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APPLICATION OF THE EQUIVALENCE SCALES TO POVERTY MEASUREMENT

1. Introduction

For the analysis of poverty, of a crucial importance is the choice of a definition of this phenomenon and of the way to measure it. According to most definitions, poverty denotes inability to satisfy some needs on required level [3]. In general, it means not only lack of financial resources and material supplies but also other limitations which do not allow person (family, household) to live on the level acceptable in given country [8]. However, the extent of needs that is taken into account in poverty measurement has been changing with time. At first poverty had been understood as the lack of resources that are necessary to satisfy the so called basic needs comprising food, accommodation and clothing. In the course of time the extent of needs that are taken into account has been growing wider: poverty, understood as limitation in making choices that influence quality of life, imposes no restrictions on their extent (however, when poverty is regarded to be the same as deprivation, only the so called basic needs are taken into consideration).

In official statistics of the European Union, besides a notion of poverty, there exists also a term of social exclusion. It should be stated that those terms are not equivalent. In this work poverty refers only to a situation in which a unit (person, family, household) does not possess sufficient resources for satisfying its needs. Thus poverty is described as purely economic category, and does not embrace cultural and sociological aspects of life (which are playing the crucial role in the analysis of social exclusion).

Apart from the definition of needs that is taken into consideration, the basic methodological problem with economic poverty measurement is the choice of the

poverty threshold – called also the poverty line – that distinguishes units staying in poverty from the other.

In practice, many various methods are used to define the poverty line. They differ mainly in treatment of poverty as absolute or relative category, in the character of data used for poverty line estimation and in selection of unit. For the latter household usually is chosen – but it rises the problem with preserving the comparability between units (such problem occurs also in comparisons of individuals, but in slightly different sense). For sustaining the ability to compare the conditions of households varying in size and demographic structure, in poverty research, the so called equivalence scales are being used. Incompatibility in the construction of such scales results in great number of them being used in practice.

As an outcome of using different definitions of poverty threshold and various equivalence scales we get often very divergent results in estimation of poverty risk level in specified groups of households. And the proper estimation of poverty is essential for designing adequate social policy programmes aiming at fighting poverty.

For that reason, one of the aspects of European Union enlargement is the adaptation of the statistical standards of acceding countries to the requirements of EUROSTAT. In analysis of people's life conditions, Central Statistical Office of Poland is using the so called OECD scale, while the EUROSTAT – since the middle of the 90's – employs the so called modified OECD scale.

In this context, there are 2 basic aims of this paper. The first one is to define, to what extent the choice of equivalence scale implies the shape and parameters of income and expenditure distribution in households of different demographic profiles. The second one is an attempt to estimation of changes in the extent and the depth of poverty of chosen household types, caused by the choice of different equivalence scales. In poverty analysis two normative scales were used: original and modified OECD scale.

2. Methodological remarks

2.1. Indicators of households' welfare

Among indicators describing the welfare of households and their living standard, one of the most important is the average disposable income and the average expenditures sustained by these households for purchase of material goods and services, satisfying various needs of their members. The disposable income is defined as the sum of all household incomes – both in money and in kind – with all bonuses included, after subtracting the tax. In practice, in cases of statistic analysis, there is always some ambiguity about use of aforementioned indicators.

Researches on poverty, carried out by EUROSTAT, use information on incomes despite the fact that this kind of data is said to be less stable in time and, as

the practice of many countries shows, understated. On the contrary, in the analysis of poverty extent carried out by Polish CSO the level of expenditures of a household (including natural consumption) is used as the indicator of the welfare of a household. It is thought, on the ground of long term observations, that in Household Budget Survey (which in Poland is the main source of information about households) the data about the expenditures are more reliable, more stable in time and directly related to the level of permanent income – expected by the households in longer perspective [11].

However, not only the level of income and expenditures, but also their structure across households rely highly on such demographic characteristics like the number of people in a household, the number of children, age structure of household members or the place of living. The instrument that makes possible to gauge the influence of demographic structure of a household on its needs (and costs of living) are, mentioned in the introduction, equivalence scales. Dividing the disposable income (or expenditures) of a household by the value of this parameter, we get the so called equivalent income (or expenditures) which may be interpreted as a household welfare indicator. If, for example, overall expenditures of a household consisting of two adults should be 70% higher than expenditures of one lone adult (to preserve the same level of wealth), the equivalence scale for two-person household will be 1.7 assuming that for one-person household – that is the point of reference – this scale equals 1. Equivalent income is a basic indicator used in researches on extent and depth of relative poverty. The acknowledgement of equivalence scales makes it unessential to define the poverty lines for each type of household – it will suffice to define them for a standard household for which the scale equals 1.

