

ASSESSMENT OF THE RISK OF MONETARY POVERTY IN POLISH HOUSEHOLDS

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Abstract: Traditionally, the financial status of households is ascribed by categorizing them as either poor or nonpoor. This study does not make use of such categorization when assessing monetary poverty. Instead, it employs elements of the theory of fuzzy sets. Thus, each household was given a value from the interval $[0,1]$ that indicated the degree of financial poverty according to its equivalised income. The analysis was based on data from household budget survey conducted by the Central Statistical Office in 2010.

Keywords: identification of the poor, monetary poverty, risk of poverty, poverty in Poland

INTRODUCTION

Monetary poverty is defined as poverty indicated by the financial status of households. Traditionally, households are categorized by ascribing them to either of just two subsets: poor or nonpoor. Such a restrictive categorization does not take into account differences in achieved values of monetary indicators. Moreover, a particular poverty line needs to be used, which affects any obtained results. Therefore, instead of dividing households into two categories, one can determine the risk of poverty. This solution was first developed by Cerioli and Zani, who, following the theory of fuzzy sets, proposed a linear membership function [Cerioli, Zani 1990]. A membership function ascribes each household a value that indicates the risk of poverty. Publications on the subject provide different forms of the membership function [Dudek, Landmesser 2010]. The most popular forms include the linear function [Cerioli, Zani 1990], the empirical distribution function [Cheli, Lemmi 1995], the function that limits the effect of ranks on the degree of risk of poverty [Betti, Verma 1999], and the function that

takes into account the empirical distribution function together with the limited effect of ranks [Betti, Verma 2008].

This study assessed the risk of monetary poverty in Polish employees' households by using a risk of poverty indicator based on a membership function developed by Cheli and Lemmi. Values of the membership function were obtained based on equivalised incomes according to the *OECD*_{70/50} scale. The obtained values of the risk of poverty indicator were compared in terms of selected characteristics of a household. The analysis did not include nonmonetary dimensions of poverty.

METHODOLOGY

Comparability of Monetary Indicators Between Households

Income and consumption expenditure are the most frequently used monetary indicators. A comparison of household wealth based on nominal values of these indicators does not include demographic differences through which a household's income is divided among all its members. Income is usually divided unequally between the members [Rusnak 2007]. Furthermore, multimember households benefit from economies of scale, meaning that the individual cost of living decreases with the increase of the number of members in a household¹.

Uneven distribution of income between household members and the economies of scale phenomenon require the use of equivalence scales [Dudek 2011]. Equivalence scales are relative, which means that the obtained equivalised income is compared to the income of a household with a particular demographic composition, called the reference household. Usually, the reference household is assumed to be a single adult person or two adult persons [Rusnak 2007]. Nowadays, one of the most frequently used equivalence scales in the European Union are the OECD scales. There are two types of OECD scales: *OECD*_{70/50} (also called the OECD original scale) and *OECD*_{50/30} (known as the OECD modified scale). The former ascribes a greater value to large households. The Central Statistical Office of Poland still uses it to determine the poverty line [*Poverty...* 2011]. The value of the *OECD*_{70/50} scale is calculated according to the following formula:

$$OECD_{70/50} = 1 + 0.7 \cdot (d - 1) + 0.5 \cdot c \quad (1)$$

where:

d – number of adult persons in a given household,

c – number of children² in a given household.

¹ This is especially true for expenditures on heating, electricity, and access to the Internet.

² A child is usually defined as a person aged below 15 years [Panek 2007],[*Poverty...* 2011].

The equivalised income of a household is obtained by dividing the nominal income by value of the equivalence scale. For instance, a household comprising two adult persons and one child will have 2.2 on the *OECD*_{70/50} scale. If the nominal income in a household is PLN 4,400, then its equivalised income will be PLN 2,000.

Risk of Monetary Poverty Indicator

The financial situation of a household is one of the most important factors considered when identifying its degree of poverty. Traditionally, this identification involves determining whether the household is poor or not. Thus, each household is divided into one of two subsets: poor or nonpoor. This requires one to determine a threshold value, called the poverty line. A household is considered poor if its income or equivalised expenditures are lower than the poverty line. This method has its limitations. One needs to determine the particular value of a monetary indicator that should constitute the poverty line. The higher the value of the poverty line, the more households are considered poor. Moreover, this approach does not take into account the differences in values of monetary indicators achieved by households. These differences are especially important for households in which the value of income (expenditures) is close to the poverty line³.

