Social Interactions and Product Quality: The Value of Pooling in Cooperative Entrepreneurial Networks

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Abstract

Why do cooperatives often pay a pooled price, despite the free-riding incentives it entails? In this paper we highlight that a cooperative is an enterprise owned by a network of entrepreneurial members. By taking explicitly into account the social interactions among entrepreneurial members and the impact of social ties on members' product quality provisions, we identify the circumstances when pooling is efficient. It is shown that social interactions mitigate the free-riding effect of pooling and that the amount of members' social interactions depends upon, and increases with, the cooperative's pooling ratio. We show that the complete pooling policy is not only economically efficient but also socially advantageous when the context of the cooperative is conducive to frequent social interactions among members.

Keywords: Social Capital, Social Interaction, Cooperatives, Pooling Policy

JEL classification: D21, L23, Q13

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Abstract

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'Most behaviour is closely embedded in networks of interpersonal relations.'

(Granovetter 1985, p.504)

1. Introduction

'A cooperative is an enterprise collectively owned by many independent farmers as input suppliers in a production chain' (Feng and Hendrikse 2012, p.242). This entrepreneurial network is formed to advance their member's economic interests by bringing the following benefits: economies of size, elimination of double marginalisation, profits from processing, assurance of product outlet, gains from vertical and horizontal coordination, risk reduction, countervailing power, competitive yardstick effect and auxiliary services for members, etc. (e.g. Cook 1995; van Dijk 1997).

Cooperatives play an important role in the world economy.[1] However, various traditional cooperative business practices seem not to be conducive to meeting consumers' need for quality (e.g. Saitone and Sexton 2009; Pennerstorfer and Weiss 2013). Specifically, 'the practice of pooling in cooperatives is commonly believed to place cooperatives at a competitive disadvantage in quality-differentiated markets' (Liang 2013, p.66). In a pooling arrangement, all members receive the same price for the delivered quantity of input. Under the assumption of self-interest and due to the potential free-riding behaviours of individual members, collectively optimal quality outcomes will not arise for the cooperative with a pooling policy. This raises the question why cooperatives adopt a pooling policy even when it puts them at risk of opportunistic behaviour?

In this paper, we take the view that a cooperative is not only an entrepreneurial network but also a society of members with a social network. The pooling policy thus cannot be fully analysed without considering the social aspect of cooperatives. We highlight that pooling has a prominent social effect and the strength of it largely depends on the social context of the entrepreneurial network. By taking explicitly into account the social interactions among members and the impact of social ties on members' product quality provisions, we identify the circumstances when pooling is efficient. In particular, we show that members can receive the highest total utility under the complete pooling policy when the marginal cost of social interactions is low. This result offers an additional justification or strategic explanation for the pooling policy of traditional cooperatives, next to the economies of scale (Staatz 1987), production risk sharing (Deng and Hendrikse 2013) and ideology (Abramitzky 2008) explanations.

According to Granovetter (2005, p.43), 'a firm cannot be viewed simply as a formal organization, but must also be understood as having the essential elements of any social community'. Granovetter's argument is particularly true for agricultural cooperatives, which are jointly owned and

[1] Nowadays, cooperative enterprises worldwide provide 250 million jobs in various sectors and the largest 300 cooperatives generate a turnover of more than 2.2 trillion USD in 2014 (ICA 2014). Cooperatives are especially important in the agricultural sector. For instance, as of 2007, cooperatives have a 95% market share of the dairy market in New Zealand (ICA 2014). 'The average market share of all agricultural marketing cooperatives in the EU is 40%' (Bijman et al. 2012, p.29). In Japan, 91% of farmers are registered as cooperative members in 2007 (ICA 2014), and in China, more than 25% of agricultural households have joined cooperatives by the end of 2013 (MoA 2014).

controlled by a society of farmers. According to Valentinov (2004, p.5), ‘every cooperative represents simultaneously an association of persons in the sense of sociology and social psychology, i.e. social group, and a joint enterprise, owned and operated by the same members of this group’. Cooperatives therefore have a ‘double nature’ (Valentinov 2004, p.5) or are regarded as a ‘dual organization’ (Nilsson and Hendrikse 2011, p.339). Members of a cooperative are not anonymous financiers but real persons who run their own agricultural enterprises (Nilsson, Svendsen and Svendsen 2012). The local nature of cooperative membership entails that the members are likely to know each other and have social relationships (Cropp and Ingalsbe 1989; Hendrikse and Feng 2013).

Sociologists have forcefully argued that the embeddedness of economic activities in social communities has a profound impact on the economic performance of organisations (e.g. Coleman 1984; Granovetter 1985; Turner 1999). Nowadays, this is also reflected in economic models of social networks (e.g. Goyal 2007). It seems therefore appropriate to model the social connections among members in cooperatives in the analysis of cooperatives’ efficiency. In this paper, we investigate the social ties between members in cooperatives, which can be characterised as the structural dimension of social capital. According to Nahapiet and Ghoshal, (1998), structural social capital reflects the overall pattern of social connections between the members in the organisation. A high level of structural social capital featured by the existence of strong social ties among members. It is beneficial for cooperatives in various aspects. It not only facilitates the exchange of information between the members but also supports the formation of the cognitive and relational dimension of social capital, such as shared vision, trust, and norms in the cooperative (e.g. Granovetter 1985; Gulati 1995; Tsai and Ghoshal 1998). Furthermore, social ties in a cooperative community carry personal attachments between the members. According to van Dijk and van Winden (1997, p.325), a social tie between two individuals consists of their ‘sentiments’ about each other, which are defined as ‘the extent to which one person cares about the other’s welfare and derives satisfaction from it’. Social ties thus give rise to altruism between members. Similar to the altruism between colleagues in a workplace or in a team (Rotemberg 2006), the altruism between cooperative members may promote reciprocal behaviours. That is, an altruistic member will care about the fellow members’ wellbeing, and then adapts his or her future actions accordingly. Therefore, in addition to other benefits, social ties between cooperative members may serve as a source of social motivation for their production activities and have potential impacts on cooperative's economic performance.