There are two, significantly different, approaches to equivalence scales' estimation. The first one – objective – embraces the so called normative and empirical (econometric) methods of defining scales. In the second one – subjective – scales are constructed using the information on households' judgements on the level of income that, in their opinion, can guarantee achievement of specified level of wealth.

In this paper two normative scales, used by Polish CSO and EUROSTAT¹, will be taken into account. Normative scales fixed upon the calculations of experts sig-

¹ Empirical scales are estimated on the basis of real consumption expenditures of households. Although they enable taking into account demographic characteristics other than the number of adults, children and age structure, it is essential to estimate parameters of usability function, which causes much trouble in empirical research. In the last 20 years many works have been published in which authors consider different aspects of the problem of defining equivalent scales such as: identification of scales, limitations and the choice of proper usability function essential in calculating unconditional scales (useful in comparison of welfare in distinction from conditional scales for aims of demand analysis), testing of assumptions required in various systems describing linear and non-linear preferences of households etc. [1; 2; 5; 7; 9].

nify the average rise in living costs connected with the increase in the number of persons in the household. One of the best known scales of this kind is the original OECD scale type 70/50 (used, among others, by Polish CSO) and calculated according to the formula [13]:

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

where: d – number of adults in the household, c – number of children (aged 14 or less).

According to this scale, the coefficient for a first adult equals 1, for successive adults in the household – 0.7 and for every child – 0.5. However, in EU-countries more and more frequently is used ‘flatter’, modified OECD scale type 50/30 which assumes that every (but first) adult is attributed the value of 0.5, and every child – only 0.3.

The main flaw of these two scales is the fact that they are fixed (usually by the experts) while their saving grace is their simplicity and the possibility of using them in international comparisons without the necessity of modification.

2.2. Measures describing distribution of incomes and expenditures

Usage of original and modified OECD equivalence scales results in different distributions of expenditures and equivalent disposable income. For the analysis of these distributions some basic measures of location, variation and skewness will be used. This analysis will be broadened by investigation of inequality in income distribution.

As the basic characteristics of income for households belonging to the specified group will serve the average equivalent income. It is calculated as weighted arithmetic mean of incomes per equivalent unit. For measurement of differentiation classic coefficient of variation has been chosen:

$$V_s = \frac{s}{\bar{y}} 100\%, \quad (2)$$

and as measure of skewness – classic coefficient of skewness:

$$A_s = \frac{\frac{1}{n} \sum_{i=1}^k (y_i - \bar{y})^3 \cdot n_i}{s^3}, \quad (3)$$

where: y_1, y_2, \dots, y_k – equivalent incomes per equivalent unit in group consisting of k households,

n_i – number of equivalent units in household i ,

n – number of equivalent units in all analysed groups of households,

\bar{y} – average equivalent income,

s – standard deviation of equivalent income.

For graphical description of extent of inequality Lorenz curve will be applied. This curve is set up by points

$$[F(y), F_1(y)], \quad (4)$$

where $F_1(y) = \frac{1}{ny} \sum_{y_i < y} y_i$ is percentage of cumulative income for people having overall income not higher than y and $F(y)$ is a cumulative distribution function of income distribution.

As a measure of inequality – mostly because of its popularity – Gini index will be applied. One of specifications of this coefficient is given by the formula:

$$G = \frac{\Delta}{2\bar{y}}, \quad (5)$$

where $\Delta = \sum_{i=1}^n \sum_{j=1}^n \frac{|x_i - x_j|}{n^2}$ is an average absolute difference between the incomes of random pair of households.

For equal distribution of incomes G equals 0, and for extreme distributional inequality G equals 1.

The Gini coefficient can be interpreted as doubled size of the area between Lorenz curve and the line of equal distribution. Additionally, doubled value of G informs what fraction of average income is the average absolute difference between the incomes of randomly chosen pair of households [6].

