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LEAVING LAND FALLOW –
THE CASE OF SUBSISTENCE FARMING IN THE WESTERN BALKANS

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LEAVING LAND FALLOW – THE CASE OF SUBSISTENCE FARMING IN THE WESTERN BALKANS

Abstract
The key question of this paper is why farmers in Kosovo leave land fallow when the total land of their farms is rather small and households are rather large. In order to elicit some barriers to land utilisation in Kosovo, the paper is based on a comprehensive survey investigating agricultural households' perceptions of production and market conditions, and employs several households and farm characteristics to empirically approximate the significance of different factors for leaving land fallow and not using it for production purposes. Three different models have been estimated. All estimated model specifications show a statistical significance at a satisfactory level and no severe signs of misspecification. One of the main factors farmers stated for their decision to leave land fallow was the low profitability of farming. The increase in incentives to farmers by improving market institutions up- and downstream is one measure which could alleviate the barriers to land use. Larger arable areas decrease the probability for fallow land. This emphasises the need for land consolidation.

Keywords: fallow land decision, Kosovo, Tobit regression, Fractional response regression, Zero-inflated binomial regression

1 Introduction

Western Balkans incorporates several potential EU candidate countries.[1] They are more underdeveloped and poorer in comparison to the two most recent EU Member States from the Balkans – Bulgaria and Romania. In agriculture, structural differences prevail between these countries and EU8+2 (the New EU Member States from Central and Eastern Europe). Despite some reforms in the agricultural sector, interrupted by military conflicts, subsistence and semi-subsistence farming prevails in Western Balkans. In their Progress reports on the potential candidate countries of November 2008, the Commission of the European Communities underlined the structural weaknesses, land fragmentation and the low level of technical education of farmers as impediments to competitive agriculture (CEC, 2008). Moreover, the Progress report on Kosovo concluded that farms are too small and lack modern technologies to compete even on the domestic market. This creates an interesting research and policy problem, namely to see how this unfavourable farm structure and lack of modern technologies impact farmers decisions for land utilisation and production of food. Although in this paper the case study country is only Kosovo, the study can shed light on the main barriers faced by farmers in the potential EU candidate countries to use their small land plots and produce food for subsistence and/or market. Thus, the key question of the paper is why farmers leave land fallow when the total land of their farms is rather small and households are rather large. It has to be noted that land has not been left fallow for the sake of long-term improvements of fertility or other agri-environmental reasons. Kosovo farmers would like to cultivate it and generate incomes but seem to be constrained by underdeveloped markets and market institutions. Also, labour force in Kosovo is in relatively good health and they do not face HIV/AIDS epidemic that may potentially incapacitate family labour and decrease the ability to provide farming input.

In order to elicit some barriers to land utilisation in Kosovo, the paper is based on a comprehensive survey investigating agricultural households' perceptions of production and market conditions, and employs several households and farm characteristics to empirically

[1] The potential candidate countries are Albania, Bosnia and Herzegovina, Kosovo, Montenegro and Serbia.

approximate the significance of different factors for leaving land fallow and not using it for production purposes.

The paper is structured as follows. The next section includes a brief overview of Kosovo agriculture and presents the data set used. The third section is devoted to modelling and analysis, whilst section four presents and discusses the results. The last section concludes and provides some directions for future research.

2 Sectoral Background and Data Set

Kosovo is a small country with total area of 1.1 million ha, out of which 53% is agricultural land. It has high density of population and as a result a small agricultural land area per inhabitant (0.24 ha) and small arable land per household (Riinvest, 2005). Eighty six percent of agricultural land is privately owned and is operated by family farms; the remaining is under the ownership of producer cooperatives (1%) and Socially-Owned Enterprises (13%) (UNMIK, 2003).

Agriculture accounts for 25% of GDP and between 25 and 35% of all employment (World Bank and SOK, 2007). Nearly 60% of total population lives in rural areas. GDP per capita is relatively low, EUR 1,200. According to the World Bank estimate (World Bank and SOK, 2007) the level of unemployment is around 30% of the labour force. Despite its typical rural character, the country is strongly dependent on imports of agricultural commodities and processed food. Lingard (2003) argues that one of the main reasons for this situation is that agriculture is stagnating as most of the farms produce for self-consumption only. Latruffe at al. (2008) indicate that on average the share of agricultural output sold is only 13.5%, whilst the share of output used for household consumption is 38.1%. They argue that the main barriers to commercialisation are the imperfections in land and labour markets.

