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A quantile regression analysis of the effect of farmers' attitudes and perceptions on market participation

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Abstract

The objective of this study is to investigate the subjective determinants of farmers' participation in output markets in five EU New Member States (NMS) characterised by large semi-subsistence sectors. It employs quantile regression to model market participation reflecting the heterogeneity amongst farmers. The study also uses the Bayesian adaptive lasso to simultaneously select important covariates and estimate the corresponding quantile regression models. The empirical results show that only two variables affect all quantiles, while their effect varies across quantiles. Some of the remaining variables affect the share of output sold at the lower quantiles (i.e. for subsistence and semi-subsistence oriented farmers) only, while other variables are only significant at the upper quantiles (i.e. for more commercially oriented farms). Advisory services, and particularly agricultural business advice, and information and advice on markets and prices can facilitate the market participation of subsistence oriented farms.

Keywords: *quantile regression, Bayesian adaptive lasso, semi-subsistence farmers, commercial farmers, EU New Member States*

JEL classifications: *C11, C21***,** *D12, Q12*

1. Introduction

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The analysis of the characteristics of subsistence and semi-subsistence farming in Europe has become more prominent due to the two 'Eastern' enlargements of the European Union (EU) in 2004 and 2007. Several theoretical and empirical studies have been carried out in relation to semi-subsistence farming in different European countries (Kostov and Lingard, 2002; Kostov and Lingard, 2004; Mathijs and Noev, 2004; Petrovici and Gorton, 2005; Latruffe *et al*., 2008; Davidova *et al*., 2009; Davidova, 2011; Fritzsch *et al*., 2011; Davidova *et al*., 2012). Davidova (2011) estimates that in 2007 in the current 27 EU Member States there were 5.9 million farmers who used more than 50% of the output for household consumption.

One of the main characteristics of semi-subsistence farmers is their partial engagement in market activity. Although this is a common feature, semi-subsistence farmers are heterogeneous in terms of their objectives in farming, farm assets, human capital, income sources and strategies. Miracle (1968) criticised the concept of subsistence farming because it obscures the heterogeneity in farmers' situations and the diversity of their decision-making process. Davidova *et al*. (2009), Fritzsch *et al*. (2011) and Davidova *et al*. (2012) acknowledged this heterogeneity and employed cluster analysis to produce a typology of semi-subsistence farmers. However, cluster analysis does not allow for a formal procedure to select the relevant variables and the best model. Davidova *et al*. (2009) attempted to mitigate this shortcoming by using the clusters in a stepwise linear regression together with other variables in order to investigate the determinants of the share of output sold. However, the variables for the initial inclusion in the regression were selected by the researchers based on previous studies and not by a formal procedure.

The objective of this article is to investigate the subjective determinants of farmers' participation in output markets in five EU New Member States (NMS) – Bulgaria, Hungary, Poland, Romania and Slovenia. These countries account for 94% of all farms that use more than 50% of the output for household consumption in the NMS and 84% of those in the whole EU (Davidova, 2011). This paper employs quantile regressions to investigate the impact of attitudes and perceptions on the conditional distribution of market participation. Quantile regressions not only allow to model the heterogeneous effects of covariates on the response variable but also allow for heteroscedasticity among the disturbances (Koenker, 2005). The study also implements the Bayesian adaptive lasso to simultaneously select important covariates and estimate the corresponding quantile regression models. The impact of different motivations and perceptions is investigated on the extent to which the farms are integrated into the output markets. This is carried out for a range of quantiles which cover the continuum from zero to 100% share of sales in output.

The study also fills a gap in the literature on market participation which mainly investigates the persistence of subsistence and semi-subsistence farming in relation to transaction costs or, separately, entry and/or exit costs (e.g. Cadot *et al*., 2006; Petrick and Tyran, 2003; De Janvry *et al*., 1991; Key *et al*., 2000). Several studies have explored empirically the association of farmers' marketing behaviour with household assets, location and household characteristics (for a review of this type of empirical literature on Africa, see Barrett, 2008). Much less attention has been paid to the way farmers' objectives, values and attitudes shape their marketing behaviour. One attempt in this direction is Davidova *et al*. (2009) who used attitudinal statements to cluster farm households and in the second step employed these clusters in a stepwise regression together with other variables characterising farm assets, location and technology. The present study explores both the patterns of farmers' attitudes and the way these are related to market participation.

The next section presents the conceptual framework and the third section describes the data. Section 4 presents the empirical model and Section 5 discusses the results. Section 6 concludes.

2. Conceptual framework

The partial market participation of small scale farmers has been conceptualised by various theoretical models. The most frequently used is the transaction cost model (e.g. De Janvry *et al*., 1991; Löfgren and Robinson, 1999; Key *et al*., 2000). This comparative static perfect foresight equilibrium model demonstrates that the presence of transaction costs leads to a band between a lower selling price and a higher buying price for an identical commodity. When the equilibrium solution falls within that band neither sale nor purchase is preferred resulting in a subsistence state. Within this framework a farmer is conditioned to be subsistence or commercial by externally determined prices and household specific transaction costs.

An alternative is the two-stage decision process model of Kostov and Lingard (2004) (henceforth KL). Unlike the transaction cost model which is firmly based on assumptions such as perfect foresight, rational expectations and static equilibrium, the KL model is based on concepts of dynamic transaction costs and farmers' orientation.

Dynamic transaction costs (Langlois, 1992) are defined with respect to change. In contrast to rational choice, individuals are not assumed to know all future situations and options, so their choice of outcome is generated through a deliberation process (Chaserant, 2003). Since change is subject to radical uncertainty, its potential effect is also uncertain, so dynamic transaction costs arise through a subjective deliberation process. This means that they are an intrinsically subjective and procedural rational concept.[2] In addition, change can only be evaluated against the *status quo* and as such the model assumes, similarly to all behavioural economic or finance models, a reference point. Decisions are made locally with regard to the reference point (the *status quo*), rather than globally with reference to a global equilibrium - subjective views affect economic actions and outcomes.

This idea is made more explicit through the use of the concept of orientation. KL defines two types of farmers' orientation, namely subsistence and commercial, depending on their primary objective in farming. Subsistence oriented farmers have household consumption as a primary objective, while the commercially oriented ones view marketing of the output and revenue generation as a primary objective. It should be noted that orientation, in the sense of the KL model, is different from the observed outcome (i.e. the actual level of subsistence or commercialisation measured by the share of output sold) and is related to responses to market signals. The two types of orientation produce different responses of the amount of output sold to e.g. price changes and/or other economic incentives. Two otherwise identical, in terms of endowments, households may respond very differently only because they have different orientation which is subjective and reflects views/attitudes (see Kostov and Lingard, 2004). We do not attempt to test KL model directly, rather, we use it as a general conceptual framework, which requires accounting for unobserved heterogeneity in behaviour, i.e. the unobserved orientation.

3. Data

The data for the empirical study were generated through a primary survey carried out within the EU FP6 project 'Structural Change in Agriculture and Rural Livelihoods' (SCARLED). This was a collaborative European project and the survey was designed to serve the research tasks of all participants. The survey was focused on agricultural households in five EU NMS (Bulgaria, Hungary, Poland, Romania and Slovenia) characterised by large semi-subsistence

[2] Procedural rationality includes the cognitive processes that are involved in a choice.

sectors. It was organised by the project participants from these NMS[3] and was implemented in the Autumn 2007 - Spring 2008 through face-to-face interviews which took place in respondents' houses. On average the interview took 2 hours. Farmers were not given incentives to participate. All farmers who were approached agreed to participate but not all of them answered all the questions.