2.3. Measurement of extent and depth of relative poverty

Household and thus all its members are defined as living in the poverty if the level of its expenditures or income is lower than the value accepted as the threshold of poverty. In analysis of the so called objective poverty, absolute and relative poverty lines are taken into account. Two of such absolute lines are, for example, estimated by IPiSS (Institute of Labour and Social Studies). They are referring to basic needs, and are called social minimum level of income (the threshold of poverty risk) and subsistence minimum (the threshold of extreme poverty).

In opposition to absolute lines, the relative ones are constructed by the assumption that poverty means relative lack of resources for living – defined in comparison with resources possessed by other, better-off people.

In analyses of relative poverty, carried out by Polish CSO, the line of relative is defined as half of an average equivalent expenditure, calculated for the collection of all surveyed households. However, in research led by EUROSTAT the relative line is situated at 60% of equivalent income median.

Because of the fact that equivalence scales used in official statistics should have been changed after joining the European Union, in the next part of this paper, there will be analysed influence of these changes on extent and depth of poverty. There will be calculated 4 different relative poverty lines, defined according to 2 OECD equivalence scales (type 0.7/0.5 and type 0.5/0.3) and differing in levels of equivalent expenditures or income.

For estimation of poverty extent, a simple indicator, called poverty rate, will be used. It is defined as quotient of the number of people living in the poverty to the number of people in the whole population [8] and denotes percentage of poor in given sample.

The poverty rate takes value 0 when in given population (sample) there are no poor people and equals 1 when all households are located beneath the poverty line. This rate takes the same value regardless of the fact whether equivalent expenditures (income) of poor people are very close to the poverty line or much lower. Thus, in measurement of poverty usually an additional indicator of average expenditure (income) gap is calculated. It measures discrepancy in the actual income of poor households and boundary income, constituted by poverty line. The average income gap indicator is defined as follows [8]:

$$I = \frac{1}{N_{\mu} z} \sum_{i=1}^{N_{\mu}} (z - y_i), \quad (6)$$

where: N_{μ} – number of households of poor people,

z – poverty threshold,

y_i – equivalent income of household number i .

If, for example, $I = 0.2$ incomes of poor households in given households sample are in average 20% lower than the poverty line.

3. Empirical research

3.1. Data

Data used in the analysis come from Household Budget Survey, carried out every year by Polish CSO. Random sample embraced 31,847 households from the whole Poland – their income and expenditures were recorded in chosen period of the year 2001.

The estimation of the influence of the change in definition of equivalence scales on the shape and basic parameters of the incomes distribution was carried out for groups of households distinguished due to the biological type of the family. In studies provided by Polish CSO, there are specified 12 types of families, but in this paper only 6 were considered (subsample consisting of 17,549 households):

- childless couples – marked in the following part by letter (C),
- couples with one, two, three and at least four children marked adequately (C+1), (C+2), (C+3), (C+4),
- households including lone parent (mother or father) with children on maintenance – marked (M/F+ch.).

For distinguished family types, empirical distributions of equivalent income and expenditures were set, as well as basic statistical parameters describing those structures were calculated. Moreover, for these family types, a poverty was briefly analysed on the ground of aforementioned indicators.

3.2. Equivalent incomes and expenditures distributions

In this part there will be shown results of comparisons of parameters of equivalent income and expenditures distribution for chosen 6 types of families. Equivalent income and expenditures were calculated for the original equivalence scale OECD type 0.7/0.5 and for the modified scale type 0.5/0.3.

The structure of the sample and number of equivalent units for both OECD scales for given family types are shown in Table 1. Distinguished family types constituted over 55% of all households being surveyed. Analogous structure has been observed for number of people and equivalent units.

Table 1. The structure of sample of households embraced in budget research in the year 2001

		Family type					
In percentage of households included in research		C	C+1	C+2	C+3	C+4	M/F+ch.
Households		18.13	12.66	13.62	4.88	2.19	3.60
Members of households		11.64	12.19	17.49	7.83	4.63	3.04
Members of households with secondary or higher education		16.57	15.99	17.12	5.10	1.48	2.77
Equivalent units	Scale 0.7/0.5	13.03	12.26	16.48	7.08	3.99	3.03
	Scale 0.5/0.3	14.00	12.33	15.86	6.61	3.60	3.08

Source: own calculations on the basis of panel data received from Polish CSO.