Family (household) farms in Kosovo are small. The definition of 'small' varies according to different authors (Hazel et al., 2007). Some commentators argue that small are farms with less than 2 ha of arable area; others put an emphasis on factor and product market integration defining as 'small' farms that depend mainly on household labour and have as a primary goal the production for household consumption. In this paper, as the focus is on land utilisation, small is understood as measured in agricultural land. In the Kosovo Green Book (UNMIK 2003:8) it is argued that "most farms in Kosovo are run to provide subsistence for households that, more often than not, are extended families and comprise well over ten members. Individual farms are of widely differing sizes ranging from below 1 ha to over 25 ha. Average farm size is 2.2 ha divided into an average of eight plots. Eighty percent of farms are between 0.5 and 2 ha".

Similarly to Latruffe at al. (2008), the present study is based on the Agricultural Household Survey (2005) carried out by the Statistical Office of Kosovo (SOK) in November and December 2005.[2] The survey covers land farmed by agricultural households living and farming in rural areas[3]. The survey does not include land belonging to agricultural households in rural areas that are not farming or land belonging to agricultural households living in urban areas in Kosovo or abroad unless the land is rented out to rural farming households. Additionally, land belonging to co-operatives and socially-owned enterprises, thus not farmed by households, is not included in the survey. The applied definition of household is a union of persons that live together and pool their income. Kosovo still has the traditional large rural

[2] The survey benefitted from technical support of the project 'Agricultural Statistics and Policy Analysis Unit for Kosovo' (ASPAUK) funded by the EU EAR. One of the co-authors of this paper, S. Davidova, provided assistance to SOK for processing and interpreting the survey data.

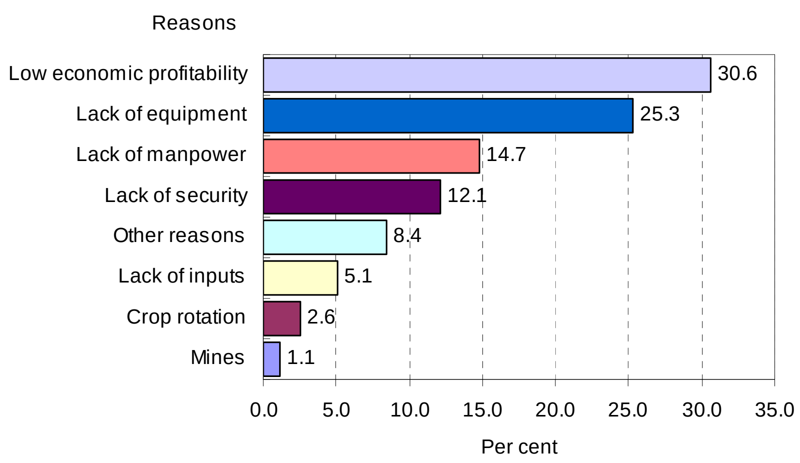
[3] At least one member of the agricultural household should be farming.

households where several generations live under the same roof, and share income and meals. Usually the decision-maker is the head of household.

The survey is based on a two-level stratified sample (SOK, 2006). The initial sample size comprised 4,446 agricultural households.[4] The first level of stratification is by region in order to obtain region estimates and to ensure full geographical coverage. The second level of stratification is by farm size to ensure representation of agricultural households. Once a village was chosen to be in the survey, the agricultural households in the village were stratified into three size categories (using land under cultivation as the value for stratification): 0-1.5 ha, 1.51-3.0 ha, and greater than 3 ha. After stratification, households were randomly selected for interviewing (SOK, 2006). To reduce the heterogeneity of the sample frame, and thus improve the estimates, all farms that were beyond the normal distribution, in terms of farm size or numbers of livestock, were identified and enumerated fully. These are referred to as 'large and specialised farms', and treated separately. They are not included in the present analysis.[5]

Land use was recorded plot by plot, including kitchen gardens. The survey also recorded plots left fallow and asked the respondents (usually the heads of household) to identify the reasons for the fallow land from a pre-determined list with an open option to specify a reason not included in the list. The responses concerning farmers' perception of barriers to cultivate all their land area are summarised in Chart 1.