Social ties between people are not always constant. Instead, 'they depend on the history of interaction between the individuals' (van Dijk and van Winden 1997, p.324). In cooperatives, members are socially connected to each other and the altruism between them is rooted in their social ties. Following Dur and Sol (2010, p.295) on the formation of social ties, we assume that a member's altruistic feelings towards others depend on the 'attention' the member has received. The formation and strength of the altruism in a cooperative thus depend on the amount of the members' social interactions. By adopting Coleman's (1988) approach of incorporating agents' actions in a social context, we argue that cooperative members' social interactions are driven by the net utility they can derive from them. Two aspects are likely to play an important role in members' decisions regarding social interactions. First, the income rights structure of the cooperative may influence the members' willingness to interact because it determines the externality of their economic payoff on their social interactions. The members will interact more if the externality is larger because the economic benefits of social interactions are better internalised. Second, the utility and costs of social interactions will be considered by the members. It is natural to expect that the members will interact less if social interactions are more costly or bring less social utility.

According to Singh (2012, p.107), 'there are two main classes of social interaction models in economics, one that uses non-cooperative game theory to study the strategic interaction among agents, and another that uses empirical models to determine the existence of social interaction effects reflecting the role of nonmarket influences on individual decision-making'. In this paper, our approach belongs to the first class. Specifically, we present a game theoretic model to capture the members' social interactions and product quality decisions under different pooling policies. We obtain two main results. First, the model shows that the income rights structure of cooperatives influences the social interactions of members and social ties in the cooperative. The amount of the members' social interactions and the strength of social ties depend upon, and increase with, the cooperative's level of pooling. Second, the social ties have a positive impact on the members' production activities, economic payoff, and total utility. With strong social ties, the cooperative can approach the first-best level of product quality and joint economic payoff under the complete pooling policy. When we consider the members' total utility instead of merely their economic payoff, the complete pooling policy is economically and socially desirable if strong social ties can be formed in the cooperative. However, when complete pooling cannot facilitate sufficient social interactions between the members due to high social interaction costs, the cooperative should abandon the complete pooling policy and adopt the no-pooling policy.

This paper proceeds as follows. In Sections 2 and 3, we present the model and derive the equilibrium. In Section 4, we provide the comparative statics analysis. In Section 5, we discuss the empirical implications and the final section concludes.

2. Model

We model a cooperative with two identical members.[2] We consider the members' production activities as well as social interaction activities. Members decide on their social interaction activities simultaneously in the first stage of the game, while production activities are determined in the second stage.

Each member produces one unit of raw product and supplies it to the cooperative. The cooperative sells the product in a functioning market, pays the members and retain no profit. We focus on the members' production activities regarding their quality provisions. The members decide the product quality $q_i\ (\geq 0;\ i = 1\ or\ 2)$ individually, which is assumed to be fully contractible. The cooperative's pooled product quality Q_C is the average quality of the raw product of both members:

$$Q_C = \frac{1}{2}(q_1 + q_2).$$

The cooperative's income rights structure is represented by its pooling policy. It is captured by the pooling ratio σ $(0 \leq \sigma \leq 1)$, which measures to what extent a member's product will be paid according to the pooled quality Q_c (Saitone and Sexton 2009). $1 - \sigma$ thus denotes the fraction of a member's product that is paid based on the member's individual product quality q_i. When $\sigma = 1$,

[2] This setting can be extended to a cooperative with n (>2) members in order to analyse richer network structures.

the cooperative applies the complete pooling policy, whereas the cooperative applies no pooling when $\sigma = 0$. Partial pooling is characterised by $0 < \sigma < 1$. The cooperative's pooling ratio is known and treated as exogenous. Assume that $P_0(> 0)$ is the marginal price of product quality, which can be understood as the aggregated 'taste parameter' of the market (Mussa and Rosen 1978, p.301). Define c as the cost coefficient of quality provision. The economic payoff of a member's production activity is

$$\pi_i = \sigma P_0 Q_C + (1 - \sigma) P_0 q_i - \frac{1}{2} c q_i^2 \, , i = 1 \; or \; 2.$$

The members' social interaction activity $s_i \; (\geq 0; \; i = 1 \; or \; 2)$ is modelled as the social interaction initiated by member i. According to Dur and Sol (2010, p.294), social interactions can be modelled as an exchange of 'attention' between agents. A member initiates social interactions by giving social attention to the other member. It can be the 'kind gestures' the member gives to the other (p.294), e.g. an invitation for coffee or a conversation about family issues. The members' social interaction activities s_i are not contractible but costly in terms of time and/or money and/or efforts. The cost is assumed to be ds_i, where $d(> 0)$ is the marginal cost coefficient of social interaction activities.

Social interactions generate two important consequences (van Dijk and van Winden 1997; Dur and Sol 2010). First, it brings a direct social utility to the receiver. For example, when member 1 (he) initiates social interactions, member 1's social interaction activities s_1 will bring member 2 (she) a direct social utility of $ks_1(k > 0)$ because people enjoy being treated kindly by others. k measures the marginal social utility that member 2 enjoys when she receives the 'attention' from the other member. Second, social interactions lead to altruistic feelings among the members. That is, when member 1 initiates social interactions with members 2, his activity will lead to member 2's feeling of altruism towards him. When member 2 is altruistic towards member 1, she will care about member 1's wellbeing in addition to her own economic payoff. Sheldon (1971) claims that this effect is increasing in the time and effort invested in a relationship. Likewise, the more frequently agents interact, the more cooperative behaviours will emerge and sustain (Duffy and Ochs 2009). We thus assume that the strength of the altruistic feeling member 2 will develop towards member 1 is proportional to the 'attention' member 2 receives from member 1. We use s_1 to measure the strength of the developed social ties from member 2 to member 1 (Dur and Sol 2010). Member 2's utility function thus incorporates an altruism utility term $s_1\pi_1$. It is assumed that social interactions have the same altruism-creating effect on both members. Member 1 will appreciate the social interactions initiated by member 2 in the similar way. These consequences of social interactions are presented in the members' utility functions:

$$U_1 = \pi_1 - ds_1 + ks_2 + s_2\pi_2$$

$$U_2 = \pi_2 - ds_2 + ks_1 + s_1\pi_1.$$

We assume that the members' quality provision cost coefficient, social interaction activity cost coefficient, and the market's preference for product quality are common knowledge. We determine the equilibrium outcomes of the game in the next section.