One of the factors having influence on families' income situation is education. As can be seen in Table 1, couples with more children (at least 3) and families of lone parents with children are characterised by much lower percentage of individuals with secondary or higher education, which is directly connected with worse income situation of these families.

Equivalent incomes distribution for original OECD scale and chosen types of families are shown in Fig. 1. Basic statistical parameters, describing this distribution, are presented in Table 2.

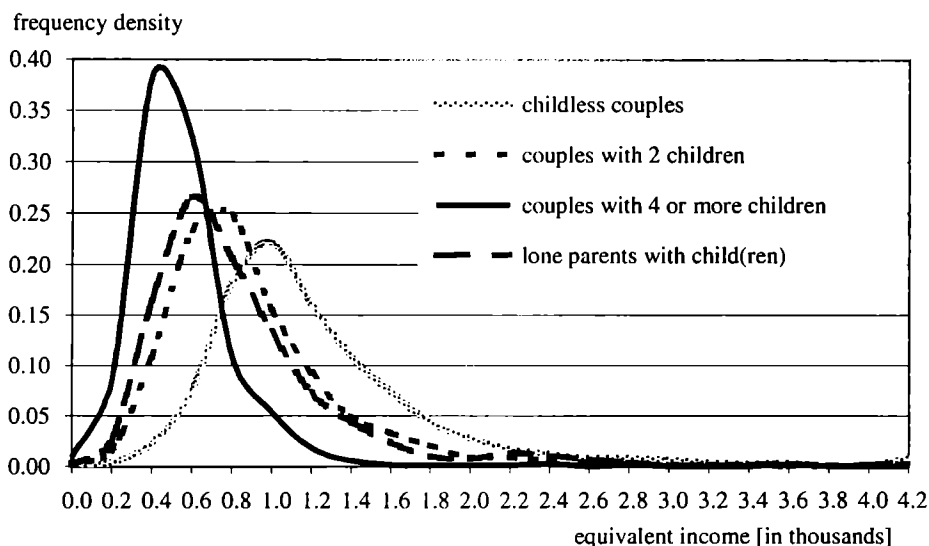


Fig. 1. Equivalent income distribution for scale 0.7/0.5

It can be observed that income distributions are of similar type, however the more children in the household the closer the distribution is moved to the beginning of the co-ordinate plane. The closest one is the income distribution of families with 4 or more children. These families are generally in the worst income situation among all considered family types. Also basic parameters like an average income per equivalent unit and all quartiles confirm this observation. These parameters not only take lowest values but also the differences in comparison to other family types are huge – they are, for example, over 2 times lower than for families with 1 child.

All income distributions are characterised by strong right skewness, which means that in every case most of the families attain equivalent income beneath the arithmetic mean set for a given distribution. Comparing income distributions, there can be seen that the strongest skewness and – at the same time – the lowest coefficients of variation and inequality were obtained for income distribution of childless couples. On the other hand, the biggest variety and inequality of incomes may be observed in the case of lone parent with children on maintenance (see Tables 2, 3 and Fig. 2).

Table 2. Descriptive parameters of equivalent income distribution for scale 0.7/0.5

Parameters	Family type						
	Total	C	C+1	C+2	C+3	C+4	M/F+ch.
\bar{x}	855	1146	1001	813	650	458	773
s	618	712	647	524	424	302	560
1 st quartile	516	768	612	510	407	281	456
Median	738	993	866	710	563	406	637
3 rd quartile	1037	1343	1227	976	780	551	899
Maximum	24556	14576	7500	9011	4375	3406	4986
V_x	0.72	0.62	0.65	0.65	0.65	0.66	0.72
A_x	6.37	5.04	2.00	3.90	2.83	3.22	2.92
G	0.32	0.27	0.31	0.30	0.30	0.30	0.33

Source: own calculations on the basis of panel data received from Polish CSO.