The survey questions were related to two time points. First, the preceding full calendar year - 2006 for which detailed information was required and, second, 2003 - the year preceding the accession to the EU of Hungary, Poland and Slovenia for which less detailed information was collected. Since the focus of the survey was to study agricultural households there was a filter question and only households that reported being engaged in agricultural production in 2006 and/or 2003 (including production from house gardens) were included in the sample (Möllers et al., 2001).

The survey instrument was designed in such a way that both quantitative and qualitative information was collected. It required quantitative data on: household members, time allocation and income sources; inputs and outputs, including information on purchased inputs and self-consumed or marketed output product by product; land and non-land assets, and labour use. The largest part of the questionnaire consisted of qualitative statements measured on a 5-point Likert scale concerning motivation for farming, attitudes to commercialisation, barriers to and drivers for income diversification, and market participation. The present paper is mainly based on the agreement or disagreement with the qualitative statements which reflect the aims and attitudes of the respondents at the time of the interviews.

The survey used geographical cluster sampling. Regions and villages were selected through a two-stage clustered sampling process. In the first stage, three regions in each of the five surveyed countries were selected using EUROSTAT data at the NUTS3[4] level according to their degree of economic development – poor, average or prosperous – corresponding to a gross domestic product (GDP) per capita relative to the national average. Since the emphasis was on rural areas, the regions of the capital city and other large cities were excluded from

[3] The only exception was the Polish participant who subcontracted the survey to the Research Institute of Agricultural and Food Economics in Warsaw (IERiGZ), the main centre for farm level data collection in Poland.

[4] NUTS stands for Nomenclature for Territorial Units for Statistics. In the countries analysed NUTS 3 level corresponds to districts in Bulgaria, counties in Hungary and Romania, regions in Slovenia and sub-regions in Poland.

the selection. In the second stage, three villages per NUTS3 region were selected – a prosperous, an average and a poor one in comparison to the regional average – and agricultural households in these villages were surveyed (for more detail, see Davidova *et al*., 2009).

Based on the survey data, the dependent variable for the empirical analysis was constructed, i.e. the share of output sold in the total agricultural output per household, measuring the degree of output market participation. In the literature, this is the measure used most often in defining subsistence, although it has sometimes been criticised as reflecting farmers' behaviour in output markets only (Miracle, 1968). The subsistence-commercial continuum could also be defined with regard to the participation in input markets. However, the latter is more difficult to measure and does not provide any information about output use and the output supply response which is of interest to policy makers from the point of view of food security and farm revenues.

The construction of the dependent variable required several calculations. First, the total value of sales per individual household was established product by product by multiplying the quantities sold by the sale price. This was the price reported by farmers and it was an average price across all sales of a product by an individual household in 2006. Second, similarly, the total value of output was derived on a product by product basis by multiplying the quantities produced by the price per household (assuming that the reported sales prices are reasonable proxies for the shadow prices on all production) and, third, the share of output sold per household was calculated as a ratio of sales value in the value of the total output.

One issue in the above calculations is the use of different units for quantities and prices/values within the questionnaire. Since the values were aggregated, this was not a problem as long as the values for all products were expressed in the same units (national currency units). Whenever this was not the case, the aggregation was not possible. For this reason, all households for which the units of measurement were different and could not be easily reconciled were removed. Furthermore, households for which there were missing data for any product (meaning that a household reported producing a particular product, but some data were missing and it was not possible to calculate the corresponding values) were also excluded.

These procedures decreased the original 1,012 households to 766 for which the share of output sold could be calculated. The number of useable independent variables was 128. Out of these 17 variables were excluded mainly due many missing values (i.e. if more than 30% values were missing). This procedure resulted in 280 households which had information for all 111 independent variables and which constituted the final sample analysed. According to country 141 households were from Bulgaria, 27 from Hungary, 56 from Poland, 22 from Romania and 34 from Slovenia.

However, the missing data might be over-representative of some categories of households and correspondingly these categories of households might be under-represented in the final sample. The histograms of the empirical distribution of the market participation variable for the households included in (280 households) and excluded from the sample (732 households) are presented in Figure 1.

Figure 1 around here

Visual examination of the two histograms suggests that there are relatively more missing households in the lower quantiles - between the 0.05^{th} and the 0.20^{th} quantiles, and fewer missing in the higher quantiles. The differences have been formally tested by t-test and Wilcoxon test[5]. The test results are presented in Table 1.

Table 1 around here

While the t-test is highly significant suggesting a significant difference between the included and missing samples, there is an issue about the normality assumption implicitly assumed in the t-test construction. The non-parametric alternative, namely the Wilcoxon test, is on the other hand only significant at 90% confidence limit. Although marginally the null hypothesis is not rejected and therefore the sample used in the estimation is approximately representative in terms of market participation. By reducing the sample size to incorporate more variables the more subsistent farms which are the focus of our study were not unduly under-represented.

The variable selection procedure, explained in the next section, retained 17 covariates as statistically significant out of the 111 included in the selection process. The description of the

[5]These are tests for difference in means. However, the visually observed displacement of probability mass from one tail towards the other between the two samples should effectively result in mean difference.

retained covariates is presented in Table 2 and their means and standard deviation for the pooled sample and per country are presented in Table 3.

Tables 2 and 3 around here

4. Empirical Methodology

Quantile regression models heterogeneous effects of variables on a response and allows for heteroscedasticity among the disturbances (Koenker, 2005). The quantile regression can be written as:

$$y_i = X_i^T \beta_\tau + u_{\tau i} \quad u_{\tau i} \sim H_{\tau i} \ \textit{subject to}\ H_{\tau i}(0) = \tau \qquad (1)$$

where the index *i* denotes the individual agent (household/farm), y_i is the dependent (response) variable and X_i is the vector of covariates for individual *i*, β_τ denotes the quantile specific linear effects and $0 < \tau < 1$ is a given (i.e. fixed and known) quantile. Compared to the linear regression model the coefficients are allowed to vary between quantiles. For this reason they are represented in (1) as an unknown function of the quantile τ. The unknown error term $u_{\tau i}$ is characterised by an unspecified cumulative distribution function $H_{\tau i}$. No specific distributional assumptions are made about this function except from the restriction in (1), which implies that the distribution function at 0 is τ. The latter is known as a linear quantile restriction and can be relaxed if non-parametric versions of the quantile regression models are considered.

The linear quantile restriction leads to the following interpretation: the model describes the quantile function $Q_{y_i}(\tau \mid X_i)$ of the response variable y_i conditional on a vector of covariates X_i at a given quantile τ. More specifically:

$$Q_{y_i}(\tau \mid X_i) = H_{y_i}^{-1}(\tau \mid X_i) = X_i^T \beta_\tau \qquad (2)$$

In contrast, the linear regression model describes the mean of the dependent variable. The fundamental difference is that the mean models assume that the response variable is conditionally Gaussian, which means that the mean equation applies to all parts of the distribution. The quantile regression makes no such distributional assumptions and, hence, the conditional quantile function that is estimated can vary across quantiles. It would also be useful to clarify that in estimating any quantile, including the most extreme ones, the (linear) quantile regression uses all available observations.

The conditional quantile can be alternatively expressed as the following optimisation problem (see Koenker and Bassett, 1978):

$$\arg\min_{\beta_\tau} \sum_{i=1}^{n} \rho_\tau \left(y_i - X_i^T \beta_\tau \right) \quad (3)$$

where $\rho_\tau(.)$ is called the 'check function', i.e. $\rho_\tau(u) = u(\tau - I(u<0))$, with $I(.)$ denoting the indicator function. Solving (3) leads to the most popular linear quantile regression estimator, namely the linear programming estimator of Koenker and Bassett (1978).