3. Equilibrium

The equilibrium social interaction activities and product quality decisions are determined by backward induction. In the second stage of the game, member 1's product quality is determined by the first-order condition of his utility function:

$$\frac{\partial U_1}{\partial q_1} = \frac{\partial \pi_1}{\partial q_1} + s_2\frac{\partial \pi_2}{\partial q_1} = \frac{\sigma P_0}{2} + (1-\sigma)P_0 - cq_1 + s_2\frac{\sigma P_0}{2} = 0, \text{ i.e.}$$

$$q_1^* = \frac{P_0}{c}\left[1 - \frac{\sigma}{2}(1 - s_2)\right].$$

Similarly, member 2's quality decision is $q_2^* = \frac{P_0}{c}\left[1 - \frac{\sigma}{2}(1 - s_1)\right]$.

The cooperative's equilibrium product quality is $Q_C^* = \frac{P_0}{c}\left[1 - \frac{\sigma}{4}(2 - s_1 - s_2)\right]$.

Substitute q_i^* and Q_C^* in π_i:

$$\pi_1^* = \frac{\sigma P_0^2}{c}\left[1 - \frac{\sigma}{4}(2 - s_1 - s_2)\right] + \frac{(1-\sigma)P_0^2}{c}\left[1 - \frac{\sigma}{2}(1 - s_2)\right] - \frac{P_0^2}{2c}\left[1 - \frac{\sigma}{2}(1 - s_2)\right]^2$$

$$\pi_2^* = \frac{\sigma P_0^2}{c}\left[1 - \frac{\sigma}{4}(2 - s_1 - s_2)\right] + \frac{(1-\sigma)P_0^2}{c}\left[1 - \frac{\sigma}{2}(1 - s_1)\right] - \frac{P_0^2}{2c}\left[1 - \frac{\sigma}{2}(1 - s_1)\right]^2.$$

In the first stage of the game, the social interaction activity of each member is determined by:

$$\frac{\partial U_1}{\partial s_1} = \frac{\partial \pi_1^*}{\partial s_1} - d + s_2 \frac{\partial \pi_2^*}{\partial s_1} = \frac{\sigma^2 P_0^2}{4c} - d - \frac{\sigma^2 P_0^2}{4c} s_1 s_2 = 0$$

$$\frac{\partial U_2}{\partial s_2} = \frac{\partial \pi_2^*}{\partial s_2} - d + s_1 \frac{\partial \pi_1^*}{\partial s_2} = \frac{\sigma^2 P_0^2}{4c} - d - \frac{\sigma^2 P_0^2}{4c} s_1 s_2 = 0.$$

We obtain $s_1 s_2 = 1 - \frac{4cd}{\sigma^2 P_0^2}$. The symmetric solution of the members' equilibrium social interaction activity is formulated in Proposition 1.

Proposition 1: The equilibrium social interaction of a member is

$$s_i^* = s^* = \begin{cases} 0 & , \quad 0 \leq \sigma \leq \frac{2\sqrt{cd}}{P_0} \\ \sqrt{1 - \frac{4cd}{\sigma^2 P_0^2}} & , \quad \frac{2\sqrt{cd}}{P_0} < \sigma \leq 1. \end{cases}$$

Figure 1 presents a graphical illustration of the members' equilibrium social interaction activity as a function of the pooling ratio. There exists a threshold pooling ratio $\sigma_T = \frac{2\sqrt{cd}}{P_0}$. When $\sigma > \sigma_T$, social interactions will occur and social ties will be formed. When $\sigma > \sigma_T$, we can rewrite $s^* = \sqrt{1 - \frac{\sigma_T^2}{\sigma^2}}$.

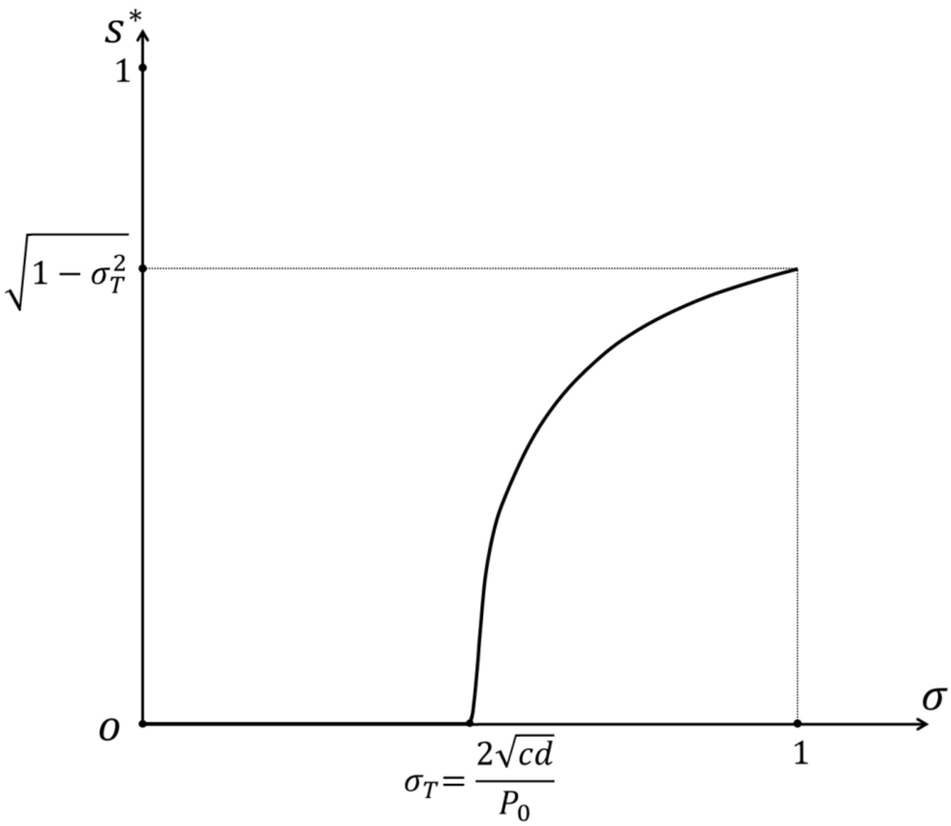

Fig 1 Members' social interactions

The equilibrium product quality of the cooperative is obtained by substituting s_i^* in Q_C^*. Proposition 2 presents the result.

