

CAN TRANSACTION COST ECONOMICS EXPLAIN THE DIFFERENT CONTRACTUAL ARRANGEMENTS FOR THE PROVISION OF AGRICULTURAL MACHINERY SERVICES? A CASE STUDY OF BRAZILIAN STATE OF RIO GRANDE DO SUL

Alcido Elenor Wander*
Regina Birner**
Heidi Wittmer***

ABSTRACT

Agricultural mechanization represents an important phase in agricultural development. Unlike other modern inputs, mechanization typically involves considerable economies of scale, affecting its adoption. Experiences show that small farmers try to overcome this problem by engaging in a variety of contractual arrangements that allow sharing machinery services. Taking the case of Brazilian State of Rio Grande do Sul as an empirical example, the present paper explores the possibilities of transaction cost economics (TCE) to analyze the contractual arrangements concerning machinery services. The paper shows that the classical framework of TCE can be extended to account for peculiarities of transactions in this field. It is recommendable to take transaction costs into account together with other economic factors affecting the costs of providing machinery services.

Key words: transaction costs economics, transaction costs, contractual arrangements, contract choice, and machinery services, Rio Grande do Sul.

* B.Sc. Agronomy, M.Sc. Socioeconomics of Rural Development, Ph.D. Agricultural Economics, Empresa Brasileira de Pesquisa Agropecuária – EMBRAPA (Mailing address: Embrapa Caprinos, Estrada Sobral-Groaíras, km 4, 62011-970 Sobral-CE. E-mail: awander@cnpc.embrapa.br).

** M.Sc. Agricultural Economics, Ph.D. Agricultural Economics, Institute of Rural Development / Georg-August-University of Goettingen (Germany).

*** M.Sc. Agricultural Economics, Ph.D. Agricultural Economics, Centre for Environmental Research Leipzig-Halle (Germany).

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INTRODUCTION

As the theory of induced technical change in agriculture holds (Hayami & Ruttan, 1985), mechanization is an important phase in agricultural development, which is stimulated by raising wages in rural areas. Unlike the typical land-saving forms of technical change, such as the introduction of chemical fertilizer or improved seeds, mechanization typically involves considerable economies of scale. This affects the possibilities of small farms to mechanize their farm operations, when the economic frame conditions require the adoption of this technical change. However, both historical¹ and contemporary experience shows that small farmers are able to overcome this problem by engaging in a variety of contractual arrangements that allow sharing machinery services. While the New Institutional Economics (NIE) has been widely applied to analyze contract choice with regard to labor, land and credit contracts,² NIE concepts have hardly been used to analyze the choice of contracts concerning the use of agricultural machinery. The present paper aims to contribute to filling this gap, taking a case from Rio Grande do Sul, the southernmost state of Brasil, as an example.

The globalization of economies has confronted producers in all sectors of the economy with new conditions. Market-oriented farmers have to be more competitive and need to improve their quality of production. Mechanizing farming activities can contribute to a reduction of production costs and thereby improve the competitiveness of farmers. The necessity to exploit economies of scale in the use of machinery and limitations in the capacity for large investments make it necessary to create new institutional arrangements as well as improve existing arrangements to provide mechanization services to smaller farmers. In the Central Region of the Brazilian State Rio Grande do Sul (RS), a variety of different contractual arrangements has already emerged. Therefore, this case is well suited to apply transaction costs economics for the study of contract choice in the provision of machinery services.

This paper proceeds as follows: Section 2 introduces the empirical case and highlights the contractual arrangements to be explained. Section 3 outlines an analytical framework that includes a number of extensions of the “classical” TCE framework. Section 4 applies this analytical framework to the empirical case. Section 5 discusses the results and Section 6 finally draws some conclusions.

¹ See Chayanov (1919/1991), Olmstead & Rhode (1988).

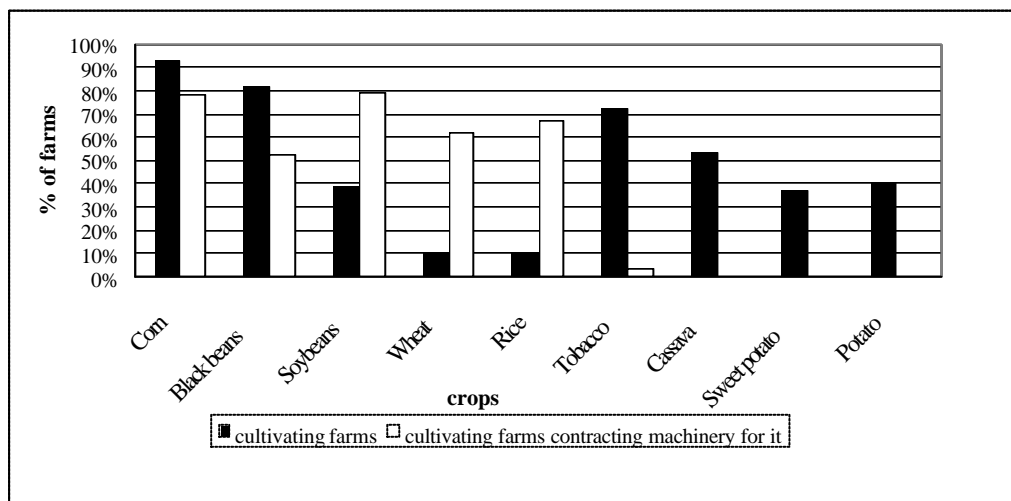
² See Hayami & Otsuka (1993).