Koenker and Machado (1999) noted that the minimisation problem (3) can be recast as an equivalent maximum likelihood problem where the distribution of the response variable is the skewed asymmetric Laplace distribution. This has been exploited to propose Bayesian versions of the quantile regression (see Yu and Moyeed, 2001). Although distributional assumptions are necessary for the Bayesian approach, these are relatively innocuous since the Bayesian estimation of a quantile regression is simply established to be equivalent to the frequentist estimation that does not employ any.

The dependent variable (market participation) is a ratio taking values from zero (no sales) to 1 (all produce is sold). For this reason, it is preferable to use a fractional response model. The most widely applied approach in modelling a fractional response variable is to transform the original variable in such a way that the interval restriction no longer holds. The latter can be expressed by applying the logit transform $y^* = log(y/1-y)$, where y is the original (interval valued) fractional response variable, and build a model for the transformed variable y^*. This can be more easily seen if one considers the opposite transform, i.e. that $y = exp(y^*)/[1+exp(y^*)]$, showing that for any value of y^*, y is guaranteed to be in the (0,1) interval. The problem arises when the fractional variable is measured at the boundary of the unit interval (i.e. when it takes the value 0 or 1), because then the logit transform is undefined. It can be overcome by a preliminary 'scaling' of the fractional variable to map it from the [0,1] to the (0,1) interval. This can be achieved by replacing y by $(y+e_1)/(1+e_2)$, where e_1 and e_2 are arbitrary small numbers, such that $e_1 < e_2$. Adding e_1 moves y away from zero, while dividing by $(1+e_2)$ scales back its values and as long as $e_1 < e_2$ the scaled values will be lower than 1. Here $e_1=10^{-32}$ and $e_2=10^{-8}$ are used. Essentially our approach replicates Bottai *et al*. (2009) with a small difference with regard to the boundary correction.

To allow for a (conceptually) unrestricted dependent variable, the logit transform also preserves the ranking of the dependent variable, which is an important property particularly when using a quantile regression. Furthermore, the coefficients in the transformed model can be interpreted in the usual way with regard to their signs. Similarly, larger coefficients indicate a larger effect. Their magnitude, however, would not have a direct interpretation, although one can use estimated coefficients to calculate 'odds ratios' in the same way as in a logistic regression. Since the magnitude of the effects is not a primary focus of this study it is not applied here.

Despites its strengths the transformation approach still creates a fixed censoring since the transformed data contains additional probability mass at the boundary. Whether one considers censoring to be an issue or not depends on the nature of the problem and the size of this probability mass (see Bottai et al., 2009). Bearing in mind that almost 15% of the sample consists of fully commercial farms creating additional probability mass at the upper boundary, it is advisable to consider censoring in estimating the model. Details on this are presented in the discussion of the estimation algorithm.

In addition to estimating a quantile regression for a range of quantiles, the interest in this study is also in determining which variables affect the corresponding conditional quantiles. Penalised (also called regularised) regression methods have emerged as important techniques for variable selection. Two of the most popular regularisation approaches, namely the least absolute shrinkage and selection operator (lasso) of Tibshirani (1996) and the smoothed clipped absolute deviations (SCAD) method of Fan and Li (2001), have already been considered in a quantile regression setting (see Li and Zhu, 2008; Wu and Liu, 2009; Belloni and Chernozhukov, 2009). In general, these papers have established the consistency of such regularised estimators for quantile regression problems subject to appropriately chosen 'optimal' penalty parameter(s).

A regularised (penalised) linear quantile regression estimator can be formally defined as:

$$\min_{\beta_\tau} \sum_{i=1}^{n} \rho_\tau \left(y_i - X^T \beta_\tau \right) + \lambda J \left(X^T \beta_\tau \right) \tag{4}$$

where $J(.)$ is a given penalty function.

The shrinkage effect is determined by the positive penalty parameter λ that needs to be chosen according to some criterion (typically an information criterion or cross-validation).

The adaptive lasso estimator for the linear quantile regression can be defined as weighted lasso problem in the following way:

$$\min_{\beta_\tau} \sum_{i=1}^{n} \rho_\tau \left(y_i - X^T \beta_\tau \right) + \lambda \sum_{j=1}^{d} \tilde{w}_j \left| \beta_{j\tau} \right| \qquad (5)$$

where $|\,.\,|$ denotes the *L1* norm, while the weights are given by $\tilde{w}_j = \frac{1}{\left|\tilde{\beta}_{j\tau}\right|^{\gamma}}$ for some $\gamma > 0$, where $\tilde{\beta}_{j\tau}$ are initial estimates for the parameters. In this case $\tilde{\beta}_{j\tau}$ are obtained by an unpenalised quantile regression. The conventional lasso estimator is a particular case when all weights are equal rather than adaptively chosen. The adaptive lasso, when implemented in a quantile regression setting, retains the oracle property (Zou and Yuan, 2008) similar to the mean regression case. *L1* norm estimators are by far the most widely studied regularisation estimators for quantile regressions (Belloni and Chernozhukov, 2009; Wu and Liu, 2009; Zou and Yuan, 2008).

In linear regressions such regularisation methods have equivalent Bayesian formulations obtained by adopting suitable prior distributions on the regression coefficients (Park and Casella, 2008; Hans, 2009). Li *et al*. (2010) employ a Laplace prior on the quantile regression coefficients to obtain a Bayesian version of the lasso. Alhamzawi *et al.* (2012) combine such Laplace priors on the coefficients with inverse Gamma priors on the individual shrinkage for each parameter to obtain a Bayesian adaptive lasso regression. This is the approach used in this study. The main advantage of the Bayesian approach to the lasso is that the amount of shrinkage is no longer given but is treated as unknown to be estimated from the data jointly with the parameters. In addition, the Alhamzawi *et al.* (2012) approach allows the shrinkage to be individually determined for every single coefficient, hence preserving the oracle property of the resulting estimator. Furthermore, the Bayesian estimation provides confidence intervals, unlike the frequentist versions in which the final model needs to be re-estimated to obtain these intervals. A disadvantage of the Bayesian lassos is that since continuous priors are imposed on the regression parameters, draws from the posterior distributions are never exactly zero. This means that some *ad hoc* typically thresholding methods must be applied to implement variable selection. In this paper a Bayesian approach is followed with a hard thresholding at the 90% confidence limit.

Additionally, in order to account for country heterogeneity the study applies country 'fixed effects'. In quantile regressions the term 'fixed effects' has a different meaning compared to the classical panel data fixed effects approach. It usually denotes shrunken random coefficients[6]. The main problem in specifying quantile 'fixed effects' is that, as in any other non-linear model, the standard linear transformation approaches designed to deal with the issue of a large number of parameters are not applicable. This means that the individual 'fixed effects' (countries in this case) have to be estimated directly alongside the other quantile coefficients[7]. In the absence of censoring such an approach could have been implemented using the publicly available R package BayesQR (Benoit *et al*, 2012) without imposing any shrinkage priors on the country effects (and discarding the draws that fail the censoring constraint prior to summarising the results). In this study a slightly more general approach is applied following Koenker (2004). In essence, Koenker (2004) applies shrinkage on the 'fixed effects' towards a common value via $L1$ penalty. Within the framework of this study this is applied by simply adding an adaptive group lasso penalty on the country effects. The amount of shrinkage is estimated in a way similar to the shrinkage on the other coefficients.