Proposition 2: The equilibrium product quality of the cooperative is $Q_C^* = \begin{cases} \frac{P_0}{c}\left(1-\frac{\sigma}{2}\right) & , \quad 0 \le \sigma \le \sigma_T \\ \frac{P_0}{c}\left[1-\frac{\sigma}{2}(1-\sqrt{1-\frac{\sigma_T^2}{\sigma^2}})\right], & \sigma_T < \sigma \le 1. \end{cases}$

Denote $\pi_C = \pi_1 + \pi_2$ as the joint economic payoff of the cooperative. It is equal to

$$\pi_C^* = \begin{cases} \frac{P_0^2}{c}\left(1-\frac{\sigma^2}{4}\right) & , \quad 0 \le \sigma \le \sigma_T \\ \frac{P_0^2}{c}\left[1-\frac{\sigma^2}{4}\left(1-\sqrt{1-\frac{\sigma_T^2}{\sigma^2}}\right)^2\right], & \sigma_T < \sigma \le 1. \end{cases}$$

The cooperative members' total utility in equilibrium is $U_C^* = U_1^* + U_2^* = \pi_C^* + [\pi_C^* + 2(k-d)]s_i^*$.

Because the cooperative can neither contract on the members' social interaction activities nor measure the costs and social utility of social interactions, its attention is confined to the product quality Q_C and joint economic payoff π_C. They are important for the cooperative because, as a business firm, the cooperative competes with other types of firms in the market.

For the purpose of comparison, it is useful to derive the equilibrium results of the standard economic model and the first-best product quality of the cooperative. In the standard economic model, the social interactions and the related social effects are ignored, i.e. $s_i = 0$ ($i = 1$ or 2). The members' utility functions U_i converges to π_i and the equilibrium results of the economic model are $Q_E = \frac{P_0}{c}(1-\frac{\sigma}{2})$ and $\pi_E = \frac{P_0^2}{c}\left(1-\frac{\sigma^2}{4}\right)$. Furthermore, we can derive the first-best product quality Q_{FB} of the standard economic model, with which the cooperative can obtain the maximum joint economic payoff. To obtain Q_{FB}, the cooperative, instead of the members, determines the product quality the members should deliver (Albaek and Schultz 1998). The first-order condition of π_C leads to $Q_{FB} = \frac{P_0}{c}$, and therefore the first-best joint economic payoff $\pi_{FB} = \frac{P_0^2}{c}$. A direct comparison shows that

$Q_E < Q_{FB}$ and $\pi_E < \pi_{FB}$ when $\sigma > 0$. It indicates that the pooling will decrease the cooperative's efficiency by decreasing the product quality.

The equilibrium results of the social interaction model and standard economic model can be normalised by using Q_{FB} and π_{FB}, respectively. The first-best product quality and joint economic payoff are represented by the horizontal lines equal to 1 in Figures 2 and 3. The solid curves in each figure present the normalised equilibrium results of the social interaction model $Q_C^{*\prime}$ and $\pi_C^{*\prime}$. The dotted curves represent the normalised equilibrium results of the standard economic model. When $0 \leq \sigma \leq \sigma_T$, the equilibrium results of the standard economic model and the social interaction model are the same because there is no social interaction in the cooperative. Therefore, the dotted curve and solid curve overlap in this interval in both figures and they are simply represented by the solid curve. When $\sigma_T < \sigma \leq 1$, the solid curve and dotted curve separate.

