Determinants for fallowing land: The case of Kosovo

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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 carried out in 2005 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 econometric models are used expected to fit the data distribution.

All estimated model specifications show a statistical significance at a satisfactory level and no severe signs of misspecification. The main determinants of the share of land left fallow by farmers in Kosovo are economic and institutional: low profitability of farming and difficulty to access inputs. The increase in incentives to farmers by improving market institutions up- and downstream is one measure which could alleviate the barriers to land use.

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

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1. Introduction

Western Balkans incorporate several potential European Union (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 the 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 unfavorable farm structure and lack of modern technologies impact farmers' decisions for land utilisation and production of food.

The aim of this paper is to investigate the determinants behind farmer's decisions to leave land fallow in the Western Balkans, taking Kosovo as a case study. This 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. Is land left fallow for the sake of long-term improvements of fertility or other agri-environmental reasons, or are Kosovo farmers' production decisions constrained by underdeveloped markets and market institutions?

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 household and farm characteristics to empirically approximate the significance of different factors for leaving land fallow and not using it for production purposes. Three different econometric models are used, that are expected to fit the data distribution.

The paper is structured as follows. The next section comprises a literature review on the potential determinants of the decisions to leave land fallow. The third section includes a brief overview of Kosovo agriculture and presents the data set used. The fourth section is devoted to modeling and analysis, whilst section five presents and discusses the results. The last section concludes.

2. Potential determinants of the decisions to leave land fallow

Fallow agricultural land means that some arable land is left uncultivated or some pasture land is kept unused. Several terms for this practice can be found in the literature: fallow land, unused land, unutilised land, idle land, abandoned land, land taken out of production. While most of the terms are interchangeable, it is understood that abandoned land is land left fallow for a long time without the intention to use it in the near future. With a different aim and different methods, researchers in several fields – agronomy, geography, environment, economics – have investigated land use decisions of farmers, including fallowing decisions.

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

Factors influencing the decisions to leave land fallow can be grouped in five categories: agronomic, economic, human, institutional, and policy.

Agronomic factors

Fallowing some land may be part of a strategy to improve soil fertility. Leaving land uncultivated for one or more seasons helps soil recovery and can result in higher crop yields (e.g. Grisley and Mwesigwa, 1994; Ravnborg and Rubiano, 2001). Besides such fertility strategy, leaving some land unused or even abandoned may be the result of poor climate and agronomic conditions in specific areas, which may discourage farmers from using certain plots. For example, Chomitz and Thomas (2003) explain that land abandonment is common in high rainfall areas in Amazonia, while Mmopelwa (1998) reports that insufficient rainfall is one reason for fallowing land in Botswana. Bamewerinde et al. (2006), Coxhead and Demeke (2004), Ravnborg and Rubiano (2001) and Wicky (1994) have shown how low soil conditions positively influence fallowing decisions for farmers in Uganda, Philippines, Colombia and Poland respectively.

Economic factors

The assumption that farmers behave as profit-maximisers may help explain why some land is left unused. In particular, plots for which farming costs outweigh the revenue are left fallow. This may be the case for plots located in remote location, and for which the access may be too difficult or costly (e.g. Wicki, 1994; Bamewerinde et al., 2006; Gellrich and Zimmermann, 2007; Bakker and van Doorn, 2009). Fallowing may also be applied to plots of low soil quality, for which improving fertility by chemical or mechanical techniques is costly (see agronomic factors above). Farmers may also choose to leave some land idle when it is highly fragmented: farming a small parcel of land may not be profitable. Fragmentation is, for example, put forward by Kopeva et al. (2002) as one reason explaining the amount of unused land in Bulgaria during transition, while Baudry and Thenail (2004) observe that in France smaller fields are more often left fallow than the larger ones. Some studies also report that costly access to inputs or not enough liquidity may prevent farmers from using agricultural land (e.g. Mmopelwa, 1998; Coxhead and Demeke, 2004; and Ravnborg and Rubiano, 2001).

Farmers also trade-off between farming and having a non-farm occupation, potentially resulting in land being unused. Part-time farmers, having to split their time between on-farm and off-farm labour, may leave some land idle due to time constraint. Gellrich and Zimmermann (2007) observe that land abandonment is higher in Swiss mountainous regions characterised by a low share of full-time farmers. Wicki (1994) reports that at the beginning of the transition in Poland one of the main reasons for leaving land fallow was the availability of jobs outside agriculture. Farmers may also fully abandon their farm activity and leave land fallow until the farm is taken over. Migration of rural inhabitants to cities or abroad may thus be a factor leading to land abandonment, as observed in Albania during transition (Müller and Sikor, 2006).

