Participation, incentives and social norms in partnership arrangements among farms in Sweden

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1. Introduction

Partnerships arrangements among farms that involve machinery and labour sharing have been recognized as one of the most important factors to improve farm profitability and reduce production costs (Williams, 2001; Weness, 2001). Today, 60-80% of the farms in Sweden are involved in some form of collaborative arrangement with one or several other farms (own survey, 2006; Lantbruksbarometern, 2005). 41% of the farmers in Sweden intend to increase the level of collaboration with other farms in order to improve profitability (Lantbruksbarometern, 2005).

There are large variations in the design of the machinery- and labour sharing arrangements as the form, extent and the nature of the contract vary. Common forms of collaboration include owning machinery together, mutual exchange of machinery and driving own machinery for each other. In the most integrated form of partnerships, the farms pool all their production resources. The share of farmers that participate in this form of collaboration has increased from 2% to 6% between 2001 and 2004 according to the survey (Lantbruksbarometern, 2002; 2005). The collaboration may involve one or several activities at the farm such as cultivation, planting, fertilizer application, pesticide application and harvest. The contracts may be either written or oral.

One of the probably most important potential gains from collaboration is reduced cost of capital. This is because capital such as machinery and equipment can be used more intensively when it is shared among several partners. Collaboration may also facilitate internal funding of capital when costs are shared. Other potential benefits of collaboration include improved possibilities to obtain access to more advanced technology and task specialization among the partners.

There are also potential costs associated with machinery- and labors sharing arrangements between farms. When machinery is shared, timeliness costs may arise if a field operation cannot be performed at the optimal point in time. Another potential cost is the so-called moral hazard problem. A well-known result in the team production literature is that there is a problem of moral hazard among partners in a team if they are rewarded according to their joint effort level and at least one input, often described as "work effort" or "effort", is unobservable to the other partners (Holmstrom, 1982). In agriculture, a farmer's "managerial ability", i.e. ability to take the right production decisions, may be considered as an unobservable input that potentially can cause incentives to shirk in a partnership (Eswaran and Kotwal, 1985[1]). In the case when inputs are shared, there may be incentives to overuse or misuse assets, because the user of an asset does not consider the full value of the asset when he/she does not own it or partly owns it (Holmstrom and Milgrom, 1991; 1994; Hart, 1995).

Factors that mitigate the problem of moral hazard have been suggested in the literature and include peer pressure and social norms (Barron and Gjerde, 1997; Kandel and Lazear, 1992) and dynamics (Radner, 1982). Partnerships between farms are often characterized by personal relations among the collaborating farmers (friends, neighbours, relatives) and it is reasonable to believe that shirking in effort is more costly in social terms when one has a personal relation to his/her partners at the same time as the level of trust is likely to be higher.

The objective of this study is to analyze farmers' decisions to engage in partnership arrangements focusing on incentive aspects, potential moral hazard problems and the role of social norms. The analysis is conducted theoretically and empirically. A theoretical framework developed by Allen and Lueck (1989) that illustrates the choice of being a partnership farm as a trade-off between the gains from task specialization and lower capital costs and the cost from moral hazard is extended to also consider the effects of social norms among the collaborating partners. It is shown that moral hazard problems are lower when social norms are present. Moreover, a model of an input sharing arrangement (such as sharing of machinery) is used to

[1] Eswaran and Kotwal (1985) suggest that moral hazard problems might arise in contractual arrangements between landlords and tenants because of the unobservability of the landlords "ability to supervise labor" and the tenants "managerial ability", i.e. his ability to take the right management decisions in the production.

illustrate that the presence of social norms reduce the incentives to misuse or overuse shared inputs.

In the empirical application, FADN-variables (Farm Accountancy Data Network) for Swedish farms for the period 2001-2004 are complemented with a survey to the same farmers concerning their involvement in partnership arrangements with other farms. In the survey, farmers are asked form and organisation of the collaboration as well as the nature of the contract. Moreover, questions concerning social relations and perceived effort levels of the partners are included in the survey to get an idea of trust and perceived moral hazard problems in the partnerships.

The outline of the paper is the following. First, some potential benefits and costs associated with partnership arrangements between farmers are discussed. Thereafter, a comprehensive review of the theoretical literature dealing with moral hazard in team production is provided. In the following section, theoretical models of collaborations between farmers (partnership and machinery sharing) are used to illustrate the impact of social norms. In the following sections, results from the survey are presented and predictions from the theoretical models are tested. Finally, reasons why some farmers choose not to collaborate are discussed.

2. Potential benefits and costs in partnership arrangements among farmers

In this section, some potential effects from collaboration among farmers are discussed. One of the probably most important potential benefits is the reduced cost of capital due to a more intensive use of machinery. Other potential benefits include increased possibility to specialize in different activities at the farm and the possibility to use more advanced technology. Potential costs include timeliness costs and incentives to shirk (the moral hazard problem) among the partners.

2.1 Potential benefits

2.1.1 Specialization

Partnership arrangements among farmers make it possible for the individual farmers to specialize in different activities at the farm. For example, a farmer who drives a certain machine more intensively will improve his/her skill and, as a result, the productivity of labor will increase.

2.1.2 Reduced capital costs

One of the probably most important benefits from machinery collaboration among farms is the reduced cost of machinery and equipment. Sharing machinery and equipment with other farmers makes it possible to use capital more intensively and the fixed cost per hectare will accordingly be reduced. Self-financing is also easier when several partners pool their resources and interest costs may therefore be lower than if all machines where bought independently.

2.1.3 Better technology

When several farmers pool their resources, it is often possible to buy more powerful machines and equipment. With better technology, the yield losses (skördeförluster) may be reduced, the quality of fodder might increase and output may have a higher quality (Neumann, 1991). Moreover, higher environmental- and quality standards imply that some operations must to be done with a higher precision, requiring a more advanced technology, which a collaborative arrangement facilitates (Neumann, 1991).

2.1.4 Risk sharing

Risk sharing and diversification in production activities may create incentives to participate in a partnership where revenues and/or costs are shared[2]. Agricultural production is characterized by uncertainty and variations in output prices and weather, and thus yields, which contribute to uncertainty in the farmers' net income. Therefore, partnerships where revenues and costs are shared might be attractive for farmers that are risk-averse. When farmers buy machinery and equipment is together, the risks associated with trying new technique is shared.

2.2 Potential costs

2.2.1 Moral hazard

Two potential costs of contracts in agriculture are *effort moral hazard* and *asset moral hazard*. Incentives to shirk in effort (effort moral hazard) arise when workers efforts are unobservable and the workers are rewarded according to their joint effort level (the moral hazard problem in team production was originally discussed by Holmstrom (1982)). Eswaran and Kotwal (1985) suggest that the quality of a farmer's management decision, "managerial ability", is crucial for the efficiency of agricultural production and that incentives to shirk arise when a farmers "managerial ability" is unobservable to the other part.

