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The role of the service cooperative in attenuating the transaction costs in dairy farms: a case study from Tunisia

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Abstract – The paper develops an analytical framework of estimating the magnitude of transaction costs on the basis of previous related studies and the specific trade characteristic of dairy farmers in Mahdia, centre of Tunisia. The main objective dealt with in this study was to determine the influence of the transaction cost and the role of the cooperative membership on the productivity among the dairy farms in the zone. The main results show that the price cost is lower among the cooperative membership. The non-cooperative members suffer from heavy transaction cost which influences negatively their productivity. Thus, the average technical efficiency among non-cooperative members is lower than that of cooperative's memberships. Our investigation indicates that cooperative can largely support farmers and reduce the influence of the transaction cost and consequently improve the farms' productivity.

Keywords: Dairy farms, cooperative, transaction cost, Technical efficiency, Tunisia

1. Introduction

In Tunisia, as in most developing countries, products of animal origin (milk, meat) have become strategic. The dairy sector occupies an important place in the Tunisian economy. Since the dairy production in 2013 was 1175 000 T and 1218 000 T in 2014, 98% of which were of bovine origin. More over the dairy sector is contributing by 11% of the value of agricultural production , 25% of the value of animal production and 7% of the value of the agri-food industry.This is the result of the given government encouragement to the sector. However, the sector remains very vulnerable. Knowing that 70% of herds are less than 3 female heads and 80% less than 5 heads and more over 59% of the livestock were off-land.

These small farmers when acting lonely face many marketing difficulties specially to collect information about both for up and downstream markets' prices, to negotiate with administration, sellers, buyers and financial institutions etc... Such situation will increase the transaction cost which leads to limit the farms' productivity. Since, belonging to a service cooperative is necessary. Cooperatives have been treated as a trading outlet for small household farmers due to the integrated service functions and internalized transaction (Hu et al.2004). In fact, there is growing pressure for farmers in developing countries to accelerate their efforts to commercialize production facing increasing market competition (Aubert, et al., 2004). The small scale trading amount of products and the poor organized situation also post farmers in a disadvantageous position when negotiating with their up and downstream partners (Song and Qi, 2011; Wang and Huo, 2014). Given the disadvantages of small scale farm characteristic and multiple marketing channels, choosing a proper trade channel can help growersreduce transactioncosts. Therefore, the growing gap between family farms and their upand downstream partners dictated an increasing need for inter-sectorial coordination within the agro-food sectors and thereby enhances the potential role that can be played by cooperatives. The purpose of cooperatives is to provide various services involving in production and sales process, to generate greater profits by obtaining input factors and services at lower price than the price which they would pay elsewhere, and also by marketing their products at better prices than the price which they would sell through other marketing channels.

Cooperatives are the appropriate vehicle to reduce transaction costs and to facilitate access of small-scale producers faced high transaction costs as reflected primarily in their low level of education, poor road and communication infrastructure, lack of market information, as well as long distance to markets to input and product markets (Ortmann and King, 2007).

Abdelhafidh et al. (2008) also highlight that farm household income can be raisedby reducing transaction cost such as investing in roads, an efficient legal system, farmer support services including input supply, marketing information, and extension, etc.

Regarding the previous literatures, questions related to that how much is the effect related to the magnitude of transaction costs among farms belonging or not to a cooperative is raised ?

As cooperatives being a connection between farmers and markets play an important role in agrofood market, we try to keep our methodology and calculation as straightforward and simple as possible in the comparison of transaction costs on this specific market outlet between cooperatives members (CM) and non members (NM).

2. Analytical framework

2.1. Transactions costs

Transaction costs are simply the costs of carrying out any exchange, whether between firms in a marketplace or a transfer of resources between stages in a vertically integrated firm (Hobbs,1996)

Transaction costs refer to those costs that arise when individuals exchange ownership rights to economic assets and enforce their exclusive rights. Holloway et al. (2000) define transaction costs as 'the costs of searching for partner (or group) with whom to exchange, screening potential partners to ascertain their trustworthiness, bargaining with potential partners (and officials) to reach an agreement, transferring the products, monitoring the agreement to see that its conditions are fulfilled, and enforcing the exchange agreement. (Bhim Adhikari, Jon C. Lovett, 2005).