Human factors

The fact that part-time farmers, or farmers who migrate out of rural areas/or abroad, keep their land unused instead of transferring it to another land user may be explained by non-economic factors. For example, land may be viewed as an asset with a personal or family value. This reason may also drive aged landowners to keep their land unused to bequeath to their heir or to transfer once their successor is ready.

Attachment to land may explain the widespread case of land left unused by absentee landowners in the former centrally planned countries. During transition, land that was previously collectivised was restituted to former owners or their heirs, or distributed among

State farm workers or citizens, depending on political decisions in different countries (see Lerman, 2001, and Giovarelli and Bledsoe, 2001). A large part of the land was restituted to the heirs living in cities and engaged in non-farming jobs. Some of these absentee landowners wanted to keep the land as an attachment to a family asset and, although some have rented it out, some have left it abandoned. Nikodemus et al. (2005) mention such a situation in Latvia, while Hedin (2005) underlines that this might be the case for Swedes living in Sweden who have had some land restituted in Estonia due to the change in country boundaries.

Institutional factors

Institutional factors, such as unclear property rights and missing land market institutions, are common in the former centrally planned countries due to the incomplete land reforms (Swinnen and Vranken, 2005; Latruffe and Le Mouël, 2006). Land reforms take long due to high transaction costs, namely problems of identification (due to the removal of physical boundaries of land parcels during collectivisation or the decease of the former owners) and the slow creation of the necessary institutions such as land registry (Latruffe et al., 2008b). Uncertainty regarding land ownership and transaction costs incurred during land exchanges may prevent agricultural land from being used (e.g. Kopeva et al., 1994; Vranken et al., 2004).

Policy factors

Agricultural policy, in terms of support price and subsidies, may result in land being left fallow. It may be compulsory for farmers to leave some arable land uncultivated, such as the case of set-aside requirements in the context of the EU Common Agricultural Policy (CAP) until the June 2003 Reform. Some studies have shown that farmers set aside land that is the least productive (e.g. Rygnestad and Fraser, 1996). Some complementary measures such as rotational set-aside were introduced to limit such practice (e.g. Guyomard et al., 1996). By contrast, in the United States Goodwin and Mishra (2006) have shown that AMTA (Agricultural Market Transition Act) payments imply less land being left fallow. Price support may also determine farmers' acreage decisions; for example, Schoney (1995) reports that price stabilization programs influence Canadian farmers' fallow decisions.

3. Kosovo background and data set

Kosovo is a small country with total area of 1.1 million hectares (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 a small arable area per household (Riinvest, 2005). Following the privatisation of the socially-owned enterprises, 86% of agricultural land is privately owned and is operated by family farms; the remaining is still under the ownership of producer cooperatives (1%) and socially-owned enterprises (13%) (UNMIK, 2003).

Agriculture accounts for 25% of gross domestic product (GDP) and between 25 and 35% of employment (World Bank and SOK, 2007). Nearly 60% of total population live 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. In the Kosovo Green Book (UNMIK 2003:8) it is argued that "most farms in Kosovo are run to provide subsistence for households". Latruffe at al. (2008a) 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.

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 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. Land use was recorded plot by plot, including kitchen gardens. The survey also recorded plots left fallow for the production season 2005/2006, and the respondents (usually the heads of household) were asked to identify the reasons for leaving some land fallow 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 summarized in Chart 1. The majority of respondents (30.6%) emphasise the low economic profitability of farming as one of the reasons behind their decision. The lack of equipment and lack of manpower came as a second and third main reason. This indicates that farmers identify economic factors (low profit from farming and costly access to inputs) as their main constraints to utilisation of agricultural land. Farmers gave a lower priority to reasons such as general insecurity, danger due to possible land mines left from the military conflict, lack of other inputs than equipment and manpower, intentional crop rotation.

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 for the coming production year. The descriptive statistics of some variables used in the analysis are presented in Table 1. 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 when measured in land area, they are operated by large extended households (on average 9.4 members) and the share of output sold is low – around 9%. This illustrates the semi-subsistence character of farm households. During the previous season, on average, the sample households had left 6% of their land fallow.

4. Modeling the fallow decision

Determinants of fallowing decision of Kosovo's farm households are investigated using three different econometric modeling procedures that possibly fit the shape of the data distribution. The classic Tobit model is firstly used, and then results are compared with those of two other

[2] The survey benefited from technical support of the project 'Agricultural Statistics and Policy Analysis Unit for Kosovo' (ASPAUK) funded by the EU EAR.