Asset moral hazard arises when the user of the asset does not consider the asset's full (long-term) value, because he/she does not own or partly owns the asset (Holmstrom and Milgrom, 1991, 1994; Hart, 1995). As a result, this might lead to a misuse or overuse of the asset.

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[2] The probably most analyzed partnership in the agricultural economics literature is the one between a landlord and a tenant. Usually, the objective is to explain the choice of contractual form: fixed wage, fixed rental or sharecropping (see for example Eswaran and Kotwal, 1985; Laffont and Matoussi, 1995). Different approaches for explaining the existence of sharecropping contracts have been suggested, of which the tradeoff between incentives and risk sharing is one.

Thus, incomplete control rights over farm machinery (by owning it together, renting or borrowing it) may create incentives to damage or not repair/maintain the machinery.

Factors that mitigate moral hazard problems, such as social norms, peer pressure and dynamics, have been suggested in the literature (Barron and Gjerde, 1997; Kandel and Lazear, 1992; Radner, 1987). These factors will be further discussed in the literature review in section 3.

2.2.2 Timeliness cost

For most field operations, it is costly for the farmer if the operation cannot be performed at the optimal time. For example, a delayed harvest might imply a lower quality of the yield and accordingly reduced revenue for the farmer. This cost is referred to as timeliness cost. The size of the timeliness cost depends on several factors, including soil quality, type of crop and type of field operation.

3. Moral hazard in team production - a literature review[3]

This section provides an overview of some literature dealing with incentives in team production and will be the starting point for the model illustrating the special case of collaboration among farms in section 4.

In the seminal paper by Holmström (1982), the incentives problem in a production with many agents (team production) is considered. The idea is that there exist incentives to shirk in a team production when the workers efforts are unobservable and is illustrated with the following example. Assume that there is a team with n identical workers who exerts an equal amount of effort, e_i. The output of the team, $f(e)$, is assumed to be a function of all workers effort level. For simplification, all workers are assumed to receive an equal share of the output, i.e. $1/N$. The maximization problem of each worker is

[3] This section may be removed or moved to the introductory part of the thesis as I am not sure it fits in here…

$$\max_{e_i} \frac{f(e)}{N} - C(e_i) \tag{1}$$

with the first order condition

$$\frac{f_i(e)}{N} - C'(e_i) = 0 \tag{2}$$

The first-best choice of e_i is obtained when the sum of the workers utility is maximized

$$\max_{e_i} f(e) - \sum_{i=1}^{N} C(e_i) \tag{3}$$

with the first order condition

$$f_i(e) - C'(e_i) = 0 \tag{4}$$

Thus, given that the cost of effort is increasing and convex, $C' > 0$ and $C'' > 0$, the first best effort level exceeds the effort level chosen by each member of the team.

There exists no sharing rule that gives the workers incentives to exert their first best effort level when their choice of effort level is unobservable if budget-breaking[4] is not allowed. If budget-breaking is allowed, however, incentives for each team member to exert the first best effort can be achieved. In order to resolve the moral hazard problem, Holmström (1982) suggests an incentive mechanism where each team member gets zero pay off if the output is less than the Pareto-optimal level.

Several authors have discussed factors that have the role of mitigating the problem of moral hazard in team production. The implications of peer pressure and social norms in teams is discussed by Barron and Gjerde (1997) and Kandel and Lazear (1992). The presence of peer pressure implies that members of a team experience a disutility of deviating from the social norm. Kandel and Lazear (1992) formalized this by introducing a "peer pressure function", P:

$$P = P(e_i; e_j, ..., e_N, a_i, a_j, ..., a_N) \tag{5}$$

[4] Budget-breaking is the case when the sum of the payoffs to the team members does not equal the total value of the team output.

where e_i is the own effort, $e_j, \ldots, e_N$ is the effort of the partners and $a_i, \ldots, a_j$ is actions that the partners might take. One difference between the efforts and actions is that the actions do not have any direct effect on firms output. However, both efforts and actions are assumed to be costly:

$$C = C(e_i, a_i) \tag{6}$$

Assuming that the pressure function is additive separable in output, cost of effort and actions and peer pressure and that the actions do not affect the peer pressure and that each farmer receive the same share of output, each partners utility can be written as

$$\frac{f(e)}{N} - C(e_i, a_i) - P(e_i; e_j, \ldots, e_N) \tag{7}$$

The presence of peer pressure implies that each partner's choice of effort level exceeds the one chosen if there had been no peer pressure. It is easily shown that the level of effort chosen in the presence of peer pressure exceeds the one when no peer pressure is present (since peer pressure implies that $\partial P / \partial e_i < 0$).

Moreover, Kandel and Lazear (1992) discuss the reasons for peer pressure and classify the pressure as either external (guilt) or internal (shame). It is suggested that the peer pressure arise from social norms. When a worker deviates from a norm that has been established in the group, he experiences a disutility. They furthermore discuss the possibility of mutual monitoring among the partners. The actions, a_i, in (5) can then be thought of as actions to monitor each other. Another issue discussed by Kandel and Lazear is whether the effort always falls when the firm size increases. They argue that this might not necessarily be the case. Up to some point, being observed by one more worker might imply that the social embarrassment increases. Again, it is important to note that a higher effort level not necessarily imply a higher utility.

The role of peer pressure and monitoring in team production is also discussed by Barron and Gjerde (1997). The authors use a sequential game theoretic approach and introduce a principal. The stages are the following. First, the principal decides the level of the workers compensation. Thereafter, the workers chose their level of monitoring activity. In the final stage, the workers chose their effort level. It is noted that the peer pressure also has a downside since it implies a cost for the workers. In this case, the cost is ultimately born by the principal. Thus, it might be optimal for the principal to reduce the link between compensation to individual team members and the team performance.

Hück et al (2001) discuss the possibility of multiple equilibria in identical incentive schemes. The existence of multiple equilibria depend on the workers social preferences and the conditions for uniqueness of equilibrium are stated. The authors suggest that, as a consequence of multiple equlibria, it might be desirable for the principal (firm owner) to chose a bonus rate that is slightly higher than the critical value above which a unique equilibrium exist.

Radner (1986) discuss the role of dynamics in team production using repeated games. When there are several time periods, each member of the team can observe the effort levels, or some signal of the effort levels, exerted by the other members in the previous periods. Radner (1986) shows that the first-best may be achieved if there is an infinite time horizon and the discount rate is zero.