Transaction cost economics (TCE) is most commonly associated with the work of Oliver Williamson. Rooted in the economic theory, TCE theoretically explains why a transaction subject favours a particular form of transaction over others. The basic principle of TCE is that people like to conduct transactions in the most economic way. Williamson assumed that firms pursued profit maximization, and that profit maximization required costs minimization. TCE is an equilibrium theory that assumes rationality on the part of owners and/or managers.

(Thompson S.H. Teo, YuanyouYu, 2005).

It is useful to divide transaction costs into three main classifications: information costs, negotiation costs, and monitoring (or enforcement) costs. Firms and individuals face costs in the search for information about products, prices, inputs and buyers or sellers. Negotiation costs arise from the physical act of the transaction, such as negotiating and writing contracts (costs in terms of managerial expertise, the hiring of lawyers, etc.), or paying for the services of an intermediary to the transaction (such as an auctioneer or a broker). Monitoring or enforcement costs arise after an exchange has been negotiated. This may involve monitoring the quality of goods from a supplier or monitoring the behaviour of a supplier or buyer to ensure that all the preagreed terms of the transaction are met (Hobbs, 1996).

Under some circumstances, transaction cost may be lower if the transaction takes place in an open market (market), while under other situations, transaction cost will be lower if managers coordinate the transaction (hierarchy). There are two assumptions underlying the choice between market and hierarchy. They are bounded rationality and opportunism.

Bounded rationality refers to the fact that people have limited memories and limited cognitive processing power. People cannot digest all the information they have and they cannot accurately work out the consequences of the information.

Opportunism refers to the possibility that people will act in their own self interest. That is, some people may not be entirely honest and truthful about their intentions some of the time, or they may attempt to make use of unexpected circumstances that gives them the chance to make the most off another party in a transaction.

The real illuminating power of TCE comes from the four dimensions or variables that are employed to characterize any transaction. They are frequency, uncertainty, concentration and asset specificity. Transactions can be rare or frequent; have low or high uncertainty; or involve specific or non-specific assets. (Thompson S.H. Teo.,YuanyouYu, 2005).

2.2. Efficiency

This paper will use parametric approaches to estimate efficiency of off-land dairy farms production in the governorate of Mahdia in Tunisia during 2014. The former is based on stochastic frontier production function (SFPF) technique.

The parametric approach in this paper is adopted from Kopp and Diewert (1982)'s cost decomposition procedure to estimate technical, allocative, and economic efficiency measures. In general, the technology of a decision-making unit (DMU) i (e.g., a firm, a sector, or a province) represented by a stochastic production frontier can be expressed as follows:

$$Yi = f(X_i; \beta)+\varepsilon_i , \qquad (i=1, 2, \ldots, N) \qquad (1)$$

Where Y_i denotes the outputs of the i^{th} DMU; $X_i=(xi1,x_{i2}.....x_{iP})$ is a vector of functionsof actual input quantities used by the i^{th}DMU; β is a vector of parameters to beestimated; ε_i is the composite error term; and K is the number of DMUs.
In Aigner et al. (1977) and Meeusen and Van den Broeck (1977), ε_i is defined as follows.

$$\varepsilon_i = V_i - U_i, \qquad (i=1, 2, \ldots, K) \qquad (2)$$

Where V_is are assumed to be independently and identically distributed (i.i.d) randomerrors under distribution $N(0, \sigma_i^2)$, and they are independent of the U_is;and U_is are nonnegative random errors, which are associated with technical inefficiency in production, and assumed to be (i.i.d) and truncated (at zero) under normal distribution with mean μ ,and variance $\sigma_u^2(|N(\mu, \sigma_u^2|)$.
The maximum likelihood estimation for equation (1) provides estimators for β and variance parameters,

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \text{ , as well as } \gamma = \frac{\sigma_u^2}{\sigma^2}$$