THE EMPIRICAL CASE

This paper is based on an empirical case study done by the first author in the Central Region of the Brazilian state Rio Grande do Sul (RS). This region was selected because it has a very divided farm size structure and was one of the first regions in RS receiving subsidies and incentives to introduce the multifarm mechanization at the early 1970s.

From the farms contracting machinery services in the region (IBGE, 1997) a sample of 121 farms was randomly selected. The data was collected through a standardized questionnaire with open and closed questions applied by the first author on visits to farms and the results were statistically analyzed.

In the research region, mainly corn, black beans, soybeans, wheat, rice, tobacco, cassava, sweet potato and potato are cultivated. Fig. 1 displays the relevance of contracting machinery services for the different crops. The farms use contractual arrangements for provision of mechanization mainly for the production of corn, black beans, soybeans, wheat and rice (see Fig. 1). The types of machinery that are most often contracted for these crops are the following: no tillage planters, field sprayers, stationary threshers, combine harvesters and silage corn harvesters.



Source: Field Research.

Figure 1 - Percentage of farms contracting machinery services that cultivated different crops and used the contracted machine for its cultivation in the Centro-Serra Region (RS/Brazil), 1998/99

A variety of different institutional arrangements exists for the provision of machinery services (Tab. 1). The Tab. 1 shows how many farmers own the machines considered herein, the share of them providing services with their overcapacity to other farmers³ as well as the mentions of farmers considering the provider they prefer for these equipments. According to Fig. 1, only corn, black beans, soybeans and wheat are considered.

Table 1 - Share of farmers owning machinery as well as mentioned providers of machinery for no planting, crop protection and harvesting in the Centro-Serra Region (RS, Brazil) 1998/99

Machinery	Value (R\$)*	Farmers' own				Providers of contracted machinery (% of n ₃) as percent (and number)				
		n ₁	%	n ₂	n ₃	Informal sharing	Farmer contractors	Co-operatives	Farmer groups	Municipal government
No tillage planter (N=84)	5,000	27	32.1	21	57	1.8 (1)	45.6 (26)	5.3 (3)	24.6 (14)	22.8 (13)
Field sprayer (N=66)	2,000	32	48.5	24	34	2.9 (1)	55.9 (19)	5.9 (2)	35.3 (12)	-
Stationary thresher (N=55)	3,000	30	54.5	24	25	8.0 (2)	88.0 (22)	4.0 (1)	-	-
Combine harvester (N=52)	30,000	7	13.5	4	45	-	77.8 (35)	20.0 (9)	2.2 (1)	-
Silage corn harvester (N=29)	4,000	3	10.3	-	26	7.7 (2)	-	11.5 (3)	46.2 (12)	34.6 (9)

* This value is applicable to new equipments except combine harvester, which is normally bought from other larger farms (second-hand). 1RS = US\$ 0.52 at the beginning of 2000.

N = All cases in the sample using specific machines; n₁ = Cases using own machinery; n₂ = Subset of n₁ using their overcapacity to provide services as informal sharing or farmer contractors; n₃ = Cases contracting specific machinery; Farmers' own comprise those farms who own the mentioned machines and use them on their fields and in some cases, also to provide services to other farms (as informal sharing or farmer contractors).

Source: The authors.

An interesting pattern that calls for explanation is shown in tab. 1. While it is not surprising that the most expensive machine, the combine harvester, is owned only by a small number of farmers, the ownership pattern of the other machines is less obvious. It is, for example, interesting to observe that only a small percentage of farmers own the silage corn harvester, even though it is in the same price range as the other machinery types apart from the combine harvester. Informal sharing generally does not play a major role. Around half of the farmers who use the no tillage planter or the sprayer on

³ Selection bias: some of farmers owning the machines can be providers to other farmers, but as the names of providers are not considered in this study, some machines are mentioned as "own" (by its owner) as well as contracted from "farmer contractor" (overcapacity provided in form of services to other farms).

a contract base, chose a type of market arrangement: contracting from another farmer. For the stationary thresher and the combine harvester, this option is even more important, but it does not play a role at all for the silage corn harvester.