Finally we take into account the fixed point censoring present in the dependent variable. From Bayesian point of view the resulting censoring is a form of constraint that can be incorporated into the specification. Following Gelfand et al. (1992) this can be done by attaching the constraints to either the prior or the likelihood specification. The effect of the latter is that the posterior of the model given the constraints is simply the (appropriately normalised) unconstrained posterior. Then the full conditional distribution can be obtained by imposing the relevant constraints to the unconstrained posterior. We achieve this by drawing directly from the constrained full conditional following Ji *et al*. (2012).

5. Discussion of results

Model results provide insights into the effect of the motivations and perceptions of farm households on their market participation. The results are meaningful in two aspects. First, the pattern of the variables included in the model varies across different quantiles. Some

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[6] Since all quantile coefficients are random by design.

[7] In many panel data problems such an approach could lead to a version of the incidental parameters problem, resulting in estimation bias. This is not the case here, since the fixed effects dimension (i.e. the number of countries) is fixed and cannot increase faster than the sample size.

variables only affect the share of output sold at the lower quantiles, while other variables are only significant at the upper quantiles. Second, even when some variables affect the outcome at different quantiles, their impact varies between different types of farmers.

We focus on the differences in the estimated coefficients for different quantiles. Five different quantile regressions have been estimated for quantiles from the 0.05th up to the 0.95th: - 0.05th, 0.25th, 0.50th , 0.75th and the 0.95th. In order to limit the volume of results from different possible quantile regressions, a common practice in the empirical literature is to present quantile regression results at quartiles (i.e. the 0.25th, 0.5th and 0.75th quantiles) complemented by results at two quantiles in the tails (Buchinsky, 1994; Eide and Showalter, 1998). In this study the 0.05th and the 0.95th quantiles are chosen to summarise the tails.

Before proceeding to the interpretation of the estimation results, model specification tests are presented.

Tables 4-6 about here

Table 4 presents the probability values for the goodness of fit tests proposed by He and Zhu (2003). The tests are satisfactory across all quantiles. Since the estimation sample is relatively small (280 households) the specification tests based on the subsampling inference approach of Chernozhukov and Fernandez-Val (2005) were applied as well. The results are presented in Table 5. The 'no effect' hypothesis (which is the opposite of the test for significant effects), is rejected for all quantiles which is consistent with the results in Table 4. Furthermore, the "shift hypothesis" which tests for heterogeneous against constant effects cannot be rejected, showing that the quantile regression specification is superior to the constant effects model. Finally, Table 6 presents Wald tests on equality of slopes for different quantiles. The corresponding quantiles are tested against a common reference quantile (the 0.95th in this case), rather than against the whole quantile regression process as in the subsampling inference approach. The results confirm the variability of the effects across quantiles.[8]

In order to better understand the estimation results, it is useful to review the interpretation of quantile regressions. The standard quantile regression model (Koenker and Bassett, 1978) represents the conditional quantile of the dependent variable as a function of covariates.

8 Wald tests are of course only asymptotically valid, but they are routinely applied in empirical research.

Following Doksum (1974) who interpreted the disturbance term in a quantile regression as individual ability or proneness, it is now well accepted to consider the conditional quantiles as measuring unobserved proneness (see Powell, 2011 for discussion of the underlying conceptual issues). In the present application, conditional quantiles measure the proneness to market participation subject to the covariates. In simple terms the higher conditional quantiles denote households which given their attitudes and subjective evaluations sell a higher share of their output than other comparable households. Similarly, the lower conditional quantiles represent households who sell a lower share. These households may not be the same ones who are unconditionally more or less commercial. For example the 0.95^{th} (conditional) quantile refers to households that sell a higher share of their output than 95% of the comparable households and the 0.05^{th} conditional quantile denotes households that sell a smaller proportion than 95% of the comparable households.

The unobservable proneness to sell is similar to the unobservable orientation in KL model. More market oriented households have higher desire (i.e. proneness) to sell and will sell a higher share of their output relative to other households with similar characteristics. The conditional quantiles of market participation could be viewed as one possible measure of KL orientation. For this reason, in the following discussion the higher and lower conditional quantiles are interpreted as denoting market and subsistence oriented households. Following Wharton (1969) terminology, the 0.05^{th} and the 0.95^{th} quantiles can be labelled as subsistence and commercially oriented, the 0.25^{th} quantile as semi-subsistence oriented and the $0.\ 75^{th}$ quantile as semi-commercially oriented.

Table 7 presents the coefficient estimates for the analysed quantiles, together with their probability levels. It also includes estimates of the 'fixed' country effects.

Table 7 about here

There are 17 covariates that were retained by the models as exerting statistically significant effects on the dependent variable. These fall into six groups: household off-farm occupation (E variables); incomes (F variables); land assets (G variables); agricultural production, use and sales (H variables); contribution of own food production to household welfare (I variables) and future farming activities (K variables). A description of the retained variables, together with the way they are measured, is presented in Table 2.

The estimation results indicate a clear clustering of the effects at the two extreme quantiles i.e. for subsistence and commercially oriented households. Most of the variables (11) affect the lowest quantile, and eight variables affect the two uppermost quantiles. The intermediate quantiles are affected by a smaller number of variables. Another general observation is that when a variable affects several quantiles, although the magnitude of the coefficients varies across the quantiles the sign does not change, so the direction of the effect does not differ across the quantiles.

The country fixed effects show that while at the two lower quantiles (subsistence and semi-subsistence oriented households) only Poland has a statistically significant effect, the number of significant fixed effects increases with a more commercial orientation. For the commercially oriented farms, all countries but Poland have a statistically significant effect. While this could be affected by the small sample used in this study, it seems to suggest that more subsistence oriented farms are more homogeneous across countries, while for more commercially oriented farms country differences are more important.

There are two variables that influence all quantiles. The first is the agreement that the current aim in farming is to provide work for the household members (H2b). The estimated impact of this variable is negative, implying that a higher level of agreement with this statement is associated with more subsistence orientation. Higher scores for this variable suggest that farmers may pursue this objective at the price of underemployment and low labour productivity. In this case, farmers may not be competitive in the market and maybe forced to consume a great deal of their output. Therefore, it is not surprising that the coefficients of the variable are negative across all quantiles.

The other variable that affects all quantiles relates to the functioning of the land market (G9j). The respondents were asked about their agreement with the statement that they would like to sell land. At first glance, this variable seems to have the wrong sign since it shows a positive relationship. If land is sold, this would reduce output which, everything else being equal (e.g. the self-consumed quantity remaining unchanged), would decrease the marketed share. The willingness to sell land is expected to have a negative impact on the dependent variable. However, if the land under consideration for sale is underutilised (which is the reason for wanting to sell it) then a positive effect is materialised. Since the farmers may not be able to cultivate all their land, to improve the factor mix they need to sell (or rent out) land. Welldocumented land market imperfections in NMS (e.g. Ciaian and Swinnen, 2006) impede land transactions.

The remaining empirically selected variables only affect some quantiles and not others. The interpretation below is structured according to the cluster of effects either in the lower or upper quantiles.

A wider range of variables is associated with lower proneness to sell suggesting that subjective factors are more important in shaping the market behaviour of subsistence oriented households. These variables can be grouped into those with a positive effect on market orientation (F7, H2e, H3c, H6f, K5, G9a) and those with a negative effect (E15h, I6_2006, G9). The impact of these variables is discussed in turn.

The variable F7 contains information on the subjective assessment of respondents of their incomes and consumption in kind in 2006 in comparison to the situation in 2003, where increasing values indicate a perception of improvement. The perceived improvement exerts a positive impact, which is only observed for the 0.05^{th} quantile.