Battese and Coelli (1995) proposed an extension and Model (1) can be expressed as:

$$Y_i = f(X_i,\beta)\exp(V_i - U_i)$$

The TE can be measured as the ratio of actual output observed (Equation 3) to that expected maximum level from the use of available inputs.

$$TE = \frac{Y_i Observed}{Y_i max} = \frac{f(Xi,\beta)\exp(Vi-Ui)}{f(Xi,\beta)\exp(Vi)} \qquad (4)$$

3. Data and methodology

3.1. study area

In this paper data were collected in the governorate of Mahdia in east centre of Tunisia.It is characterized by the weakness and the irregularity of the precipitations (the annual average is 270mm), the scarcity and salinity of water resources. This greatly limits the possibilities of irrigation.Local agriculture is of the family type. It is practicedin small production units. Indeed,95% of farms' sizesdo not exceedthe 10ha. Main agricultural activities are olive trees which occupy 52% of the agricultural area, followed by cereals (22%). Vegetable crops and fodderare present especially in farms with irrigation water. Sheep, the main animal activitypracticed before, have considerably lost importancefollowing the reduction of grazing land. They are replaced by off-land dairy cattle. The cattle herd in the governorate of Mahdia account about 32000 heads, of which 23450 are females. These herds were appropriated by 7164 breeders. Most farms have small herds, 86% less than 5 heads and 94% less than 10heads.
In Mahdia there are 24 milk collection centres: 10 private centres and 14 centres belong to the service cooperative of El Jem. The cooperative members are of 6333.

3.2. Methodology

To estimate transaction costs faced by producers marketing through the milk marketInterviews and surveys were conducted through 71 farms 41 of which are members of the cooperative. At first stage we calculated the cost price which is equal the sum of the expenses corresponding to the final stage including distribution costs, second we estimated the transaction. The marketing of agricultural and livestock products can not be done without costs. In fact, the prices collected by farmers are different from the prices observed on the market. This is mainly due to the existence of transaction costs that are generally unobserved. However the costs of unobserved transactions can be expressed by proxies

(means of transport, information, distance, quantity sold ...). Transaction costs differ from one farmer to another depending on the characteristics and heritage of each farmer (Makhura, 2001).
The two distinct transactional mechanisms are defined as:
1) The cooperative transaction mechanism which grower participates in cooperatives andtrades products in large quantity through cooperatives;
2) The non-cooperative transaction mechanism which grower trades products in largequantity through other marketing outlets (i.e., retailers, wholesalers, agents, middlemen, processing firms, etc.) except cooperatives.
Note that a few of their products can be also sold through cooperatives only those products achieve the basic quality requirement of cooperatives.
For the purpose of comparing the magnitude of transaction costs of both transaction mechanisms under consideration, a description of the determinants and measurement of transaction costs are promoted. The transaction costs are categorized into information cost (IC), negotiation cost (NC), Execution and enforcement cost (EC) and transportation cost (TRC). In each category, we apply several concrete explanatory variables concluded from questionnaire to calculate the magnitude of the transaction cost.
In the next step we calculated the technical efficiency scores using the Frontier 4.1 soft ware. Under the parametric approach, we will use the Cobb-Douglas stochastic production frontier to estimate efficiency levels for the dairy activity in in Mahdia. The production function is generally specified as follows:

$$Ln(Yi) = \beta 0 + \beta 1 \ln(ALi) + \beta 2 \ln(TRAi) + \beta 3 \ln(FEEi) + \beta 5 \ln(FVIi) + \varepsilon i \quad (5)$$

Where:
Y_i : is output value;
The inputs used by every farm i are : Al_i : cost of livestock feeds; TRA_i: labor cost; FEE_i: Cost of energy; FVI_i : Veterinary cost; β0,.... β5 : parameters to be estimated andε_i is the composite error term, which was defined previously.
In a final stage the obtained Technical efficiency scores were regressed by explanatory variables corresponding to transaction costs, to the membership of the cooperative and to farms' specific factors which can affect their productivity using the tobit model.