Table 3. Descriptive parameters of equivalent income distribution for scale 0.5/0.3

Parameters	Family type						
	Total	C	C+1	C+2	C+3	C+4	M/F+ch.
\bar{x}	1041	1298	1213	1028	848	618	925
s	730	806	785	664	554	404	655
1 st quartile	646	871	742	644	531	381	560
Median	903	1126	1050	897	729	551	768
3 rd quartile	1255	1522	1482	1235	1014	736	1080
Maximum	29468	16519	9000	11586	5833	4439	5753
V_x	0.70	0.62	0.65	0.65	0.65	0.65	0.71
A_x	6.32	5.04	1.99	3.92	2.85	3.15	2.90
G	0.31	0.27	0.31	0.30	0.30	0.30	0.33

Source: own calculations on the basis of panel data received from Polish CSO.

Location of Lorenz curves and Gini coefficient values seem to suggest that the inequality of income in families depend mostly on whether there are children in the family and whether there are both parents in the family (see Fig. 2). In Fig. 3 the equivalent income distributions, calculated by means of original and modified OECD equivalence scale, were presented. As can be seen, the change of scales caused the flattening of equivalent income distributions and their shift towards higher values. As a result, basic average measures took higher values while coefficients of variation and skewness as well as Gini coefficients had not changed. The rise of values of all parameters of location means that households are supposed to be in a better income situation than it would result from the original OECD scale.