H2e refers to the objectives in agricultural activity and reflects agreement with the statement that the main aim is to generate cash income. As expected, this objective is positively related to market orientation.

H3c refers to the use of agricultural business advice and information. It shows a positive impact only present at the two lower (q=0.05 and q=0.25) quantiles (i.e. for subsistence and semi-subsistence oriented households). When farmers are more commercially oriented, they are likely to have gained both experience and knowledge through advisory services, showing that the marginal effect of additional advice decreases with the increasing market orientation.

The next variable from the same group H6f 'We lack information and advice on markets and prices' also has a positive impact at the lowest quantile. This variable reflects the perceived need for information and advice. As the ability to sell increases in the higher quantiles this perception diminishes and its effects on market orientation disappear.

A more optimistic evaluation of the mid-term (next 5 years) economic prospects of the farm, as measured by K5, exerts a positive impact again on lowermost quantile only (q=0.05). It is more important for subsistence oriented farms since often they face a strategic decision on whether to become more market oriented or cease farming altogether, a decision influenced by the evaluation of future economic prospects.

G9a ('Would like to buy more land') has a positive impact but only for the lowest quantile (q=0.05). The disappearance of this effect for the higher quantiles suggests that other factors than land ownership dominate the participation outcome for more market oriented farms in our sample.

Several variables negatively affect the market orientation mainly at the lowest quantile. The first variable is the judgement about the contribution of own food production to household welfare (I6_2006). As expected, the relationship is negative. Those households in the lowest quantile who feel that the contribution is very important have lower proneness to sell. KL model explicitly labels those as farmers with subsistence orientation since their primary objective in farming is household consumption.

The next variable that exerts a negative effect on market orientation of the lower quantiles (q=0.05 and q=0.25), G9f, indicates that respondents wish to rent-in more land. Swinnen and Vranken (2008) argue that corporate farms in the NMS have led to imperfect competition in the land markets influencing the rent rates and rental contract conditions at the expense of individual farmers.

E15h measures insufficient availability of low cost credit as a constraint to engaging in off-farm business, which impacts on both tails (subsistence, semi-commercial and commercial orientation) but does not appear for the intermediate quantiles.

The other aspect of interest concerns the variables that mainly influence the two uppermost quantiles, i.e. the farmers most prone to sell (semi-commercially and commercially oriented households). The analysis indicates four variables that affect negatively the expansion of their market activity (H6g, K10a, G9d and G9o).

The first variable (H6g) is the agreement with the statement that they cannot meet the standards of public and private regulations which affects negatively their market orientation. This is an important policy result since it demonstrates a market participation constraint for households who are both willing and able to participate in output markets. Traditionally, public sector agents set and enforce such standards but private standards, including buyer specific standards particularly set by supermarkets, have become increasingly prominent in the modern, usually global food supply chain. However, there are costs of certification and they may inhibit market participation. The fact that this variable does not affect more subsistence oriented farmers suggests that they use some shorter food chains without attempting to enter the modern supply chain.

Another set of evaluations about households' abilities to adapt to the EU regulations has been retained by the model. K10a contains households' assessment on how easy or demanding is for them to adjust to the EU veterinary and phytosanitary standards. It exerts negative impact on the higher quantiles. The higher values of the variable indicate that households perceive that adapting to the standards is easy. There is not an intuitive interpretation of the negative sign of this variable.

At the higher quantiles (q=0.75 and 0.95) one way to further their commercial orientation is to have efficient agricultural factor markets. The last two variables that affect negatively the further market orientation of the semi-commercially and commercially oriented farmers imply land market imperfections. This underlines once again farmers' opinions about difficulties in land transactions.

6. Conclusions

This study focuses on the impact of motivations, perceptions and attitudes of agricultural households in five EU NMS – Bulgaria, Hungary, Poland, Romania and Slovenia – on their market orientation. Understanding the effect of their subjective evaluations of facilitators and barriers to commercialisation on their marketing behaviour is important to inform agricultural and rural policies. The conceptual framework is based on Kostov and Lingard (2004), suggesting that objective factors influence market behaviour through their subjective evaluations.

One of the contributions of this study is that it employs a more rigorous method than previous studies in this area to model the differing effect of covariates on conditional market participation, i.e. a quantile regression. The methodology applied is coupled with the Bayesian adaptive lasso to simultaneously select important covariates and estimate the corresponding quantile regression models. It provides more detailed insights that may help policy makers better target those subsistence and semi-subsistence oriented farmers who would like to integrate further into the output markets, insights which cannot be achieved by the mean regression methods prevailing in most previous research.

The empirical results indicate that, first, the patterns of the variables included in the model vary across different quantiles and, second, the impact of individual variables varies across different types of farmers according to their market orientation. In particular, only two variables affect all quantiles while the effects of the variables included in the empirical model vary across different quantiles. Some variables affect the proneness to sell in the lower quantiles (i.e. for subsistence and semi-subsistence oriented farmers) only, while other variables are only significant at the upper quantiles (for semi-commercial and commercially oriented farmers).

The results highlight the heterogeneity of farm households and the impact of their subjective motivations, attitudes and evaluations of future prospects on their marketing behaviour. Only two of the 17 variables retained by the model as being statistically significant in determining market orientation are important for all five analysed quantiles. The remaining variables affect some quantiles but not others. It is interesting that clustering of effects has emerged since most of the variables affect mainly, first, the lowest quantile (subsistence oriented farmers) and, second, the two upper quantiles, of semi-commercially and commercially oriented farmers. This suggests that the marginal effects of subjective perceptions and attitudes on farmers' orientation are large for farmers with a specific orientation but not for farmers with a different one. This implies that policy measures have to be more targeted and that blanket measures, if effective at all, may not be effective for the overall policy target group.

The results also suggest a potential role for the advisory services in facilitating market participation of subsistence and semi-subsistence oriented farmers. In the current (2007-2013) EU rural development policy there is support for advisory services amounting to 80% of the eligible cost per service and capped at 1,500 Euro. However, the main focus is on advice on how to keep the land in good agri-environmental conditions (GAEC) and meet the occupational and safety standards, thus the emphasis is on the conditions necessary to receive direct payments from CAP Pillar 1, which is not very beneficial for small and not well market integrated farmers (Council Regulation 1698/2005). In the proposal for the new regulations post-2013, the focus is widened with actions necessary to mitigate climate change and maintain biodiversity – but again nothing specific for the millions of semi-subsistence farmers. There is a general provision that "advice may also cover issues linked to the economic, agricultural and environmental performance of the holding or enterprise" (COM(2011) 627 final/2:13), thus advice on market participation is not precluded but at the same time is not targeted either. The empirical results also show the need for more targeted training and advice to semi-commercially and commercially oriented farmers to meet public and private food safety and quality standards.

The model retained five variables related to agricultural land transactions and the legal requirements for such transactions. The interpretation of these effects on different quantiles is not easy. We have identified the associations between our explanatory variables and the degree of market orientation, but cannot provide convincing and reliable interpretations of the implications of these associations for the transition from subsistence to commercial farming, More research is needed including the development of a coherent and consistent theory of transition to explain these associations.

References

Alhamzawi, R., Yu, K. and Benoit, D.F 'Bayesian adaptive LASSO quantile regression', *Statistical Modelling*, (2012), 12, pp. 279-297.

Barrett, C. 'Smallholder market participation: Concepts and evidence from Eastern and Southern Africa', *Food Policy* Vol. 33, (2008) pp. 299-317.