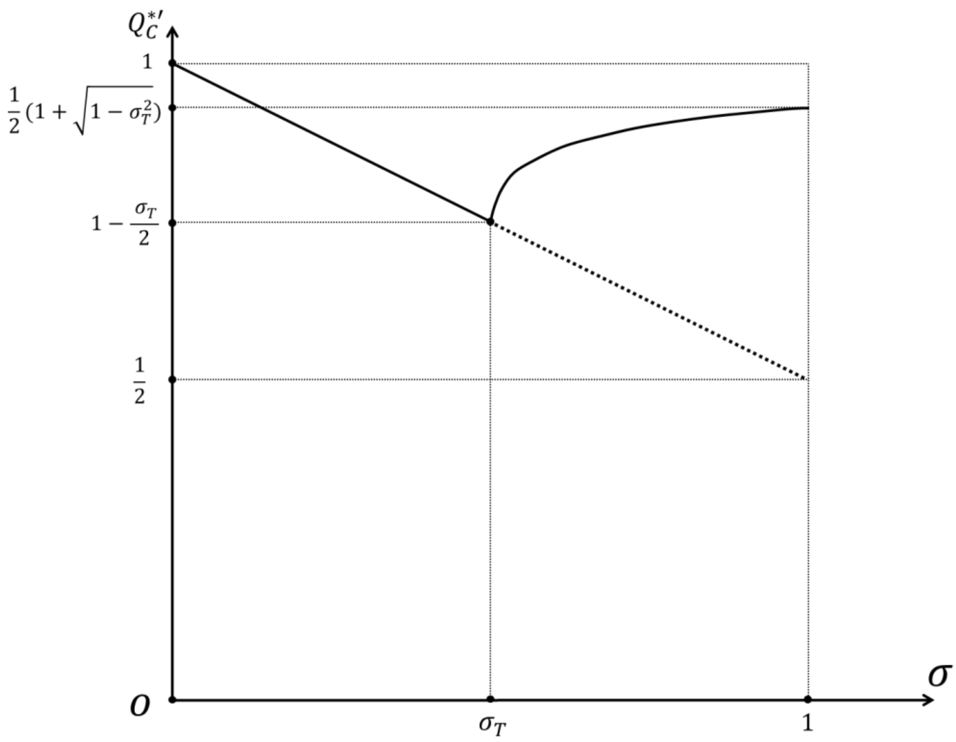

Fig 2 Cooperative's equilibrium product quality

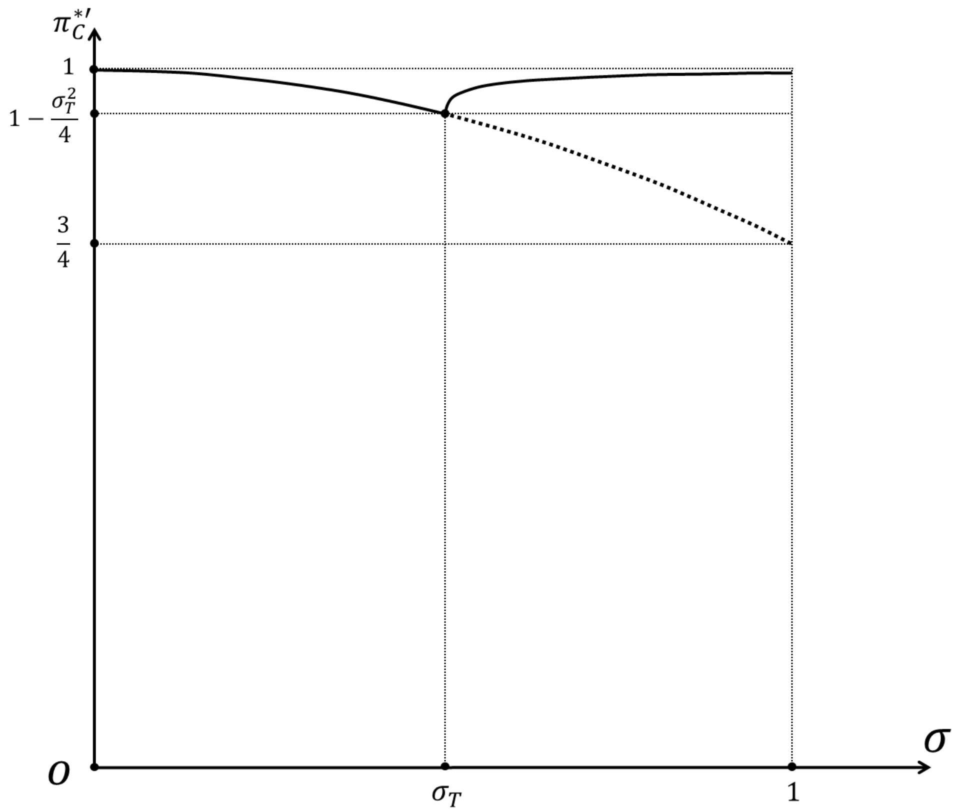

Fig 3 Cooperative's equilibrium joint economic payoff

Several implications regarding the cooperative's choice of pooling policy can be drawn. First, when $\sigma = 0$, i.e. the cooperative adopts the no-pooling policy, the first-best product quality and joint economic payoff are realised. Each member is paid individually according to his or her own product quality. There will be no free-riding in the product quality provisions, but in the meantime, there will be no social interactions between the members.

Second, the cooperative's equilibrium product quality and joint economic payoff will fall below the first-best levels when the cooperative applies a pooling policy. The cooperative's equilibrium product quality and joint economic payoff are determined by the joint effect of economic and social motivation. The former is directly determined by the pooling ratio, whereas the latter is driven by the social ties between the members. Pooling facilitates the members' free-riding behaviours in their product quality provisions. The larger the pooling ratio, the more severe the free-riding problem. As Figures 2 and 3 show, the cooperative's equilibrium product quality and joint economic payoff will decrease continuously in σ in the interval of $[0, \sigma_T]$, where no social interactions occur and the equilibrium results are the same as what the standard economic model predicts. In other words, there is only economic motivation for the members, which is weaker than that under the no-pooling policy.

Third, when $\sigma_T < \sigma \leq 1$, pooling will elicit social interactions between the members. With social interactions, the members develop social ties and altruism starts to play a role in their decision-making regarding product quality provisions. With social motivation based on altruism, the cooperative's equilibrium product quality and joint economic payoff will be above the equilibrium outcomes of the standard economic model and increase in σ when $\sigma \in (\sigma_T, 1]$. The pooling policy is indispensable for social motivation because the externality of production activities is dependent on the pooling ratio. Although a larger pooling ratio leads to more free-riding, it also stimulates more social interactions and facilitates the development of stronger social ties. The equilibrium social interactions will reach the maximum level $s_{max}^* = \sqrt{1 - \sigma_T^2}$ when the cooperative has the complete pooling policy, i.e. $\sigma = 1$.

Finally, when the cooperative chooses the complete pooling policy, the equilibrium product quality and joint economic payoff are determined by σ_T. When $\sigma = 1$, we rewrite $Q_C^{*\prime} = 1 - \frac{1}{2}(1 - \sqrt{1 - \sigma_T^2})$ and $\pi_C^{*\prime} = 1 - \frac{1}{4}\left(1 - \sqrt{1 - \sigma_T^2}\right)^2$. As $\sigma_T = \frac{2\sqrt{cd}}{P_0}$, the efficiency of the complete pooling policy is largely dependent on the social interaction activity cost coefficient d. When d is very small, σ_T approaches 0, and $Q_C^{*\prime}$ and $\pi_C^{*\prime}$ can be close to the first-best levels. The reason is that, when σ_T decreases to 0, s_{max}^*, i.e. the members' social interactions under complete pooling, will increase to 1. Member 1's utility U_1 will be almost equal to $\pi_1 + \pi_2 + k$. It entails that member 1 puts the same weight on member 2's economic payoff as on his own economic payoff. Member 1 will not free ride and the same reasoning applies to member 2. Therefore, the economic incentives under an egalitarian distribution such as the complete pooling policy are efficient when 'complete social consciousness' is obtained in the agricultural cooperative (Sen, 1966, p.369). Proposition 3 summarises the result.

Proposition 3: The complete pooling policy is efficient when the marginal cost of social interactions is very low.

According to LeVay (1983, p.3), ‘cooperatives are known to appeal to people not merely as a means of running a business but also as an instrument of social amelioration’. Therefore, the social utility resulting from social interactions and social ties should not be ignored when we evaluate the cooperative’s pooling policy. The cooperative members’ total equilibrium utility is $U_C^* = U_1^* + U_2^* = \pi_C^* + [\pi_C^* + 2(k-d)]s_i^*$. The first term of U_C^* is the total economic payoff of production activities and the second term is the social utility originated from the members’ social interactions and social ties. The social utility includes the members’ satisfaction derived from other members’ economic payoff and the net benefits of social interactions. In Figure 4, the members’ normalised total utility $U_C^{*\prime}$ is represented by the dashed curve. When $\sigma \in [0, \sigma_T]$, there are no social interactions in the cooperative, i.e. the total utility curve is the same as the economic payoff curve (the solid curve). When $\sigma \in (\sigma_T, 1]$, the total utility curve starts to increase and will dominate the equilibrium economic payoff due to the additional social utility the members receive.

