FACTORS INFLUENCING THE ABILITY OF EUROPEAN HOUSEHOLDS TO MANAGE WITH THE FINANCIAL RESOURCES

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Abstract

The article focuses on the examination of the ability of European households to manage the financial resources depending on various social factors. The objective evaluation of managing households with the financial resources and analyses of the causes of this situation cannot be performed. Information from survey EU-SILC (European Union Statistics on Income and Living Conditions) allows performing only subjective analyses of dealing with the money. For this research we used answers to a question about ability to make ends meet (defined as the variable HS120). This analysis includes identifying the influence of various household´s characteristics such as their equivalized income, sex, age, educational level and self-defined current economic status of the head of household, household type, dwelling type, total housing costs and country. Logistic regression (logit model specifically) was used to estimate the impact of these factors on the choice of the positive or negative answer to the question about ability to make ends meet. Sampling survey EU-SILC 2011 has been used for this research.

Key words: Ability to make ends meet, EU-SILC, household, logistic regression

JEL Code: D31, I32, R10

Introduction

The current financial crisis is most influenced by the relatively poor households – households with incomes below the poverty line or in its vicinity. As a result of this crisis rising unemployment, increases the risk of poverty and households often have problems with financing expensive commodities of long-term consumption. Poverty and financial problems have higher affect the "lower" layers of our society that with less access to the labour market. Of course, there are differences depending on sex, age, educational level, country, region and other factors. At higher concentration of the risk factors, such as a low or high age, a low level

of education, a lack of employment opportunities in the region, etc., you can expect a higher unemployment rate, poverty rate and frequently financial problems. For more information see e.g. (Bartošová & Želinský, 2013), (Bílková, 2013), (Fiala & Langhamrová, 2013), (Malá, 2013), (Pacáková & all., 2012), (Řezanková & Löster, 2013), (Stankovičová, 2010), (Vojtková & Labudová, 2010) or (Želinský, 2014).

The objective evaluation of managing households with the financial resources and analyses of the causes of this situation cannot be performed. Date files which include the sufficiently detailed information are not available. A sample survey EU-SILC (European Union Statistics on Income and Living Conditions) is the only detailed survey of income and social situation of household whose results we can use. The EU-SILC is an instrument aiming at collecting timely and comparable cross-sectional and longitudinal multidimensional micro data on income, poverty, social exclusion and living conditions. This sample survey is obligatory for all states of EU and ensures comparability of survey results. For the first time this investigation was carried out in EU in 2004 (in the Czech Republic in 2005 under the name Living Conditions). Long-term monitoring allows creating a picture of the financial development of the households and to model changes over time. For more information see e.g. (Bílková, 2013), (Marek & Vrabec, 2014) or (Marek, 2013).

Information from survey EU-SILC allows performing only subjective analyses of managing with the money. These date resources include the answers to questions about ability to make ends meet (variable HS120), capacity to face unexpected financial expenses (variable HS060), etc. These answers allow monitoring the subjective feelings and opinions. The subjective approach allows finding out how people feel to be satisfied with the financing of needs of households. It is more a sociological approach to this problem. Its results are interesting not only for sociologists but too for bank institution and other financial institution which provide the loans to households.

1 Logistic regression

The Generalized Linear Models (GLM) were created due to requirements for working with the real data. The Generalized Linear Models have broader range and are more flexible. These models add the categorical factors to the regression functions. The Generalized Models extend the Classical Liner Models of other fixed (non-random) effects by including categorial explanatory variables (factors). These models model the other types of dependent variables:

- Continuous dependent variable with other than the normal distribution (distribution of exponential type (McCullagh & Nelder, 1989)
- Dichotomous (binary) dependent variable
- Countable dependent variable.