4. Results and discussion

4.1. The cost price

In purpose to analyse the effect of the herd size the sample is divided into three groups: small size (herd size ≤ 5 heads), medium size (5 < herd size ≤10 heads) and large size (herd size> 15 heads).
Since we observethat within the cooperative members, 48% are of small size farm, 35% of medium size and 17% are of large size while within the non cooperative members, 60% are of small, 30% of medium size and 10% are of large size. The results are presented in table2.

Table 1. cost price/group (TD/Liter)

Groups	Small scale size	Medium scale size	Large scale size
Cooperative members	0.673	0.540	0.504
Non cooperative members	0.753	0.627	0.557

The results show that farms with large size are more competitive than the smaller both for the members and non members of the cooperative. Also, the cost price is higher for the non-cooperative members. This proves the impact of the support provided by the cooperative to breeders which lead to lower cost price.

4.2. The transactions costs (TC)

Belonging to the cooperative can reduce the uncertainty and improve the information. Price and product quality information and sales opportunities and trends play an important role in influencing the other party.The components of TC are presented in table 2.

Table 2. Transaction costs components

Variables	Cooperative members (CM)	Non cooperative members (NM)	TC
• Regular suppliers :			
Yes	73%	40%	
No	27%	60%	
• regular customers			
Yes	100%	53%	
No	0%	47%	
• information collection on market's price by :			IC
- moving to the market (time spent ant costs)	24,3%	63%	
- phone	4.8%	13.3%	
- from other breeders	0%	23.3%	
-from cooperative	70,7%	0%	
• Number of visit to market/month	1.6	2.7	
• Number of market days to have a certain information /month	1.2	3.6	
• Number of suppliers/month	1.6	3.5	
• Number of customers/month	1	3.1	
• Negotiation time when buying	1.36	4.32	NC
• Negotiation time when selling	0	1.45	
• number of times of change of sale's places/year	0.33	2.6	
• number of times of no payment when selling milk			
1 time	0%	15%	
2times	0%	10%	
3times	0%	6%	
	31.7%	43.3%	
• complaint about price fluctuations of livestock feed	0%	27%	EC
• complaint about late payement	2.4	4.5	
• Number of milk refusals / year	87	200	
• loss due to milk refusal /TD/ year			
• Average travel cost to the point of purchase (TD/ month)	10.1	18.3	
• Average Travel cost to the point of sale(TD/ month)	0	34.4	
• Total travel time (H / month)	1.15	13.53	TRC

The table 2 shows that 73% of the cooperative members have regular suppliers against only 40% for the non members, And the 100% of the members have regular customers against 53% of non members farmers, this implies that, the non members farmers spent more time to find their partners in the market which is costly. On the other hand, 70.7% of the cooperative members have the market's price information given by the cooperative while the non members collected the information by moving to the marker (63%) or by phone (13.3%) and from neighbours breeders (23.3%). The number of visit to the market to have certain information is greater in the non members group which is 3.6 against 1.2 market days in the cooperative members' group. The cooperative gives its members all information about market prices, quality of inputs and market opportunities while the non members spent much time to find the good partners the good place to sell their productions which reduce the trust and increase uncertainty about the transaction. More over the information cost is majored by the transportation cost. With regard to the subscribing farmers who are provisioned to the cooperative, which reduces the loss of time for finding a new supplier. We also note that they sell all of their productions to the cooperative. Since the collection trucks recover production from these breeders, this reduces the total cost of transport, which is reduced to an average of 10TD / month.

On the other hand, the multitude of places of purchase of cattle feed and of places of sale of milk for 70% of the non-adhering producers generates additional costs of transport, which is estimated at 52TD/ month. To these costs are added the opportunity costs of travel time for finding partners.

Negotiation cost

The second component of the transaction cost is the negotiation cost. It is measured by the followed indicators: The number of suppliers from which the member farmers can buy is an average of 1.6 people, of course the main customer is the cooperative, while, non-adherent farmers report that the average number of suppliers is 3.5 and an average of 3.1 customers/month. These breeders change places of sale 2.6 times a year; they have justified their behaviour by: either a disagreement over the payment of milk, or a disagreement between people. In any case, a change of place of sale involves the search costs of another partner. In general, producers contact two or three customers, by telephone or by moving, to compare the benefits and make their choice, which results in additional bargaining costs.