Co-operatives, which are by definition rather large and formal organizations, play a limited role in providing machinery services, except for the combine harvester. Farmers' groups, a smaller and less formal type of organization, are not important for the stationary thresher and the combine harvester, but they are relevant for the other machines. Finally, a state institution, the government of the municipality (prefeitura) plays a role in supplying the machinery services of the no tillage planters and silage corn harvesters, but not of any other machine. How can this pattern of contract choice be explained? The following sections deal with this question on the basis of transaction cost economics.

ANALYTICAL FRAMEWORK

Transactions and their Attributes

According to Williamson (1985) "the Transaction Cost Economics [(TCE)] adopts a micro analytic approach to the study of economic organization, focusing on transactions and the economizing efforts that attend the organization thereof. A transaction occurs when a good or service is transferred across a technologically separable interface. One stage of activity terminates and another begins".

As the term "contractual arrangements for provision of machinery services" suggest, the provision of services to farmers is the central type of transaction considered in this paper. Therefore, when referring to this term, we prefer to use a shorter word like "provider" of services, which includes all contractual arrangements aiming at the provision of agricultural mechanization services.⁴ As has been shown by Williamson (1985), the Transaction Cost Economics explains how transaction costs (TC) influence the creation and improvement of contractual arrangements in an economy, where limited rationality and opportunism play an important role. The central hypothesis of transaction cost economics holds that transactions are organized in such a way that the

⁴We consider as "contractual arrangement" all transactions between farmers and other agents to provide services to the first. Of course, if farmers own all the needed equipments, they don't need "providers" for it. So, only farmers who do not own the equipment themselves but would like to use such machinery are involved with this kind of transactions and resulting transaction costs.

overall costs of the transaction – including the transaction costs and production costs – are minimized.

Originally three main attributes with respect to which transactions – and the resulting transaction costs – differ have been described (Williamson, 1985): a) asset specificity, b) uncertainty and c) frequency. Other authors introduced complexity (Shelanski & Klein, 1995) and measurability (Barzel, 1982; Alchian & Demsetz, 1972) as additional attributes. These dimensions help to explain which contractual arrangements are most suitable for a certain type of transactions.

Regarding to the transactions of contracting machinery services, the attributes can be understood in the following way: Asset specificity: The extent, to which the investment in a certain type of machinery is limited to certain crops and/or activities; Uncertainty: The importance of issues such as timeliness; Frequency: The frequency with which the machine is used (number of transactions) over a year; Complexity: The complexity of the contracts between the transaction partners that are appropriate to assure their satisfaction; Measurability: The possibilities of the farmer receiving the service of the machine to measure quantity and quality of the service.

To take the peculiarities of machinery services into account, it appears useful to consider the following attributes as well: Requirement of group activities: The extent to which activities (e.g. silage harvesting) for which certain machines are used, require group activities by the farmers, involving other machines and labour; Specific hold-up possibilities: The extent to which hold-up possibilities can arise for other reasons than asset-specificity (as considered by Williamson (1985)). An example is silage preparation, which has to be finished within a very limited time period after starting the harvesting process; otherwise the entire silage can be lost.

It appears useful to consider together with the above attributes two investment characteristics that influence the overall costs of machinery provision and the economies of scale that are associated with particular machines: the investment level and the time period for which investments are made.

Types of Contractual Arrangements / Governance Structures

Williamson (1985) focused on the question: Under which conditions are transactions organized within “hierarchies” – that is within firms – and not in markets as conventional neo-classical economics suggests. Williamson (1985) also considers “hybrid forms” or organization such as alliances between different firms (hierarchies). The different types of organizations are also referred to as governance structures.

Some authors have argued earlier that it is useful to consider – next to markets and hierarchies – co-operative forms as a third, distinct, governance structure (Birner & Wittmer, 2000). Co-operative forms include both formal registered co-operatives and a wide variety of more informal organizations. Co-operative types of organization, such as marketing, processing and credit co-operatives, play an important role in the agricultural sector, especially in developing countries. The above case study confirms that general observation is also true for the case of machinery. For analytical purposes, it appears justified to consider co-operative forms next to markets and hierarchies as a distinct type of organization, because these co-operative organizations are by definition non-hierarchical and have to overcome the problems of collective action that are quite different from the principle-agent problem typically found in hierarchical relations. In the agricultural sector, the state often also plays a role as provider of services and has, therefore, to be considered as a further distinct type of organization. Considering markets, hierarchies, co-operatives and state agencies as four basic types of organization, the contractual arrangements found in our Brazilian case study can be classified as followed:

1) **Market arrangements:** A market transaction occurs, if a farmer hires a machine from a provider without establishing any relationship with the provider. In a typical agricultural setting, this pure “spot market” for machinery services does not appear to be very relevant, because the farmers may continuously hire machinery from the same provider, thus establishing a relationship. Between the available contractual arrangements farmer contractors represent the most market-oriented solution. But even here some relationships between provider and asking farmer can be found. In some cases the farmers prefer to re-use the same farmer contractor because of the established relationship. This leads to the following type of governance structure.