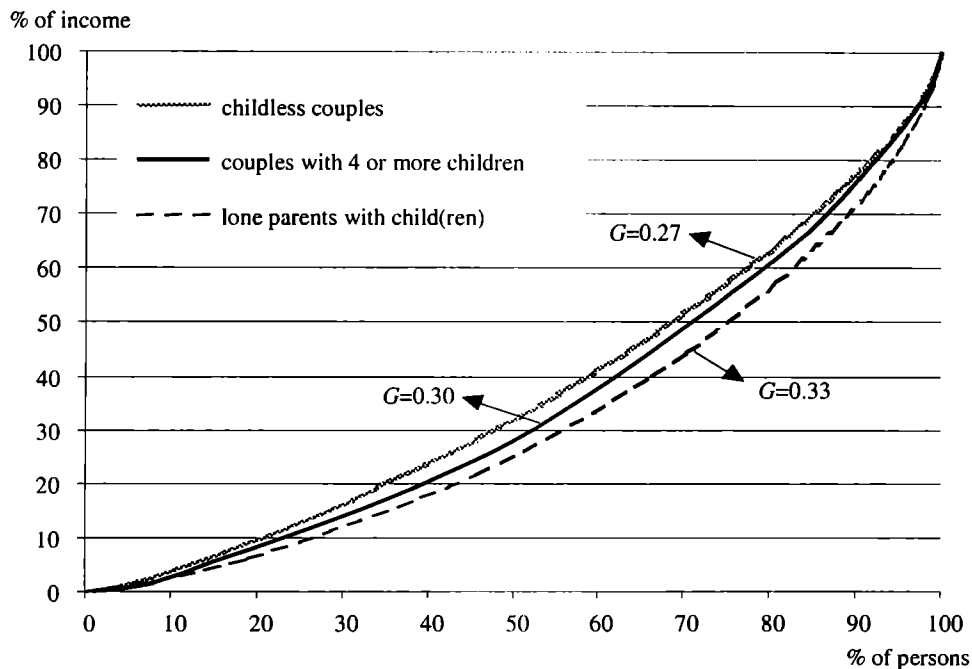


Fig. 2. Lorenz curve for different family types

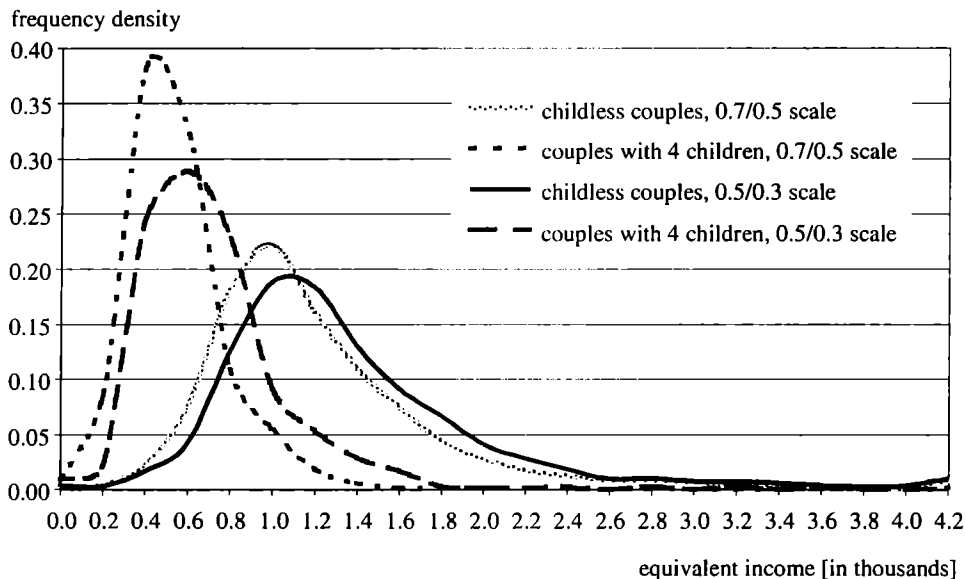


Fig. 3. Distribution of equivalent income for different scales

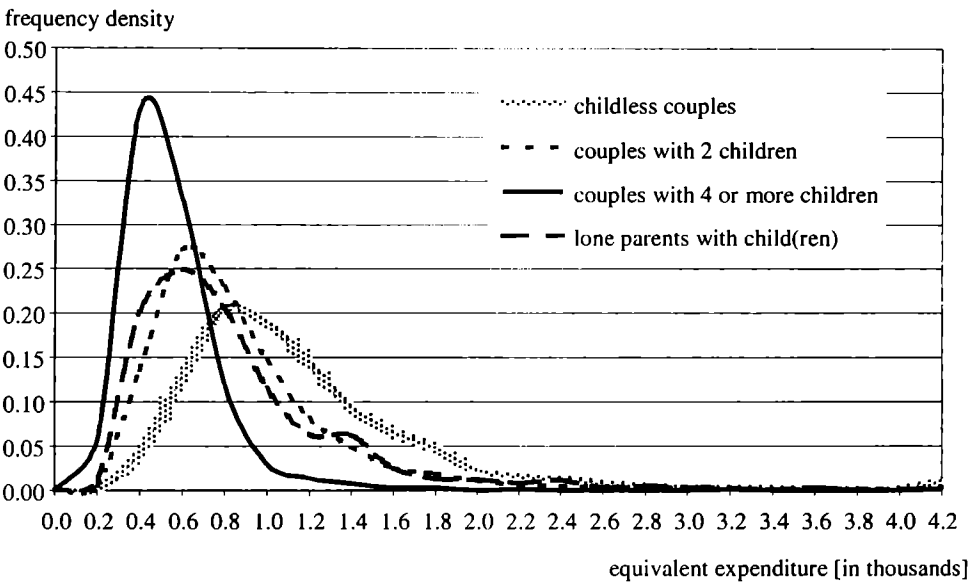


Fig. 4. Distributions of equivalent expenditure for scale 0.7/0.5

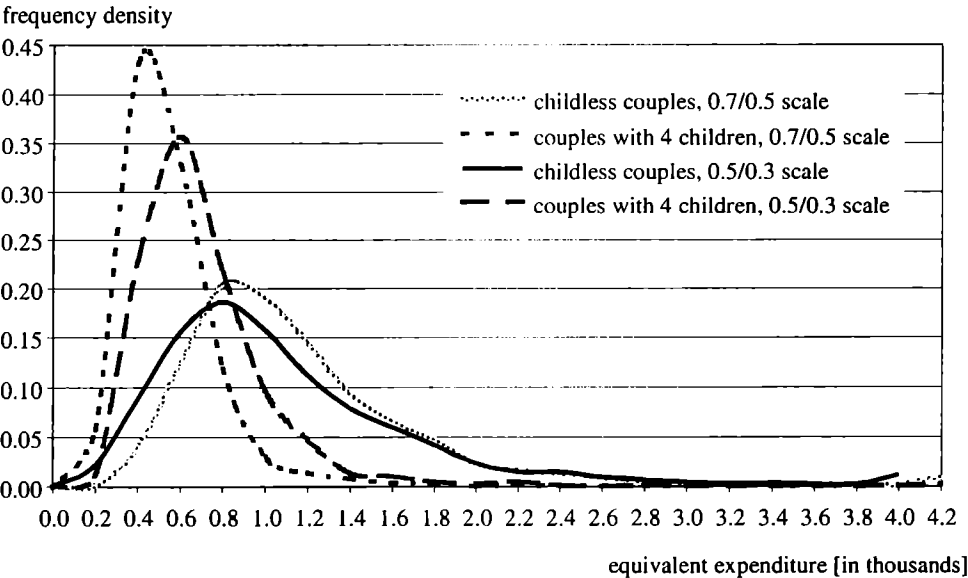


Fig. 5. Distributions of equivalent expenditures for different scales

Similar conclusions could be drawn from the analysis of the shape and mutual location of equivalent expenditure distributions for chosen family types and by comparing basic statistical parameters of these distributions (see Figs 4 and 5, and Tables 4, 5). For all family types the average parameters of expenditures distributions are slightly lower than analogous parameters of income distributions, while inequality and variety measures are quite similar. Though, significant differences may be observed in skewness coefficient values. Generally, the expenditure distributions are characterised by much stronger skewness than income distributions.

Table 4. Descriptive parameters of equivalent expenditure distribution for scale 0.7/0.5

Parameters	Family type						
	Total	C	C+1	C+2	C+3	C+4	M/F+ch.
\bar{x}	808	1088	942	790	628	459	782
s	586	708	652	535	365	298	576
1 st quartile	471	686	574	489	402	297	429
Median	672	929	791	663	542	404	628
3 rd quartile	969	1286	1120	931	737	538	929
Maximum	20408	10199	12756	12479	4016	4933	6111
V_s	0.72	0.65	0.69	0.68	0.58	0.65	0.74
A_s	5.38	4.21	5.04	5.16	2.74	6.44	3.06
G	0.32	0.29	0.30	0.30	0.28	0.27	0.34

Source: own calculations on the basis of panel data received from Polish CSO.

Table 5. Descriptive parameters of equivalent expenditure distribution for scale 0.5/0.3

Parameters	Family type						
	Total	C	C+1	C+2	C+3	C+4	M/F+ch.