Belloni, A. and Chernozhukov, V. *L1-penalized quantile regression in high-dimensional sparse models*, Working Paper 10/09 (Centre for Microdata Methods and Practice, Institute for Fiscal Studies, 2009).

Benoit, D. F., Al-Hamzawi, R., Yu, K. and Van den Poel, D., (2012) BayesQR: Bayesian quantile regression, Version 1.3, http://CRAN.R-project.org/package=BayesQR.

Bezemer, D.J. 'Credit Markets for Agriculture in the Czech Republic', *Europe-Asia Studies*, Vol. 54, (2002) pp. 1301-1317.

Bottai, M., Cai, B. and McKeown R. E., 'Logistic quantile regression for bounded outcomes', *Statistics in Medicine*, 29 (2), (2009), 309-317.

Buchinsky, M. 'Changes in the U.S. wage structure 1963-1987: Application of quantile regression', *Econometrica*, 62, (1994), 405–458.

Cadot, O., Dutoit, L. and Olarreaga, M. *How costly is it for poor farmers to lift themselves out of subsistence?* World Bank Policy Research Working Paper No 3881 (The World Bank, April 2006).

Chaserant, C.. 'Cooperation, contracts and social networks: From a bounded to a procedural rationality approach', *Journal of Management and Governance*, Vol. 7, (2003) pp 163-186.

Chernozhukov, V and I. Fernandez-Val, 'Subsampling Inference on Quantile Regression Processes', *Sankhya*, (2005), 67(2), pp. 253-276.

Ciaian, P. and Swinnen, J.F.M. 'Land market imperfections and agricultural policy impacts in the new EU Member States: a partial equilibrium analysis', *American Journal of Agricultural Economics*, Vol. 88, (2006) pp. 799-815.

COM(2011) 627 final/2 Proposal for a Regulation of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD), Brussels 19.10.2011.

Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD), Official Journal of the European Union, L277 21.10.2005.

Davidova, S. 'Semi-subsistence farming: An elusive concept posing thorny policy issues', Presidential address, *Journal of Agricultural Economics* Vol. 62, (2011) pp. 503-524.

Davidova, S., Fredriksson, L. and Bailey, A. 'Subsistence and semi-subsistence farming in selected EU new Member States', *Agricultural Economics*, Vol. 40, (2009) pp. 733-744.

Davidova, S., Fredriksson, L., Gorton, M., Mishev, P. and Petrovici, D. 'Subsistence farming, incomes and agricultural livelihoods in the new Member States of the European Union, *Environment and Planning C Government and Policy*, Vol. 30 (2012) pp. 209-227.

Davis, J., Buchenrieder. G. and Thomson, K. 'Rural Credit for Individual Farmers: A Survey Analysis of Rural Financial Markets', in Davidova S. and Thomson K. (eds) (2003) *Romanian Agriculture and Transition toward the EU* (Lanham/Boulder/New York/Oxford, Lexington Books).

De Janvry, A., Fafchamps, M. and Sadoulet, E. (1991) 'Peasant household behaviour with missing markets: Some paradoxes explained', *The Economic Journal*, Vol. 101**,** (1991) pp. 1400-1417.

Doksum, K., 'Empirical probability plots and statistical inference for nonlinear models in the two sample case', Annals of Statistics, 2 (1974), pp. 267–277.

Eide, E. and Showalter, M. H., The effect of school quality on student performance: A quantile regression approach, *Economics Letters*, 58, (1998), 345–350

European Network for Rural Development (ENRD). *Semi-subsistence farming in Europe: Concepts and key issues* (Background paper prepared for the seminar "Semi-subsistence farming in the EU: Current situation and future prospects", Sibiu Romania 13-15 October 2010) available at: http://enrd.ec.europa.eu/app_templates/filedownload.cfm?id=FB3C4513-AED5-E24F-E70A-F7EA236BBB5A (last accessed 1 November 2011).

Fan, J. and Li, R. (2001), 'Variable selection via nonconcave penalized likelihood and its oracle properties', *Journal of the American Statistical Association*, Vol. 96, (2001) pp. 1348-1360.

Fritzsch, J., Wegener, S., Buchenrieder, G., Curtiss, J. and Gomez y Paloma, S. 'Is there a future for semi-subsistence farm households in Central and Southeastern Europe? A multiobjective linear programming approach', *Journal of Policy Modeling*, Vol. 33, (2011) pp. 70-91.

Gelfand, A. E., A. F. M. Smith and T.-M. Lee, 'Bayesian Analysis of Constrained Parameter and Truncated Data Problems Using Gibbs Sampling', *Journal of the American Statistical Association*, 87(418), (1992) pp. 523-532.

Hans, C. 'Bayesian lasso regression', *Biometrika*, Vol. 96, (2009) pp. 835–845.

He, X. and L.X. Zhu, 'A lack-of-fit test for quantile regression', *Journal of the American Statistical Association*, 98(464), (2003), pp. 1013–1022.

Ji, Y., N. Lin and B Zhang, 'Model selection in binary and tobit quantile regression using the Gibbs sampler', *Computational Statistics & Data Analysis*, 56(4), (2012), pp. 827–839.

Key, N., Sadoulet, E. and De Janvry, A. 'Transactions costs and agricultural household supply response, *American Journal of Agricultural Economics*, Vol, 82**,** (2000) pp. 245-259.

Koenker, R. 'Quantile Regression for Longitudinal Data' , *Journal of Multivariate Analysis*, 91, (2004), pp. 74-89.

Koenker, R. and Bassett, G. 'Regression quantiles', *Econometrica*, Vol. 46, (1978) pp. 33-50.

Koenker, R. and Machado, J. 'Goodness of fit and related inference processes for quantile regression', *Journal of the American Statistical Association*, Vol. 94, (1999) pp. 1296-1310.

Koenker, R. *Quantile Regression* (Econometric Society Monograph Series, Cambridge: Cambridge University Press, 2005).

Kostov, P. and J. Lingard 'Subsistence agriculture in transition economies: its roles and determinants', *Journal of Agricultural Economics*, Vol. 55, (2004) pp. 565-579.

Kostov, P. and J. Lingard 'Subsistence farming in transitional economies: lessons from Bulgaria', *Journal of Rural Studies*, Vol. 18, (2002) pp. 83-94.

Langlois, R. (1992). 'Transaction cost economics in real time', *Industrial and Corporate Change*, Vol1, (1992) pp. 99-127.

Latruffe, L. 'The impact of credit market imperfections on farm investment in Poland', *Post-Communist Economies*, Vol. 17, (2005) pp. 349-362.

Latruffe, L., Davidova, S. and Desjeux, Y. Perpetuation of subsistence farming in Western Balkans: The role of factor market imperfections. *82nd Annual Conference of the UK Agricultural Economics Society (AES)* (Royal Agricultural College, 31 March-2 April 2008).

Latruffe, L., Davidova, S., Douarin, E. and Gorton, M. 'Farm expansion in Lithuania after accession to the EU: The role of CAP payments in alleviating potential credit constraints', *Europe-Asia Studies*, Vol. 62, (2010) pp. 351-365.

Li, Q., Xi, R. and Lin, N. 'Bayesian regularized quantile regression', *Bayesian Analysis*, Vol. 5, (2010) pp. 1-24.

Li, Y. and Zhu, J. 'L1-Norm quantile regression', *Journal of Computational and Graphical Statistics*, Vol. 17, (2008) pp. 1-23.

Löfgren, H. and Robinson, S. 'Nonseparable farm household decisions in a computable general equilibrium model', *American Journal of Agricultural Economics,* Vol. 81**,** (1999) pp. 663-670.