2) **Hierarchical arrangements:** If a farmer purchases the machine for his farm, one can interpret this as a “hierarchical arrangement” in Williamson’s sense because the transaction is organized within the farm enterprise (hierarchy) rather than hired in form of a market transaction. If a farmer establishes a long-term relational contract with an enterprise to hire in machinery services, this has can also be considered as a hierarchical arrangement.

3) **Co-operative Arrangements:** The case study shows that it is useful to consider three different types of co-operative arrangements: a) Informal sharing: Sharing of machinery and work between neighbours without cash payment. The payment could be in kind or even in work. This type of organization occurs mainly on farms with smaller area; b) Farmer groups: Informal group of farmers, who buy machinery together and

use it within the group (often extended family members and their neighbours); c) Cooperatives: Formal organized larger group of farms, where farmers are members and pay annual fees and the machinery belongs to the cooperative.

4) **Contractual arrangements with state agencies:** In the case study the municipal governments own the machines and provide services to farmers against monetary payment. In other situations, it is often the Municipal Bureau of Agriculture that offers such services.

Hypothetical Cost Curves

Concerning the comparative suitability of the different governance structures for the different transactions, we assume that co-operative governance structures are better suited to protect farmers from hold-up situations. The larger the co-operative organization is, the better it is suited for types of machinery that involve large investments and need to exploit economies of scale. However, with increasing size of a co-operative organization, the internal transaction costs of organizing collective action increase as well. Therefore, one can assume that from a certain investment level onwards, contractors may provide the services to the farmer at a lower level of total costs, even though the farmer has to bear the transaction costs that arise out of hold-up situations.

For types of machinery that do not require large investments but involve considerable hold-up problems, contracting may never become the contract choice. For machinery with very low investment levels, ownership may be the preferred form because it does neither involve transaction costs for collective action nor for avoiding hold-up situations. For small farmers with no access to capital, however, this option loses its comparative advantage as soon as the required investment levels increase. Fig. 2 illustrates these hypothetical cost curves (costs for provision of services, including transaction costs) for the three governance structures according to the level of investment.

These considerations contain some general hypotheses on the preferred contract choice. The Brazilian case allows applying these considerations in more detail to a practical example.

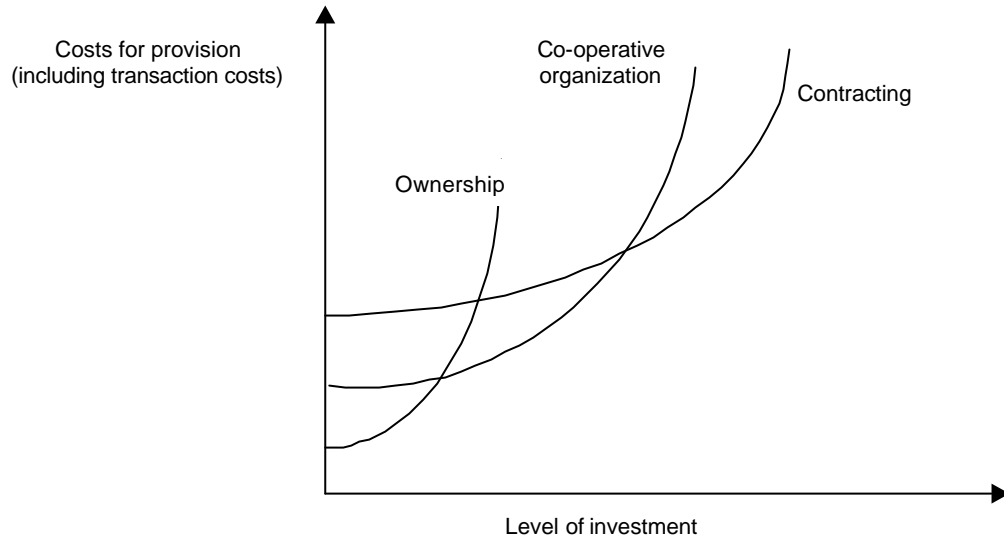


Figure 2 - Hypothetical costs for machinery provision under different governance structures

APPLICATION OF THE ANALYTICAL FRAMEWORK TO THE BRAZILIAN CASE

What does TCE predict?