4. The impact of social norms in collaborative arrangements among farms

This section begins by extending a model of a partnership arrangement developed by Allen and Lueck (1989) to consider presence of social norms among the partners. The majority of the partnerships among Swedish farmers are, however, not characterized by sharing of all revenues and costs, but rather by input-sharing arrangements (see section 6). Therefore, we also introduce the presence of social norms in a model illustrating an input-sharing arrangement. It should be noted that the objective of this section is not to predict the optimal organisation of a machinery- and labour sharing arrangement. The objective is instead to analyse the impact of social norms on *effort moral hazard* and *asset moral hazard* respectively. An intuitive result is that the presence of social norms reduce the incentives to act opportunistic (both effort and asset moral hazard is reduced).

4.1 A model of a partnership arrangement with social norms

The model of a partnership farm presented here builds on the model developed by Allen and Lueck (1998). They illustrate a partnership as a trade-off between the gains from task specialization and lower capital costs and the costs of moral hazard when analysing optimal farm organisation. Following Allen and Lueck's model, we assume that the partners share the different tasks equally among themselves and a specialization scalar is defined as $a=(N/T)^{\alpha}$, where N is the number of partners, T is the number of tasks and $0 \leq \alpha \leq 1$[5]. Thus, for a non-partnership farm, the specialization scalar is $a=(1/T)^{\alpha}$. The effects of reduced capital costs in a partnership is captured in the model by assuming that the marginal cost of capital, r, is a function of the number

[5] The gains from potential task specialization are greatest when α=1. Task specialization has no value when α=0.

of partners, $r=r(N)$, where r is assumed to be decreasing and convex in N (Allen and Lueck, 1998).

A moral hazard problem is assumed to be connected to the input "managerial ability", i.e. the ability of a farmer to make the right production decisions (Eswaran and Kotwal, 1985). This input will be referred to as "effort" and will be represented by the time, t_{tn}, spent by the nth farmer, on task t (Allen and Lueck, 1998). The characteristics of this input differ from those of the remaining inputs: while the amount of inputs such as materials, labour and land are easily observable and can be contracted upon, managerial ability is not as easy to observe. Thus, the unobservability of effort provided by each farmer creates incentives to shirk. It is assumed that the farmers choose to use their effort in an off-farm activity, O (Allen and Lueck, 1998). The value of O is thus the farmer's opportunity cost of effort.

We furthermore assume presence of a social norm. Following Hück et al (2001), the norm is assumed to be to exert an effort level that corresponds to the "work ethic" (which they assume to be the team optimum effort level). Correspondingly, we assume that the "work ethic" is to devote as much time to each task as the individual partners would have done as independent (utility maximizing) farmers, i.e. the "first-best" (FB) effort levels ($t_{tn} = t_{FB}$). The disutility or embarrassment that each partner experiences from exerting an effort level that is less than the social norm is assumed to be an increasing function in the other farmers' average effort (Hück et al, 2001). The disutility farmer n experiences when deviating from the social norm when performing task t is

$$P = \frac{1}{2} v\left(t_{-tn}\right)\left(t_{FB} - t_{tn}\right)^2 \qquad (9)$$

where t_{-tn} is the sum the average effort exerted by all other partners on each task, i.e. $t_{-tn} = \sum_{tm \neq tn} t_{tm} \big/ (N-1)$. The part $v\left(t_{-tn}\right)$ is a measure of the degree of "penalty" or "social cost" that each farmer experiences when exerting an effort level that deviates from the social norm and is assumed to be an increasing function of the other partners' average effort.

As in Allen and Lueck (1998), we illustrate the partnership in two stages using backward induction. In the first stage, the farmers maximize their joint utility by choosing optimal number of partners, capital level and production activities subject to the partners' incentive compatibility (*IC*) and individual rationality (*IR*) constraints. The *IC* constraint ensures that each farmer provide the effort level that maximizes his/her expected utility. The *IR* constraint ensures that the individual farmers are willing to engage in the partnership if their utility is equal to or greater than their utility as independent farmers. In the second stage, the decision problem of the individual farmers is analyzed. For simplification, homogeneity among the farmers is assumed (implying that there will be a symmetric Nash equilibrium).

4.1.2 Each farmer's choice of effort level

First, the decision problem of each farmer is analyzed. Each farmer is assumed to receive an equal share of the net revenues, i.e. $S_i=1/N$. The farmers are assumed to be risk neutral and their utility functions are assumed to be additive separable in income and disutility of deviating from the social norm. Each farmer takes the effort levels of the other farmers as given. The optimization problem of each farmer is thus

$$\max_{t_{1n},\dots t_{(T/N)n}} V^P = \frac{1}{N}\cdot P_Y \cdot f\left(\left(\frac{N}{T}\right)^{\alpha} t_{tn};\bar{k}\right) + (1-\sum_{t=1}^{T/N} t_{tn})\cdot O_n - \sum_{t=1}^{T/N}\frac{1}{2}v\left(t_{-tn}\right)\left(t_{FB}-t_{tn}\right)^2 \qquad (10)$$

$$n = 1,\dots,N \qquad t = 1,\dots,T/N$$

where O_n is farmer i's net income from an off-farm activity. The optimal choice of task effort level, $t_{tn}^* = t_{tn}^*(N,T,\alpha,O,\bar{t}_{tn},k,v(t_{-tn}))$, solves

$$\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial f}{\partial t_{tn}}\left(\left(\frac{N}{T}\right)^{\alpha}t_{tn}^{*};\overline{k}\right)=O_i-v(t_{-tn})(t_{FB}-t_{tn}^{*}) \quad (11)$$

The left hand side of (11) is the marginal benefit of task effort and the right hand side of (11) is the marginal cost of task effort. Consider first the case that would occur if no social norms were present (i.e., $v(t_{-tn})=0$)[6]. In that case, the farmer will choose to exert an effort level smaller than the first best effort level because he/she only receives a share of the total output but pays the full cost for his/her own effort. In the presence of a social norm, the perceived marginal cost of effort decreases as long as $t_{FB}>t_{tn}^{*}$ (alternatively, the marginal cost of shirking increases). Thus, the partners shirking in effort will be lower when social norms are present.

4.1.3 Optimal capital level and optimal number of partners

Following Allen and Lueck (1998) we also analyze the trade-offs concerning the choice of optimal capital level, k^*, and optimal number of partners, N^*. This is done by maximizing the sum of all partners' utility functions:

$$\begin{aligned}&\max_{k,N} P_Y f\left(\left(\frac{N}{T}\right)^{\alpha}t_t^{*};k\right)+N(1-\sum_{t=1}^{T}t_t^{*})O_n-r(N)k\\&-N\sum_{t=1}^{T}\frac{1}{2}v_t\left(t_{-t}\right)\left(t_{FB}-t_t^{*}\right)^2\end{aligned} \quad (12)$$

$$n=1,...,N \qquad t=1,...,T/N$$

subject to the *IC* constraint

$$t_t^{*}=t_t^{*}(N,T,\alpha,O,\overline{t_t},k,v_i(t_{-i}))=\arg\max V^P \quad (13)$$

and the *IR* constraint

$$V^P\geq\overline{V} \quad (14)$$

where $\overline{V}$ is the utility of a farmer when operating independently.

