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REGULAR ARTICLE

THE SOCIOECONOMIC DETERMINANTS OF ASSET CONTROL CHOICES IN ALGERIAN AGRICULTURE

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ABSTRACT

This study aims to investigate the effect of main socioeconomic factors of technology adoption, with special reference to the role of assets specificity in farm management. The contribution of this study is largely empirical by testing some hypotheses in Algerian context. We investigate the determinants of technology asset control choices in the agricultural production in order to conclude on the constraints of farm extent and its implications for farm management and economic efficiency. Our main results assert that the technology asset control choice is determined by the farm size, organizational form, human capital, social status, and geographical location. These findings corroborate the existing theories and generate some empirical implications, leading to propose some directions for future research.

Keywords: Technology adoption, asset control, asset specificity, farm management, Algeria
JEL: D02, D22, Q15, Q16

INTRODUCTION

This paper draws upon the relevant lessons from some evidence on the institutional structure of the agricultural production in developing countries. We have underlined obviously the quasi-absence of studies that shed light on the agricultural organization and technology adoption in Algeria. In this research, we investigate the role of assets specificity in farm management. By identifying conditions in which forces shaping contractual arrangements vary, we derive some hypotheses about the socioeconomic determinants of technology adoption. To test these hypotheses, we'll use modern conceptual advances in order to explain how farming systems perform in developing countries and analyse socioeconomic determinants of the contractual arrangements in farming activities. Data used for this study are derived from a Regional Sample Survey provided by the National Research Program on Farming and Agricultural Cooperatives (2012-2015). The data were collected through detailed interviews realized across a sample of farmers. We aimed to develop a questionnaire, which was adapted to the farmers. These interviews were undertaken to capture several agricultural producers' characteristics (farming activities, economic and social environments) and the data represented by a matrix, which contains qualitative and quantitative variables. Therefore, we have chosen the adequate econometric model.

Despite the multitude of theoretical frameworks recently elaborated for the analysis of the extent of the farm, the new institutional economics provides helpful analytical tools to examine the farmer's behaviour and choices, in different institutional environments. Therefore, we refer by here to the transaction costs theory (TCT). This approach has been largely applied in economic organization of agricultural practices in the last three decades. The TCT offers an advanced conceptual framework to explain the different features of contractual arrangements in agriculture (**Allen and Lueck, 1993, 2001, 2005; Roumasset, 1997; Baerenklau and Knapp, 2007; Chavas, 2008; Cook et al., 2008**). It advances that the organization of farm production is largely determined by the efforts made to economize on transaction costs. Besides, the TCT focuses essentially on the different issues of asset specificity, like site, physical, and human capital. As stated by **Allen and Lueck (2001)**, farming can hardly be characterized as a production process laced with specific assets. When considering the performance considerations in the farm management, more attention should be called to the aspects of asset specificity, in other words, the vertical integration issues. The main idea of this research asserts that these aspects are determined by economic considerations as farm size, organizational choice and non-economic factors as human capital, social status, and geographical location.

The modern theoretical framework, and more particularly the TCT, suggests that the firm's technology adoption is influenced by some kinds of asset specificity, such as site specificity and physical asset specificity (**Williamson, 1988**). As a result, larger farms may also be located in areas with better information sources or with growing conditions, which are more favourable for more performances.

The modern studies in the last decades are mostly insisting on the dichotomy of the binary choice, i.e., adopt or not adopt a technology. Recently, more attention is given for the accurate treatment of the adoption case. Therefore, on how technology is adopted, i.e., explaining differences in asset control arrangements and its relative performances, which is our focus in this research. Asset control refers, by here, to the irrigation assets and machinery assets. Assets control forms are between ownership and a simple contracting. Hence, the assets' control is strongly affected by particular economic and non-economic factors. In terms of asset control, we use the irrigation asset and machinery asset adoption as proxies. Our choice is explained by the fact that that irrigation and machinery assets are, in many cases, transaction-specific assets involved in a farmland contracts (**Allen and Lueck, 2001, 2005**).

The objective of our study was to confirm that the technology assets control forms are strongly affected by particular socioeconomic factors such as: farm size, organizational form, human capital, social status, and regional location. These findings corroborate partially the existing theories and enable us to deduce some empirical implications.

MATERIAL AND METHODS

In this study, we use farm-level data to test our hypotheses. The data from the Regional Sample Survey is realized on a random sample of local farm operators from Northern Algeria, through detailed interviews realized across 660 farmers. Table 1 provides variables definitions and summary statistics for the variables we used in this study.