To include differences in equivalised income (or expenditures), elements of Zadeh's fuzzy set theory are used. A fuzzy subset A of a set X is defined as ordered pairs $[x, f_A(x)]$ [Zadeh 1965]:

$$A = \{x, f_A(x)\}, x \in X \quad (2)$$

The $f_A(x)$ function is called the membership function of member x of a subset A of a set X . The function takes values from the interval $[0,1]$. In terms of assessing poverty, set X constitutes all households in the sample. Subset A includes poor households, while the values of the membership function $f_A(x)$ indicate the degree to which the household belongs to the poor households subset. If:

- $f_A(x) = 0$, then the household does not belong to the poor households subset;
- $f_A(x) = 1$, then the household fully belongs to the poor households subset;
- $f_A(x) \in (0,1)$, then the household partially belongs to the poor households subset. The membership of a given household is fuller the closer the value of the membership function is to 1.

Membership functions have been introduced to the analyses of poverty by Cerioli and Zani, who proposed that the values of a linear membership function be

³Assuming that the poverty line is equal to the minimum subsistence, which amounted to PLN 443 in 2010 [Poverty... 2011], a household with an income of PLN 442 would be considered poor, whereas a household with an income of PLN 444 would be considered nonpoor. Despite the two households being in a very similar situation, they are classified as belonging to different subsets.

calculated once two threshold values are determined: the value below which poverty is definitely present and the value above which poverty is definitely absent [Cerioli, Zani 1990].

Cheli and Lemmi, to evade arbitrarily defining threshold values, proposed a membership function that used an empirical distribution function [Cheli, Lemmi 1995]. The function is calculated according to the following formula:

$$f(x_i) = f(x^{(r)}) = \frac{1 - F(x^{(r)})}{1 - F(x^{(1)})} \quad (3)$$

where:

x_i – values of equivalised income (or expenditures) for the i -th household,

$x^{(1)}, x^{(2)}, \dots, x^{(n)}$ – values of equivalised income (or expenditures) in nondecreasing order, where $n \leq N$,

n – number of different values of equivalised income in households within the sample,

N – total number of households in the sample,

$F(x^{(r)})$ – value of the empirical distribution function for the variable.

The membership function allows one to assess the degree to which a household belongs to the poor households subset according to a characteristic represented by the x variable. When assessing monetary poverty, only equivalised income or expenditures of households are taken into account. The risk of monetary poverty indicator can be calculated based on the membership function.

DATA AND RESULTS

The analysis concerns the assessment of monetary poverty based on data from household budget survey conducted by the Central Statistical Office in 2010. A total of 18,422 employees' households were included in the analysis. Households with negative income, which constituted 0.09% of the sample, were not included in the analysis. Disposable income was chosen as the monetary indicator. Due to a varied demographic structure of households in the sample, values of nominal income were scaled by the *OECD*_{70/50} scale. Values of the scale for each household were calculated according to Formula 1. A child was defined as a person aged 14 years or below. The membership function, Formula 3, was used to determine the value of the risk of poverty indicator. Table 1 shows a comparison of the values of the indicator according to selected characteristics of the household head⁴.

⁴ The head of household is defined as the person who provides all or most of the financial resources needed to maintain the household. When such a person cannot be determined, the head of household is considered to be the person who manages most of these resources.

Table 1. Values of the risk of monetary poverty indicator for selected characteristics of the household head

Characteristic	Mean	Median	Standard deviation	Min	Max	Size
Total	0.498	0.495	0.281	0	1	18,422
Household head's occupation						
Manual labour position	0.622	0.650	0.243	0.002	1	9,794
Non-manual labour position	0.357	0.310	0.253	0	1	8,628
Gender of the household head						
Female	0.476	0.462	0.283	0	1	6,060
Male	0.509	0.510	0.279	0	1	12,362
Level of education of the household head						
Lower secondary or less	0.705	0.750	0.224	0.025	1	1,505
Basic vocational	0.624	0.650	0.240	0.001	1	6,450
Secondary general	0.477	0.469	0.251	0.003	1	1,368
Secondary vocational	0.493	0.488	0.253	0.003	1	4,042
Post-secondary	0.426	0.406	0.243	0.002	0.996	455
Bachelor's degree or engineer	0.329	0.283	0.235	0	1	846
Master or equivalent	0.265	0.211	0.218	0	1	3,601
University	0.134	0.097	0.150	0.001	0.875	155

Source: own calculations based on the household budget survey conducted in 2010

The mean value of the risk of monetary poverty indicator for all employees' households was 0.498. The median was slightly lower and equaled 0.495. This means that the risk of monetary poverty for half of the assessed households was over 0.495. The values of the indicator were considerably dispersed around the mean; the dispersion amounted to 56% of the mean. This was due to differences in equivalised income and variation of income between the households. There were 14,674 different values of equivalised income within the analyzed sample.

When the values of the indicator were analyzed in terms of the household head's occupation, the risk of monetary poverty was on average twice as high for persons performing physical work than for persons performing nonphysical work. Standard deviation for both types of households was similar. Therefore, the risk of monetary poverty was much greater for households in which the reference person performed physical work.