Figure 4 indicates that the cooperative’s pooling policy, especially the complete pooling policy, can be better justified when the members’ social utility is taken into account. If the members have strong social ties, i.e. s^* being close to 1, the members’ total utility U_C approaches $2(\pi_{FB} + k)$, which is apparently higher than the first-best economic payoff π_{FB}. The members enjoy the social interactions and develop strong social ties between each other. In turn, the altruism towards each other makes them better off when seeing other members achieving high economic payoff, and drive them to invest optimal efforts in the provisions of product quality. As such, the pooling policy can lead to the members’ total utility being much higher than the first-best economic payoff under the no-pooling policy.

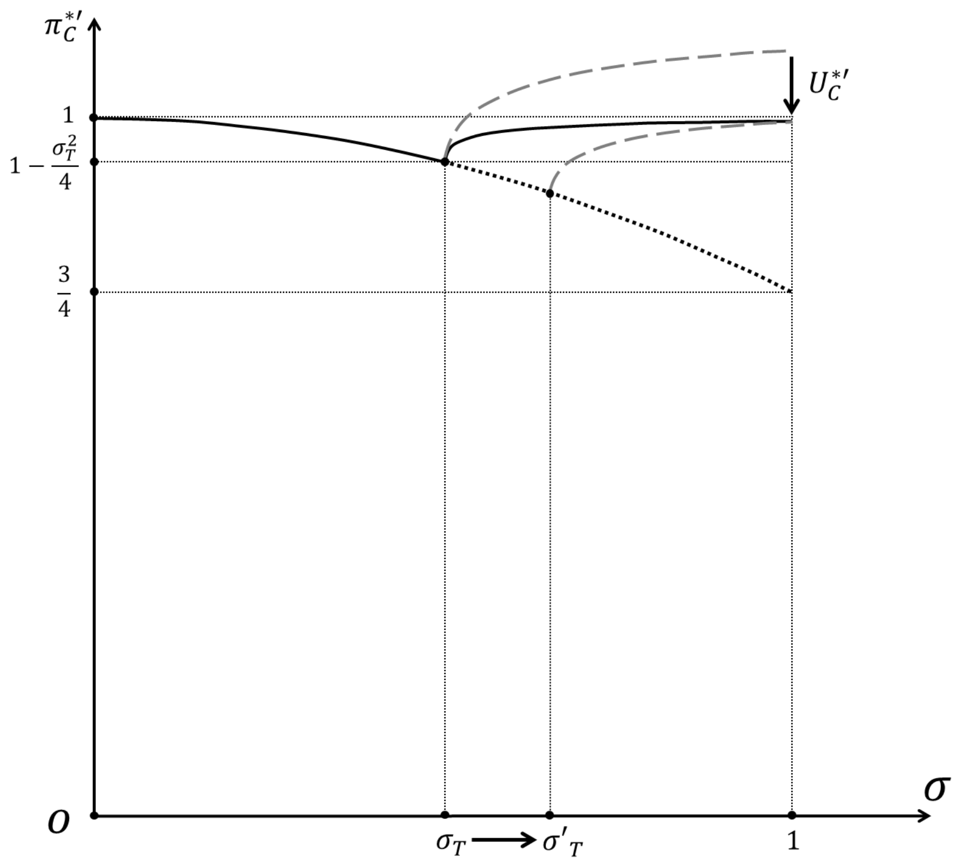

Fig 4 Members' total utility

However, when the social interaction activity cost coefficient d increases, the members' social interactions will become less because they are more costly. As a consequence, the members' total utility will decrease. The reason is twofold. On the one hand, less social interactions result in weaker social ties and less social motivation. The members care less about the other's economic payoff and become more willing to free ride on product quality provisions. The members' economic payoff drops with the decreasing product quality in the cooperative. On the other hand, the members' social utility drops as well because the members appreciate others' economic payoff less and receive lower net social benefits due to the lower social attention from others and the higher costs of social interaction activities. Under the complete pooling policy, if σ_T increases to 1, the $U_C^{*\prime}$ curve will converge to the standard economic payoff curve (the dotted curve). As shown in Figure 4, when σ_T is larger than a certain value σ'_T (< 1), the members' total utility will fall below the first-best economic payoff.[3] This makes the complete pooling policy sub-optimal even when we consider its

[3] σ'_T can be obtained by solving the equation: $U_C^{*\prime} = 1$. However, it is not possible to derive an analytical expression of the solution.

social effect. In this case, the no pooling policy is a better choice for the cooperative. We summarise this insight in Proposition 4.

Proposition 4: The complete (no) pooling policy maximises total utility when $\sigma_T < (\geq)\ \sigma'_T$.

4. Comparative Statics Analysis

This section provides the comparative statics analysis of the equilibrium outcome. We focus on the factors that influence the members' social interaction activities. Members' social interactions are highly dependent on the cooperative's pooling policy. First, the existence of a threshold pooling ratio $\sigma_T = \frac{2\sqrt{cd}}{P_0}$ indicates that only when $\sigma > \sigma_T$ will the members undertake social interaction activities. Otherwise, no social interactions will take place and no social ties will be formed. Second, if social interactions occur, then they are increasing in the pooling ratio. When the cooperative enacts the complete pooling policy ($\sigma = 1$), the members will undertake the maximum amount of social interactions: $s^*_{max} = \sqrt{1 - \sigma_T^2}$, and develop the strongest social ties and the highest level of altruism towards each other. The following proposition summarises the relationship between the pooling ratio and social interaction.

Proposition 5: There will be social interactions between the cooperative members only when $\sigma > \frac{2\sqrt{cd}}{P_0}$ *and it is increasing in the pooling ratio.*

Pooling influences cooperative members' social interactions because it creates an externality in their production activities. In our model, if a member increases (decreases) his product quality, the other member will benefit (suffer) through the pooling. A larger pooling ratio entails a larger externality because one member's quality decision will have more impact on the other's economic payoff and vice versa. An altruistic member's utility depends positively on the economic payoff of the other member. He will partly internalise the effect of his production activity on the other member, therefore adjusting his product quality decision in the desired direction in response to the receipt of social interactions. As such, the members will attempt to make others feel altruistic towards them by investing in social interactions. The larger the pooling ratio, the more willing are the members to invest in social relationships with their fellow members because the benefits from social interactions are more internalised. The cooperative's income rights structure thus influences the members' social interactions via the economic incentives it offers.