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

models addressing potential problems not accounted for in the Tobit model: a fractional response regression, and a zero-inflated binomial regression. All models were estimated accounting for endogeneity.

Dependent and explanatory variables

Instead of using binary models to explain why some farmers leave land fallow and others do not, as in most of the existing literature, here quantitative models are used to explain the determinants of the proportion of land left fallow. This enables to obtain deeper insights into the constraints faced by rural households in Kosovo. In all three models used here, the dependent variable of interest is the 'fallow share', reflecting the share of the total amount of land per farm left fallow in the reference production year 2005/2006. Some farmers in the data set utilised all their land and consequently reported a zero fallow share. However, to avoid a likely selectivity bias with respect to estimation, the full sample is used and not just the sub-sample of farms that left some of their land fallow. Hence, by definition, the dependent variable is censored at 0 (i.e. total amount of land is utilised) and 1 (i.e. total amount of land is left fallow).

Based on the above literature review about the determinants of fallowing decisions, several explanatory variables are included in the three models: agronomic, human, economic and institutional determinants. Some of the stated reasons might however 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. For these reasons, exogenous determinants must be used as instruments. Table 2 summarises such potential exogenous determinants for the different stated factors.

Model 1 - Instrumental variable Tobit regression

As explained above, the dependent variable's distribution is censored on the left at 0 and on the right at 1, and thus a Tobit model seems appropriate. 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 (Maddala, 1991; Greene, 2003). Formally,

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

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

where $i = 1,\ldots,N$ with N the number of farms, y_{2i} is a $(1\times p)$ vector of endogenous variables, x_{1i} is a $(1\times k_1)$ vector of exogenous variables, x_{2i} is a $(1\times k_2)$ vector of additional instruments, and the equation for y_{2i} is written in reduced form. By assumption, the error terms u_i and v_i are randomly normally distributed with zero means. β and γ are vectors of structural parameters, and Π_1 and Π_2 are matrices of reduced-form parameters. The latent variable y_{1i}^{*} is not observed, instead, we observe

$$\begin{cases} y_{1i}^{*} = 0 \;\; if \;\; y_{1i} \leq 0 \\ y_{1i}^{*} = y_{1i} \;\; if \;\; y_{1i} < 0 < 1 \\ y_{1i}^{*} = 1 \;\; if \;\; y_{1i} \geq 1 \end{cases} \qquad [3]$$

More specifically, y_{1i} is the share of land left fallow, the vector y_{2i} refers to the stated reasons for leaving land fallow that are endogenous (see Table 2), the vector x_{1i} refers to the other stated reasons and additional explanatory variables, and the vector x_{2i} refers to

instruments (see Table 2). The exogeneity of the instruments used was tested by considering a Wald test formula. The model was estimated by using an efficient full maximum likelihood technique based on the likelihood function outlined in Greene (2003).

Model 2 - Fractional response regression

The dependent variable being the share of land left fallow, it is based on proportional data 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 (Model 1 above) 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 (Lin and Schmidt, 1984; 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, namely

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

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 and be

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

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

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

The corresponding QML estimator of θ is defined by (Wagner, 2001)

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

To account for the possible endogeneity of some of the stated reasons for the fallow decision, in a first stage a multivariate probit is estimated (Maddala, 1991; Greene, 2003). Hence, the following *M*-equation multivariate probit model is considered

$$\begin{cases} y_{im}^{*} = \beta_m' x_{i1m} + \gamma_m' x_{i2m} + \varepsilon_{im} \\ y_{im} = 1 \text{ if } 0 < y_{im}^{*} < 1 \\ y_{im} = 0 \text{ otherwise} \end{cases} \qquad [8]$$

where $m = 1,\ldots,M$ with M the number of stated reasons, 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 $(1 \times M)$ vector of dependent variables y_{im} refers to the stated reasons for leaving land fallow. x_{1i} refers to the same exogenous variables and x_{2i} are the same instruments as in Model 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].[4]

[4] Because of limited space the estimates for the multivariate probit are not reported here.

Model 3 - Zero-inflated binomial regression

The distribution of the dependent variable 'fallow share' is skewed to the left and contains a large proportion of zeros (i.e. excess zeros), namely 84%. To account for this, a zero-inflated negative binomial regression model (ZINB) is 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 following zero-inflated Poisson (ZIP) model

$$\begin{cases} y_i \sim 0 & \text{with probability } q_i \\ y_i \sim Poisson(\lambda_i) & \text{with probability } 1-q_i \quad (y_i = 0,1,2,3,...) \end{cases} \qquad [9]$$

where $q_i = \dfrac{e^{z_i\gamma}}{1+e^{z_i y}}$.