Chart 1: Reasons indicated by the head of households for leaving land fallow



Source: SOK (2006)

For the present study, the survey data was cleaned and 2,010 usable records were analysed. Out of these 2,010 households, 322 had some land left fallow. The descriptive statistics of some variables used in the analysis are presented in Table 1.

Table 1: Descriptive statistics of household sample used

	Mean	Standard Deviation	Minimum	Maximum
Total arable area (ha)	1.41	2.41631	0	62.0
Share of area owned (%)	93.78	18.65784	0	100
Area under grains (ha)	0.94	2.09956	0	61.1

[4] The authors are grateful to Yann Desjeu who cleaned the initial Agricultural Household Survey dataset and reformatted some variables.

[5] For example, the threshold for large and specialised farms was 50 ha cereals, 10 ha potatoes, 4 ha vineyards, 3 ha field vegetables etc.

Area under fruit and vegetables (ha)	0.18	0.54677	0	11.2
Area under forage (ha)	1.01	1.28812	0	13.8
Share of land left fallow	0.06	0.16453	0	1.00
No of household members	9.37	5.46341	1	71
Share of output sold (%)	8.95	20.67182	0	100
Gross income (Euro)	1003	3053.66041	0	53550

The minimum size of zero concerning the arable land is due to the fact that some households may have other type of utilised land, for example orchards, vineyards or pastures, but those were classified in different categories. The sample used in the present study confirms what was previously mentioned, i.e. farms in Kosovo are small measured in land area, they are operated by large extended households (on average 9.4 members) and the share of output sold is small – around 9%.

Three different models were specified to estimate the decision to leave land fallow which are detailed in the next section.

3 Modelling and Analysis

To estimate the fallow decision different econometric modelling procedures were employed.

Endogeneity Problem

Some of the stated reasons by sample farmers might be endogenously determined by: the prevailing soil and environmental conditions; the location of the farm and the plots; the infrastructure; the socioeconomic characteristics of the farmer and the household; the social interaction with peer-group members and opinion leaders. Table 2 summarizes such potential exogenous determinants for the different stated factors:

Table 2: Exogenous determinants for the stated reasons to leave land fallow

Stated reason for the fallow share	Exogenous determinants (i.e. instruments)
crop rotation	soil type and quality, plot altitude, environmental factors as e.g. average precipitation
danger due to possible mines	location of the farm/plot: e.g. border region to Macedonia, border region to Serbia, border region to Albania, main municipality, located near major road axis
general insecurity	location of the farm/plot: e.g. border region to Macedonia, border region to Serbia, border region to Albania, main municipality, located near major road axis
other reasons	peer-group effects (proxy: average fallow share in village, average fallow share in municipality), transaction costs for input/output market participation

Dependent Variable

The dependent variable ‘fallow share’ reflects the share of the total amount of land per farm left fallow in the reference production year 2005/06. Hence, by definition, this variable is censored by 0 (i.e. total amount of land is cultivated) and 1 (i.e. total amount of land is left fallow). Further, as stated in the previous section, a considerable number of farmers in the data set cultivated all their land and consequently reported a zero fallow share. However, to avoid a likely selectivity bias with respect to estimation, the full sample was used and not just the sub-sample of farms who left some of their land fallow.

