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A Return of the Threshing Ring? A Case Study of Machinery and Labor-Sharing in Midwestern Farms

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Machinery-sharing provides an alternative for smaller producers to obtain the efficiencies of large farming operations and remain competitive in an increasingly concentrated agricultural industry. This research uses a multiple case study design to examine the motivations for sharing equipment and labor among farms and to better understand how group members handle the transaction costs of sharing. Our case evidence finds that in addition to cost savings, access to reliable labor is an important motivation for participating in a sharing arrangement. Trust and frequent communication among group members helps to minimize the transaction costs incurred from sharing.

Key Words: machinery sharing, transaction costs, farm-level cooperation

JEL Classifications: Q12, Q13

A number of market forces favoring larger farm operations are driving U.S. agricultural production toward a larger scale. Among them is escalating input costs, especially machinery costs. Estimated per-farm costs for tractors and other self-propelled machinery in Midwestern

states rose 54% in real terms over the past decade, from roughly \$4400 per farm in 1998 to \$6800 per farm by 2008 (NASS, 2009). Because machinery is a "lumpy input" that must be adopted in discrete amounts, expanding production to take advantage of size economies is one way to overcome the associated rise in fixed costs (Johnson and Ruttan, 1994).

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Although many producers have increased their farm size, this strategy is not always appropriate or feasible. Insufficient access to land and capital can limit expansion. Expanding production may increase risk as a result of larger investments in a small set of related commodities (Roe, 2005). Also, there are limits to farm size growth. The weather-dependent nature of farming and the high level of uncertainty involved in farming requires quick decision-making by farm managers, a role that cannot typically be delegated to workers (Johnson and Ruttan, 1994). The prevalence of family farms has been explained as a result of their ability to minimize transaction costs, particularly the costs of monitoring workers (Allen and Lueck, 2000; Valentinov, 2007).

An alternative strategy to deal with escalating farm machinery and equipment costs is to share machinery.¹ Many farmers occasionally share a piece of equipment or trade a few days labor and it is common for neighbors to help when a farmer is sick or injured. However, there is evidence that a number of U.S. farmers are revisiting the practice of sharing equipment and labor with other producers on a more routine basis. For example, the original idea behind the agricultural leasing firm MachineryLink was to share machinery between farmers over a geographic distance to take advantage of differences in growing seasons across regions (Ginder, Artz, and Colson, 2004).

Machinery-sharing rings and other farm-level cooperative arrangements are more common in Europe and Canada.² Studies of these machinery cooperatives have documented machinery costs savings for members as well as several related benefits. These include access to specialized or more efficient machinery; scale economies; an ability to draw on the experience, labor, and ideas of other members; the possibility of labor or task specialization; access to volume discounts on other inputs; risk-sharing; and environmental benefits from reduced input use. Potential drawbacks identified include a loss of timeliness in field operations, decreased autonomy in decision-making, more complex management, potential problems with lenders and split lines of credit, and difficulties in unwinding the arrangement (Andersson et al., 2005; de Toro and Hansson,

2004; Gertler, 1981; Gertler and Murphy, 1987; Groger, 1981; Harris and Fulton, 2000a, 2000b, Nielsen, 1999; Samuelsson et al., 2008).

The research on resource-sharing arrangements in the U.S. is sparse. A few University Extension guides address machinery-sharing as one of several options for controlling equipment costs on the farm (for example, see Edwards, 2001; Weness, 2001). Lawless, Cropp, and Harris (1996) address potential advantages and disadvantages of various legal business structures for multifamily dairy operations in Wisconsin but do not analyze other aspects of these arrangements. Stofferhn's (2004) survey of North Dakota farmers and ranchers found roughly 11% of respondents indicating a willingness to share equipment or labor with a neighbor but did not document examples of the actual practice. Evidence of cooperative agreements between producers for sharing equipment is therefore largely anecdotal and not well understood.

This research seeks to 1) describe the motivations of farmers who have entered into agreements to share machinery and/or labor with one another; and 2) document the ways in which these groups have experienced and addressed the transaction costs (timeliness, group decision-making, moral hazard problems) of sharing. Given the limited amount of information on machinery-sharing groups in the U.S., this research is exploratory in nature. We use a case study approach that complements existing theoretical and empirical research by providing more detailed information about how existing machinery-sharing arrangements function.

The article proceeds as follows. We outline a conceptual framework of the benefits and costs of sharing equipment and labor between farms in the next section. We discuss the data collection methods next. Presentation and discussion of the internal and external economies of scale and transaction costs uncovered in the case studies follow. The final section concludes with a summary of research findings.

A Conceptual Framework for Machinery-Sharing

Participation in a machinery-sharing arrangement involves a tradeoff between access to internal and

¹Sharing equipment among farming operations is not new. In the early 20th century, U.S. farmers often worked together during harvest on threshing rings (Olmstead and Rhode, 1995). Today, it is less common.

