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## **DETERMINANTS OF POVERTY IN POLISH FARMERS' HOUSEHOLDS – BINARY CHOICE MODELS APPROACH**

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### **ABSTRACT**

The study investigates relationship between monetary poverty and demographic and socio-economic characteristics of farmers' households in Poland. The empirical analyses are based on the Household Budget Survey carried out by the Central Statistical Office. In order to indicate the group of high risk of poverty binary choice models are applied. Unlike simple arrangements presented in tables these methods allow estimate of "pure" effects of household attributes. The analysis of determinants of poverty provides meaningful insight into the relevance of various policies, such as the feasibility of using targeting devices.

**Key words:** poverty, farmers' households, demographic and socio-economic characteristics, logit and probit model.

*"If a free society cannot help the many who are poor, it cannot save the few who are rich"*

John F. Kennedy, Inaugural speech, 1961/01/20

### **INTRODUCTION**

The transition process from a centralised to a market economy in Poland has been accompanied by an increase in poverty. The analysis of situation of these groups of households which are not in a position to satisfy their basic needs has become of a major concern. Poverty is a great economic and social problem. It leads to the marginalisation of numerous population groups and gives rise to various social pathologies. These are sufficient reasons for counteracting the causes of poverty and reducing it.

Knowledge about poverty in Poland has recently been broadened and enriched. The Institute of Labour and Social Welfare and Central Statistical Office have carried out numerous surveys and comparative studies on the scale of poverty and its forms. The measurement of poverty extent and depth are the basic stages of the study on poverty. However, it does not exhaust all aspects of poverty investigation. The very important issue in such study is determination of factors influencing poverty. It can recognise mechanism of appearance of poverty and it can help create proper social policy.

The aim of this study is research of influence of selected demographic and socio-economic characteristics of being poor in farmers' households. This group of society has been particularly affected by the economic transformation. Uncertain markets and prices for agricultural goods have worsened conditions of farmers' households. It has caused increase of poverty in this group of society.

## **DATA**

Data employed in this study came from the Household Budget Survey carried out by the Central Statistical Office in 2003. This survey was based on the sampling method which allows for the generalisation of the results to the whole population of households within a margin of an error. The number of households participating in the survey was 32452. Household Budget Survey covered households representing six basic socio-economic groups of the population, namely:

- employees' households,
- employees-farmers' households,
- farmers' households,
- households of the self-employed,
- households of retirees and pensioners,
- households living on unearned sources.

In this paper farmers' households were taken into account. In those households exclusive or main source of maintenance is income from used private farm in agriculture. Additional sources of maintenance for this group of households may include old age pension, other types of pension or any other unearned income, self-employments outside a private farm in agriculture, or free profession. The income gained from additional sources is lower than from the private farm in agriculture [2].

Household Budget Survey encompassed 1241 farmers' households in 2003. The data from household budget survey covered information on household incomes, expenditures and on household demographic and socio-economic attributes.

## **METHOD OF ANALYSIS**

The most common definition of poverty is based on income or expenditures of households. Such meaning poverty is called monetary poverty. Poverty in a broader sense covers also deprivation, i.e. lack or shortage of some particular items or resources, like hot meal every day, hot running water etc. The households reported as poor in terms of income or expenditures may reach more than enough in terms of their assets and vice versa [7]. In this study only monetary poverty was taken into account.

There are some pros and cons for using income or expenditures as measurement of monetary poverty [4]. In Polish Household Budget Survey the monthly rotation of households has been implemented since 1993. It assumes that every month of the year a different group of households participates in the survey. The monthly rotation causes the huge seasonality of agricultural income. The seasonality of households' expenditures is lower. The next problem is that the coverage of a number of income sources is weak due to the existence of the informal economy. This is the reason that this poverty assessment uses expenditures (rather than income) since the extent of underestimation is thought to be smaller with expenditures than with income. These are the reasons for the choice of expenditures in this study about poverty.

To adjust household's expenditures to its size and demographic composition OECD 70/50 equivalence scales are applied. This assigns a value of 1 to the first adult household's member, of 0.7 to each additional adult and of 0.5 to each child. So, for example, the scale for two adults with two children is 2.7. Expenditure of household divided by appropriate equivalence scale is called equivalent expenditure.