\bar{x}	984	1233	1141	1000	819	619	936
s	686	803	791	677	476	399	671
1 st quartile	593	777	694	619	525	405	524
Median	830	1053	957	838	709	546	759
3 rd quartile	1173	1458	1356	1181	958	726	1101
Maximum	20408	11559	15307	16044	5087	6524	6926
V_s	0.70	0.65	0.69	0.68	0.58	0.64	0.72
A_s	5.29	4.21	5.03	5.25	2.72	6.36	3.03
G	0.31	0.29	0.30	0.30	0.28	0.27	0.33

Source: own calculations on the basis of panel data received from Polish CSO.

In researches on living conditions, also changes in structure of expenditures are analysed over the time. In particular, there are taken into account indicators informing about the share of expenditures (in relation to overall expenditure of a house-

hold) spent on basic groups of goods such as: food, clothing, housing upkeep, health, education, culture, sport, transport and communication. Although the change of equivalence scale does not affect the structure of expenditures, this structure is one of basic factors taken into consideration in the process of choosing the proper equivalence scale. The structure of consumption in Poland is significantly different from the structure of consumption in the European Union and it is one of the main arguments against introducing the modified OECD scale in Poland [11]².

As it can be observed, the biggest share of overall expenditures is constituted by the expenditures on food and rises with increase in the number of children. For childless couples this share equals 28.9%, whereas in the case of families with at least 4 children it rises up to 41.4%. The expenditures for maintenance of housing as well as transportation and communication are, next to food-related expenditures, two most important positions in families' budgets. In both cases share of these expenditures decreases with increase in the number of children.