²The web site for the Machinery Ring Association of England and Wales lists 10 member machinery rings. Likewise, the Scottish Machinery Ring Association claims 10 member rings. Some of these are very large. Tayforth Machinery Ring in central Scotland reports 800 members (www.tayforth.co.uk). A report on the socioeconomic impacts of rural business rings in Scotland estimates that 23% of Scottish farmers belong to a machinery ring (SAOS, 2008). de Toro and Hansson (2004) report 5000 members in 20 associations in Sweden noting this is only approximately one-fifth the level of activity in Germany. Harris and Fulton (2000a) report more than 1000 member farms in 47 CUMA's ("Coopérative d'Utilisation de Matériel Agricole—loosely translated as "cooperative for the use of farm implements") in Quebec.

external economies of scale and increased transaction costs (Allen and Lueck, 1998; Valentinov, 2007). Internal economies of scale arise from improvements in technological efficiency; that is an ability to produce more output with the same inputs or to produce the same output with fewer inputs (Varian, 1992). Working in a group to share machinery tends to increase the number of acres serviced by the machinery, reducing inputs, and average costs for a given amount of output. Sharing can therefore make newer, larger, more technologically advanced equipment economical. In addition, group members can improve labor productivity by coordinating tasks to reduce duplication and allow for task specialization.

External economies of scale are related to advantages larger farms may have in accessing inputs; obtaining and negotiating terms of credit, storage, services; and marketing and distribution opportunities (Johnson and Ruttan, 1994). For example, larger farms can negotiate volume discounts on inputs (McBride, 2003). Larger farms might be able to attract specialty contracts that pay premiums for delivery of greater quantities of product. Like marketing cooperatives that obtain higher retail prices through quality assurance, smaller farmer groups may be able to successfully coordinate production practices such as planting and harvest times to maximize quality specifications (Sexton and Iskow, 1988).

Transaction costs related to farming in a partnership or group include timeliness costs, monitoring costs, and costs related to group decision-making. Timeliness costs may occur when a field operation cannot be performed at the optimal time (de Toro and Hansson, 2004; Larsén, 2007). Monitoring costs may arise to ensure that other members are careful with the shared equipment (an asset moral hazard problem) or are contributing an agreed-on number of hours of work when labor is shared (an effort moral hazard problem) (Allen and Lueck, 1998; Larsén, 2007). In addition, collective decision-making may be costly, particularly when the interests of group members are not well-aligned (Hansmann, 1996).

Allen and Lueck (1998) model the optimal farm organization (family farm, partnership, or

corporation) as a tradeoff between gains from task specialization and lower capital costs and increased transaction costs, particularly moral hazard costs.³ They empirically test their theory by examining the prevalence of organizational forms across production types (different crops, different regions, and over time). Their analysis shows that when production is seasonal and there are many stages to production with few tasks, the gains from specialization are limited while monitoring costs are high. In this type of production such as with grain farming, family farms are the dominant organizational form and partnerships are relatively rare.

Larsén (2007) builds on Allen and Lueck's model to incorporate social norms, peer pressure, and dynamics (repeated interaction) as factors that might mitigate the moral hazard costs involved in partnerships. Her survey of 640 Swedish farms found 62% participating in some form of partnership arrangement. The partnership farms in this study were characterized by a high degree of trust and Larsén concludes that the perceived moral hazard problems were negligible.

It is important to note that both the benefits and the costs of sharing relative to farming alone will vary with the size and scope of the sharing and the parties involved. Sharing only a combine with a neighbor during harvest may lower machinery costs while requiring some amount of coordination between partners but is unlikely to result in volume discounts on other inputs or increased output prices. In contrast, a group of many producers farming in a more integrated manner year-round might encounter both significantly greater benefits as well as significantly greater coordination costs.

³In this model, the benefit of task specialization comes from "learning by doing," in which the more a worker concentrates on a particular task, the better he becomes at it. Capital costs decline as the number of partners increases for two reasons. First, self-financing becomes easier. Second, capital will be used more intensively and thus more efficiently. The moral hazard problem arises as the number of partners increases because each partner shifts effort from farm to off-farm activities.

Study Design and Data

We examine the tradeoffs between internal and external economies of scale and transaction costs in a set of 10 cases of machinery-sharing groups primarily located in the Midwestern U.S. We focused our study on farms with similar production types, primarily grain production (corn, soybeans, wheat), but chose cases to represent variety in the degree of inter-farm cooperation to understand how changes in the scope of sharing affect transaction costs. Additionally, we sought cases in which some, if not all, members were unrelated, believing that kinship ties might confound the analysis of group dynamics.⁴

Case study approaches are well-suited for gaining an in-depth understanding of current events and for asking the types of “why” and “how” questions at the heart of this study (Kennedy and Luzar, 1999; Sterns, Schweikhardt and Peterson, 1998; Westgren and Zering, 1998; Yin, 2003). Analysis of organizational forms in secondary data like the Agricultural Resource Management Survey is hampered by the fact that most machinery-sharing arrangements are informal and therefore not reflected in the data. Given the relatively small number of machinery sharing groups in the U.S., data collection through a random survey of producers might not identify many, if any, groups for analysis.