Model 1 - Instrumental Variable Tobit Regression

To take into account the possible endogeneity problems with respect to some of the stated reasons for the fallow decision, an instrumental variable Tobit regression is used (see Greene, 2003 or Maddala, 1991). Formally,

$$y_{1i}^{*} = y_{2i}\beta + x_{1i}\gamma + u_i \quad [1]$$

$$y_{2i} = x_{1i}\prod_1 + x_{2i}\prod_2 + v_i \quad [2]$$

where i = 1,…,N, y_{2i} is a (1 x p) vector of endogenous variables, x_{1i} is a (1 x k_1) vector of exogenous variables, x_{2i} is a (1 x k_2) vector of additional instruments, and the equation for y_{2i} is written in reduced form. By assumption, u_i and v_i are randomly normal distributed with zero means. β and γ are vectors of structural parameters, and Π_1 and Π_2 are matrices of reduced-form parameters. y^{*}_{1i} is not observed, instead, we observe

$$\begin{array}{ll} y_{1i} = 0 & \text{if } y_{1i}^{*} \le 0 \\ y_{1i}^{*} & \text{if } y_{1i}^{*} > 0 \le 1 \end{array} \quad [3]$$

In our case y_{1i} is the share of land left fallow, y_{2i} refers to the stated reasons for leaving land fallow contained in table 1 (i.e. crop rotation, danger due to possible land mines left from the military conflict, general insecurity, and other reasons). x_{1i} refers to the following exogenous variables: other stated reasons for leaving land fallow as lack of inputs, lack of manpower, lack of equipment, low profitability, average age of the household members, household size, total arable land, total land owned, total land rented, total area irrigated, share of the overall output sold, gross income, main farm output, maximum years of education. x_{2i} refers to instruments as listed in table 1 (i.e. soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects). The exogeneity of the instruments used is tested by considering a Wald test formula. The model is estimated by using an efficient full maximum likelihood technique based on the likelihood function outlined in Greene (2003).

Model 2 - Fractional Response Regression

As noted above, the dependent variable is based on proportional data - the share of total land left fallow - censored by 0 and 1. As Maddala (1991) observes, such data are not observationally censored but rather are defined only over the interval [0,1]. Hence, the censored normal regression model is conceptually flawed for proportional data and might result in misleading and biased estimates. Rather, the conditional mean must be a nonlinear function of the regressors and heteroscedasticity could be a problem (see Lin and Schmidt, 1984 and Cook et al., 2008). Here the procedure follows Papke and Wooldridge (1996, 2008) who propose the assumption of a functional form for the dependent variable that imposes the desired constraints on the conditional mean of the dependent variable

$$E(y|x) = G(x\theta) \quad [4]$$

where G(·) is a known nonlinear function satisfying 0 < G(·) < 1. The most obvious choice for G(·) is the logistic function which must be estimated using nonlinear techniques. The fractional response model to be estimated would follow the one outlined by [1] above

$$E\left[y_{1i}^{*} \middle| (y_{2i}\beta + x_{1i}\gamma) \right] = G\left[(y_{2i}\beta + x_{1i}\gamma)\theta \right] \quad [5]$$

A quasi-maximum likelihood (QML) estimation procedure is used based on the Bernouilli log-likelihood function given by

$$LL_i(\theta) = y_{1i}^{*} \log[G\left((y_{2i}\beta + x_{1i}\gamma)\theta\right)] + (1 - y_{1i}^{*})\log[1 - G((y_{2i}\beta + x_{1i}\gamma)\theta)] \quad [6]$$

and the corresponding QML estimator of θ is defined by

$$\hat{\theta} \equiv \arg\max_{\theta} \sum_{i=1}^{N} LL_i(\theta) \quad [7]$$

(see also Wagner, 2001). To account for the possible endogeneity of some of the stated factors for the fallow decision, in a first stage a multivariate probit is estimated (see Greene, 2003 or Maddala, 1991). Hence, the M-equation multivariate probit model is considered

$$y_{im}^{*} = \beta_m^{'} x_{i1m} + \gamma_m^{'} x_{i2m} + \varepsilon_{im}, \quad m=1, ..., M$$
$$y_{im} = 1 \text{ if } 0< y_{im}^{*} <1 \text{ and 0 otherwise} \qquad [8]$$

where ε_{im} are error terms distributed as multivariate normal, each with a mean of zero, and a variance-covariance matrix V, where V has values of 1 on the leading diagonal and correlations $\rho_{jk} = \rho_{kj}$ as off-diagonal elements. The vector of dependent variables y_{im} refers again to the stated reasons for leaving land fallow contained in table 2. x_{1i} refers to the same exogenous variables as in Model 1 and x_{2i} refers to instruments as listed in table 1. The model is estimated by using a simulated maximum likelihood technique based on the likelihood function outlined in Cappellari and Jenkins (2003). The estimates obtained by the multivariate probit model are then used as the vector y_{2i} in [5].[6]