In order to examine the relationship between technology adoption and some factors, we used the Logit model to generate maximum likelihood estimates of the model for a farm sample. This is viewed as an econometric advantage with respect to the binary nature of variables. We used the following empirical specification, where for any farm i the complete model is:

$$P(Y_i = 1|\boldsymbol{X}) = \Gamma\ (\alpha\boldsymbol{X})\ =\ [\ e^{\alpha\boldsymbol{X}}\ /\ (1\ +\ e^{\alpha\boldsymbol{X}})\ ] \qquad (1)$$

where Y_i is the observed dichotomous choice of the technology adoption, $\boldsymbol{X}$ is a row vector of exogenous variables, α_i is a column vector of unknown coefficients, and $\Gamma(.)$ represents the logistic cumulative distribution function.

The independent variable Y_i reflects the asset control choice. Subsequently, we have two Logit estimation models of technology adoption. The first model concerns a dummy variable of irrigation technology adoption (*IRRIG*). It takes the value of 1 if the farmer owns well drilling irrigation technology system and 0 if he contracts for the irrigation water provision. The empirical specification is:

$$IRRIG\ _i = \alpha_i\boldsymbol{X_i} + \boldsymbol{\varepsilon_i} \qquad (2)$$

where and ε_i is a farm-specific error term. The second model is related to a dummy variable of machinery ownership (*MACHIN*). It takes the value of 1 if the farmer owns hard machines (such as combines, harvesters, tractors, etc.) and 0 he contracts for machine use. The empirical specification is as follows:

$$MACHIN_i = \alpha_i\boldsymbol{X_i} + \boldsymbol{\varepsilon_i} \qquad (3)$$

The model estimation is shown in Table 2. We turn now to the row vector of exogenous variables X_i. In order to reflect the farm size, we used the effectively cultivated farmland (*FARM_SIZE*), which is equal to the farmland area in hectares. The organizational choice is represented as following: a dummy variable of family farm (*FAMILY*) as a farm organization choice. It takes the value of 1 if the organization choice is owner-operator family farm and 0 otherwise, and a dummy variable of partnership forms (*PARTNER*) as a farm organization choice. It takes the value of 1 if the organization choice is leased or sharecropped farm operator, and 0 otherwise. The other block of variables reflects some farmer's characteristics, as the farmer's age (*AGE*) in the number of years, a variable of the farmer's education (*EDUCAT*) in number of years of formal schooling level, another dummy for the marital status (*MARITAL*) taking the value of 1 if the farmer is married and 0 otherwise, and another variable of farmer's household size (*HOUSEH*) in number of his own family members. In our set of exogenous variables, we include also the regional dummies captured by design variable for the north of the country (*EAST*, *WEST*, and *CENTRE*).

RESULTS AND DISCUSSION

The Table 1 presents a summary of descriptive statistics of a farm data from our regional sample survey. In terms of the ownership of irrigation technology, 32% have their own well drilling (water well) and the associated irrigation technique, since 68% use different contractual arrangements to obtain farm water (by contracting with neighbour farms or direct spot market or collective management of water distribution). The second independent variable, the ownership of machinery, it seems that 22% of the farmers own technological and physical capital as tractors and hard machinery, while the rest (78%) contracts machinery acquisition by different range of contracts (mainly lease contract).

The mean of the farm size land is 7.33 hectares, with a standard deviation of 16.31. In our context, the family farms represent 64% as a dominant organizational form, since the partnership forms are present with 36%. The mean age of a farmer is around 52 years old, which reflects the fact that the representative farmer is an old man (the minimum value is 18 years old but the mode and the median are respectively 57 and 60 years old). It seems that young entrepreneurship in farming is less present in the Algerian agriculture. The human capital dummy, represented by the formal education, farmers has an average of 7 years of schooling. The portion of married farmers represents an average of 69% and the average of farmer's household size is about 6 individuals in his family. The regional location in our sample shows homogeneous proportions on each region, 35% from the East, 32% from the West, and 33% from the Centre of the Northern Algeria.

Table 2 shows the maximum likelihood estimates of the Logit model of technology adoption from the regional sample survey in the Algerian agriculture.

Table 1. Summary of descriptive statistics for farm data from the Regional Sample Survey in Algerian agriculture

Variables	Definition	Mean	S.D
IRRIG	1 if farmer own irrigation technology, 0 if contract.	0.32	0.27
MACHIN	1 if farmer own machinery technology, 0 if contract.	0.22	0.47
FARM_SIZE	The farmland area in hectares	7.33	16.31
FAMILY	1 if the farmer operates on familial farm; 0 otherwise	0.64	0.23
PARTNERSHIP	1 if the farmer operates by leasing farm; 0 otherwise	0.36	0.53
AGE	The age of the farmer in years	52.40	74.50
EDUCAT	The formal education level in years	7.28	9.20
MARITAL	1 if the farmer is married; 0 if he is single	0.69	0.45
HOUSEH	The household size of farmer's family	6.26	37.19
EAST	1 if the farm is located in Northeast; 0 otherwise	0.35	0.23
WEST	1 if the farm is located in Northwest; 0 otherwise	0.32	0.22
CENTRE	1 if the farm is located in North-middle; 0 otherwise	0.33	0.21