The case study approach does have its limitations. We cannot calculate an incidence of machinery-sharing, for example. In addition, our findings do not generalize to the population, but rather to a set of theoretical propositions (Yin, 2003). The case approach taken in this study does allow us to illustrate the range of organizational forms and strategies used to share machinery in Midwestern grain farms, to document differences across cases, and to describe any systematic patterns in these differences.

We used a multiple case design in which the unit of analysis was the machinery-sharing group. Potential case study subjects were identified through a web-based survey of University

Extension professionals in five Midwestern states.⁵ Respondents were asked to identify local groups that fit the following description: “independent farms that are participating in co-operative arrangements to share resources for production, yet retaining decision making sovereignty over their assets and labor.” University Extension staff responding to the survey identified 50 groups in five states (Iowa, Illinois, Wisconsin, Nebraska, and Indiana) sharing equipment and/or labor.

The majority of groups identified in the survey had only two or three members (39 of 50). Half of the groups contained no family members, whereas 30% of the groups were comprised solely of family members and 18% combined solely of family members and 18% combined family and nonfamily members. Slightly more than half of the groups had existed for more than 5 years. Although the groups were engaged predominantly in grain production, cooperative arrangements among vegetable, livestock, and fruit growers were also identified.

The web survey discovered a wide range of cooperative arrangements. Seventy percent of groups identified share both machinery and labor. Fourteen percent were reported to share only machinery, whereas 10% reportedly share only labor. A variety of equipment types were identified in the respondents’ comments. A number of groups share sprayers, combines, and harvest equipment. A few groups share equipment for haying, manure hauling, seeding, and irrigation. Some producers only share the cost of a single piece of equipment. Other groups share whole machinery sets (e.g., combine, tractor, planter, and sprayer) as well as labor for operating the equipment. Some others share not only equipment and labor, but also purchase inputs and market output as a group.

The formality of the sharing arrangements varied from simple verbal agreements to written contracts and formal business structures. Over half of the groups identified have a verbal agreement for sharing resources. Only four of

⁴The exception is the Spauldings case, which consists solely of family members.

⁵The five states included in the survey were Iowa, Illinois, Nebraska, North Dakota, and Wisconsin. Attempts to solicit cooperation from the Extension services in Minnesota and South Dakota were unsuccessful at the time of the survey.

		Degree of Formality	
		Verbal agreement	Written contract or business entity
Degree of Cooperation	Share one piece of equipment, no labor		Duncans and Fergusons
	Share one piece of equipment, plus labor	Johnson and Olson Stevens and Smith	
	Share machinery sets & labor	Erickson & Zimmerman	
	Share equipment & labor; buy inputs together	Parker and Anderson Bennett, Nelson & Taylor	
	Share equipment & labor; buy inputs; formal record system for group	The Spauldings	Progressive Farmers Panhandle Farms LMC

Figure 1. Taxonomy of Possible Cooperative Arrangement Types

the groups identified were known to have a written agreement. However, for a significant portion of the groups (40%), the type of agreement was unknown by Extension staff at the time of the survey.

Based on the web survey results, we developed the two-dimensional taxonomy of cooperative arrangements shown in Figure 1. The vertical dimension represents the degree of cooperation, ranging from sharing only one piece of machinery to a highly integrated case in which producers share all equipment, purchase inputs jointly, and market at least some output together. The horizontal dimension represents the degree of formality of the agreement ranging from a verbal agreement to a formal business structure.

Cases focused on examples of sharing in Midwestern grain operations, but we attempted to identify cases representing the spectrum of formality in arrangements and degree of cooperation. Selecting cases to represent this diversity was meant to facilitate comparisons among groups. Ten case study analyses based on in-person interviews of producer groups

who share or have shared resources among farms were completed between June 2004 and January 2005. Figure 1 places these cases in the context of our taxonomy. Potential participants were contacted by telephone and by mail to solicit their participation in the study. With the exception of LMC whose members were interviewed during a visit to our university, we conducted interviews with group members “on-site” in a neutral location such as a local Extension office or hotel meeting room in their local community. Once a meeting time and location were agreed on, a pre-interview questionnaire was sent to the group contact requesting basic information about group history and members.

We conducted group interviews with as many group members as possible using interview guides, basic outlines of the general topics, and open-ended questions to be discussed.⁶

⁶The number of group members interviewed for each case is reported in Table 1.

Interviews lasted approximately 2 hours and each participant received \$50 to compensate them for their time. The interviews were tape-recorded when possible and later transcribed. Investigators took notes during the interview and wrote summaries of the conversations as soon as possible after the interviews occurred. As a result of a concern that members would not feel comfortable expressing negative opinions about their arrangement in the presence of their partners, we provided each member with an exit questionnaire to be completed at a later time and mailed to the investigators in a stamped, addressed envelope we provided. The exit questionnaire solicited members' opinions about the most negative aspects of their equipment-sharing practices and requested any other information they felt relevant to the study.⁷ The notes of the investigators, transcripts, and completed questionnaires served as the basis for the analysis of the case study findings.