Model 3 - Zero-Inflated Binomial Regression

As outlined above, the distribution of the dependent variable 'fallow share' is generally skewed to the right and contains a large proportion of zeros (i.e. excess zeros). To address this, a zero-inflated negative binomial regression model (ZINB) was applied which is a modified Poisson regression model and accounts for unobserved individual heterogeneity as a reason for such overdispersion in the data set. Lambert (1992) introduced the ZIP model

$$y_i \sim 0 \quad \text{with probability } q_i$$
$$y_i \sim \text{Poisson}(\lambda_i) \quad \text{with probability } 1\text{-}q_i \;\; (y_i = 0,1,2,3,...) \qquad [9]$$
$$\text{where } q_i = \frac{e^{z_i\gamma}}{1+e^{z_i\gamma}}$$

The individual farms are divided into those which use all land for production (i.e. fallow share = 0) with probability q_i, and farms that potentially set a proportion of their land aside with probability $1-q_i$. The unobservable probability q_i is generated as a logistic function of the observable covariates to ensure nonnegativity. Following Greene (1994) the observed variable y_i - here 'fallow share' - is generated as a product of the two latent variables z_i and y_i^*

$$y_i = z_i y_i^* \qquad [10]$$

where z_i is a binary variable with values 0 or 1 and y_i has a NB distribution. Then,

$$\Pr(y_i = 0) = \Pr(z_i = 0) + \Pr(z_i = 1, y_i^* = 0) = q_i + (1-q_i) f(0)$$
$$\Pr(y_i = k) = (1-q_i) f(k), \quad k = 1,2,... \qquad [11]$$

where f(·) is the negative binomial probability distribution for y_i^*. The binary process z_i is modeled as a logit specification using a constant-only specification for the inflation part whereas the likelihood function is given in Greene (2003). The Vuong non-nested test can be used to choose the best model specification, following

$$V = \frac{\sqrt{N}\tilde{m}}{s_m} \qquad [12]$$

where $m_i = \ln\left[\hat{P}_1(y_i|x_i)/\hat{P}_2(y_i|x_i)\right]$ and $\hat{P}_1(y_i|x_i)$ and $\hat{P}_2(y_i|x_i)$ are the predicted probabilities of the two competing models with $\tilde{m}$ as the mean, s_m as the standard deviation, and V following an asymptotically normal distribution. To account for the possible endogeneity of some of the stated factors for the fallow decision, in a first stage a multivariate probit is again estimated following the specification outlined above by [8].

[6] Because of limited space we do not report the estimates for the multivariate probit here.

4 Results and Discussion

The results of the estimated models are summarised in tables 3 to 5 given in the appendix. According to the different diagnosis tests performed, all estimated model specifications show a statistical significance at a satisfactory level and no severe signs of misspecification. The results provide several insights into the determinants of the decision to leave the land fallow.

First, the results are quite robust. It appears that all stated factors impact farmers' decisions to leave land fallow. This is particularly the case of the exogenous factors which are significant a 1% level across the three models. The coefficients are the largest for the lack of input and equipment. This problem has been known to the policy-makers in Kosovo. In the Green Book (UNMIK, 2003) it was pointed out that in the mid-term the target population for support should be subsistence and semi-subsistence farms, and the necessary incentives for these farms might include some tax concessions on inputs and equipment.

Second, within the group of endogenously determined reasons, the 'Other reasons', including transaction costs to access input and output markets, are significant a 1% level in the three models. This corroborates with Kostov and Lingard (2004) and Mathijs and Noev (2002) who argue that transactions costs are one of the main problems faced by subsistence farmers in Central and Eastern Europe.

Third, farmers perceive farming as a low profit activity and this is an important reason for their decision to leave part of the land fallow.