The linear predictor which is in the Generalized Model

$$\eta_i = \mathbf{x}_i\boldsymbol{\beta} = \sum_{j=1}^{m} x_{ij}\beta_j \qquad (1)$$

where $\mathbf{x}_i$ is vector of independent variables *i*-th of examined unit with averaged fixed effects which are created the components of the vector of parameters $\boldsymbol{\beta}$. This vector has not to explain directly the conditional mean value μ_i of dependent variable Y_i but any function of conditional mean value $g(\mu_i) = \eta_i$, where g is differentiable and strictly monotone link function. This function gives the opportunity to construct of the regression models with other (non-normal) distribution of random variable. The Generalized Linear Models are containing from three components which have to be specified. Three components are:

- Linear predictor η_i with the vector of parameters (fixed effects) $\boldsymbol{\beta}$
- Mean value μ_i which is connected with the linear predictor by link function g
- Variance function (Bartošová, 2013).

These models include linear regression with categorical factors, logistic regression and Poisson regression. It is reasons why these models (GLM) are better in modelling of influence of external and internal factors on incomes, expenditures, poverty and other socio-economic variables.

Typical representatives of the GLM are the models with discrete (dichotomous) dependent variable where probability is estimated mean value and linear predictor is

$$g(\pi_i) = \eta_i = \mathbf{x}_i\boldsymbol{\beta} = \sum_{j=1}^{m} x_{ij}\beta_j \qquad (2)$$

Logit function is the most useful link function in these models which is defined like

$$g(\pi_i) = \text{logit}(\pi_i) = \ln\frac{\pi_i}{1-\pi_i} \qquad (3)$$

The relationship between the probability and the vector of explanatory variables is non-linear and you will receive it by back transformation. This is an exponential function of the form

$$\pi_i = \frac{e^{\mathbf{x}_i\boldsymbol{\beta}}}{1+e^{\mathbf{x}_i\boldsymbol{\beta}}} = \frac{e^{\sum_{j=1}^{m} x_{ij}\beta_j}}{1+e^{\sum_{j=1}^{m} x_{ij}\beta_j}} \qquad (4)$$

The parameters of this regression model are estimated by maximal likelihood method. The algorithms for finding of these estimates are implemented in commonly available statistical programs like S-PLUS, SAS, Statgraphics, etc. The availability of program support is the one of the main factors which contributes to frequent using of logistic regression in data analysis. The second important factor is easy and straightforward interpretation of estimates of parameters of logistic regression model. The *odds* (i.e. ratio of probability of success to probability of unsuccess) are used for interpretation. The formula of odds looks

$$\text{odds} = \frac{\pi_i}{1-\pi_i} = \text{e}^{\,\text{logit}(\pi_i)} \qquad (5)$$

The odds are generally known and are used even outside of statistics for example when betting. Odds ratio is used for expressing the influence of particular regressors on the dependent variable (Šimpach, 2013).

The testing of statistical significance of variables in model we can made with Likelihood Ratio Tests, or with Wald´s test which allow testing all categorial variables together. Log-likelihood function or deviance represents the quality of models. ROC curve (Receiver operating characteristic curve) is often used too. This curve represents the relation between the sensitivity of classification and the complement to her specificity. The sensitivity and specificity can be combined to only one evaluating statistic, i. e. likelihood ratio. AUC statistic (Area under the ROC curve) is derived from ROC curve. AUC statistic indicates the size of the area between ROC curve and the diagonal of unit square determining all combinations of sensitivity and complements of specificity. The quality of classification increases with the growth of deviation ROC curve from the diagonal (Bartošová, 2013).

1.1 Logistic model of the ability to make ends meet

Logistic regression (logit model) was chosen from the group of Generalized Linear Models (GLM) for the modelling dependence of risk of European household inability to make ends meet on the chosen factors. Through logistic regression model, we find the conditional probability that the household is unable to make ends meet, depending on the selected quantitative and qualitative factors. Description of the variables using in this regression

analysis is shown in Table 1. As the dependent variable in the regression model enters the binary variable HS120 – ability to make ends meet – and our task is to model the value 1, i.e. the household is able to make ends meet (household is able to make ends meet fairly easily, or easily, or very easily).

Tab. 1: Description of the variables of regression analysis.