The individual farms are divided into farms 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 (2003) the observed variable y_i - here 'fallow share' - is generated as a product of the two latent variables z_i and y_i^*, such as

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

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

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

where $f(.)$ is the NB 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].

5. Results and discussion

The results of the three estimated models are presented in Tables 3, 4 and 5 respectively. 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 some land fallow in Kosovo. First, regarding the reasons stated by the farmers, five of them have a highly significant impact (at 1 percent) on the fallowing decision in all three models: low profitability, lack of equipment, lack of manpower, lack of input, other reasons. The three other reasons – namely crop rotation, mines and lack of security – are not identified as highly significant factors behind the decisions to leave land fallow. This does not fully confirm Chart 1, where lack of inputs was not a common reason among respondents while lack of security was more important, indicating that survey qualitative (yes/no) answers are not always sufficient to illustrate farmers' decisions regarding the share of land left fallow.

Second, regarding the other explanatory variables, several variables are significant determinants of the share of fallow land in all three models: the total arable land area, the total land owned, the dummy for the farm specialisation in fruits and vegetables, the share of irrigated land, the mean size of fallow plots, the dummy for farm location at the border to Albania, the dummy for infrastructure access, the peer-group village effects, the dummy for main soil type alluvial, and the average precipitation.

Results suggest that agronomic factors partly explain the decision to leave some land fallow in Kowovo. The negative effects of alluvial soil and precipitation indicate that good soil and climatic conditions decrease the share of land left fallow. However, economic and institutional factors are the main determinants of fallow land in Kosovo. Farmers' perceptions that agriculture is a low profit activity and their difficulty to access inputs are the major constraints to full land utilisation. Difficulties in obtaining production factors are revealed by the reasons stated by the respondents, as well as by the positive effect of total land owned. Farmers may own land that is inappropriate for them (it may be remote, fragmented, etc) and would need to exchange it on the land market. However, the high transaction costs to participate in the rental market may be an important reason for leaving land fallow. This corroborates with Kostov and Lingard (2004) and Mathijs and Noev (2004) who argue that transactions costs are one of the main problems faced by subsistence farmers in Central and Eastern Europe. The negative impacts of total arable area and of the mean size of fallow plots reveal that smaller plots are left fallow. This suggests the existence of scale economies in production, which may not be fully exploited by Kosovo farmers due to the lack of suitable machinery. Access to input and output markets indeed seems to constrain farmers in their production decisions: farmers with infrastructure access leave less land fallow, while those located in less developed area such as around the Albanian border leave more land fallow. This is in line with Latruffe et al. (2008a) findings about difficult access to input markets. Finally, specialisation, namely fruit and vegetables, has a positive and significant impact on the fallow share, may be in relation to the fact that such production is labour intensive and is thus affected by the lack of inputs.

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Table 1: Descriptive statistics of the household sample used

	Mean	*Standard deviation*	*Minimum*	*Maximum*
Share of land left fallow	**0.06**	**0.16**	**0**	**1.00**
Total arable area (ha)	1.41	2.41	0	62.0
Share of area owned (%)	93.78	18.66	0	100
Area under grains (ha)	0.94	2.10	0	61.1
Area under fruit and vegetables (ha)	0.18	0.55	0	11.2
Area under forage (ha)	1.01	1.29	0	13.8
Number of household members	9.37	5.46	1	71
Share of output sold (%)	8.95	20.67	0	100
Gross household income (Euro)	1,003	3,054	0	53,550

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 such as e.g. average precipitation
Mines	location of the farm/plot: e.g. border region to Macedonia, border region to Serbia, border region to Albania, main municipality, location near major road axis
Lack of security	location of the farm/plot: e.g. border region to Macedonia, border region to Serbia, border region to Albania, main municipality, location near major road axis
Other reasons	peer-group effects (proxy: average fallow share in village, average fallow share in municipality), transaction costs for participation in input or output markets