[6] which corresponds to the case in equation 5, page 352, in Allen and Lueck (1998)

Assuming that a solution to (12) exist, the optimal capital level, k^*, solves

$$P_Y \frac{\partial f}{\partial k} - r(N) = N\left[O - P_Y \frac{\partial f}{\partial t_t}\left(\frac{N}{T}\right)^{\alpha} - v_t(t_{-t})(t_{FB} - t_t)\right]\sum_{t=1}^{T}\frac{\partial t_t^*}{\partial k} \tag{15}$$

The left hand side of (15) is the net marginal benefit of capital (marginal revenue of capital minus marginal cost of capital). The right hand side is the indirect effect of capital choice on task effort. The bracketed term is the size of the "distortion effect" on effort. We can see that the distortion effect is smaller in the presence of social norms, i.e. when $v(t_{-t}) \geq 0$ (compare with equation A1, page 380, in Allen and Lueck, 1989). The sign of the right hand side depends on the sign of ($\partial t_t^* / \partial k$). As is shown in Appendix I, the sign of this derivative depends on whether capital and effort are complements or substitutes. Moreover, it is shown that the size of the effect of capital on effort is lower when there is presence of social norms. To summarize, presence of social norms reduces the distortion effect of capital choice on the task efforts.

The optimal number of partners, N*, solves

$$\begin{aligned} &\left[P_Y \frac{\partial f}{\partial t_t}\alpha\frac{N^{\alpha-1}}{T^{\alpha}} - O\right]\sum_{t=1}^{T} t_t + \left[O - \left(\frac{\partial r}{\partial N}\right)k\right] \\ &= N\left[O - P_Y \frac{\partial f}{\partial t_t}\left(\frac{N}{T}\right)^{\alpha} - v(t_{-t})(t_{FB} - t_t)\right]\left[\sum_{t=1}^{T}\frac{\partial t_t^*}{\partial N}\right] \end{aligned} \tag{16}$$

The left hand side of (16) is the marginal benefit of including more partners in the partnership. The first term is the benefits from increased task specialization and the second component in the second term reflects the benefits from reduced capital costs when the number of partners increases. The right hand side of (16) is the indirect effects of adding one more partner on task efforts. The bracketed term is the size of the "distortion effect". We can see that the distortion effect is smaller when there are social norms, i.e. when $v_n(t_{-n}) \geq 0$ (compare with equation A2 page 380 in Allen and Lueck, 1989). The sign of the right hand side depends on the sign of ($\partial t_t^* / \partial N$). This derivative has a negative sign except when α=1 (see Allen and Lueck, 1989, p

381[7]). Thus, the presence of social norms reduces the distortion effect of adding one more partner on the task efforts.

4.2 A model of input sharing arrangement among farms with social norms

In this section, a simple model is used to illustrate the case of an input sharing arrangement among farms/farmers were social norms are present. In a first step, each farmer determines the quantity of capital he/she wants to use in a capital sharing arrangement with *N* partners. In a second step, the optimal number of partners is determined. It is assumed that each farmer pays an equal share of the total capital costs, i.e. each partner pays $\left(\frac{1}{N}\right)\cdot r(N)\cdot k_{tn}$. For simplification, output is here assumed to be a function of only capital, $f\left(k_{tn}\right)$ ($f'\left(k_{tn}\right) > 0$ and $f''\left(k_{tn}\right) < 0$). Because each partner does not pay the full cost for the shared capital, there are incentives to overuse capital. However, a social norm is assumed to be present that will influence the choice of capital level. The social norm is assumed to be to choose a capital level that is equal to the capital level that would have been chosen in independent production, the "first-best" level of capital (k_{FB}).

The problem of each farmer is

$$\max_{k_{1n},\ldots k_{(T/N)n}} V^P = P_Y\cdot f\left(k_{tn}\right)-\left(\frac{1}{N}\right)\cdot r(N)\cdot k_{tn}-\sum_{t=1}^{T/N}\frac{1}{2}v\left(k_{-tn}\right)\left(k_{FB}-k_{tn}\right)^2 \tag{17}$$

$n=1,\ldots,N \qquad t=1,\ldots,T/N$

Each farmers optimal choice of capital level, $k_{tn}^*=k_{tn}^*(N,T,v(k_{-tn}))$, then solves

[7] This derivative will be exactly the same as in Allen and Lueck (1998) since the last term on the right hand side of (11) is not a function of N. However - to be completely correct – the right hand side is in fact a function of N since t_{-i} is the average of all other partners' effort levels, i.e. the sum of all other partners efforts divided by N, but this is neglected here.

$$P_Y \frac{\partial f}{\partial k_{tn}}\left(k_{tn}\right)=\left(\frac{1}{N}\right)\cdot r(N)-v(k_{-tn})(k_{FB}-k_{tn}^{*}) \tag{18}$$

Consider first the case that would occur if no social norms were present ($v(k_{-tn})=0$). In that case, the farm/farmer will choose a capital level that exceeds the first best capital level (i.e. there is an "overuse" of capital) because he/she does not bear the full cost of capital. In the presence of a social norm, the perceived marginal cost of capital increases as long as $k_{FB}<k_{tn}^{*}$. This implies that the overuse of capital is reduced. Thus, the presence of social norms reduces the asset moral hazard problem in an input sharing arrangement.

In the second step, the optimal number of partners is solved for by maximizing the sum of all partners' utility functions

$$\max_{N} N\cdot P_Y\cdot f\left(k_{tn}\right)-r(N)\cdot k_{tn}-N\sum_{t=1}^{T/N}\frac{1}{2}v\left(k_{-tn}\right)\left(k_{FB}-k_{tn}\right)^{2} \tag{19}$$

The first order condition is

$$P_Y\cdot f\left(k_{tn}\right)-\frac{\partial r(N)}{\partial N}\cdot k_{tn}=-\sum_{t=1}^{T/N}v\left(k_{-tn}\right)\left(k_{FB}-k_{tn}\right)\frac{\partial k_{tn}}{\partial N} \tag{20}$$

The left hand side of (20) is the net marginal revenue of capital (marginal revenue of capital minus marginal cost of capital). The right hand side of (20) is the indirect effects of adding one more partner on the choice of capital (asset moral hazard). We can see that the cost of adding one more partner on the asset moral hazard is smaller when there are social norms, i.e. when

$v_n(t_{-n})\geq 0$ (when $\frac{\partial k_{tn}}{\partial N}$ is positive).