Macours, K. and Swinnen, J. F. M. 'Agricultural Labor Adjustments in Transition Countries: The Role of Migration and Impact on Poverty', *Review of Agricultural Economics*, Vol. 27, (2005) pp. 405-411.

Miracle, M. 'Subsistence agriculture: Analytical problems and alternative concepts', *American Journal of Agricultural Economics,* Vol. 50, (1968) pp. 292-310.

Möllers, J., Buchenrieder, G. and Csaki, C. (eds.) *Structural Change in Agriculture and Rural Livelihoods: Policy Implications for the New Member States of the European Union* Vol. 61 (IAMO: Haale, 2011).

Park, T. and Casella, G. 'The Bayesian LASSO', *Journal of the American Statistical Association,* Vol. 103, (2008) pp. 681-686.

Petrick, M. 'A microeconometric analysis of credit rationing in the Polish farm sector', *European Review of Agricultural Economics,* Vol. 31, (2004) pp. 77-101.

Petrick, M. and Tyran, E. 'Development perspective of subsistence farmers in Southeastern Poland: Social buffer stock or commercial agriculture' in Abele, S. and Frohberg, K. (eds.), *Subsistence agriculture in Central and Eastern Europe: How to break the vicious circle* (conference proceedings, IAMO: Halle, 2003).

Petrovici, D. and Gorton, M. 'An evaluation of the importance of subsistence food production for assessments of poverty and policy targeting: Evidence from Romania', *Food Policy,* Vol. 30**,** (2005) pp. 205-223.

Powell, D, 'Unconditional Quantile Regression for Exogenous or Endogenous Treatment Variables', (2011), WR-824, RAND Labor and Population working paper series.

Powell, J. L. 'Censored Regression Quantiles' *Journal of Econometrics,* 32, (1986), pp.143-155.

Reed, C., Dunson, D. and Yu, K. *Bayesian variable selection in quantile regression*, Technical report (Department of Mathematical Sciences, Brunel University, 2009).

Rizov, M. and Swinnen, J. F. M. 'Human capital, market imperfections, and labor reallocation in transition', *Journal of Comparative Economics,* Vol. 32, (2004) pp. 745-774.

Stiglitz, J. E. and Weiss, A. 'Credit rationing in markets with imperfect information', *American Economic Review*, Vol. 71, (1981) pp. 393-410.

Swinnen, J. and Gow, H. 'Agricultural credit problems and policies during the transition to a market economy in Central and Eastern Europe', *Food Policy*, Vol. 24, (1999) pp. 21-47.

Swinnen, J. and Vranken L. *Review of transitional restrictions on acquisition of agricultural land in NMS* (Brussels: CEPS, 2008) available at: http://ec.europa.eu/internal_market/capital/docs/study_en.pdf (last accessed 6 January 2012).

Tibshirani, R. J. 'Regression shrinkage and selection via the LASSO', *Journal of the Royal Statistical Society, Series B*, Vol. 58, (1996) pp. 267-288.

Wharton, C. R. Jr. 'Subsistence agriculture: Concepts and scope, in Wharton, C. R. Jr (ed), *Subsistence Agriculture and Economic Development* (New Brunswick, NJ: Transaction Publishers, (1969), pp.12-20).

Wu, Y. and Liu, Y. 'Variable selection in quantile regression', *Statistica Sinica*, Vol. 19, (2009) pp. 801–817.

Yu, K. and Moyeed, R. A. 'Bayesian quantile regression', *Statistics and Probability Letters*, Vol. 54, (2001), pp. 437-447.

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The definitive version is available at wileyonlinelibrary.com

Zou, H. and Yuan, M. 'Regularized simultaneous model selection in multiple quantiles regression', *Computational Statistics & Data Analysis*, Vol. 52, (2008) pp. 5296–5304.

This paper has been published as: Kostov, P. and S. Davidova (2012) A Quantile Regression Analysis of the Effect of Farmers' Attitudes and Perceptions on Market Participation, Journal of Agricultural Economics, http://dx.doi.org/10.1111/j.1477-9552.2012.00366.x
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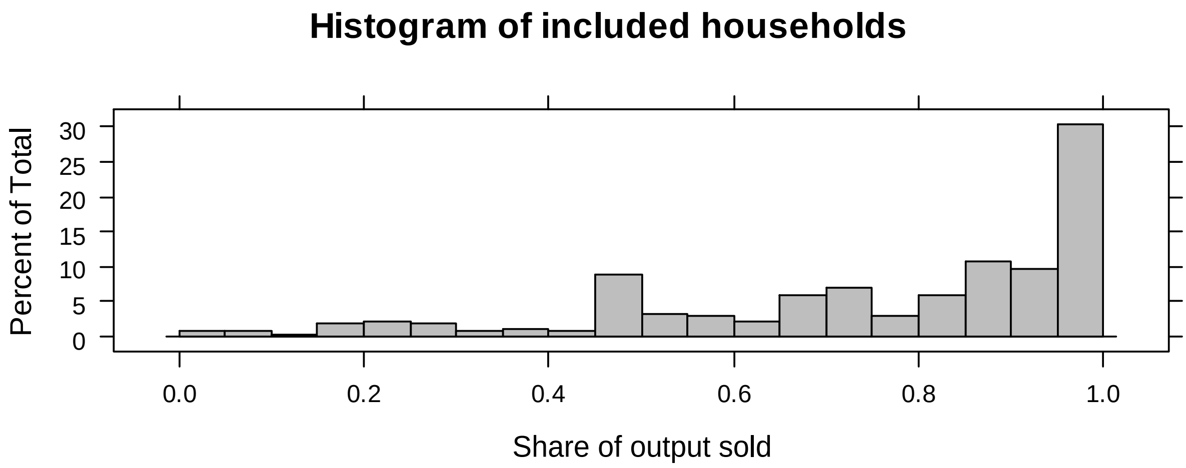
Figure 1. Histograms of the households included and excluded from the analysed sample, according to the share of output sold.



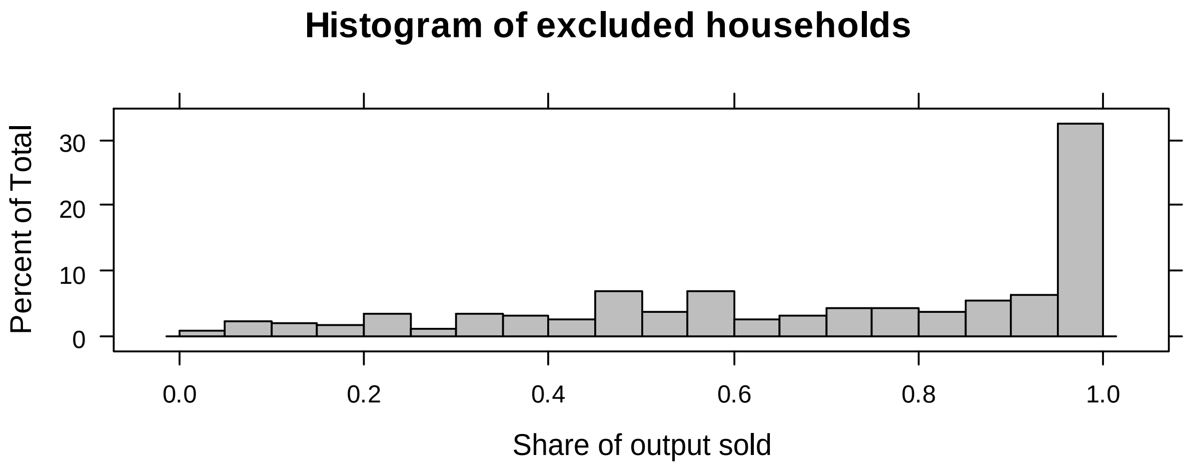


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Table 1. Tests of the difference between farms included in and excluded from the sample (in term of the market participation values)