Enforcement cost

Execution costs appear after completion of the purchase or sale transaction. They include the costs of verifying and enforcing the terms of the agreement such as product compliance in quantity and quality. Thus the mode and deadlines for payment and agreed prices. Other transportation costs, commissions, taxes, losses incurred by refusal and non-compliance of products. Table 2 also shows that 36% of non-adherent farmers may not be paid by their customers at least once time, 16% for two times and 6% for three times , while the membership in the cooperative may reduce the costs of the risk of insolvency of customers.

For cooperative farmers, 15% of which are not paid for once time, 10% for two times and 6% for three times which is a lot when compared to the cooperative members where they are fully paid.

Results chow too, the costs generated by the obligation to apply the terms of agreements between breeders and their customers or suppliers. According to Table 2, the complaints of 31% of the members relate to the prices of livestock feed. 12% complain of delay in milk collection which can lead to losses during warm periods. While 43% of non-ranchers suffer from higher livestock feed prices, 26.7% complain of late payment and 30% complain of delayed milk collection by private centres. The result of the violation of the terms of the contracts is that the farmer will suffer loss of time and sometimes additional travel expenses for the restitution, achievement or renegotiation of the agreements. These procedures actually increase the costs of applications and subsequently the transaction costs which decreases the profit of the farmers.

We also note that the cost of refusal of milk due to non-compliance with the quality standard is of the order 87TD / year for members, against 199 TD / year for non-members. Indeed, thanks to the daily control and the supervision provided by the technicians of the cooperative, the members are more attentive to the quality of the milk. Hence, being a member in cooperative can largely lower the risk and simultaneously reduce or avoid the loss of arrangement termination.

4.3. The technical efficiency

We used the Cobb-Douglas form function to estimate the production frontier using. We use the computer program FRONTIER Version 4.1 (Coelli, 1996) for our estimation. The maximum-likelihood (ML) estimates of the parameters for the stochastic production frontier obtained from the program are presented in table 3

Table 3. The estimation results of the maximum likelihood of the modelproduction stochastic frontier with technical inefficiency

variables	Parameters	coefficients	t-ratio
constant	B_0	3,248***	3,644
TRA	B_1	0,048	1,135
AL	B_2	0,577***	5,007
FVI	B_3	0,050*	1,569
FEE	B_4	0,113**	2,659
Sigma squared	σ^2	0,695	0,235
gamma	γ	0,99***	6,266

* significant at 10% ** significant at 5% ***significant at 1%

As expected, the signs of the slope coefficients of the stochastic production frontier are positive and significant indicating that all production elasticises of all inputs are positive. The estimate of the variance parameter, γ is also positive and significantly different from zero, implying that the inefficiency effects

are significant in determining the level and the variability of output. The elasticity of the feed is the most important (0.577), followed by the elasticity of energy with value of 0.113.The estimation results of the technical efficiency scores are presented in table 4

Table 4: Frequency Distribution of Production Technical Efficiency (TE)

	CM		NM	
TE	N	%	N	%
TE ≤0,60	0	0	6	20%
0,60 <TE ≤0,80	13	31 ,70%	14	46,66%
TE>0,80	28	68,29%	10	33,33%
Mean		0,88	0,76	
Min		0,72	0,54	
Max		0,98	0,85	

The average value of technical efficiency for the member farmers is strictly higher than that of all non-member farms, ie 88% against 76%. This means that the cooperative members can reduce their costs by 12% and the non-members can reduce their costs by 24%. It is noted that there are no adherent breeders with a level of efficiency lower than 60% against a minimum of 54% for non-members. Only 46.66% of the non-members farmers which have a technical efficiency higher than 0.8 while there are 68.3% of the cooperative member having a technical efficiency more than 0.8. These results show, the effect of the cooperative membership on the improvement of technical efficiency.