4.3 Prediction to be tested

An implication from the models above is that partnership arrangements with a high degree of social norms among the partners are more likely to sustain than those with a low degree of social norms, everything else equal, because partnerships with higher social norms are characterized by less moral hazard problems. In empirical work on social capital and trust, norms are often analyzed by looking at the outcome of the norm rather than the norm itself (see for example Stone, 2001). In this case, the outcome of the social norm is the (perceived) effort levels of the partners. Obviously, perceived effort levels in non-existing partnerships cannot be observed. Instead, we will look at the impact from perceived effort levels on the extent of collaboration (measured by the number of tasks covered in partnership). Thus, a prediction to be tested in section 5 is that partnerships characterised by high perceived effort levels among the partners are more likely to have a higher extent of collaboration, everything else equal.

5. Empirical models

5.1 Participation in collaborative arrangements with other farms

The farmers *i´s* choice to participate in a partnership with other farmers is analysed by estimating (21) using a Probit model.

$$P^*_{\mathrm{it}} = \beta_1 + \beta_{2-5}(CV_{it}) + \beta_{6-10}(\mathrm{P}\,RD_i) + \beta_{11}(TFD_{it}) + e_{it} \qquad (21)$$

where P^*_{it} is an underlying latent variable and

$P_{it} = 1$ if $e_{it} > -Z_{it}\beta \quad i = 1,...,N; \; t = 1,...,T;$

0 otherwise

where P_{it}=1 for a farm that is involved in any form of collaboration with other farms (0 otherwise). The model is also estimated using a dummy indicator for collaboration in specific tasks (cultivation, planting, fertilizer application, pesticide application and harvesting). Moreover, the model is estimated for different forms of collaboration; common ownership of capital, mutual exchange of machinery, driving own machines for each other etc;

CV_{it} is a vector of control variables such as the age of the farmer and farm size.

PRD_i is a vector of dummy variables for production regions.

TFD_{it} is a dummy variable indicating specialized livestock farming.

5.2 Extent of collaboration and number of partners

Among the farms in the sample that participate in any form of collaboration with other farms, the extent of the collaboration, measured by the number of tasks that the partnership covers (*Ntasks*) as well as the number of partners (*Npartner*), is analyzed by estimating the two-equation model in (22) and (23) (Maddala, 1983). Consistent with the model in section 4, we consider the simultaneity between *Ntasks* and *Npartner* by using two-stage least squares. The predicted values of *Ntasks* and *Npartner* are denoted *pred_Ntasks* and *pred_Npartner.*

$$Ntasks_{it} = \beta_1 + \beta_2(Effort\_hat_{it}) + \beta_{3-6}(CV_{it}) + \beta_{7-11}(PRD_i) + \beta_{12}(TFD_{it}) + \beta_{13}(pred\_Npartners_{it}) + u_{it} \tag{22}$$

$$Npartners_{it} = \beta_1 + \beta_2(Effort\_hat_{it}) + \beta_{3-6}(CV_{it}) + \beta_{7-11}(PRD_i) + \beta_{12}(TFD_{it}) + \beta_{13}(pred\_Ntasks_{it}) + u_{it} \tag{23}$$

where

$Ntasks_{it}$ is the number of tasks in which the farmer collaborates with other farmers (between 0 and 10);

$Effort\_hat_{it}$ is the level of perceived effort of partners (the original variable is rated on a scale 1-5 but this variable is transformed according to Terza 1987, see below);

CV_{it} , PRD_i and TFD_{it} are defined as above.

$Npartners_{it}$ is the number of partners.

It should be noted that the measure of perceived effort is an ordinal qualitative variables (1, 2, …, 5) and not cardinal. Methodologies that can be employed when latent variables such as attitudes and perceptions are included as explanatory variables have been suggested in the literature (see for example Ben-Akvia et al, 1999). In this study, we apply a methodology suggested by Terza (1987) which implies a transformation of each discrete category value[8].

6. Survey to farmers

A survey concerning farmers' involvement in machinery and labor sharing arrangements with other farms/farmers was sent to 1042 farms in Sweden in the spring 2006. As a complement to the survey, FADN-variables (Farm Accountancy Data Network) for the sample farms are available for the years 2001-2004. The surveyed farms participated in the FADN for at least one year during the period 2001-2004. The FADN consists of accountancy data from a sample of agricultural holdings that are representative with respect to region, economic size and type of farming.

62% of respondents indicated that they collaborate with other farms. In Table 1, summary statistics for all sample farms is displayed, as well as separately for partnership farms and non-partnership farms. It can be noted that partnership farms are, on average, larger (in terms of land) and that farmers who are involved in partnership arrangements are, on average, younger.

[8] The transformation suggested by Terza (1987) implies that each discrete category, d_j, is replaced with $\hat{d}_j = \left[n_{j-1}(\delta_{j-1}) - n_j(\delta_j) \right] / p_j$, where *n* is the probability denstity function of the standard normal evaluated at δ_j, p_j is the percentage of the sample observed in category *j*, and δ_j is calculated as $\partial_j = N^{-1}(\sum_{i=1}^{j} p_i), (j = 1,...,J-1)$, where $N(d_1)=p_1$, $N(d_2)=p_1+p_2$, …, $N(d_{j-1})=p_1+p_2+…+p_{j-1}$.

Table 1. Descriptive statistics of sample farms.

Variable	*Unit*	*All sample farms (N=640)*		*Partnership farms (N=399)*		*Non-partnership farms (N=241)*	
		Mean	St.dev	Mean	St.dev.	Mean	St.dev.
Land (arable and pasture)	Ha	92.6	115	99.1	101	82.5	108
Age of farmer	Years	51.0	9.9	49.2	8.6	53.2	10.4
Hired labour	Share	0.088	0.20	0.094	0.19	0.066	0.18
Owned land	Share	0.57	0.35	0.57	0.33	0.58	0.36
Specialized livestock	Share	0.46		0.47		0.45	
Number of tasks that the partnership covers		-	-	2.85	1.87	-	-
Number of partners		-	-	2.92	2.30	-	-

* The production areas used are the ones used in Agriwise (2005) and are shown on a map in Appendix I.

The collaborating farms were asked about the form of collaboration, the organisation of the partnership and tasks that the partnership involves (see Table 2). The most common forms of collaboration were common ownership of machinery (37% of the farms) and hiring machinery from a machinery station (37%). Other common forms of collaboration is to drive own machinery for each other (32%) and mutual exchange of machinery (27%). A small share of the surveyed farms stated that they cultivate land together with other farmer(s) or have common operation (4% and 2% respectively). It should be noted that the shares sum up to more than 1 since many farms are involved in more than one form of collaboration.