The relevance of the attributes and investment characteristics for the different machines that are relevant in the Brazilian case introduced in Section 2 are shown in Tab. 2. As can be seen in Tab. 2, Williamson's (1985) asset specificity as well as the uncertainty are more relevant for harvesting machines, particularly combines and silage corn harvesters, than for planting or crop protection equipment. The highest frequency of use can be observed for the field sprayer, because this is a multipurpose machine.

The complexity of contracts can be assumed to increase with the value of machinery involved in the transaction; consequently it is the highest for combines (Shelanski & Klein, 1995). Measurability (Barzel, 1982; Alchian & Demsetz, 1972) of a machinery service is easier for planting with planters and harvesting with stationary thresher and becomes more difficult for crop protection with field sprayers and harvesting by combines and/or forage harvesters (Tab. 2).

Table 2 - Assessment of some important attributes of transaction costs for the most frequently contracted machinery in the research region

Attributes of transaction	How important are the attributes on different machinery type				
	No tillage planter	Field sprayer	Stationary thresher	Combine harvester	Silage corn harvester
Asset specificity	++	+	+++	+++	++++
Uncertainty	++	++	+++	+++	+++
Frequency	+++	++++	++	+++	++
Complexity	++	++	++	+++	++
Measurability	+++	++	+++	++	++
Group activities	++	+	+++	+++	++++
Special hold-up	+	+	++	++	++++
Planning time	++	++	++	++++	+++
Investment level	++	+	+	++++	++

Scale: “+” not specific, certain, seldom used, simple, not measurable, no group activities required, no hold-up risks, short planning time, low investment level – “++++” very specific, uncertain, very often used, very complex contracts, well measurable, group activities are very important, high hold-up risks, long planning time, high investment level. The levels “++” and “+++” are between the extreme limits and therefore, do not need to be explained. These scales were created by the authors.

The attributes that have been introduced additionally, including amount of investment, planning period of time and group activities, seem to be helpful for explanation. The amount of investment⁵ varies in the case study from roughly R\$ 2,000 for field sprayer to up to R\$ 30,000 for a used combine (8-10 years of use). The planning period of time is associated with the amount of investment as well as with the frequency. Therefore, cheaper machines, like planters, sprayer and stationary threshers, imply a shorter planning time than forage harvesters and even combines, which have longer depreciation periods. The need for group activities is low for crop protection, but increases for planting and reaches the highest level for harvesting activities, especially for silage corn. For harvesting silage corn, besides of the tractor for powering the harvester, at least one more tractor with trailer is needed for transportation to the silo, one more tractor is needed for compaction of the silo, besides the labor involved in these activities. The corn harvesting transaction also involves the highest special hold-up possibility, as explained above.

⁵ Value (investment costs) of most used machinery: R\$ 5,000 for no tillage planter, R\$ 2,000 for field sprayer, R\$ 3,000 for stationary thresher, R\$ 30,000 for combine harvester and R\$ 4,000 for silage corn harvester. This value is applicable to new equipments except combine harvester, which is normally bought from other larger farms (they are not new; new combines cost more than R\$ 100,000). 1 R\$ = US\$ 0.52 at beginning of 2000.

Table 3 - Importance of attributes of transactions as factors explaining the choice for or against this type of contractual arrangement for provision of machinery services

Attributes of transaction that causes transaction costs	Providers of machinery services and the importance of attributes of TC			
	Informal sharing	Farmer groups	Cooperatives	Farmer contractors
No tillage planter				
- Asset specificity	+	-	+	++
- Uncertainty	+	+	-	--
- Frequency	++	++	-	-
- Complexity	++	++	-	--
- Measurability	+	+	-	--
- Group activities	0	0	0	0
- Special hold-up	0	0	0	0
- Planning time	+	---	++	+++
- Investment level	++	--	-	++
Field sprayer				
- Asset specificity	+	-	+	+
- Uncertainty	+	+	-	--
- Frequency	++	++	--	-
- Complexity	+	+	-	--
- Measurability	-	-	--	--
- Group activities	0	0	0	0
- Special hold-up	0	0	0	0
- Planning time	+	--	++	+++
- Investment level	++	--	-	++
Stationary thresher				
- Asset specificity	+	--	+	++
- Uncertainty	+	++	--	---
- Frequency	+	+	-	-
- Complexity	+	+	-	-
- Measurability	+++	+++	+	-
- Group activities	+++	+++	+	++
- Special hold-up	++	++	+	--
- Planning time	+	--	+	+++
- Investment level	+	--	-	++
Combine harvester				
- Asset specificity	-	---	-	+++
- Uncertainty	++	+++	+	---
- Frequency	++	++	-	--
- Complexity	-	-	-	++
- Measurability	++	++	-	-
- Group activities	+	+	+	+
- Special hold-up	++	+++	++	--
- Planning time	-	---	-	+++
- Investment level	+	---	--	+++
Silage corn harvester				
- Asset specificity	+	---	-	++
- Uncertainty	+	++	+	---
- Frequency	+	+	-	-
- Complexity	+	+	-	--
- Measurability	+	++	-	--
- Group activities	++	+++	+	---
- Special hold-up	++	+++	+	---
- Planning time	-	---	-	++
- Investment level	+	--	-	++

