cost in their model.

The paper is structured as follows. Section 2 describes the network model. Section 3 studies whether a network other than the complete network can be stable when farmers distrust their potential partners. Policy implications of the results are also discussed. Finally, section 4 concludes the paper.

2. Research Methodology

A pilot survey was designed with the objective of determining whether lack of trust among potential partners can indeed negatively affect the

formation of collaborative alliances. While this has already been reported in the literature (Gerichhausen *et al*., 2009; and Banaskar, 2008), no analysis has been conducted to explain the nature of distrust among farmers. In order to obtain this information, a qualitative research was conducted by the author of this article in 2008 in the West Midlands region of the UK. This qualitative survey included ex-sugar beet farmers; which consisted of interviews using semi-structured questions with the objective of gaining an understanding of the way in which distrust affects the formation of collaborative alliances.

The survey revealed that these farmers were only willing to form alliances with no more than two partners. According to these individuals the formation of larger alliances involves costs arising from distrust among partners. They also reported that these costs increase at an increasing rate as the number of alliances increase. The responses of the pilot investigation are considered as representative for the West Midlands region of the UK. These responses were used as the basis for the proposed network model presented in the next section.

3. Network Model of Farm Supply Cooperatives

3.1 The Network Model

A collaborative alliance between farmers i and j is described by a link, given by a binary variable $g_{ij} \in \{0,1\}$ with $g_{ij} = 1$ if an alliance exists between farmers i and j and $g_{ij} = 0$ otherwise. A network $g = \{(g_{ij})_{ij \in N}\}$ is a description of the collaborative alliances that exist among a set $N = \{1,\ldots,N^*\}$ of farmers, where N^* is the total number of farmers. Networks g^c and g^e are the complete network (*i.e.* $g_{ij} = 1$ for all $i, j \in N$) and the empty network (*i.e.* $g_{ij} = 0$ for all $i, j \in N$). Let G denote the set of all possible networks, $g + g_{ij}$ denote the network obtained by replacing $g_{ij} = 0$ in network g by $g_{ij} = 1$, and $g - g_{ij}$ denote the network obtained by replacing $g_{ij} = 1$ in network g by $g_{ij} = 0$. Let $N_i(g) = \{j \in N : g_{ij} = 1\}$ be the set of farmers with whom farmer i has a collaborative alliance in network g. Assume that $i \notin N_i(g)$ so that $g_{ii} = 0$. The cardinality of $N_i(g)$ is denoted by $\eta_i(g)$. That

is, $\eta_i(g)$ is the number of collaborative alliances that farmer i has in network g. Given this definition, it always holds that $\eta_i(g+g_{ij}) = \eta_i(g)+1$.

3.2 The Objective Function of Farmers

The original model of Goyal and Joshi (2003) was modified in different aspects with the objective of reflecting the agricultural sector of the UK. First, these authors assumed that firms have market power. However, farmers in the UK are too small as to exercise market power (MAFF, 2000). It is for this reason that farmers were assumed to be price takers. Formally, assume for simplicity and without losing generality that all the farmers in set N produce the same crop. Let $p(g)$ be the price of this crop in network g. Because farmers are price takers, it is assumed that $p(g) = p$ for all $g \in G$. Second, farmers in the short-medium run cannot respond to exogenous changes of marginal cost by increasing production because they face a land constraint given by the existence of clear property rights (*i.e*. they have a fixed area of land). This restriction was introduced as follows. Let c_i be the marginal cost faced by farmer $i \in N$. If $p = c_i$, then farmer i maximizes profits by using all its land endowment. If $p < c_i$, then the farmer maximizes profits by choosing an output smaller than that obtained when using all its land endowment. Finally, if $p > c_i$, then farmer i produces the same output than that produced when $p = c_i$ as a consequence of the land restriction. Formally, if $p \geq c_i$, then $Q_i(g) = Q_i$ for all $g \in G$, where Q_i represents the output of the crop produced by farmer i. In contrast, if $p < c_i$, then $Q_i(g) < Q_i$. Third, the marginal cost faced by farmer i in network g is given by $c_i = \lambda_i - \theta_i\eta_i(g) + \gamma_i\eta_i^2(g)$, where λ_i is the marginal cost faced by farmer i when this individual does not have collaborative alliances. The term $\theta_i\eta_i(g)$ represents the beneficial effect of collaborative alliances on marginal cost, where $\theta_i > 0$ reflects how strong this beneficial effect is. Finally, the term $\gamma_i\eta_i^2(g)$ represents the distrust cost of collaboration. Since the pilot survey revealed that this cost increases more than proportionally as the number of alliances increase, this cost was assumed to be a quadratic function of $\eta_i(g)$. Finally, the coefficient γ_i reflects how strong the

negative effect of this cost is. Using these definitions, the objective function of farmer *i* in networks *g* and $g + g_{ij}$ is defined as follows:

$$\pi_i(g) = p(g)Q_i(g) - [\lambda_i - \theta_i\eta_i(g) + \gamma_i\eta_i^2(g)]Q_i(g) \quad (1)$$

$$\pi_i(g+g_{ij}) = p(g+g_{ij})Q_i(g+g_{ij}) - [\lambda_i - \theta_i\eta_i(g+g_{ij}) + \gamma_i\eta_i^2(g+g_{ij})]Q_i(g+g_{ij}) \quad (2)$$

For simplicity it is assumed that $p = \lambda_i$ for all $i \in N$. This implies that farmers will have an incentive to form a collaborative alliance as long as $p > \lambda_i - \theta_i\eta_i(g) + \gamma_i\eta_i^2(g)$. On the other hand, since $p(g) = p$ for all $g \in G$ and $Q_i(g) = Q_i$ for all $g \in G$ when $p > c_i$, farmer *i* will have an incentive to form a collaborative alliance with farmer *j* when the following expression is positive:

$$\pi_i(g + g_{ij}) - \pi_i(g) = \{\theta_i - \gamma_i[\eta_i(g + g_{ij}) + \eta_i(g)]\}Q \quad (3)$$

4. The Stable Network

Before showing that a stable equilibrium different from the complete network exists when farmers distrust potential partners, let us consider the following result:

Proposition 1: *If* $\pi_i(g + g_{ij}) - \pi_i(g) = 0$, then $\pi_i(g) > \pi_i(g - g_{ik})$.