Results and Discussion

Table 1 and Appendix A provide a summary of the 10 cases included in the study.^{8,9} Groups varied from sharing a single piece of equipment to sharing entire machinery sets. The degree of labor-sharing varied from none, in the case of a long-distance equipment-sharing arrangement, to a few weeks during harvest season to fully integrated labor operations year-round. Agreements between group members were of two basic types. Groups involving fewer than four members, regardless of the number of equipment pieces or amount of labor shared, predominantly had only a verbal agreement. Groups with a significant scale and scope of operations typically had a written contract, and most had formed a business entity (e.g., LLC). Nine of the groups were operating at the time of the interviews; one group had dissolved.

⁷ Only three members of Panhandle Farms and one member of Progressive Farmers completed and returned the exit questionnaire.

⁸ The names of the individuals and organizations have been changed to protect their confidentiality.

⁹ More detailed versions of the case studies are available in Artz, Edwards, and Olson (2009).

Internal Economies of Scale

In nearly all cases, sharing helped groups improve technical efficiency. Sharing machinery and working together reduced per-acre equipment and labor costs in the majority of cases. In others, machine costs per acre remained comparable to farming individually but allowed members access to newer, technologically advanced machinery. Producers reported an increased speed of operations as a result of higher-capacity machines, especially during harvest, fewer breakdowns, larger pools of labor, and more efficient use of labor. As one producer put it, "Three go twice as fast as two." Some producers stated that, as a result of the cost and time savings of their cooperative agreement, they were able to significantly expand the acreage of their crop operation or expand the size of their livestock operation.

Somewhat surprisingly, labor, more so than machinery costs, motivated sharing in a number of cases. Many producers rely on family members or retired neighbors to help during busy times, but finding reliable, skilled, and seasonal labor can be a challenge.¹⁰ Working with nearby producers offers one solution to this problem. Several groups reported that sharing eliminated their need to hire outside labor and improved efficiency of operations, particularly during harvest. Operating as a group allows for some specialization. To the extent that group members can take advantage of their complementarities, sharing can reduce the amount of individual effort required. In several cases, producers reported assuming responsibility for tasks they enjoyed or for which they had special training or knowledge. For example, in the case of Zimmerman and Erickson, Zimmerman takes care of most machinery maintenance and repairs because he is a mechanic by training. Erickson, who has a commercial driver's license, handles much of the hauling and scheduling with their local cooperative.

The exception was the case of Bennett, Taylor, and Nelson. Rather than improving efficiency

¹⁰ By "skilled labor," we refer to an individual with demonstrable experience as a farm operator, including modern farm equipment technologies. By seasonal, we mean employed less than year-round.

Table 1. Basic Characteristics of Individual Case Studies

Group ^a	Current No. of Members (farms)		No. of Members Interviewed	Start Year	Location	Total Acres (acres per farm)	Major Equipment Jointly Owned ^b	Periods of Labor-Sharing	Agreement Type
Johnson and Olson	2 (2)	2	2	2003	NE	1600 (800/800)	C	Harvest only	Verbal
Stevens and Smiths	4 (3)	3	3	2002	NE	3250 (1500/1300 /450)	C	Harvest only	Verbal
Duncans and Fergusons	3 (2)	2	2	1996	ND, MN	3250 (4500 /1000)	C	None	Written (LLP)
Erickson and Zimmerman	2 (2)	2	2	1984	IA	1530 (800/730)	C, P, T, FC, M	Year-round	Verbal
Parker and Anderson	2 (2)	2	2	1997	IA	4600 (split unknown)		Year-round	Verbal
Bennett, Nelson and Taylor	3 (3)	1	1	1996	IL	3600 (1200/1200 /1200)	C, P	Year-round	Verbal
The Spauldings	4 (4)	3	3	Pre-1986	IL	4010 (1350/1100/ 1200/360)	C, P, T	Year-round	Verbal
Progressive Farmers	3 (3)	3	3	1999	IA	2125 (775/750/600)	C, P, T, S, FC, TT, M	Year-round	Written (LLC)
Panhandle Farms	5 (1)	5	5	1986	NE	8400 (N/A)	C, P, T, S, M	Year-round	Written (LLC)
LMC	6 (6)	3	3	1970	Sask., CA	8000 (split unknown)	C, P, T, S, FC, TT, M	Year-round	Written (Ltd.)

^a Names of the individuals and organizations have been changed to protect their privacy.
^b C, combine; P, planter; T, tractors; S, sprayer; FC, field cultivator; TT, tractor/trailer; M, other miscellaneous equipment, including augers, GPS systems, grain carts, irrigation system, etc. This denotes equipment jointly owned by the group. In most cases, individually owned equipment was also shared among group members.

through group efforts, in this case sharing seemed to reduce it. This failed cooperative effort was stymied by the group's inability to agree on farming practices and scheduling (specifically how, when, and by whom field work would be done) as well as the purchase of an undersized combine for their combined number of acres.