In order to get an idea of the variation in the extent/organisation of the partnerships the farmers were asked to mark one of four alternative forms of organisation that they think best describes their collaboration with other farms. The different types of organisation are described in Table 2. The most common form of organisation is to borrow/rent machinery from other farms and/or owning parts of the machinery together (25% of the farms indicated this alternative). A large share of the farms, 18%, shares all machinery with other farms (by renting, borrowing and/or owning together). Of these, 3% also purchase production factors and/or sell products together with their partnership farm(s). The tasks that were most frequently involved in the collaborations were: harvest of silage (33%), planting (26%), cultivation (24%), harvest of grain (24%) and pesticide application (21%).

84% of the surveyed partnership farms stated that they only have an oral contract with their partner(s). In most cases (81%), the contract is not specified for a certain period of time. Some further summary statistics concerning what is specified in the contract can be found in Table 1A in Appendix. In general, the contracts do not appear to be very detailed.

Table 2. Form of partnership arrangement, organisation and tasks covered by partnership

	Share
Farms involved in any form of partnership arrangement with other farms	0.62
Form of collaboration	
Owning machinery together	0.37
Mutual exchange of machinery	0.27
Drive own machines for each other	0.32
Hires services from a "machinery station" or other part	0.37
Cultivates land together with other farmer(s)	0.04
Common operation with other farmer(s) (Driftsbolag)	0.02
Network of exchange of machinery services with other farmers (Maskinring)	0.13
Selling of products and/or purchase of production factors	0.10
Other type of collaboration	0.02
Organisation of partnerhip:	
Org 1: Hire services from third party	0.13
Org 2: Borrow/rent machinery from other farmer(s) were the payment takes place in form of settlements, invoice or exchange and/or common ownership of parts of the machinery with other farmer(s)	0.25
Org 3: Share all machinery with other farm(s) (by borrowing, renting and/or owning together)	0.15
Org 4: Share all machinery with other farm(s) and coordinated marketing of products and/or purchase of production factors	0.03
Other type of organisation	0.03
Tasks involved in partnership:	
Cultivation	0.24
Planting	0.26
Fertilizer application	0.14
Pesticide application	0.21
Harvest of grain	0.24
Harvest of silage	0.33
Harvest of potatoes	0.03
Harvest of sugar-beets	0.06
Purchase of production factors	0.08
Marketing of products	0.02
Other task	0.12

The farms in the survey were asked about the social relations to their partner(s), trust in the partnership and perceived effort levels of their partners. This was conducted by providing statements like "I think that my partner perform his/her obligations in the partnership in the best possible way", whereupon the respondent was asked to indicate his/her answer on a scale between one and five where one is "Definitely disagree" and five is "Definitely agree". Summary statistics of the results are displayed in Table 3. A general impression is that the farmers are, on average, satisfied with the social environment in the partnership, that there is a high degree of trust among the partners and that moral hazard problems are perceived as small or non-existing.

Table 3. Statements concerning social relations, perceived trust and perceived moral hazard in the partnership.

	Scale Definitely disagree - Definitely agree (1) – (5)		Don't know
Statement	*Average*	*St. dev.*	*Share*
Social relation among partners			
I believe that a good social relation among me and my partner(s) is very important for the partnership to be successful	4.42	0.79	0.02
I believe that the business relation is of greater importance than the social relation in my partnership	2.90	1.08	0.04
I believe that a high degree of trust among me and my partner(s) is very important for the partnership to be successful	4.47	0.74	0.03
I think that the social relation among me and my partner(s) is very good	4.45	0.69	~0.03
I knew my partner(s) when the collaboration was initiated.	4.47	0.90	~0.03
I think that potential conflicts that arise in the partnership can be resolved easily.	4.46	0.70	0.05
Overall, I believe that the partnership in which I participate works very well.	4.48	0.72	0.02
Trust			
I trust my partner(s) to perform his/her (their) obligations in the partnership in the best possible way.	4.59	0.68	~0.02
I think that my partners trust me to perform my obligations in the partnership in the best possible way.	4.62	0.63	0.04
Perceived effort			
I think that my partner(s) perform his/her (their) obligations in the collaboration in the best possible way.	4.59	0.67	~0.02
I think that I perform my obligations in the collaboration in the best possible way.	4.66	0.63	0.02

Coefficients of correlation between some of the variables for the partnership farms are displayed in Table 4. It is reasonable to believe that trust among partners is positively related to perceptions of actual effort levels of the partners (in fact, these two variables probably measure the same thing since one is likely to trust a partner who has performed well in the past). The coefficient of correlation between these two variables is presented in Table 4 as well as the correlation with the number of tasks, *Ntasks,* and the number of partners, *Npartner*. As expected, there is a positive and significant (at a 5% level) correlation between trust and perceived effort. The correlations between perceived effort and the number of tasks and between perceived effort and the number of partners are also positive and significant on a 5% level. Thus, farmers that participate in partnerships with more tasks involved or more partners involved perceive higher effort levels among their partners. The correlation coefficients for trust and the number of tasks and trust and the number of partners are not significant on a 5%-level. Casual effects are further analyzed using in a multivariate analysis in section 7.

Table 4. Correlation coefficient between measures of trust, perceived effort, number of tasks (*Ntasks*) and number of partners (*Npartners*).

	Correlation Coefficient (95%-confidence interval within brackets†)			
Variable	*Trust_hat*	*Effort_hat*	*Ntasks*	*Npartners*
Trust_hat	1	0.406* (0.354 – 0.456)	0.0285 (-0.0327-0.0895)	-0.00627 (-0.0684-0.0559)
Effort_hat		1	0.0824* (0.0212-0.143)	0.0282* (0.0193-0.0900)
Ntasks			1	0.201* (0.142-0.258)
Npartners				1

† calculated using the Fisher transformation.
* indicate statistical significance at 5%

The partnership farms in the survey were furthermore asked to respond to some general statements concerning their collaboration with other farms (see Table 2A in Appendix). Many farmers think that they have access to better and more modern technology as a result of their collaboration with other farmers. They also think their collaboration with other farms contributes to a more pleasant work environment.

7. Estimation results

Table 6 displays the results of the estimation of the participation equation (equation 21). The results suggested that farm size (measures by land) has no statistically significant impact on the probability of being a partnership farm. Age of farmer has a negative and significant impact; that is, the younger the farmer is, the more likely he/she is to collaborate with other farms. The share of hired labor has a positive and significant impact on the probability of being involved in a partnership arrangement. Specialized livestock farming has a positive and significant impact on the likelihood of being a partnership farm. The dummies for production regions are significant for most regions, indicating that the localization of the farm has an impact on the choice to collaborate with other farms.

Table 6. Determinants of farmers' decision to participate in partnership arrangements with other farms (Equation (21)).