Indicators of monetary poverty are based on absolute or relative poverty lines. The first type is usually the social minimum or subsistence minimum, the second one is based on median or mean of expenditures (or income). In this study the poverty line is 50% of mean of expenditures in the whole sample of households. Such poverty line is accepted by Central Statistical Office [9]. The household is considered poor if its equivalent expenditure is below the poverty line.

The aim of this study is definition of influence of selected demographic and socio-economic characteristics of being poor. The set of factors considered as potential explanatory variables can be divided into two groups [6]: attributes of the family head and attributes of whole household. The first one encompasses characteristics such as:

- age of the family head,
- female household head,
- level of education of the family head.

The second group contains following attributes:

- number of children,
- lone parent in family,
- receiving pension,
- land area.

In order to indicate the group of high risk of poverty econometric method was applied. In this method dependent and independent variables occur.

Dependent variable Y is defined in following manner: if an i-th household is poor, then  $y_i=1$ , 0 otherwise. In such methods where dependent variable is dummy binary choice models should be applied.

These models assume that  $P_i = P(y_i = 1) = F(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki})$  [Green], where:

$P_i$  – probability,  $i=1,2,\dots,n$ ,  
 $F$  – distribution function,  
 $\beta_j$  – parameters,  $j=0,1,2,\dots,k$ ,  
 $x_{ji}$  – value of explanatory variable  $X_j$  for i-th household,  
 $k$  – number of explanatory variables,  
 $n$  – sample size.

The typical binary choice models are logit and probit models.

In the logit model: 
$$P_i = F(\mathbf{x}_i^T \boldsymbol{\beta}) = \frac{1}{1 + \exp(-\mathbf{x}_i^T \boldsymbol{\beta})}$$

In the probit model: 
$$P_i = F(\mathbf{x}_i^T \boldsymbol{\beta}) = \int_{-\infty}^{\mathbf{x}_i^T \boldsymbol{\beta}} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{t^2}{2}\right) dt$$

where:  $\mathbf{x}_i^T \boldsymbol{\beta} = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki}$ .

Positive estimate of parameter  $\beta_j$  ( $j=1,2,\dots,k$ ) in binary choice models indicates higher than average risk of poverty attributed to a corresponding type of household [8].

Since the cumulative normal and logistic distributions are very close to each other except at the tails, we are not likely to get very different result using the probit model or the logit model, unless the samples are large [5]. In this study both methods are applied for comparison of results.

Estimation of the logit and the probit models are usually based on the method of maximum likelihood. That is reason why many measures of goodness of fit are computed on the ground of maximum value of log-likelihood function. In this study one of them is applied:

$$R_{McFadden}^2 = 1 - \frac{\ln \hat{L}_{UR}}{\ln \hat{L}_R}$$

where

$\hat{L}_R$  - the maximum of the likelihood function when maximized with the restriction  $\beta_j = 0$  for all  $j=1, 2, \dots, k$ ,

$\hat{L}_{UR}$  - the maximum of the likelihood function when maximized with respect to all the parameters.

This measure is bounded by 0 and 1.  $R_{McFadden}^2$  increases as the fit of the model improves [Green].

Another measure of goodness of fit used in this study is proportion of correct predictions [Maddala], where

$$\text{count } R^2 = \frac{\text{number of correct predictions}}{\text{total number of observations}}$$

The higher value of *count*  $R^2$  the better fit of model to data.

For testing hypotheses about the parameters likelihood ratio statistics can be computed.

$H_0: \beta_1 = \beta_2 = \dots = \beta_k = 0,$

$H_1: \text{at least one } \beta_j \neq 0, j = 1, 2, \dots, k.$

The likelihood ratio statistic is  $LR = -2(\ln \hat{L}_R - \ln \hat{L}_{UR})$ . If the hypotheses are true, then, asymptotically, the test statistic has  $\chi^2$  distribution with  $k$  degrees of freedom [3]. For testing hypotheses about the parameters the simplest method for a single parameter is based on the usual  $t$  tests [1].

The logit and probit models are used to indicate household's attributes correlated with high risk of being poor.