External Economics of Scale

The main external economies of scale reported by groups related to improved negotiating power. Several groups reported advantages with regard to renting land. Panhandle Farms felt their ability to plant and harvest in a timely fashion provided an edge in obtaining crop share leases, which are desirable because they require less capital and carry less financial risk than cash rent leases. The Spaulding family noted an advantage from their group efforts with regard to landlords. They jointly own equipment for tile work, which allows them to make improvements to their rented farms more inexpensively than the going rate.

Another perceived advantage of group size appears to be special treatment from machinery dealers, input suppliers, and local elevators. When the members of Progressive Farmers encountered problems with a new combine, the manufacturer sent two engineers directly to their farms to fix it. They felt this was a direct consequence of their size. The Spauldings reported that the local elevator occasionally extended its hours to accommodate additional deliveries from the group. Anderson and Parker also felt their larger-volume purchases resulted in improved service from their dealers.

In contrast, the cases provided very little evidence of marketing opportunities being exploited. Only Panhandle Farms and LMC jointly marketed any of their production. Only LMC had attempted to coordinate production practices to attract price premiums. LMC expanded its operations into a variety of subsidiaries, including a seed-cleaning business and a specialty crops export venture. Parker and Anderson did suggest that a major benefit of their partnership was having someone to share ideas with: "Two heads are better than one." They felt the opportunity to routinely discuss marketing strategies improved

their bottom line, although they continue to market their crop separately.

Even joint input buying was problematic in many cases because members maintained loyalties to different seed and chemical dealers. When groups did report coordinated buying of inputs, they generally claimed savings. For example, the Spauldings reported that coordinated purchases resulted in a discount of \$3 per acre on chemicals and several free bags of seed each year. Anderson and Parker estimated a 15–20% savings on seed and chemicals from joint purchases.

Despite the lack of coordination observed in input buying and marketing among these groups, if opportunities arose, these groups would be well positioned to take advantage of them. Their history of successfully coordinating group machinery use gives them experience managing group dynamics other producers frequently lack. As in the case of LMC, and to a lesser extent Panhandle Farms and Zimmerman and Erickson, such improved coordination may evolve over time as the group gains experience working together.

Transaction Costs

Sharing equipment and labor involves transactions costs. Members must coordinate schedules, production practices, and, in some cases, even seed varieties. They must make joint decisions about what type of equipment to share, when to trade, how to operate as a group, how to handle repairs and regular maintenance, and a variety of other issues. The more integrated the operations of a group, the more likely additional recordkeeping is required. These costs seem to be higher in the beginning stages of the sharing arrangement. Once groups have operated for some time, many decisions become routine.

Timeliness Costs. Several groups reported that they viewed their separate land holdings as one operation for purpose of deciding which fields to work and when. Groups tried to strike a balance between optimal timing and fairness to individual members. One member of the Spauldings explained their method for making decisions about timing in this way: "Whatever's ready first. I don't think that's ever been a question. Sometimes we go around and do a little bit of everybody's. We don't do all of one

person's first." Progressive Farmers uses a more systematic approach. Although their land is not adjacent, it has a general north-south orientation. Initially, the group began planting corn in the north working southward. They would then retrace their path from south to north when planting soybeans. Although this approach seemed efficient, they felt it gave the farmland in the middle an unfair advantage. Now the group uses a circular planting scheme and rotates the starting point each year. During harvest, they combine fields as they are ready while making sure they harvest some of each member's land as they go, not leaving any one member's land for last.

In some cases, differences in land types or locations facilitate sharing. The heart of the long-distance arrangement between the Fergusons and Duncans is their ability to exploit variation in growing seasons between their farms. Their shared combine begins the season on Ferguson's North Dakota farm for small grain harvest. The machine moves to the Duncans' Minnesota farm for corn and soybean harvest on September 20, as specified in their operating agreement. This September 20 date is flexible depending on the harvest conditions in any given year. They try to be flexible and communicate with each other to work out solutions that benefit both parties.

Even neighboring farms can take advantage of differences in their land to mitigate timeliness issues. In Zimmerman and Erickson's partnership, Erickson's property is low and consists of river and creek bottom land, whereas Zimmerman has mostly hill ground. Therefore, Zimmerman's property can usually be worked sooner than Erickson's. They realized that by working together they could avoid some of the timing problems associated with working bottom ground before it was ready and working the upland more slowly than would be desirable. In other words, if the fields were planted as if each producer's land were part of a single, larger operation, the outcome for both producers would be better.

Finally, several groups stated that taking account of one another's decisions about hybrids helped reduced timeliness issues, even if they did not make seed decisions jointly. One producer described it this way: "He doesn't tell me what specific hybrids and I don't tell him what specific

hybrids. We know that in general we need to have somewhere in the neighborhood of 110 day hybrid on this end of the stick and somewhere in the general neighborhood of 112 days on this end of the stick."

Monitoring Costs (Effort and Carefulness). In the majority of the cases, a sense of trust and shared values among partners rendered the effort moral hazard problem moot. Most groups interviewed did not track hours contributed to the group effort. In many cases, they worked together on a daily basis and could therefore "monitor" each other's efforts. Overall, statements such as "You don't ask somebody to do something that you wouldn't do yourself" reflected the sense that all partners were committed to the agreement and worked hard to make it successful.