	Participation Equation (Probit)	
	Coefficient	Standard error
Constant	0.53***	0.17
Land	2.6e-04	2.4e-04
Share own land	0.14	0.080
Age	-0.025***	0.0027
Share hired labor	0.30*	0.16
Dummy for off-farm activities	0.30***	0.053
Regions		
P1 – Nö	0.29***	0.094
P2 – Nn	0.23***	0.095
P3 – Ssk	0.35***	0.096
P4 – Ss	0.15	0.096
P5 – Gns	0.14*	0.078
Dummy for livestock	0.32***	0.060

***,**,* indicate statistical significance at 1, 5 and 10% respectively

Table 7 displays the results from the estimation of the equation system (22) and (23). Because perceived effort can only be observed for those observations (farms) that are partnership farms, the models are estimated only for this group and the dependent variable, the number of tasks, is thus truncated at 0. As the dependent variable is a count (number of tasks), we apply methods for count data estimation. The first and second columns report the results for equation (22) using an ordinary Poisson model and a truncated Poisson model respectively (reported standard errors are robust to heteroscedasticity). The third and the fourth columns report the results for equation (23) using an ordinary Negbin model and a truncated Negbin model respectively[9].

Signs and significance of the estimated parameters are robust to model choice in most cases. The level of perceived effort, *Effort_hat*, has a positive and statistically significant impact on the number of tasks. This suggests that the extent of the collaboration, measured by number of tasks, increases when the level of the perceived effort of the partners increases. Age of the farmer has a negative and significant impact on the number of tasks, i.e. younger farmers are more likely to involve more tasks in their collaborative arrangements with other farms. Most of the dummy variables for production regions were significant at a 1%-level. The number of partners has a significant (at a 1%-level) impact on the number of tasks, suggesting that there are benefits of task specialization.

[9] A test for overdispersion could reject the null hypothesis for model (22) but not for model (23), suggesting that the Poisson model is appropiarate to use only in the first case.

Table 7. Estimation result for (22) and (23).

	Dependent variable: *Ntasks* (Number of partners in the partnership)				Dependent variable: *Npartners* (Number of tasks involved in the partnership)			
	Poisson model		*Truncated Poisson model*		*Negbin model*		*Truncated Negbin model*	
	Coefficient	E-W standard error†	Coefficient	E-W standard error†	Coefficient	E-W standard error†	Coefficient	E-W standard error†
Constant	0.21***	0.064	0.70***	0.088	0.58***	0.14	0.25	0.17
Effort_hat	0.039***	0.013	0.14*	0.075	0.029	0.033	0.046	0.12
Land	-0.00041***	0.00058	-0.00049***	0.00010	0.00024	0.00017	0.00033	0.00027
Age	-0.020***	0.0011	-0.023***	0.0017	0.0070***	0.0025	0.0095***	-0.0031
Average distance to partners (km)	-0.0016	0.0015	-0.0016	0.0026	-	-	-	-
Regions P1 – Nö	0.74***	0.026	0.86***	0.043	-0.22***	0.082	-0.34**	0.14
P2 – Nn	-0.029	0.032	-0.054	0.055	0.13*	0.075	0.18**	0.087
P3 – Ssk	-0.25***	0.036	-0.24***	0.061	0.21***	0.075	0.28**	0.095
P4 – Ss	0.23***	0.028	0.30***	0.047	0.072	0.082	0.10	0.13
P5 – Gns	-0.0069	0.024	0.022	0.043	0.077	0.067	0.11	0.082
Dummy for livestock production	-0.18***	0.017	-0.23***	0.027	0.065	0.051	0.087	0.082
Pred_Npartners	0.66***	0.027	0.59***	0.031	-	-	-	-
Pred_Ntasks	-	-	-	-	-0.00068***	0.0002	-0.00091***	0.00035
Overdisp. Test $w_i=\mu_i$	-51.567		-42		2.0		1.97	
Overdisp. Test $w_i=\mu_i^2$	-26.209		-16		2.3		2.4	
Log-likelihood function	-1481		-1398		-1866		-1815	

***,**,* indicate statistical significance at 1, 5 and 10% respectively
† Eicker-White heteroscedasticity.robust standard error.

8. Non-partnership farms

The analysis has so far only been concerned with the partnership farms in the sample. Approximately 40% of the respondents/farmers in the survey stated that they do not participate in a partnership arrangement with other farms. Among these, 13 % indicated that they are considering the option to participate in a partnership that involves machinery- and labor sharing. The non-partnership farm where asked to respond to the statements in Table 8 concerning why they do not participate in machinery- and labor sharing arrangements with other farms at the moment and indicate their answer on a scale between one and five (where one is "Definitely disagree" and five is "Definitely agree"). One important reason that the non-collaborating farmers in the sample choose not to collaborate is that they want to be independent (the average score is 3.74). Moreover, the non-partnership farms do not seem to be worried that their potential partners would not perform his/her obligations in the partnership in the best possible way (the average score for this statement was 2.56). 30% of the non-partnership farms stated that they have been involved in machinery and labor sharing arrangements. Of these, only 12% indicated that social factors were the reason the collaboration was terminated.

Table 8. Statements to farmers that do not collaborate with other farms.

	Scale (1) – (5) Definitely disagree - Definitely agree		*Don't know*
Statement	*Average*	*St. dev.*	*Share*
I think it is difficult to find potential partners within a reasonable distance.	3.34	1.48	0,092
I think that I will not get the work done in the right time.	3.0	1.35	0,079
I want to be independent.	3.74	1.3	0,032
I do not think that a partnership would improve the economic situation of my firm.	3.35	1.4	0,069
I am afraid that my potential partners(s) would not perform his/her (their) obligations in the collaboration in the best possible way.	2.27	1.26	0,15
I think that the profitability of my firm is sufficiently good so that a partnership is not necessary.	2.56	1.37	0,093

9. Concluding comments

In this study, farmers´ decision to participate in partnership arrangements involving labour- and machinery sharing and role of social norms among the collaborating farmers has been analyzed. A framework for analyzing farm organization developed by Allen and Lueck (1998) was extended to consider the effects of social norms among the partners. It was illustrated that the presence of social norms reduces an opportunistic behaviour among the partners as well as it reduces the overuse or misuse of shared inputs.

The empirical part of the analysis built on the responses from a survey that was sent to approximately 1000 farmers in Sweden in the spring 2006. 62% of the respondents indicated that

that they are involved in any form of collaborative arrangement with other farms. The most common form of collaboration is to own machinery together and hiring of services (37% of the farms respectively were involved in these forms of partnership arrangement). Mutual exchange of machines and driving own machines for each other are other common forms of collaboration. The surveyed partnership farms experienced several advantages as a result of the collaboration such as access to better and more modern technology and a more pleasant work environment. The nature of the contracts was generally relatively simple (the majority of the partnership farms only had oral contracts).

The results of a Probit estimation suggested that younger farmers are more likely to collaborate with other farmers as well as farms with a high degree of hired labour and specialized livestock farms. Localisation of the farms had often a statistically significant impact of the choice to collaborate with other farms.