Table 3: Results from the instrumental variable Tobit model

(N = 2,010)	coefficient[1]	t-value
Dependent variable: share of fallow land		
Stated reasons for fallow decision – endogenously determined[2]		
crop rotation	0.623***	9.13
lack of security	0.749***	14.21
mines	0.335***	3.49
other reasons	0.691***	13.24
Stated reasons for fallow decision – exogenously determined		
low profitability	0.737***	22.08
lack of equipment	0.881***	18.90
lack of manpower	0.725***	16.44
lack of inputs	0.831***	21.61
Other exogenous explanatory variables		
dummy for main soil type - brown	-0/005	-0.18
dummy for main soil type - alluvial	-0.056*	-1.99
dummy for main soil type - clay	-0.011	-0.39
average precipitation	-0.003***	-2.60
plot altitude	8.42e-03*	1.64
mean age of 5 oldest family members	0.019**	2.24
maximum years of education within household	-0.002	-0.26
household size	0.001	0.49
total arable land	-0.089***	-6.88
total land owned	0.011***	2.65
total land rented	0.028	1.57
share of output sold	-0.001	-0.58
dummy for main farm output - grain	0.078*	1.71
dummy for main farm output - fruits and vegs	0.290***	5.71
dummy for main farm output - forage	0.011	0.24
share of irrigated land	0.104***	3.35
value of equipment per ha	-4.99e-06	-1.06
share of hired labour	0.057	0.55
mean size fallow plots	-0.126***	9.23
income per ha	-0.031*	-1.74
share of land rented from private owners	-0.478**	-1.97
share of land rented from the State	-0.197	-0.90
dummy for farm location - border with Serbia	0.008	0.27
dummy for farm location - border with Albania	0.091*	1.69
dummy for farm location - border with Macedonia	-0.081	1.56
dummy for farm location - main municipality	0.034	1.25
dummy for infrastructure access	-0.013***	-4.039
peer-group effects in the village	0.517***	4.52
peer-group effects in the municipality	0.420	1.31
constant	-0.308**	-2.47
Model statistics		
Log likelihood	56.73	
Wald chi2(29) [prob>chi2]	1809.21*** [0.000]	
Wald test of exogeneity: chi2(4) [prob>chi2]	394.61*** [0.000]	

[1] * - 10%-, ** - 5%-, *** - 1%-level of significance. [2] Exogenous instruments used are soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects village, peer-group effects municipality.

Table 4: Results from the fractional response model

(*N* = 2,010)	coefficient[1]	z-value
Dependent variable: share of fallow land		
Stated reasons for fallow decision – endogenously determined[2]		
crop rotation (estimate)	2.985***	6.89
lack of security (estimate)	2.957***	1.67
mines (estimate)	0.015*	1.80
other reasons (estimate)	1.681***	2.65
Stated reasons for fallow decision – exogenously determined		
low profitability	3.633***	20.93
lack of equipment	4.001***	17.05
lack of manpower	3.468***	14.69
lack of inputs	3.989***	20.09
Other exogenous explanatory variables		
dummy for main soil type - brown	-0.414**	-2.34
dummy for main soil type - alluvial	-0.425**	-2.28
dummy for main soil type - clay	0.338*	1.73
average precipitation	-0.001***	-11.55
plot altitude	0.002***	8.66
mean age of 5 oldest family members	0.075	0.90
maximum years of education within household	-0.058*	-1.80
household size	0.030*	1.65
total arable land	-0.756***	-7.66
total land owned	0.108***	4.33
total land rented	-0.618**	2.14
share of output sold	-0.007*	-1.77
dummy for main farm output - grain	0.404	1.44
dummy for main farm output - fruits and vegs	1.406***	4.25
dummy for main farm output - forage	-0.127	-0.46
share of irrigated land	0.936***	4.41
value of equipment per ha	-4.99e-06	-1.06
share of hired labour	0.798	1.24
mean size fallow plots	-0.236***	7.45
income per ha	-2.16e-03**	-2.08
share of land rented from private owners	-2.164	-1.26
share of land rented from the State	-0.674	-0.34
dummy for farm location - border with Serbia	0.081	0.48
dummy for farm location - border with Albania	0.057*	1.89
dummy for farm location - border with Macedonia	0.056	0.21
dummy for farm location - main municipality	0.021	0.11
dummy for infrastructure access	-0.356**	-1.98
peer-group effects in village	9.661***	8.99
peer-group effects in municipality	0.488	0.25
constant	-4.778**	-2.07
Model statistics		
Log likelihood	-180.447	
(1/df)deviance	0.076	
(1/df)pearson	0.254	
AIC	0.213	
BIC	-14646.71	

[1] * - 10%-, ** - 5%-, *** - 1%-level of significance. [2] Estimates obtained by the multivariate probit model. Exogenous instruments used: soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects village, peer-group effects municipality.