## RESULTS

In order to estimate parameters of models and to compute goodness of fit measures programs Statistica, Gretl and Statgraphics were used. The stepwise regression method was applied for the selection of explanatory variables. In the first stage of this method all mentioned before characteristics of the family head and attributes of whole household were taken into account. In final models there are 8 explanatory variables. The results are presented in [table 1](#).

**Table 1. Result of estimation of the logit and the probit models**

Variable	The logit model			The probit model		
	Estimate	Standard error	t-Statistic	Estimate	Standard error	t-Statistic
$C_2$	0.6122	0.1594	3.842	0.3700	0.0961	3.851
$C_3$	0.9394	0.1852	5.070	0.5569	0.1120	4.972
$C_4$	1.7057	0.2204	7.721	1.0239	0.1332	7.684
$E_h$	-1.6990	0.7658	-2.219	-0.9831	0.4027	-2.441
$E_s$	-0.9072	0.2209	-4.106	-0.5318	0.1282	-4.147
$E_v$	-0.3653	0.1409	-2.592	-0.2257	0.0855	-2.639
<i>Land</i>	-0.0597	0.0086	-6.980	-0.0326	0.0045	-7.220
$P$	-0.8800	0.4424	-1.989	-0.4949	0.2495	-1.984
$LR$	161.299			157.773		
$R^2_{McFadden}$	0.1007			0.0985		
<i>count</i> $R^2$	0.6950			0.6910		

Source: Own calculations based on Household Budget Survey data.

For results presented in [table 1](#) critical value are equal: for  $t$ -test is  $t_{0.05}(1232) = 1.9619$  and for likelihood ratio test:  $\chi^2_{0.05}(8) = 15.5073$ , where degrees of freedom are in parenthesis. Because all computed statistics are greater than appropriate critical values, we can reject appropriate null hypotheses. All parameters in final models are statistically significant at level  $\alpha = 0.05$ .

Review of the results presented in the table 1 indicates that that results for the logit and the probit are comparable. Signs of estimates of appropriate parameters are the same in both models. A slightly better fit is in the logit then the probit model.

The meaning of variables in [table 1](#) is following:

- $C_2$  equals 1, if household has two children, 0 – otherwise,
- $C_3$  equals 1, if household has three children, 0 – otherwise,
- $C_4$  equals 1, if household has four or more children, 0 – otherwise,

- $E_h$  equals 1, if household's head has higher or post-secondary education, 0 – otherwise,
- $E_s$  equals 1, if household's head has only secondary education, 0 – otherwise,
- $E_p$  equals 1, if household's head has only vocational education, 0 – otherwise,
- Land – land area in hectare,
- P equals 1, if household received pension, 0 – otherwise.

Positive estimate of parameters occurs at variables  $C_2$ ,  $C_3$ , and  $C_4$ . It denotes that risk of poverty was on average higher in households with at least two children than in households without children or with one child, *ceteris paribus*.

Negative estimate of parameters corresponding to variables  $E_h$ ,  $E_s$ ,  $E_p$  may be interpreting in following manner: the risk of poverty was on average lower in households with head with at least vocational education comparing with households where head had only primary education, *ceteris paribus*.

Negative sign of estimate of parameter at variable "Land" indicates that increase of land area decreased the risk of poverty in household, *ceteris paribus*.

Negative estimate of parameters at P denotes that the risk of poverty was on average lower in households receiving pension than in households without such support, *ceteris paribus*.

## CONCLUSIONS

The analysis of determinants of poverty provides meaningful insight into various poverty-generating factors. It needs to be stressed that major human capital variables – level of education of household head significantly affected households' poverty. The higher the educational attainment of household head was, the lower the chance of living in poverty occurred. The exclusive or main source of maintenance in farmers' households was income from used farm. That income was often very small. Additional sources of maintenance like pension decreased the risk of poverty. The higher the farm area was, the lower the likelihood of experiencing poverty occurred. The chances of a household being poor were related to size and demographic structure. Households with at least two children were more likely to be poor than households without children or with one child. Obtained results should create elements of a more active and effective policy of preventing poverty, removing its causes and significantly reducing its scale.

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