Different pooling ratios reflect different levels of collectivism in the cooperative's income rights structure. The presence of a pooling ratio threshold σ_T entails that if the income rights structure of the cooperative is too individualistic, it will not be able to stimulate social interactions between the members. σ_T is determined by three parameters: the members' quality provision cost coefficient c, social interaction activity cost coefficient d, and the market's preference for product quality P_0. The members will undertake social interaction activities if doing so will increase their equilibrium utility U_i^*. The benefit of social interactions is determined by the economic payoff of quality provisions and the size of the externality, whereas the cost is determined by the cost coefficient d. If c and P_0 are constant, the economic payoff of a certain level of quality provision is fixed. A larger d will require a larger pooling ratio in order to increase the externality. σ_T will thus be proportional to d. Conversely, if d is fixed, the decrease of c and increase of P_0 both will raise the payoff of quality provisions. The benefits of social interactions under the same level of externality are larger. A smaller pooling ratio is thus sufficient to stimulate social interactions. Either a smaller c or a larger P_0 (or both) will decrease σ_T, making social interactions more attractive.

The pooling ratio threshold σ_T also determines the amount of the social interactions and the strength of the social ties. Given a certain pooling ratio σ ($> \sigma_T$), the larger the σ_T, the smaller the s^*. Likewise, the maximum amount of social interactions under the complete pooling policy s^*_{max} depends on σ_T. When σ_T is close to 0, s^*_{max} approaches 1. However, when σ_T increases, s^*_{max} will decline, and the s^* curve will converge towards the point $\sigma = 1$ on the horizontal axis of Figure 1. In other words, the social interactions and social ties between the members will diminish when σ_T increases. Especially, when $\sigma_T \geq 1$, i.e., $\frac{P_0^2}{4cd} \geq 1$, there will be no social interactions and no social ties between the members even under the complete pooling policy. $Q_C^{*\prime}$ and $\pi_C^{*\prime}$ in Figure 2 and 3 will converge to the equilibrium results of the standard economic model. σ_T is increasing in c and d but decreasing in P_0. As we focus specifically on the social interactions between the members, we establish that the range of d in which the social interactions will not occur, and social ties cannot be formed, even the complete pooling policy is enacted.

Proposition 6: There is no social interaction under any pooling policy when $d \geq \frac{P_0^2}{4c}$.

Figure 5 depicts the range of d and c, in which social interactions can occur. Because σ_T is increasing in d, the formation of social ties will become difficult or even impossible when d is too large. The intuition is that, besides the income rights structure, the formation of social ties in the cooperative fundamentally depends on the social context of the cooperative community since it determines the marginal cost of the members' social interaction activities. The following aspects may lead to an increase of d. First, d is positively associated with the distance between the members. For instance, if the members are living in a close neighbourhood or attend the same church regularly, they can interact with each other easily. By contrast, if the members live far apart or don't know each other, it will be much more costly to initiate social interactions. Second, d increases with the heterogeneity of members. If the members are very different in terms of background, interest, production scale, product portfolio, and so on, there is less proximity to enable smooth social interactions. Third, d may also depend on the opportunity costs of social interactions. For instance, social interactions are time consuming. If the members perceive that the time they spend on social interactions could have generated higher utility by investing it in other activities, this translates into a larger cost of social interaction activities.

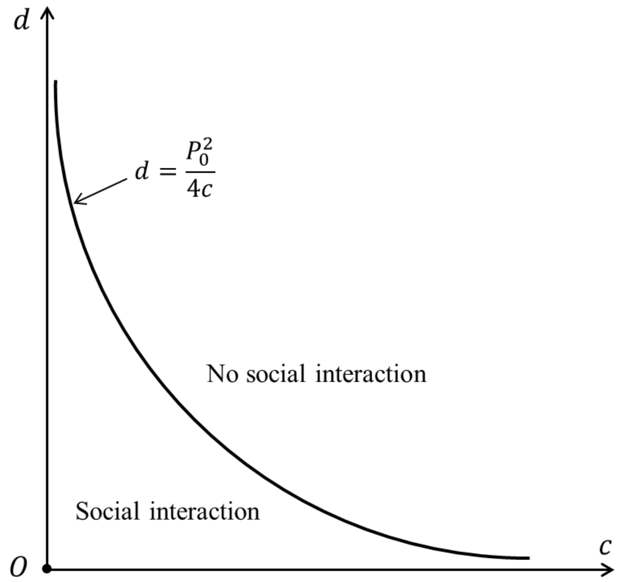

Fig 5 Parameter range of social interactions

5. Discussion

Our model incorporates several important stylised facts of the pooling policy of cooperatives. In particular, the model explains some of the commonly observed phenomena regarding the choice of the pooling policy of a cooperative along its development lifecycle.

Our model shows that the benefits of the pooling policy largely depend on the social context of the cooperative community. This can explain why the complete pooling policy is common in the early stage of a cooperative's development. According to Nilsson, Svendsen and Svendsen (2012, p.189), 'practically all cooperatives started on a small scale'. In a small community, members are usually well acquainted. The members can easily undertake frequent social interactions between each other and there are strong social ties among them. Meanwhile, the complete pooling policy creates a large positive externality in the members' production activities. Cooperative members may be motivated by more than their own economic benefits. With the social motivation based on the altruism within the membership, the members will be reluctant to free ride on the efforts of others. Therefore, when the cooperative is in the early stage of the lifecycle, given the very low social interaction costs in the cooperative community, the pooling policy, especially complete pooling, is actually efficient instead of sub-optimal due to its prominent social effect. The members not only enjoy the economic payoff comparable to the first-best level but also derive large social utility. In addition, cooperatives enjoy the benefits of complete pooling by sharing production risk among members to the largest extent and achieving economies of scale (Deng and Hendrikse 2013).