Test	Test Statistic	P-value
T-test	2.97	0.00
Wilcoxon test	73244.5	0.08

Table 2. Description of the variables retained in the model

Variable	Description	Measure
E15h	Rate the importance of Insufficient availability of low cost credit for why no household member currently works self-employed in a non-farm business:	(1) Not important to (5) Very important
F7	How is your overall cash incomes and consumption in kind compared with 2003	(1) much worse off to (5) much better off
H2	**Statements regarding your current aims for agricultural production**	**(1) totally disagree to (5) totally agree**
H2b	To provide work for household members	
H2e	To generate cash income	
H3c	Statements about agricultural production: We use agricultural business advice and information	(1) totally disagree to (5) totally agree
H6	**Possible constraints to increase agricultural production**	**(1) totally disagree to (5) totally agree**
H6f	We lack information and advice on markets and prices	
H6g	We cannot meet the standards of buyers or public regulations	
K4	There is a potential successor, but we do not know whether he/she will really continue the farming activities	Yes=1
K5	Evaluation of the economic prospects of the farm within a timeframe of 5 years	(1) Not competitive/Low profitability to (5) Very competitive/High profitability
K8b	How would contracts with influence the probability of your household investing in farming	(1) No influence to (5) High influence
K10a	Judgement about household's abilities to adapt to the EU veterinary and phytosanitary standards	1) Very difficult to (5) Very easy
I6_2006	How do you judge the contribution of your own food production to your household's welfare	(0) Not Important to (2) Very important
G9	**Agreement with statements about buying/renting in and selling/renting out land**	**(1) totally disagree to (5) totally agree**
G9a	We would like to buy more land	
G9d	Legal procedures make it difficult to buy land	
G9f	We would like to rent in more land	
G9j	We would like to sell land	
G9o	We would like to rent out land	

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Table 3. Descriptive statistics of the variables retained in the model

	All countries		Bulgaria		Hungary		Poland		Romania		Slovenia	
	mean	standard deviation	mean	standard deviation	mean	standard deviation	mean	standard deviation	mean	standard deviation	mean	standard deviation
TS	0.77	0.24	0.73	0.27	0.84	0.23	0.83	0.18	0.69	0.16	0.78	0.23
E15h	2.77	1.56	2.73	1.80	2.63	1.423	2.39	1.10	3.59	1.46	3.16	1.12
F7	3.10	0.79	3.10	0.85	2.94	0.76	3.14	0.67	3.44	0.67	2.79	0.86
H2b	3.30	1.50	3.33	1.62	3.19	1.59	3.23	1.13	3.19	1.64	3.68	1.16
H2e	4.05	1.18	4.04	1.36	4.52	0.97	3.61	1.00	4.31	0.82	3.74	0.87
H3c	2.16	1.48	1.45	1.11	3.46	1.57	2.11	1.25	2.00	1.05	3.95	0.97
H6f	2.59	1.40	2.71	1.67	2.23	1.46	2.35	0.83	2.88	1.01	2.89	1.05
H6g	2.34	1.31	2.10	1.52	2.08	1.20	2.61	0.84	3.38	0.79	2.05	0.97
K4	3.19	1.53	2.87	1.53	2.85	1.41	4.56	0.71	2.97	1.33	2.32	1.63
K5	2.63	1.26	2.72	1.43	2.67	1.23	2.37	1.10	2.59	1.04	2.84	0.83
K8b	3.32	1.63	3.18	1.80	2.79	1.59	3.77	1.43	3.97	1.20	3.11	1.20
K10a	2.33	1.38	2.01	1.43	2.67	1.33	2.04	1.19	2.81	1.09	3.63	1.07
I6_2006	1.14	0.79	1.34	0.69	1.04	0.82	0.56	0.71	1.47	0.72	1.26	0.87
G9a	2.52	1.77	2.63	1.93	2.52	1.87	2.40	1.45	2.22	1.72	2.68	1.46
G9d	3.63	1.80	3.41	1.86	2.63	1.65	4.84	1.68	3.66	1.10	3.95	1.08
G9f	2.23	1.70	2.43	1.85	2.08	1.74	2.16	1.49	1.72	1.44	2.42	1.47
G9j	1.87	1.62	2.00	1.88	1.69	1.57	1.88	1.15	1.91	1.71	1.37	0.50
G9o	2.31	1.88	3.04	2.17	1.83	1.79	1.54	0.87	2.06	1.64	1.53	0.61

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Table 4. P values for the He and Zhu (2003) goodness of fit tests without and with heterogeneity

Quantile	P-value	P-value with heterogeneity
0.05	0.95	0.65
0.25	0.27	0.70
0.50	0.95	1.00
0.75	0.80	0.18
0.95	0.90	0.25

Table 5 Subsampling goodness of fit tests

Tests	Test Statistic	Critical value	Conclusion
Quantile	0.05		
Shift	0.63	3.84	Accept
No effect	16.56	3.21	Reject
Quantile	0.25		
Shift	0.62	3.36	Accept
No effect	16.49	3.29	Reject
Quantile	0.5		
Shift	0.62	3.51	Accept
No effect	16.58	3.29	Reject
Quantile	0.75		
Shift	0.63	3.25	Accept
No effect	17.25	3.26	Reject
Quantile	0.95		
Shift	0.63	3.77	Accept
No effect	16.49	3.43	Reject

Table 6. Wald tests for (joint) equality of slopes.

Quantile	Stat	P-value
0.05	4.10	0.00
0.25	8.02	0.00

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0.50	3.37	0.00
0.75	1.58	0.02

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Table 7. Coefficient estimates

	q=0.05		q=0.25		q=0.5		q=0.75		q=0.95	
	Coef	P-Value	Coef	P-Value	Coef	P-Value	Coef	P-Value	Coef	P-Value
E15h	-0.08	0.04					-0.40	0.07	-0.55	0.08
F7	0.49	0.02								
H2b	-0.39	0.00	-0.32	0.00	-0.42	0.06	-0.53	0.06	-0.95	0.09
H2e	0.33	0.05	0.27	0.02			0.60	0.05	1.53	0.00
H3c	0.28	0.01	0.30	0.08						
H6f	0.29	0.01								
H6g					-0.20	0.04	-0.14	0.00	-0.13	0.00
K4			0.07	0.04						
K5	0.43	0.00								
K8b			-0.12	0.00						
K10a							-0.35	0.09	-0.50	0.04
I6_2006	-0.40	0.04								
G9a	0.15	0.04								
G9d							-0.20	0.03	-0.13	0.09
G9f	-0.37	0.00	-0.13	0.04						
G9j	0.33	0.00	0.20	0.03	0.22	0.08	0.32	0.07	0.72	0.04
G9o					-0.26	0.04	-0.34	0.08	-0.59	0.09
Bulgaria	0.00	1.00	0.00	1.00	-0.25	0.17	-2.17	0.02	-1.79	0.05
Hungary	0.00	1.00	0.08	0.52	1.78	0.00	12.20	0.00	6.58	0.04
Poland	0.79	0.04	0.38	0.04	0.00	1.00	0.00	1.00	0.00	1.00
Romania	-0.12	0.53	-0.16	0.15	-0.64	0.04	-2.99	0.01	-7.77	0.06
Slovenia	0.52	0.35	-0.38	0.28	0.05	0.59	0.72	0.81	5.45	0.03

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