4.4. factors affecting technical efficiency

Previously released results indicate that there is still significant potential for improving the technical efficiency of dairy cattle operations, so transaction cost variables were chosen to demonstrate to what extent this cost has an effect on efficiency.

Given the truncated efficiency scores that take values between 0 and 1, Tobit model was used to analyse the relationship between the firm specific attributes , transaction cost and belonging to the cooperative as explanatory variables and the technical efficiency scores as a dependant variable. The results are presented in the table 5.

Since the technical efficiency can be written as follow:

$$TEi = \alpha_0 + \alpha_1 Zi_1 + \alpha_2 Zi_2 + \alpha_3 Zi_3 + \alpha_4 Zi_4 + \alpha_5 Zi_5 + \alpha_6 Z_{i6} + \alpha_7 Z_{i7} + \alpha_8 Z_{i8} + \alpha_6 Z_{i6} + \varepsilon_i \quad (6)$$

Previous studies have found that the herd size is positively related to efficiency (for example, see Bailey et al. 1989; Bravo-Ureta and Rieger 1991; and Tauer 2001. This study finds the same relationship but it is not significant .

Education is measured through the use of dummy variable of those who have the elementary school and a higher degree versus those who have not. As expected, education is positively associated with efficiency, but it is statistically insignificant.

The Tobit model estimation revealed that technical efficiency was positively and significantly influenced by the cooperative membership. Belonging to the cooperative and can improve TE by 6.5%. The importance of membership in farmer organizations was also reported by (Abdelhafidh and Bachta,2017; Tchale, 2009 and Idiong, 2007). Collectively they observed that farmers who are members in producer organizations are able to benefit not only from the shared knowledge among themselves with respect to modern farming methods, but also from economies of scale in accessing input markets as a group. Hence, such farmers become more technically efficient in production.

Table 5. Maximum-likelihood estimates of variables associated with technical efficiency

Variables	Description	coefficients	t-test
Constant		0,922	16,04
Zi1 :Size of the herd	Number of cows	0,004	0,03
Zi2 : Education level	1:if education level is secondary or higher; 0 : otherwise.	0,007	0,52
Zi3 :Cooperative membership	1 : if farmers is a member of the cooperative ; 0 : if not	0,065**	2,73
Zi4: Spent time to research information	Time in days	-0,006**	-2,57
Zi5 :Negociation time	Time in days	-0,004	-1,19
Zi6 :Transportation cost	Transportation expenses (TD)	-0,008***	-5,17
Zi7 :Regular suppliers	1 : if farmers has regular supplier,0 otherwise	0,023*	1,74
Zi8 :Excecution Cost	Loss due to refusal (TD)	-0,005**	-2,37
Loglikelihood		111	-
LR chi2(8)	138		

* significant at 10% ** significant at 5% ***significant at 1%

Technical efficiency was further negatively influenced by transaction cost. Since the coefficients of spent time to research information, negotiation time, transportation cost and execution cost are negative. The value of regular suppliers also showed a positive effect on technical efficiency as hypothesised and was significant at 10% level. This implies that this variable can reduce the transaction cost and consequently improve the technical efficiency.

5. Conclusion

The main objective dealt with in this study was to determine the influence of the transaction cost and the role of the cooperative membership on the productivity among the dairy farms in Mahdia. It was established that dairy productivity was significantly influenced by transaction cost. The productivity also was influenced positively by the size of herds and the education level. Further results revealed farmer membership of the cooperative was more technically efficient than the non member one. This finding revealed too, the important role played by the cooperative. Our investigation indicates that on average the cooperative transaction mechanism lead to a reduction of breeders transaction costs compared with non-cooperative transaction mechanism.

The results in the study imply several policy recommendations. Cooperatives should upgrade their service ability to provide latest market information to reduce the information cost. Policies and regulations considerations of the government should foster an environment conducive to support the development of cooperatives and encourages farmers to join them.

On the whole, our transaction cost framework appears to provide a useful explanation of the advantages of cooperative transaction mechanism; however it is by no means a complete explanation. Many of external variables are also associated, such as the effect caused by unpredictable environmental conditions, geographical and socio-economic factors.

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