Code	Variable	Value	Variant
DEPENDED VARIABLE (regressant)			
HS120	ABILITY TO MAKE ENDS MEET	0	with great difficulty with difficulty with some difficulty
		1	fairly easily easily very easily
EXPLANATORY VARIABLES (regressors, factors)			
HB020	COUNTRY	AT CY CZ LV SK	Austria Cyprus Czech Republic Latvia Slovak Republic
HH010	DWELLING TYPE	1 2 3 4 5	detached house semi-detached or terraced house apartment or flat in a building with less than 10 dwellings apartment or flat in a building with 10 or more dwellings some other kind of accommodation
HH070	TOTAL HOUSING COST		EUR / month
HX060	HOUSEHOLD TYPE (EU definition)	5 6 7 8 9 10 11 12 13 16	one-person household 2 adults (both 65 years) without dependent children 2 adults (at least one over 65 years) without depend. children other households without dependent children 1 parent with one or more dependent children 2 adults with 1 dependent child 2 adults with 2 dependent children 2 adults with 3 or more dependent children Other households with dependent children Other households (cannot specify the type)
HX090	EQUALIZED INCOME		EUR / year
PB140x	AGE		2010 – year of birth
PB150	SEX	1 2	man woman
PE040	HIGHEST EDUCATIONAL LEVEL	0 1 2 3 4 5 6	pre-primary education primary education lower secondary education (upper) secondary education post-secondary non tertiary education first stage of tertiary education[1] second stage of tertiary education[2]
PL031	SELF-DEFINED CURRENT ECONOMIC STATUS	1 2 3 4	employee working full-time employee working part-time self-employed working full-time[3] self-employed working part-time[3]

[1] not leading directly to an advanced research qualification

[2] leading to an advanced research qualification

[3] including family worker

		5	unemployed
		6	pupil, student, further training, unpaid work experience
		7	in retirement or in early retirement or has given up business
		8	permanently disabled or/and unfit to work
		9	in compulsory military community or service
		10	fulfilling domestic tasks and care responsibilities
		11	other inactive person
PL200	NUMBER OF YEARS SPENT IN PAID WORK		year

Source: EU-SILC 2011

The analysis used data from a large European sample survey of income and social situation of households EU SILC 2011. Total number of explanatory variables used were 10, 4 variables were quantitative (HH070 – total housing cost, HX090 – equivalised income, PB140x – age, PL200 – number of years spent in paid work) and 6 were categorical (HB020 – country, HH010 – dwelling type, HX060 – household type (EU definition), PB150 – sex, PE040 – highest educational level, PL031 – self-defined current economic status). Calculations were performed in the program Statgraphics Centurion XVI. To estimate the parameters of the model we used maximum likelihood method. The quality of the model was assessed using deviance.

Table 2 shows which variables have a statistically significant effect on the ability households make ends meet. We can see that three variables – age (PB140x), household type (HX060) and the number of years spent in paid work (PL200) are not significant. We will therefore model reduction. The resulting model is obtained using stepwise selection methods (significance level 0.05), which allows the gradual exclusion and inclusion of variables into the model. The estimated model is of good quality – percentage of deviance explained by model is 82. 2034 and adjusted percentage is 82. 0027. Analysis of deviance showed that the logistic model is a statistical significant. Adjusted percentage is 82, 0027, it means that the model has a relatively high quality.

Tab. 2: Likelihood Ratio Tests (original model).

Factor	Chi-Square	Df	P-Value
PB140x	**1.42202**	**1**	**0.2331**
HX090	44.4596	1	0.0000
PL200	**0.673796**	**1**	**0.4117**
PB150	24765.5	1	0.0000
PE040	317.911	5	0.0000
PL031	173.227	10	0.0000
HB020	121.54	4	0.0000
HH010	2791.59	3	0.0000
HX060	**8.12204**	**9**	**0.5219**

Source: own calculation (output from Statgraphics Centurion XVI)

Tab. 3: Likelihood Ratio Tests (reduced model).

Factor	Chi-Square	Df	P-Value
HX090	48.8155	1	0.0000
PB150	24788.7	1	0.0000
PE040	319.646	5	0.0000
PL031	429.522	10	0.0000
HB020	124.986	4	0.0000
HH010	2895.07	3	0.0000

Source: own calculation (output from Statgraphics Centurion XVI)

From the values listed in the Table 3 it is apparent that the significance of significant variables after reduction increased. The statistical significance of the impact of each factor on the resulting conditional probability arises from the values of the test statistics (Chi -Square) based on one degree of freedom (df). The statistical significance of this effect can be assessed as well as the order in which the various factors included in the model iterative procedure.