Nowadays, cooperatives tend to adopt market-oriented strategies in order to respond to increasing competitive pressure and changing market situation. The pooling policy is increasingly regarded as detrimental to the economic performance of cooperatives (Saitone and Sexton 2009). One major reason is that members will have insufficient motivation to deliver high quality input under the pooling policy and it leads to the low product quality of cooperatives. According to our model, the complete pooling policy will become inefficient when it cannot elicit sufficient social interactions among the members. This may occur when the social context of the cooperative community changes, for example, when the cooperative expands and the membership becomes large and heterogeneous. In some large cooperatives, the members are no longer from the same village or community. Instead, they are from different regions or even from different countries (Bijman 2010). As the members are becoming anonymous, it is more difficult and costly for them to interact with each other. As a consequence, they feel alienated to each other and the social ties in the cooperative become weaker (Nilsson, Kihlén and Norell 2009; Österberg and Nilsson 2009).

The industrialisation of agribusiness also contributes to the diminishing social interactions and social ties in cooperatives. The members of some cooperatives have become large and modern farming enterprises instead of small farming households from decades ago. For instance, the members of the cheese cooperative De Producent spread in the radius of 100km around Gouda, the Netherlands (Peng, Hendrikse and Deng 2016). In the past two decades, most of the active members developed into modern farming enterprises, which are managed by professional teams and have large scales of production. Some of them reach the annual revenue of more than one million Euros. The members focus mainly on the production activities and rarely interact with each other. In such a modern cooperative, there is no space for cooperative members to develop social ties and altruistic feelings towards each other.

Therefore, as the social context of the cooperative changes along its development, and when the complete pooling policy will not lead to social interactions but severe free-riding problems among the members, the cooperative's best choice is to adopt the no-pooling policy. When members receive the individualistic economic payoff regarding their production activities, they are motivated to deliver high quality input. In the meantime, they tend to judge their cooperatives on the basis of economic efficiency more than its traditional social utility. In this sense, it can explain why cooperatives nowadays are losing their social attributes and becoming similar to conventional firms.

Finally, the evolution of the cooperative entrepreneurial network changes the social aspects of a cooperative and its value for information sharing and exchange (Gulati 1995). In the early stage of a cooperative's development, the entrepreneurial network is small and has a high intensity of interactions. In addition, the horizontal network ties, i.e. the social relationships and interactions between members in the cooperative society, play an important role in the information sharing among the members. When the cooperative membership increases and farmer members develop into modern farming enterprises, the entrepreneurial network in the cooperative becomes more professional and less personal. The vertical network ties between the members and the cooperative processor and management is the focus of governing collaborations. Peng, Hendrikse and Deng (2016) show that when the costs of information exchanges between farmers in the member society is high, the strategy of relying on vertical information exchange between the members and the cooperative CEO is efficient. This result corresponds with the findings of the current paper.

6. Conclusion and Further Research

Because a cooperative is a firm owned by a society of members, one cannot study the cooperative without considering its social context. To the best of our knowledge, the theoretical explanation of the effects of the social ties among members in cooperatives is still missing in the literature. In addition, while such social ties have been claimed to be important for cooperatives, the way that they are formed and the factors that determine their strength are less well understood. In this paper, social ties between members are viewed as the manifestation of the structural social capital of the cooperative. We develop a game theoretic model to analyse the dynamics and value of the social ties in a cooperative.

One main result is that the cooperative's income rights structure is important for the members' social interactions. Another factor is the marginal cost of the members' social interactions. While the cooperative's pooling policy results in an externality regarding the members' production activities, the marginal cost of social interactions determines the amount of social interactions that will occur. Large pooling ratios and a low marginal cost of social interactions will boost the formation of strong social ties. We show that under these circumstances the cooperative achieves superior performance due to the social ties between the members. Therefore, the complete pooling policy is not only economically efficient but also socially advantageous when the marginal cost of social interactions is low. However, when the social context of the cooperative does not allow for low-cost social interactions, the complete pooling policy will become sub-optimal. The cooperative should abandon the complete pooling policy and adopt the no-pooling policy. The results correspond with the common feature of a cooperative's development along its lifecycle regarding the pooling policy choice.

Several topics for future research may be pursued. First, the pooling parameter is exogenous in our model. It can be endogenized in several ways. One way to incorporate the choice of pooling policy in the model is to add an additional stage to the game. This raises the question about how the pooling policy is decided (Hart and Moore 1996) and where the additional stage is added. Another way to endogenize the pooling policy is to formulate a pooling policy reaction function as a function of the social interaction (Deng 2015). Second, the cooperative product quality in our model is the average of the members' product quality. There is no complementarity between the members' productive efforts. In addition, we did not capture the complementarity between the social interaction activities and production activities, which may exist because social interactions lead to the exchange of information and experience (Peterson and Anderson 1996; Peng, Hendrikse and Deng 2016). As such, although our model allows us to show the prominent altruistic effect of social ties, it will be worthwhile investigating the above-mentioned complementary effects as well. Third, the marginal costs of the social interactions have been modelled as an exogenous variable in the current study. This assumption is reasonable because the change in the social structure in cooperatives has been largely driven by the trend of increasing competition and industrialisation in agribusiness (e.g. Bijman 2010). However, the marginal cost of social interactions might be influenced by the members' social interactions. After cooperative members have developed social ties, social interactions may become less costly since they have known each other better. Fourth, we have addressed the importance of social interactions, but not the formation of social ties, and therefore the network structure of the society of members (Goyal 2007). Fifth, a cooperative is likely to experience coordination problems due to the many independent members in the society of members. It is known from the cheap talk literature that social interactions may mitigate coordination problems (Crawford and Sobel 1982). However, the relationship between cheap talk and governance structure has not been investigated.

Finally, the theoretical results of this paper call for more empirical research on cooperatives as entrepreneurial networks. We formulate a number of possibilities. First, comparative case studies regarding cooperatives with a large membership size and modern farming enterprises as members and those with a small membership size and only farmers as members will be valuable because the model predicts that the former benefit much less from a pooling strategy than the latter. Second, the characteristics of the industry may matter for the value of social interactions. If the exchange of specific knowledge between the firms is contractible and does not need social interactions, then the pooling policy is not optimal. Third, some cooperatives have started to organise social events to create opportunities for members to interact with each other. These events can be understood as the measures the cooperatives take to decrease the costs of social interactions, i.e. members may develop social ties through these organised social events more easily. It has to be determined whether this has an impact on product quality or facilitates coordination.

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