Fourth, a larger farm arable area decreases the probability that farmers would leave land fallow. Larger arable areas are easier to cultivate using machinery, own or rented, particularly in cases when these areas are not split into many plots allocated in different places. This is also confirmed by the fact that when the farm specialisation is in grains (Model 3), the probability that land would be left fallow decreases. In addition, often arable land means lowland and more fertile land with better returns.

Fifth, specialisation in labour intensive production, namely horticulture, has positive and significant impact on the decision to leave land fallow (a result indicated by all three models). This might be related to the stated reasons concerning the lack of manpower and (specialised) equipment.

Sixth, at first glance the result that older farm households (the age represents the average age of the five principal members of the household) leave less land fallow is counter-intuitive (a negative relationship results from all three models, but it is statistically significant only in models 1 and 3). However, younger people have more opportunities to find non-agricultural employment, while older people have low opportunity costs (sometimes zero), are fully dependent on agriculture for earning their livelihood and, thus, try to utilise in full the available land to produce food for the household and/or to generate some cash income. This is also related to the better education of younger households (50.8% of members of agricultural households within the age bracket 30-49 years have educational achievement of completed secondary school and above, whilst this percentage is 25.5 within the group of 50-64 years old) (SOK, 2006).

5 Conclusions

Kosovo is characterised by typical subsistence and semi-subsistence agriculture with fragmented farm land. Three models were estimated to understand the reasons behind the decisions to leave land fallow. They all produced statistical significance at a satisfactory level and did not show severe signs of misspecification.

One of the important conclusions of the analysis is that larger arable areas decrease the probability for fallow land. Smaller non-arable land areas, and in particular when skilled labour input and specialised equipment are necessary, for example horticulture, are more likely to bring fallow plots. One of the main factors farmers stated for their decision to leave land fallow area was the low profitability of farming. The increase in incentives to farmers by improving market institutions up- and downstream is one measure which can decrease the impediments to land use. During the period of typical productivist approach to farming in Western Europe, there were various (sometimes quite drastic) legal penalties for under-use of agricultural land - ranging from monetary penalties and compulsory leasing of under-utilised land to a third party, to the most controversial compulsory purchase of the land based on the principle of social obligation of ownership (Carty, 1977). However, this will really be counter-productive in Kosovo where the Government introduced process of privatisation of land of socially-owned enterprises is still underway. What could be done is to support the process of land consolidation which will allow organising larger arable land parcels. Some preparations for institutional development in this direction have been reported with a plan for a new law on land consolidation (ISMAFRD, 2008).

However, the above conclusions are only drawn on the basis of farmers' perceptions of the farm profitability and market efficiency which was analysed in this paper. This is work in progress. The future stage is to assess the farms' technical efficiency and profitability, as well as the allocative efficiency and again to predict the individual farmer's fallow-production decision but this time based on the market efficiency and profitability estimates. The comparison of the fallow-production decision based on farmers' perceived farm and market conditions to the decision based on estimated farm and market conditions will allow concluding on the rationality of the individual farmer's land allocation decision.

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Appendix

Table 3: Instrumental Variable Tobit Model

(n = 2010)	coefficient[1]	t-value
dependent: fallow share		
stated factors for fallow decision – endogenously determined		
crop rotation	0.623***	9.13
danger due to mines	0.335***	3.49
general insecurity	0.749***	14.21
other reasons	0.691***	13.24
stated factors for fallow decision – exogenous		
lack of inputs	0.831***	21.61
lack of manpower	0.725***	16.44
lack of equipment	0.881***	18.90
low profitability	0.737***	22.08
farm characteristics		
total arable land	-0.089***	-6.88
total land owned	0.011***	2.65
total land rented	0.028	1.57
total area irrigated	-0.004	-0.27
share of output sold	-0.001	-0.58
gross income	-1.92e-06	-0.39
main farm output - grain	0.078*	1.71
main farm output - veg & fruits	0.290***	5.71
main farm output - forage	0.011	0.24
socio-economic characteristics		
average age of household members	-0.002**	-2.18
household size	0.001	0.49
years of education	-0.002	-0.26
instruments: soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects village, peer-group effects municipality		
Constant	-0.481***	-6.20
Log likelihood	-2.672	
Wald chi2(13) [prob>chi2]	1620.061*** [0.000]	
Wald test of exogeneity: chi2(4) [prob>chi2]	394.61*** [0.000]	

1: * - 10%-, ** - 5%-, *** - 1%-level of significance.