Two notable exceptions to this finding are provided by the cases of the Spauldings and Bennett, Taylor, and Nelson. At the time of the interview, members of the Spauldings group recognized they would need to devise a system to account for members' unequal contributions of hours. Specifically, one of the younger members ran a growing agriculture-related business in addition to farming. Because the busy time for both operations coincides, contributing his share of hours to the farming operation in the spring and fall was becoming increasingly difficult for him. "He's getting big enough now, you are going to have to make some decisions." Another member, a son-in-law who worked full-time off-farm and was an inexperienced farm equipment operator, paid \$20-25 an acre rent to help compensate for his reduced labor contribution.

In addition to sharing equipment, an important part of the Bennett, Taylor, and Nelson's agreement was shared labor. Going into the arrangement, they thought they shared a similar work ethic and view toward farming. As a result, they did not track hours and did not compensate one another for their time. They encountered problems when Bennett hired his brother to complete fall tillage on his land while he worked with the others harvesting. Because of his full-time off-farm job, Bennett had limited time off during harvest. Hiring his brother was the only way he felt he could complete both his harvest

and fall tillage before he needed to return to his job in town. After harvest, when Nelson and Taylor still needed to complete their fall tillage, the fact that Bennett was not available to help created resentment.

Another possible moral hazard problem associated with farming in a group relates to ensuring that all members are careful with the shared machinery. Most of the discussion about treating equipment carefully in the groups interviewed pertained to concern with hired labor rather than partners. In fact, a benefit of sharing was gaining access to another operator you knew would be careful with the equipment. A quote from one of the interviews illustrates this: "You can find people out there but are they going to be reliable and have the knowledge to run the machines and the tractor?" Carefulness seemed to be a criterion for choosing potential sharing partners. "Oh there would be instances where it wouldn't work with certain people. Some people just wreck stuff, I mean, you know they are just hard on stuff. And that's just the way it is and wouldn't work."

In the long-distance sharing case, one partner mentioned carefulness as an initial concern entering the partnership, "Maybe the second [fear] is—are they hard on equipment, are they gonna beat this thing to death?" Lacking routine contact with one another, monitoring in these situations is more difficult. In this case, the group's operating agreement detailing how they would address repairs plus a warranty on the shared combine helped alleviate these concerns.

Group Decision-Making. Another potentially costly activity associated with sharing is time spent on making group decisions as well as costs associated with discrepancies between individuals' best interests and the best interests of the group. Most groups did not have a formal process for making group decisions. When Anderson and Parker were asked how they made joint decisions, Anderson replied, "It just happens." He explained that they communicate daily to discuss any issues that arise. This was the general approach taken by most other cases as well. Even Panhandle Farms, one of the larger groups interviewed with five partners, described making decisions each morning over coffee before starting work.

Progressive Farmers uses a more formal voting process for making group decisions. Like a traditional cooperative, they follow the "one member, one vote" rule giving each partner an equal voice. In other words, members with more land do not have greater say in group decisions. Although their "majority rules" voting arrangement could lead to disagreements and resentment among members, the members described working hard to reach consensus. One partner described some of the challenges the group had to overcome to work effectively: "The first problem was going to be agreeing on machinery. I didn't think that would be a big deal but it was. Track vehicles versus wheels. We had some good sessions on that and they were healthy discussions. They weren't threatening discussions, but I didn't realize that it was going to be that much of an issue." Flexibility is key to the group's success. As one member put it, "with four members, you can expect to get your way one-fourth of the time."

LMC also described holding more formal meetings to make group decisions. One of the problems LMC encountered at the beginning was the large amount of time devoted to meetings and decision-making. To reduce the time spent in meetings, most information-gathering is delegated to members who then report to the entire group before a vote. They reported that many managerial tasks became "automated," reducing the need for formal meetings. As a result, the group phased out regular Monday morning group meetings and now hold only a few formal meetings each year. The group still meets informally almost daily as they head out to work in their fields.

Trust. The evidence from these case studies concurs with Larsén's (2007) findings that high levels of trust among members helps to mitigate transaction costs in Swedish partnership farms. Trust and good communication were repeatedly cited as important factors for success. Producers emphasized the importance of flexibility, "give and take," and willingness to be part of team. In several cases, group members did not mind small individual losses or decisions by the group that ran counter to their own preferences because they felt in the long run everything evened out. They believed

they were better off within the group than outside it. The evidence from the failed case of Bennett, Nelson, and Taylor supports this. Although several factors contributed to the failure of this group, a major cause was a lack of trust among partners and, at times, the unwillingness of members to consider the well-being of the group ahead of individual interests. For example, one member of the group who had significant additional time constraints resulting from his livestock operation was unwilling to allow any work to begin on his fields until he was present and able to oversee the operations. This insistence resulted in decreased productivity, conflicts over work hours, and personal resentment among group members.