The responses to statements in the survey concerning perceived effort levels of the respondent's partner(s) revealed that perceived moral hazard problems in existing partnerships are non-existing or very small. Thus, this finding is contrary to what much of the literature in agency theory predicts - that there are incentives to shirk in contractual arrangements. The survey suggested that there is a high degree of mutual trust among the collaborating farmers, which is likely to mitigate the incentives to shirk. This may also explain the relatively simple nature of the contracts.

In a multivariate analysis, it was found that perceived effort level of the partners has a positive and statistically significant effect on the extent of collaboration (measured by number of tasks that the partnership involves). The results from this estimation should, however, be interpreted with some caution since there are obvious problems with the method used to "measure" (perceived) effort. For example, the scale used in the survey may be interpreted differently by different respondents. Finally, the results suggested that the extent of the collaboration decreases with age of the farmer and increases with the number of partners involved in the partnership.

Among the non-partnership farms in the sample, independence was an important reason for why they choose not to collaborate with other farms.

There are several opportunities for future research within the area of machinery- and labour sharing arrangements between farmers. Future theoretical work on partnerships between farmers may use a dynamic modelling framework. This could be done by using a repeated game setting such as the one suggested by Radner (1986) for team production.

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Appendix I

The effect of capital level on task effort

From (11) we know that the optimal task effort chosen by each farmer *n* solves

$$\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial f}{\partial t_n}\left(\left(\frac{N}{T}\right)^{\alpha}t_n;\bar{k}\right)=O_n-v(t_{-n})(t_{FB}-t_n) \qquad \text{(A1)}$$

Total differentiation with respect to *k* yields

$$\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_t^{\,2}}\cdot\frac{\partial t_t}{\partial k}+\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_n \partial k}=v(t_{-n})\frac{\partial t_n}{\partial k} \tag{A2}$$

Rearranging yields

$$\frac{\partial t_n}{\partial k}\left[\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_n^{\,2}}-v(t_{-n})\right]=\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_n \partial k} \tag{A3}$$

And solving for $\frac{\partial t_n}{\partial k}$

$$\frac{\partial t_n}{\partial k}=-\frac{\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_n \partial k}}{\left[\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_n^{\,2}}-v(t_{-n})\right]} \tag{A4}$$

The sign of the numerator depends on whether *t* and *k* are substitutes or complements (positive if complements and negative if substitutes). The first part of the denumerator, $\left(\frac{N^{\alpha-1}}{T^{\alpha}}\right)P_Y\frac{\partial^2 f}{\partial t_n^{\,2}}$, is negative by assumption and the second part, $v_i(t_{-i})$, is positive since it is a measure the degree of disutility of deviating from the social norm and the sign of the denumerator is therefore negative.

Thus, the sign of the derivative $\frac{\partial t_n}{\partial k}$ is positive if t and k are complements and negative if *t* and *k* are substitutes. One thing to note is that the presence of social norms implies that a change in *k* has a smaller impact on t since the absolute value of the denominator increases as the degree of disutility of deviating from the social norm increases. Another thing to note is that the presence of social norms implies that the size of the derivative $\frac{\partial t_n}{\partial k}$ is a function of $\frac{N^{\alpha-1}}{T^{\alpha}}$, which is not the case when there is no impact of social norms (compare with equation A4 page 381 in Allen and Lueck, 1989).

Appendix II

Production regions in Sweden

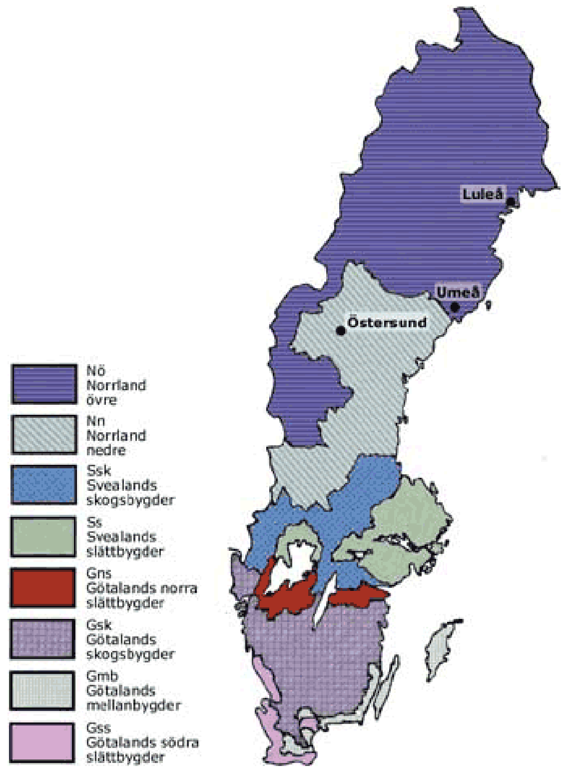

Figure 1. The division of Sweden into production areas (Agriwise, 2005).

Appendix III

Table 1A. Nature of contract.

	Yes (%)	No (%)	Not relevant (%)
Contract specifies ownership shares (if machinery is owned together)	35	23	42
Contracts specifies order of priority for using machines	2	62	36
Contracts specifies which of the partners that will drive and is responsible for maintenance of the machine(s)	20	47	33
Contract specifies how the machines should be kept at winter time	21	45	34
Contract specifies course of actions if one or several of the partners want to terminate the partnership	12	48	33
Contract specifies the course of actions if there is a conflict between the Partners	7	60	33

Table 2A. Statements concerning collaboration with other farmer(s).

	Scale (1) – (5) Definitely disagree - Definitely agree		*Don't know*
Statement	*Average*	*St. dev.*	*Share*
I believe that the profitability of my firm is higher as a result of the collaboration with other farms.	4.15	0.98	0.05
I think that the collaboration with other farmers contributes to a more pleasant work environment and more variation in my work.	3.88	1.05	0.06
I think that the collaboration contributes to give me more contact with other farmers.	3.92	1.00	0.06
I think that the collaboration increases my possibilities to produce products with a higher quality.	3.38	1.14	0.10
I think that the collaboration makes it possible for me to use better and more modern technology.	4.30	0.88	0.04
I think that it is easier for me to manage work intensive periods.	3.90	1.18	0.04
I think that it is easier for me to get help in case of illness.	3.45	1.30	0.14
I think that it is easier for me to get help in case of accidents.	3.48	1.32	0.16
I think that the stress is lower as a result of the collaboration.	3.17	1.20	0.06
I think that the quality of the performed labor is significantly higher as a result of specialization.	3.66	1.02	0.07
I think that the specialization is not desirable and I would like to have more variation in my work.	2.05	1.05	0.19
I think that I can use the services/machines when I need at the most optimal point in time.	3.44	1.10	0.08
I think that the work is organized better as a result of the collaboration.	3.60	1.11	0.08