“+” Indicate that attribute favors the choice of this contractual arrangement (“+” a little, “++” a little more, “+++” the most), while “-” indicates that the attribute discourages the choice of this arrangement (“-” discourages a little, “--” discourages a little more, “---” discourages the most). Value of “0” indicates that the effect is neutral.

Source: The authors

The next step in the application of the analytical framework consists in assessing how relevant the attributes identified in Tab. 2 are for the different governance structures discussed above. Tab. 3 shows this assessment. According to Tab. 3 especially harvesting machines are affected by different attributes of transactions that may cause transaction costs. Initially we can observe that the asset specificity limits to some extent the success of co-operative agreements (informal sharing and farmer groups) if compared to market solutions (farmer contractors). On the other side, from the uncertainty, frequency, complexity of contracts and measurability of service point of view, the co-operative based arrangements are more recommendable than market contracting. The need of group activities and possible negative effects of hold-up leads to the hypothesis that informal sharing and farmer groups fit better to provide harvesting equipment, especially stationary thresher and silage corn harvester, which need a high amount of group activities. Considering the investment level and the planning time the market solutions (farmer contractors) have the best characteristics. But even informal sharing may be a good alternative, if no farmer contractor is available.

It can be seen that the asset specificity of a transaction and its resulting transaction costs for farmers when using co-operative solutions (informal sharing and farmer groups) as provider is much higher than if using farmer contractors. Considering uncertainty, it is observable that the more the transaction (provision of machinery services) takes place under market conditions, the higher it will be. On the one hand, informal sharing and farmer groups have many advantages, mainly because of the direct and constant relationship between involved farmers. On the other hand, farmer contractors seem to be very uncertain as provider, mainly because of the hold-up effects that may take place if contractors prefer to prioritize other larger farms after starting service on a smaller production unit.

The aspect of frequency seems to be quite uniform among providers. It only may be a little higher if informal sharing or farmers groups are used because of the proximity of provider and so the higher flexibility to decide when and how often to use it, beside of the lower rates to pay for services. As mentioned before, the complexity of contracts increases for more expansive machines and services, because of the higher risks for both transaction partners. However, when using a farmer contractor as provider, farmers may also be confronted with more complex contracts, even if they use cheaper machines, like field sprayers or stationary threshers.

Concerning measurability of services we can add that at the level of informal sharing and farmer groups, it may be easier to measure it than when using services from a farmer contractor. The reason why this happens is mainly because of the close rela-

onship between asking farmer and providing organization. Considering the investment level, farmer groups have the highest demand for capital, because of buying the machines in groups (farmer has to provide a part of the investment capital). Informal sharing and cooperatives are in an intermediary level and farmer contractors imply lowest investment for farmers asking for services. Farmer contractors have their own capital or lend it from other credit sources, so that the farmers asking for services do not have to contribute directly to the contractor for buying the machinery.

Like for the amount of investment, the planning period of time is also longer when farmers are members in a group and cooperatives. Farmer contractors represent again the alternative where one can stay more flexible and change activities within shorter periods of time.

As presented before, the need for group activities increases with the evolution of the life cycle of cultivated crops, reaching the highest level for harvesting.

Comparing the predictions based on TCE with the empirical evidence

In this section, a discussion about to which extent the above predictions based on TCE explain the empirically observed distribution of contractual arrangements that has been presented in tab. 1 in section 2 is introduced. The figures on ownership support the expectations presented in Tab. 3, because the sprayers, stationary threshers and also planters are cheaper machines. If they are used more frequently, more farmers would prefer to own the technology. The silage harvester is also cheaper than the combine, but very specific, and therefore ownership is not a preferred option.

Considering the contractual arrangements for no tillage planter we found – from the more important to the less one – farmer contractors followed by farmer groups, machinery services of local government, cooperatives and informal sharing. These figures confirm our expectations, with the exception of the state as a provider. Contractual arrangements involving the state will be discussed below, for all machineries together.