Households in which the reference person was male were twice as numerous and usually showed a higher risk of monetary poverty than households with a female head. However, these differences were small in terms of the mean and the median.

The most significant differences were found for the education level of the household head. Households in which the reference person had no higher than lower secondary education were found to be in the worst situation. The mean value of the indicator for this group amounted for 0.705 and was 42% higher than the

mean value for the entire sample. The lowest risk of monetary poverty in this group equaled 0.025. The mean and median values of the indicator decreased with the increase in the education level. Households in which the reference person had university education and a scholarly title showed the lowest risk of monetary poverty; their median value of the indicator equaled only 0.134. Moreover, the indicator for half of the households in this group was lower than 0.097. Dispersion of values around the mean was also lower than in other types of households.

The characteristics of a given household affected its risk of monetary poverty. Table 2 presents the values of the risk of monetary poverty indicator according to the place of residence.

Table 2. Values of the risk of monetary poverty indicator according to the place of residence

Characteristic	Mean	Median	Standard deviation.	Min	Max	Size
Total	0.498	0.495	0,281	0	1	18,422
Place of residence						
Cities over 500 thous.	0.287	0.221	0.241	0	1	2,517
Cities 200-499 thous.	0.419	0.392	0.261	0	0.994	1,747
Towns 100-199 thous.	0.449	0.425	0.262	0.003	1	1,350
Towns 20-99 thous.	0.472	0.460	0.261	0.001	1	3,215
Towns below 20 thous.	0.527	0.532	0.264	0	1	2,246
Rural	0.601	0.63	0.263	0	1	7,347
Voivodeships						
dolnośląskie	0.473	0.451	0.277	0.001	0.998	1,439
kujawsko-pomorskie	0.535	0.544	0.267	0.006	0.999	983
lubelskie	0.579	0.598	0.274	0	1	930
lubuskie	0.503	0.491	0.266	0.008	1	504
łódzkie	0.507	0.511	0.270	0.002	1	1,220
małopolskie	0.517	0.522	0.269	0.002	1	1,612
mazowieckie	0.369	0.314	0.288	0	1	2,828
opolskie	0.519	0.521	0.272	0.013	1	495
podkarpackie	0.615	0.651	0.257	0	1	995
podlaskie	0.528	0.543	0.273	0.007	0.996	451
pomorskie	0.479	0.462	0.289	0.001	1	1,063
śląskie	0.503	0.500	0.265	0	0.998	2,281
świętokrzyskie	0.580	0.602	0.265	0.008	1	597
warmińsko-mazurskie	0.535	0.541	0.281	0.001	0.993	653
wielkopolskie	0.521	0.520	0.261	0.001	1	1,577
zachodniopomorskie	0.502	0.492	0.280	0.001	0.998	794

Source: own calculations based on the household budget survey conducted in 2010

The class of the place of residence had a considerable effect on the mean value of the indicator. Usually, households in rural areas were in the worst

situation, with the risk of monetary poverty of half of them exceeding 0.63. The mean and median values of the indicator decreased as the size of the place of residence increased, with households in cities with a population of over 500,000 being in the best situation. The mean value of the indicator was over twice as low for these households than for households in rural areas. No significant differences in the standard deviation were observed. The size of the place of residence had a considerable effect on the risk of monetary poverty but had no influence on the dispersion of the values of income.

Significant differences in the risk of monetary poverty were found between the voivodeships. Usually, the highest values of the indicator were found in Lubelskie and Podkarpackie voivodeships. Mazowieckie voivodeship showed the lowest values of the indicator.

CONCLUSIONS

The analysis showed that the risk of monetary poverty was affected by various characteristics of the household. The risk of monetary poverty was higher for households whose reference person performed physical work than for nonphysical workers. The greatest differences were found when the risk of poverty was compared to the education level of the household head. The greatest values of the risk were observed for households whose reference person had no more than lower secondary education. The risk of monetary poverty decreased with the increase of the education level. Gender of the household head usually did not affect the risk of monetary poverty. The class of the place of residence was tied to considerable differences in mean and median values of the risk of monetary poverty. Households in large cities showed the lowest values of the risk, while the highest values were observed for households in rural areas. On the voivodeship level, the Podkarpackie and Lubelskie voivodeships showed the highest level of the risk, while the Mazowieckie voivodeship showed the lowest level.

In this study, the risk of monetary poverty indicator was calculated based on a relative approach to measuring poverty, in which the results depend completely on the dispersion of the values of income. Future assessments of monetary poverty should limit the effect of ranks on the obtained results and provide indicators of monetary poverty based on an econometric model. Many authors emphasize that poverty is a multidimensional phenomenon. Therefore, a comprehensive analysis of poverty should include nonmonetary dimensions.

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