Tab. 4: Estimates of the model parameters and odds ratio (Maximum Likelihood)

Parameter	Estimate	Standard Error	Odds Ratio
CONSTANT	-0,223211	0,502292	
HX090	0,0000310886	0,00000487884	1,00003
PB150=1	**-50,6481**	**3,29452**	**$1{,}00882 \cdot 10^{-22}$**
PE040=0	**10,1897**	**16,8168**	**26626,8**
PE040=1	**10,5312**	**10,0379**	**37465,8**
PE040=2	**12,5805**	**5,27031**	**290826,**
PE040=3	0,473595	0,0700688	1,60576
PE040=4	-0,422005	0,130712	0,655731
PL031=1	-0,931014	0,497073	0,394154
PL031=2	-0,892681	0,522524	0,409556
PL031=3	-0,962574	0,508185	0,381909

PL031=4	-0,808947	0,616901	0,445327
PL031=5	-1,22701	0,520797	0,293169
PL031=6	-0,544708	0,639447	0,580011
PL031=7	0,552972	0,500537	1,73841
PL031=8	1,06144	0,590757	2,89054
PL031=9	3,6766	316,28	39,5119
PL031=10	0,420456	0,603792	1,52266
HB020=AT	1,00689	0,130992	2,73707
HB020=CY	-0,744546	0,24221	0,47495
HB020=CZ	0,435698	0,080444	1,54604
HB020=LV	-0,054697	0,0940652	0,946772
HH010=1	**17,0265**	**3,74677**	**$2{,}48028 \cdot 10^{7}$**
HH010=2	**19,4293**	**6,16839**	**$2{,}74171 \cdot 10^{8}$**
HH010=3	**19,5629**	**5,85378**	**$3{,}13371 \cdot 10^{8}$**

Source: own calculation (output from Statgraphics Centurion XVI)

Rank (from most to least significant variables) was: PB150 (step 1), HH010 (step 2), PL031 (step 3), HB020 (step 4), PE040 (step 5) and HX090 (step 6). Adjusted Percentage reduction model is performing slightly increased to 82.0352.

Quantification and interpretation of the impact of significant factors on the ability to make ends meet is determined by the estimated model parameters and the corresponding odds ratio (see Table 4). Variants of the model variables that have a positive effect (increasing the odds of the ability of households to make ends meet) compared to the reference group are shown black. Variants that reduce these odds are shown red in Table 4. The reference group includes households, corresponding to the following variants of variables:

- HB020 = SK Slovak Republic
- HH010 = 4 some other kind of accommodation
- PB150 = 2 woman
- PE040 = 6 second stage of tertiary education[4]
- PL031 = 11 other inactive person

We can see, for example, that the value of equivalised household income (i.e. comparable income households with different size and structure) has not a significant effect

[4] leading to an advanced research qualification

on the ability of household to make ends meet. The odds ratio is close to unity at increasing the equivalised income (variable HX090) of the unit. The largest decrease the chances of the ability of households to make ends meet has sex of the head of households. If a woman head of household (usually a single parent), then the odds is near zero compared to household headed by a man (odds ratio is $1.00882 \cdot 10^{-22}$). The largest increase chances on the ability of households to make ends meet has a different type of apartment from "any other type of accommodation". Also different types of the highest educational level have a significant impact on the ability of households to make ends meet.

Conclusion

Using logistic regression, we detected significant factors that affect the ability of households to make ends meet. We quantified the impact of these factors on the observed variables HS120 (1 – households are able to make ends meet). As a result, we obtained estimates of the parameters of the logistic model and the corresponding odds ratio, showing how the ability to make ends meet increases or decreases compared to the reference variants. The estimated model cannot be considered definitive. In the next phase we will try to extend the model to other EU countries, and focus on the detection of local and global differences.

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