Among the contractual arrangements concerning the field sprayers, we have similar figures for the planter. Only the state as a provider is missing for this case. The share, which involves the state in case of the no tillage planter seems to be distributed more or less homogeneously to the contractual arrangements in case of the field sprayer. There are two reasons why the distribution of these two types of machinery is very similar. The first reason is that the machines are similar in the attributes that influence the preferred contract choice. The second reason is that the use of both types of equipment is inter-

connected. First farmers use the sprayers to apply the total herbicides that allow planting the crops directly with the no tillage planters.

According to the expectations, informal sharing and farmer groups should be important providers of stationary thresher. Considering Tab. 1 a question arises as to why there no farmer group appears as provider? The stationary thresher is used mainly for one specific activity, the threshing out of black beans that were collected by hand. After starting the collection of the beans' plants, they need to be threshed out as soon as the plants are dry enough. If farmers wait too long, they will have losses through burst of the strings. That is an important reason why they only start with collecting the bean plants when they are sure the machine comes. As most farmers start harvesting the beans at the same time, only the farmer contractors (which do not cultivate this crop to large extents) can offer the service within a short time. Another important point concerning black beans is that this crop is a cash crop that is subjected to considerable price fluctuations. Therefore, it is rational for farmers to be flexible and switch to other crops, like corn or soybeans, if their price expectations are not met. Therefore, investments by farmer groups into this machine are rather risky. There is also no need for farmer groups to invest into this machine as long as contractors provide this service, as well.

For the combine harvester, farmer contractors are the most important contractual arrangement (78%), followed by cooperatives (20%) and farmer groups (2%). This confirms the hypothetical expectation that using a combine from a farmer contractor implies the lowest asset specificity for asking farmer, the lowest investment level and the shortest planning time. And considering these attributes, the cooperatives are the second best option, like the empirical results confirm. Beside that, there are several factors that explain why farmer contractors are the most important providers of the most expensive machinery (combines) as suggested by the theoretical considerations above, informal sharing and farmers' groups are not a preferred option since their mechanizable area is not large enough to make this investment profitable. They would, therefore, also have to hire out the machine in addition to using it on their own farms. However, it appears justified to assume that a farmer contractor is better suited for this purpose, because this option does not involve the transaction costs of collective action that arise in the farmers' group in addition to the transaction costs of hiring out machinery. Expectedly, the large co-operatives play a role in the provision of this machinery because their larger membership allows using the combine harvester at a sufficiently large area. However, farmer contractors are more flexible and may use the capacity of the equipment more efficiently than cooperatives, because they do not follow regular hours of service like cooperatives do and they do not involve transaction costs of collective acti-

on. Moreover, the cooperatives are somehow discredited by farmers, mainly because of low participation possibilities for the individual members as well as because of opportunism from specific administrations of other cooperatives. As farmer contractors generally use the equipment more intensively (more working hours per year), they are in a better position to adopt new technologies, which makes their services more attractive for the farmers. The high investment level also discourages the farmers' group as a provider. The farmers may have to use credit facilities for a risky investment, and they may only be able to purchase second-hand machines.

In contrast to all other equipments, no farmer contractors have been observed as providers for the silage corn harvester. More often mentioned providers are farmer groups (46%), the state (35%), cooperatives (11%) and informal sharing (8%). The fact that the farmer contractor is not used can be attributed to the combination of special hold-up problems (as already explained above) and a need for group activities involved in this machine.

Beside this, silage corn harvesting is done for animal production, which implies that the investment into a silage harvester can be planned with comparatively large security for a longer period of time. Therefore, as expected, different forms of cooperation (groups, cooperatives, and even informal sharing) seem to be more appropriate than the flexible structures of contractors.

Finally, a question appears: Why is the government such an important provider for the silage corn harvester, and also for no tillage planter? The provision of machinery by the local government does not fit into the TCE approach. Their rates for machinery services are comparatively low because they are subsidizing their machinery to a considerable amount. While contractors (and also other providers) have rates such as R\$ 35 per hour of service with no tillage planter (with tractor and operator) and silage corn harvester (with tractor and operator), the state offers the same service for R\$ 16 an hour (including tractor and operator). In the research region, mainly the smaller farms chose to hire machinery services from the state. The service seems especially useful for those who are located too far away from farmer contractors, and for those who are too small in number to set up a group. On the question of why they chose other providers than the state, the farmers with larger areas typically gave the answer: "The state may have lower prices, but the quality of its service is much lower than that of other providers". From this point of view, the state could be considered as a provider of services for low frequency and low specificity. In our study region, the state services appeared more appropriate for the smaller farmers. There is also evidence that political rather than economic factors explain the provision of machinery services by the state. In view of the high level of

subsidies, this option also involves considerable risks. If the subsidies are cut, the service may simply stop. If, at the next elections another political party wins, they may have other priorities and so these machinery services may also be reduced or even completely stopped.