Table 2. The Econometric Modelling Estimates for Technology Adoption from the Regional Sample Survey

Variables	Logit Estimation of Irrigation Technology (*IRRIG*)	Logit Estimation of Machinery Adoption (*MACHIN*)
FARM_SIZE	1.534 ***	1.009 ***
	(3.366)	(4.064)
FAMILY	-0.289	3.142 ***
	(-0.246)	(9.321)
PARTNERSHIP	3.791 ***	-3.003 ***
	(2.648)	(-6.637)
AGE	1.597 **	0.283 *
	(2.403)	(1.893)
EDUCATION	0.523 ***	0.451 ***
	(2.831)	(3.245)
MARITAL	0.001	0.014 ***
	(0.064)	(2.811)
HOUSEHOLD	2.307 ***	1.606 ***
	(6.097)	(9.510)
EAST	1.999	2.834 ***
	(1.484)	(8.769)
WEST	3.265 **	2.989 ***
	(2.167)	(8.300)
CENTRE	3.661 ***	2.700 ***
	(2.678)	(8.228)
Correctly Predicted	72.2%	65.7%
McFadden R-squared	0.262	0.215
Log-Likelihood	-837.21	-965.73
Likelihood Ratio Test: $\chi^2(9)$	198.34 [0.0000]	253.28 [0.0000]

Note: The values of the (asymptotic for Logit equation) z-statistics are in parentheses. Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level, no asterix: not significant.

Each observation is a single plot of land that operates by the farmer through one of the common forms of farm organization. The first column indicates the exogenous variables. The two others represent the dependent dummies used as response variables through the binary Logit estimation.

The first model uses the dependent variable IRRIG, and the second uses MACHIN. It seems that the two models have high correctly predicted cases, respectively 72.2%, and 65.7%. They show a very significant correlation through the McFadden R-squared coefficients respectively 0.26, and 0.21 and a highly significant level for the likelihood ratio test.

We discuss here some implications derived from the modelling of asset control determinants. The costs of contracting and ownership are determined by specific factors as farm size, organizational form, human capital, social status, and regional location. In many cases, irrigation assets are transaction-specific assets involved in a farmland contract (**Allen and Lueck, 2001**). According to the estimates from the Table 2, it seems that the age as a proxy of farmer's experience has positive effects on asset specificity. Besides, the schooling has a strong positive effect on asset specificity.

From the data we examine, the choice of machinery asset control forms is between ownership and a simple contracting. In terms of technology adoption, our model implies that the farm size has a positive effect on the technology adoption. In other words, an increase in farm size will increase the probability of holding assets. It seems also that the age and the formal education, playing the role of proxies of the farmer's experience and the human capital, have strong positive effects.

Furthermore, organizational forms exercise also a strong effect. The family form is less likely to own irrigation technology, since partnerships are. On the other hand, partnerships are less likely to adopt machinery asset control by the direct acquisition (ownership), when family farms are. Finally, it has found that regional differences show a very significant effect on the both assets control of technology. The major findings of study corroborate the findings of most of recent empirical research as **Negri and Books (1990); Panin (1995); Allen and Lueck (2001); Carey and Zilberman (2002); Koundouri et al. (2006); Uaiene et al. (2009); Chavas and DiFalco (2012); Nakano and Kajisa (2013); Odozi and Omonona (2013); Benmehaia et al. (2016); Zongo et al. (2015)**.

CONCLUSION

Based on the suggested empirical evidences, some recommendations are proposed to promote further reflections on the farmer's choices in our context. From our study, we can assert that the farm organizational forms do matter for the policy making to include the main institutional constraints that enhance efficiency in the agricultural sector. The farmer's human capital needs to be given attention, because entrepreneurship plays an important role in agriculture in term of knowledge transfer process and technological improvements. Attention should be given also to the regional differences regarding the agricultural vocation and potentialities of the regions. A more accurate study of the common forms of farm organization will emphasize on the famer's behaviour according to the geographical locations.

The analysis in this paper, which is framed in an empirical framework, suffers of some limitations. Although we performed several robustness tests to corroborate our findings, the employment of data collected and proxies make our results subject to several important restrictions. First, a theoretical framework is strongly needed to support our empirical findings. Second, we believe that many further socioeconomic factors should be considered in the subject. Finally, there are also some potential important limitations due to the data, which may affect our measurements. At a more general level, some efforts remain to be sustained in order to understand the asset control forms. However, more deep treatment of farm integration trends is needed to properly address other issues.

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