Proof: First note that $\eta_i(g + g_{ij}) + \eta_i(g) > \eta_i(g) + \eta_i(g - g_{kj})$. This implies that $\theta_i - \gamma_i[\eta_i(g) + \eta_i(g - g_{ik})] > \theta_i - \gamma_i[\eta_i(g + g_{ij}) + \eta_i(g)]$. However this mean that $\pi_i(g) - \pi_i(g - g_{ik}) > \pi_i(g + g_{ij}) - \pi_i(g)$. Therefore, if $\pi_i(g + g_{ij}) - \pi_i(g) = 0$ then, it must be concluded that $\pi_i(g) > \pi_i(g - g_{ik})$.

According to this proposition, when farmer *i* is indifferent about forming a collaborative alliance with farmer *j*, then the former does not have an incentive to break an existing agreement. The importance of

this result is due to the fact that it defines a weak stability condition. To see why, note that if $\pi_i(g + g_{ij}) - \pi_i(g) = 0$ for all $i \in N$, then all farmers are indifferent about forming additional alliances. This also implies that no farmer is willing to break an exiting one. A sufficient condition for this equilibrium to exist is, therefore, that $\pi_i(g + g_{ij}) - \pi_i(g) = 0$ for all $i \in N$. The following proposition shows that there exist a vector $\gamma^* = (\gamma_i^*, ..., \gamma_N^*)$ which satisfies this sufficient condition.

Proposition 2: There exists a vector $\gamma^* = (\gamma_i^*, ..., \gamma_N^*)$ such that $\pi_i(g + g_{ij}) - \pi_i(g) = 0$ for all $i \in N$.

Proof: Note that $\pi_i(g + g_{ij}) - \pi_i(g) = 0$ when $\theta_i - \gamma_i[\eta_i(g + g_{ij}) + \eta_i(g)] = \theta_i - \gamma_i[2\eta_i(g) + 1] = 0$. But this holds when $\gamma_i^* = \theta_i/[2\eta_i(g) + 1] \in \Re^+$. It must be concluded, therefore, that for all $\eta_i(g) > 0$ there exists a $\gamma_i^*(g) \in \Re^+$ such that $\pi_i(g + g_{ij}) - \pi_i(g) = 0$. Finally, since this result holds for an arbitrary farmer, it is concluded that there exists a vector $\gamma^* = (\gamma_i^*, ..., \gamma_N^*)$ such that $\pi_i(g + g_{ij}) - \pi_i(g) = 0$ for all $i \in N$.

According to this result, farmers cannot be fully benefited from cooperation because there exists a stable equilibrium other than the complete network that arises as a consequence of farmers' distrust. On the other hand, if farmers were able to reduce the distrust cost, then they would also be able to increase collaboration. This is formally shown in Proposition 3:

Proposition 3: *If $\gamma_i = 0$ for all $i \in N$, then the unique stable network is the complete network.*

Proof: It is inferred from equation 3 that when $\gamma_i = 0$, $\pi_i(g + g_{ij}) - \pi_i(g) = \theta_i Q > 0$ for all $g \in G$. This implies that if $\gamma_i = 0$

for all $i \in N$, then $\pi_i(g + g_{ij}) > \pi_i(g)$ for all $i \in N$ and all $g \in G$. This means, in turn, that farmers have always an incentive to form a collaborative alliance. It must be concluded, therefore, that the unique stable network when $\gamma_i = 0$ for all $i \in N$ is the complete network.

This result can be used to propose important policy recommendations. For example, policy makers could consider the establishment of private offices designed to assume the administrative tasks of collaboration. That is to find partners, find potential markets for joint production, establish clear property rights on the resources that are shared by members of the alliance, and to provide relevant information about inputs and market trends. These offices not only could be opened with the purpose of helping farmers to reduce distrust costs, but also could become alternative profitable enterprises that could contribute to the development of rural areas. In addition, they could help farmers to adjust to the current policy trend adopted by the European Union. That is, the European Union has developed important reforms of the Common Agricultural Policy to replace distorting domestic policies with lump sum transfers called decoupled payments. This new political orientation has in practice altered the business environment and farmers are now competing with smaller and more unstable international prices (Sckokai and Moro 2006, White and Dawson 2005, and Hennessy 1998). Since cooperative alliances allow farmers to gain efficiency, they can help farmers to be better prepared to face these policy changes.

5. Conclusion

This article is based on a social network model of collaboration and it shows that farmers can reach a stable collaborative equilibrium other than the complete network when they distrust partners. The main implication of this result is that farmers cannot fully benefit from

collaboration. Policy makers could consider the possibility of establishing private offices designed to assume the administrative costs of collaboration. They not only could help farmers to reduce distrust costs, but also enable them to gain efficiency. This could constitute an important opportunity for farmers to successfully adjust to future policy reforms.

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