Member Entry and Exit

The interviews revealed one particularly challenging issue for machinery and labor-sharing groups. In several cases, groups struggled with how to recruit and integrate new members into the arrangement as well as how to fairly treat members who wanted to retire from farming or leave the group for other reasons. Three of the cases had incorporated new members into their groups. The Spauldings and LMC viewed their machinery and labor-sharing group as a vehicle for easing their sons' transition into farming. Stevens and Smiths brought in a young beginning farmer who was unrelated, allowing him to contribute labor to the group in exchange for use of their machinery. Four groups, the Duncans and Fergusons, Progressive Farmers, Panhandle Farms, and LMC, had experienced member exits.

Of the groups interviewed, LMC had the most formal procedures for handling member entry and exit. The cooperative has devised a system that allows a new member to gradually build equity instead of requiring a full "upfront" investment permitting younger farmers to join with little capital and land of their own. LMC markets their crop jointly and distributes profits to members based on acreage share. For new members, 10% of this distribution is withheld until the new member has built up an equity account to match, on an acre percentage basis, that of existing members. LMC determines

equity value using prices acquired from local dealers. In a similar fashion, LMC buys out the equity share of exiting members over a 3- to 5-year timeframe. Spreading the payments over several years eases the financial burden on the remaining members and reduces the tax liability for the departing individual. This procedure has helped manage member transitions over LMC's 35 years. Its membership has numbered as many as 11 and fallen to the current number of six.

Exit of members is especially complicated because it usually involves an abrupt withdrawal of capital and labor resources from the group. Even when the transition can be extended over a 2- or 3-year period, there is likely to be a significant negative impact on the remainder of group. If the withdrawing member(s) have provided significant contributions of labor and capital to the group, both the capital position of the group and the internal dynamics of the group are affected. To replace such a member requires that a new member who has similar personal characteristics, similar capital to invest, and a desire to participate in the group be located. Finding new interested partners may be especially problematic in very rural areas. Both LMC and Panhandle Farms described concerns about the interest of younger family members: "We've had kids, but they've all moved to the big city. And I don't think they're coming back." If new members cannot be identified, the group may be forced to dissolve and reconstitute with the remaining members into a smaller-scale group, but downsizing could diminish many of the benefits of group-sharing. It is therefore important to clearly establish the procedures for dissolution at the outset.

Conclusions

Cooperation at the farm level in the form of machinery and labor-sharing is an emerging phenomenon that may grow as machinery costs rise and the level of technical knowledge and skill required for production increases. The case evidence presented here suggests several common factors that motivate and help determine the success of farm-level sharing arrangements. Among the cases analyzed, cooperation tended to be motivated by an attempt to control

machinery costs or to fill a need for skilled, seasonal labor. Once established, many groups found other benefits of group interaction to be as important, if not more important, than any associated cost savings. For example, the ability to specialize, the increased pool of knowledge and ideas, and the camaraderie enjoyed when working together were frequently cited as significant benefits of group participation. Many of the key success factors identified involve trust among members: an ability to communicate effectively, a willingness to be flexible, and a capacity to consider group interests above individual interests, at least occasionally. Trust among partners helped minimize the transaction costs incurred from working in a group.

This research documents the variety of different sharing approaches that can be effective. Successful arrangements ranged from a fairly uncomplicated agreement between neighbors to jointly own and use a combine to a highly complex organization of both production and value-added businesses now approaching its third generation of owners. Groups devised a variety of methods for managing potentially challenging aspects of group-sharing such as how to schedule use of equipment, compensate for unequal contributions of time and machinery use, and make group decisions.

The case evidence presented suggests that machinery- and labor-sharing arrangements have potential as a strategy for transferring farm assets between generations. Machinery-sharing can enable retiring producers to smooth tax liabilities by liquidating their equipment ownership gradually. Beginning producers may enter farming with a reduced capital commitment, shared risk, and a plan to build equipment ownership over a period of time. Intergenerational sharing may present some unique challenges as well. Group decision-making dynamics may be more or less difficult relative to an arrangement in which all members are roughly the same age and have the same experience. Farm succession plans also frequently need to account for nonmember interests such as how to treat non-farming siblings of the beginning farmer.

Although there does appear to be potential for successful machinery-sharing strategies, these arrangements, particularly the most complex

ones, are clearly not for everyone. It is unlikely that widespread adoption of these organizational models will occur given their complicated nature. The more costly it is to implement a new practice in terms of time, money, and acquisition of new skills, the more slowly adoption will proceed (Hall and Khan, 2003).

Further research into resource-sharing is warranted. None of the case study groups had access to information regarding how to design a cooperative arrangement, what the potential costs and benefits may be, what the optimal scale for their operation was, or how to best manage uncertainty and problems that may arise. Additional research and related outreach materials would prove valuable in raising producers' awareness of resource-sharing as a possible business strategy and improving their understanding of the benefits, risks, and mechanics of sharing equipment and labor with other producers.