CONCLUSIONS

The study shows that Transaction Costs Economics is well applicable to analyze the sharing and contracting of agricultural machinery. TCE is useful to better understand how and why farmers prefer to contract machinery services than buying their own equipment. As can be derived from the study, to analyze the variety of contractual arrangements observed in developing agriculture on a theoretical basis, the classical TCE framework has to be extended in two aspects: First, besides the attributes of transactions typically used (asset specificity, uncertainty and frequency) have to be extended. To take the peculiarities of machinery services into account, attributes like the complexity of contracts, the measurability of services, and the need for group activities have to be taken into account. These attributes have to be considered together with other criteria that influence the costs of providing machinery services, especially investment costs. Second, it is useful to consider co-operative forms of organization as a third type of governance structures next to markets and hierarchies to better understand contract choice for machinery services.

The study presented here also shows some limitations of the TCE approach. Even though public transactions have received increasing attention in the TCE literature, the TCE approach is not suited to explain the provision of services by public agencies that occur due to political reasons. A combination of TCE with political economy could provide a more comprehensive framework for a better understanding of the variety of contract choice in developing agriculture.

This study has to be considered as a first step in applying TCE to a field that has hitherto been rather neglected in the study of contract choice in agriculture: the provision of machinery services. The author's hope is that their paper helps to highlight the potential of TCE in this field. Further qualitative and quantitative studies are required to refine and test the analytical framework developed in this paper. Increasing attention to contracts concerning machinery appears justified since this issue is highly relevant for small farmers in many developing countries who face changing economic framework conditions. A better understanding of the comparative efficiency of different contractual arrangements for the provision of machinery services can help to devise

policies that enable small farmers to become competitive under conditions of globalization that favor mechanization and require exploring economies of scale.

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SINOPSE

A ECONOMIA DOS CUSTOS DE TRANSAÇÃO É CAPAZ DE EXPLICAR A OCORRÊNCIA DOS DIFERENTES ARRANJOS PARA CONTRATAÇÃO DE SERVIÇOS DE MECANIZAÇÃO AGRÍCOLA? ESTUDO DE CASO NO RIO GRANDE DO SUL

A mecanização agrícola representa uma fase importante no desenvolvimento da agricultura. Ao contrário de outros insumos modernos, a mecanização envolve, tipicamente, as consideráveis economias da escala, afetando, assim, a sua adoção. Experiências mostram que as pequenas unidades de produção tentam superar esse problema por meio de uma variedade dos arranjos contratuais que servem para compartilhar serviços de mecanização agrícola. Analisando o caso do Rio Grande do Sul como um exemplo empírico, o trabalho atual explora as possibilidades da economia do custo da transação (ECT) para analisar os arranjos contratuais com relação aos serviços de mecanização. O trabalho mostra que a estrutura clássica da ECT pode ser ampliada para explicar peculiaridades das transações neste campo. É recomendável considerar os custos da transação resultantes para o pequeno produtor junto com outros fatores econômicos que afetam os custos de fornecimento de serviços de mecanização agrícola.

Palavras-chave: economia dos custos de transação, custos de transação, arranjos contratuais, escolha de contrato, serviços de mecanização agrícola, Rio Grande do Sul.

SINOPSIS

¿PUEDE LA ECONOMÍA DE LOS COSTOS DE TRANSACCIÓN EXPLICAR LOS DIVERSOS ARREGLOS CONTRACTUALES PARA LA DISPOSICIÓN DE LOS SERVICIOS AGRÍCOLAS DE LA MAQUINARIA? UN ESTUDIO DE CASO DEL ESTADO BRASILEÑO DE RÍO GRANDE DO SUL

La mecanización agrícola representa una fase importante en el desarrollo agrícola. Desejante de otros insumos modernos, la mecanización implica típicamente las economías considerables de la escala, afectando su adopción. Las experiencias demuestran que los granjeros pequeños intentan superar este problema enganando a una variedad de arreglos contractuales que permitan el compartir de servicios de la maquinaria. Tomando el caso del estado brasileño de Río Grande do Sul como ejemplo empírico, el documento explora las posibilidades de la economía de los costos de transacción (ECT) para analizar los arreglos contractuales referentes a servicios de la maquinaria. El trabajo demuestra que el marco teórico clásico de ECT se puede extender para explicar particularidades de transacciones en este campo. Es recomendable tomar costos de transacción en cuenta junto con otros factores económicos que afectan los costos de proporcionar servicios de la maquinaria. Palabras-clave: economía de costos de transacción, costos de transacción, arreglos contractuales, opción de contrato, servicios de maquinaria agrícola, Río Grande do Sul.

Palabras-clave: economía de costos de transacción, costos de transacción, arreglos contractuales, opción de contrato, servicios de maquinaria agrícola, Río Grande do Sul.