Table 4: Fractional Response Model

(n = 2010)	coefficient[1]	z-value
dependent: fallow share		
stated factors for fallow decision – endogenously determined [2]		
crop rotation (estimate)	2.892***	6.80
danger due to mines (estimate)	0.014*	1.74
general insecurity (estimate)	2.957***	1.67
other reasons (estimate)	1.937***	3.77
stated factors for fallow decision – exogenous		
lack of inputs	3.904***	15.11
lack of manpower	3.495***	14.16
lack of equipment	4.040***	17.47
low profitability	3.574***	21.51
farm characteristics		
total arable land	-0.775***	-7.58
total land owned	0.114***	4.74
total land rented	0.314	1.33
total area irrigated	0.002	0.02
share of output sold	-0.006*	-1.89
gross income	-0.001	-1.29
main farm output - grain	0.318	1.16
main farm output - veg & fruits	1.57***	4.93
main farm output - forage	-0.242	-0.90
socio-economic characteristics		
average age of household members	-0.014	-1.57
household size	0.027	1.48
years of education	-0.089*	-1.83
Constant	-4.245***	-10.43
Log likelihood	-189.238	
(1/df)deviance	0.082	
(1/df)pearson	0.257	
AIC	0.209	
BIC	-14964.82	

1: * - 10%-, ** - 5%-, *** - 1%-level of significance. 2: estimates obtained by the multivariate probit model (exogenous variables used: soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects village, peer-group effects municipality

Table 5: Zero-Inflated Binomial Model

(n = 2010)	coefficient[1]	z-value
dependent: fallow share		
I) zero-inflated negative binomial model		
stated factors for fallow decision – endogenously determined [2]		
crop rotation (estimate)	1.131	1.48
danger due to mines (estimate)	0.006	0.77
general insecurity (estimate)	0.171	0.15
other reasons (estimate)	1.373***	3.13
stated factors for fallow decision – exogenous		
lack of inputs	2.256***	13.54
lack of manpower	2.506***	13.09
lack of equipment	2.225***	10.85
low profitability	2.332***	16.65
farm characteristics		
total arable land	-0.512***	-5.52
total land owned	0.045*	1.81
total land rented	0.091	0.39
total area irrigated	-0.085	-0.66
share of output sold	-0.006*	-1.76
gross income	-0.001	-1.24
main farm output - grain	-1.294***	-9.11
main farm output - veg & fruits	0.616***	4.00
main farm output - forage	-1.442***	-11.13
socio-economic characteristics		
average age of household members	-0.321***	-4.17
household size	-0.009	-0.53
years of education	-0.233***	-5.91
II) inflation (logit) model		
farm characteristics		
total arable land	0.016	0.14
total land owned	-0.036	-0.59
total land rented	-0.049	-0.42
total area irrigated	0.019	0.15
share of output sold	-0.008*	-1.66
gross income	0.001*	1.71
main farm output - grain	-0.499	-0.31
main farm output - veg & fruits	-0.539	-0.33
main farm output - forage	-0.359	-0.24
socio-economic characteristics		
average age of household members	-0.086***	-5.59
household size	-0.026	-1.36
years of education	-0.071	-0.90
constant	-13.425***	-5.89
lnalpha	-16.494***	10.00
alpha	0.687***	6.32
Log pseudolikelihood	-277.667	
Nonzero observations	322	
Zero observations	1688	
Wald chi2(8) [prob>chi2]	2542.72 [0.000]	
LR-test (alpha=0) chibar2(1) [prob>chi2]	5.751*** [0.000]	
Vuong test of ZINB vs. NB	43.324*** [0.000] i.e. NB rejected in favour of ZINB	

1: * - 10%-, ** - 5%-, *** - 1%-level of significance. 2: estimates obtained by the multivariate probit model (exogenous variables used: soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects village, peer-group effects municipality