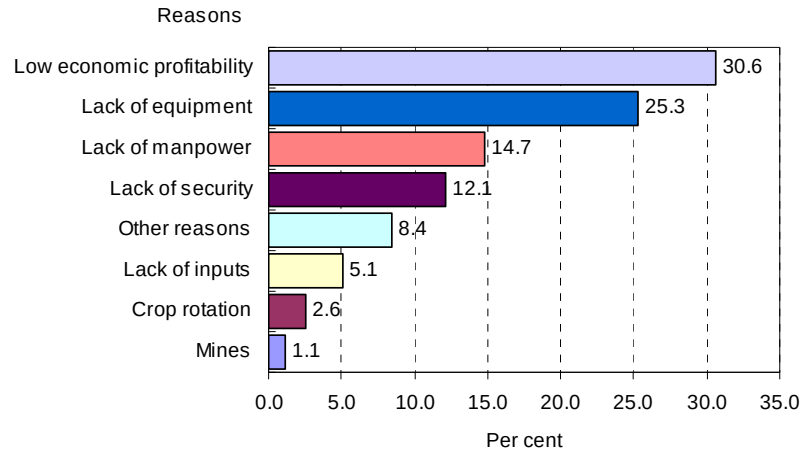
Table 5: Results from the zero-inflated binomial model

(*N* = 2,010)	coefficient[1]	z-value
Dependent variable: share of fallow land		
I) Zero-inflated negative binomial model		
Stated reasons for fallow decision – endogenously determined [2]		
crop rotation (estimate)	1.622*	1.89
lack of security (estimate)	0.041	0.08
mines (estimate)	0.015***	3.06
other reasons (estimate)	3.251***	3.97
Stated reasons for fallow decision – exogenously determined		
low profitability	2.685***	14.00
lack of equipment	2.518***	10.00
lack of manpower	2.412***	7.70
lack of inputs	2.667***	13.27
Other exogenous explanatory variables		
dummy for main soil type - brown	-0.611***	-4.89
dummy for main soil type - alluvial	-0.293**	-2.26
dummy for main soil type - clay	-0.144	-0.99
average precipitation	-0.043***	-6.84
plot altitude	5.84e-06**	2.13
mean age of 5 oldest family members	0.011***	7.25
maximum years of education within household	-0.181***	-4.00
household size	0.035*	1.93
total arable land	-0.507***	-6.02
total land owned	0.045*	1.81
total land rented	0.201	1.42
share of output sold	-0.006*	-1.76
dummy for main farm output - grain	-0.282*	-1.74
dummy for main farm output - fruits and vegs	0.412**	2.31
dummy for main farm output - forage	-0.462***	-2.89
share of irrigated land	0.431***	4.41
value of equipment per ha	-3.88e-05	-0.99
share of hired labour	0.553	1.13
mean size fallow plots	-0.343***	5.53
income per ha	-3.44e-03	-0.95
share of land rented from private owners	-3.573**	-2.44
share of land rented from the State	0.112	0.17
dummy for farm location - border with Serbia	-0.241*	-1.62
dummy for farm location - border with Albania	0.731***	3.32
dummy for farm location - border with Macedonia	0.425*	1.63
dummy for farm location - main municipality	0.118	0.58
dummy for infrastructure access	-0.165***	-3.37
peer-group effects in village	2.244***	2.65
peer-group effects in municipality	3.695	0.25
II) Inflation (logit) model		
Other exogenous explanatory variables		
maximum years of education within household	-0.071	-0.90
total income	-1.48e-04***	-3.82
household size	-0.026	-1.36
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
dummy for main farm output - grain	-0.499	-0.31

dummy for main farm output - fruits and vegs	-0.539	-0.33
dummy for main farm output - forage	-0.359	-0.24
Constant	-13.425***	-5.89
Model statistics		
Lnalpha	-16.494***	10.00
Alpha	0.687***	6.32
Log pseudolikelihood	-258.995	
Nonzero observations	322	
Zero observations	1,688	
Wald chi2(12) [prob>chi2]	2726.32 [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 favor of ZINB	

[1] * - 10%-, ** - 5%-, *** - 1%-level of significance. [2] Estimates obtained by the multivariate probit model. Exogenous instruments used: soil type, plot altitude, average precipitation, location of the farm, infrastructure access, peer-group effects village, peer-group effects municipality.

Chart 1: Reasons indicated by the heads of households for leaving land fallow: share of respondents



Source: SOK (2006)