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Appendix A. Description of Individual Case Studies

Johnson and Olson, two neighboring farmers in Nebraska, began their combine- and labor-sharing arrangement in 2003. Both farmers were faced with a labor shortage after previous helpers (a father and an older farmer) were forced to retire. Both were looking to replace their aging combines that were causing disruptions in the field as a result of breakdowns. The two farmers jointly purchased a combine that they financed 50/50 through a local dealer. They only harvest jointly and do not track fuel costs or combine usage.

Stevens and Smiths operate two nonadjacent, nearby farms in Nebraska with different cropping systems (ridge till and no till). Their combine- and labor-sharing arrangement began in 2002 and was primarily motivated by labor shortages during peak periods of the season after the loss of previous help. They purchased jointly a new higher-capacity combine (the Smiths purchased an air reel and Stevens contributed the headers). They harvest together. Stevens manages the maintenance, repairs, and insurance for the group. Recently, the group added a beginning farmer who contributes labor in exchange for access to the combine.

Duncans and Fergusons operate farms in two different states (North Dakota and Minnesota). Seeking to reduce machinery costs and inspired by the concept behind MachineryLink, the group formed an LLP in 1996 to jointly own a combine. The group has a written agreement specifying schedules for transfer of the combine among farms, repairs, maintenance, and storage. The group uses a rental rate to cover combine-related expenses and to adjust for differences in usage.

Erickson and Zimmerman, two neighboring farmers in Iowa, have an arrangement that has evolved from an initial custom combining agreement in 1984. The group recognized potential synergies as a result of natural differences in their acreage (one farmer has upland and the other has bottomland). They jointly own a combine, planter, sprayer, and tractor in addition to contributing some individually owned pieces. They pool their labor throughout the growing season. Each specializes in some tasks (e.g., repairs and hauling) that they personally enjoy.

Parker and Anderson operate nonadjacent nearby farms in Iowa. After the retirement of his father in 1997, Parker was faced with the prospect of either hiring new labor or reducing the size of his farm. Anderson, who had a reputation as a skilled operator but had older equipment, was experiencing financial difficulties after his hog operation was

decimated by disease. Parker, whose farm is larger, owns the majority of equipment used by the partnership, but Anderson has begun contributing some equipment of his own. They have jointly purchased other pieces. The partners buy inputs together, equally share maintenance and repair expenses, and use custom rates to value labor contributions. Both farmers have expanded their acreage since their partnership began. They have also rented some land together.

Bennett, Nelson, and Taylor, three long-time friends in Illinois with nearby farms, began their cooperation in 1996 motivated by the prospect of reducing their equipment costs. Each group member sold their individual equipment and they jointly leased new equipment for group use. The group disbanded 2 years later (not amicably). The group encountered three key problems. First, they underestimated their equipment requirements resulting in costly expenditures on custom combining. Second, disagreements about work hours and timing for field work led to ineffective pooling of labor and equipment use. Third, disagreements over finances, labor contributions, and field timing created an unpleasant work environment.

The Spauldings, a family operation spread across 40 miles in Illinois, began as a partnership between two brothers and has expanded to include new family members. The group uses a combination of individually owned and jointly leased equipment. They use a balance sheet system to track individual investments and determine "fair" payments. One of the motivations for the agreement, to help new family members enter farming, is reflected in their policy to give beginning sons a 2-year grace period from capital contributions. Currently the group does not track labor contributions, but as a result of increasingly divergent contributions, this may change.

Progressive Farmers is a group in Iowa founded in 1999 by four initial members seeking to increase their efficiency in the field and gain cost-effective access to modern equipment technologies. The group jointly owns or leases a full set of equipment and shares expenses on a per-acre basis. They farm as a group and track labor contributions with all labor tasks being valued at the same wage. To be equitable in the timing of field work, the group has adopted a field rotation scheme. One of the original members left the group in 2003. This created significant difficulties for the group attempting to 1) determine a fair compensation for the departing member's capital contributions; and 2) coping with being "overequipped" for their reduced acreage.

Panhandle Farms was formed in Nebraska in 1986 by six partners with no prior farming

experience but with local elevator experience. When the elevator sold to a regional cooperative, the partners formed an LLC to take over the farm land management business dropped by the elevator's new owners. One member left the group shortly after formation. The LLC co-own both equipment and land. The group jointly owns all equipment and conducts field operations together with members specializing in specific tasks (e.g., recordkeeping, mechanic work, irrigation). The group leases approximately 85% of their land and jointly own the remaining share. Inputs are purchased in bulk and the group markets their crops jointly.

LMC, was formed by seven families seeking a solution to depressed grain prices and increasing equipment costs in Saskatchewan, Canada in 1970. In its second generation, the group jointly owns a full set of equipment and farms as a group. The group pools all grain and markets their crop jointly, but they retain individual ownership of their land. Members track their labor contributions, which are valued at a fixed wage rate regardless of the labor task. They submit a time sheet each month and pay or receive compensation for differences in labor contributions. Over the years, the group has concentrated on expanding value-added enterprises (e.g., seed cleaning and export businesses) instead of expanding acreage.