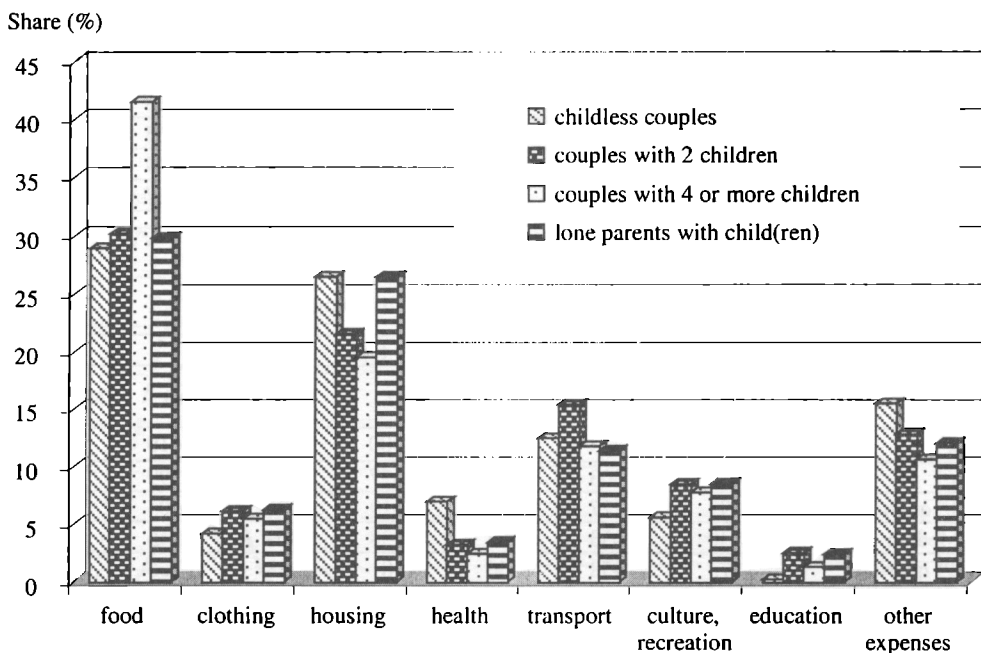


Fig. 6. Structure of households' expenditure

² For comparison in the year 2001 the share of total expenditure, spent on food for people from particular quintiles was changing from 21% (for the wealthiest from the 5th quintile) to 45.4% (for people from 1st quintile) whereas in European Union from 13% to 23% (see: Eurostat New Cronos 2003 and [13]).

3.3. Poverty analysis

The results, characterising the poverty rate for distinguished family types, are presented in Table 6. They have been obtained by use of objective and subjective poverty lines used by Polish CSO in researches on living conditions.

Table 6. Poverty rate for distinguished family types in year 2001

Biological types of households	Percentage of people living in households beneath given poverty line				Percentage of households beneath subjective line
	social minimum	legal poverty line	relative poverty line	subsistence minimum	
C	27.4	3.6	4.2	1.9	20.4
C+1	43.5	6.7	8.1	4.1	25.8
C+2	58.0	11.9	13.5	7.0	29.4
C+3	73.2	21.3	24.8	13.8	40.7
C+4	90.8	44.1	48.6	33.3	54.7
M/F+ch.	62.0	18.7	21.9	11.6	57.6

Source: own calculations on the basis of [13].

As it can be seen, regardless of chosen poverty line, families with three or more children and lone parents with children are in the highest poverty risk. For analysis of the influence of changes in equivalence scales definition on the estimation of poverty, 4 relative poverty lines were taken into account. They were defined as follows:

- A – 50% of average equivalent expenditure, original OECD scale type 0.7/0.5,
- A1 – 50% of average equivalent expenditure, modified OECD scale type 0.5/0.3,
- B – 60% of median of equivalent income, original OECD scale type 0.7/0.5,
- B1 – 60% of median of equivalent income, modified OECD scale type 0.5/0.3.

Results for extent and depth of poverty – estimated for these lines – are presented in Tables 7, 8.

Data presented in Table 7 indicate that:

- comparing results obtained for lines A and A1 (or B and B1), there can be seen that changing the scale from 0.7/0.5 to 0.5/0.3 in most cases involves lowering of poverty rate (the more children the bigger are the differences);
- changing the poverty line definition from 50% of average equivalent expenditures to 60% of equivalent income for a given equivalence scale (comparison of A and B and, adequately, A1 and B1) causes increase in poverty rate (in this case the biggest difference refers to lone parents with children);
- changing the original OECD scale to the modified one causes increase in poverty rate (the only exception are couples with four and more children).

Table 7. The extent of poverty for distinguished family types

Household types	Percentage of people in households beneath given poverty line (in %)			
	A	A1	B	B1
All households	17.20	15.50	18.23	17.06
C	4.07	5.44	3.67	4.73
C+1	8.13	8.31	10.14	10.51
C+2	13.97	12.54	17.05	15.63
C+3	25.66	20.51	30.42	26.17
C+4	50.88	41.56	56.22	48.16
M/F+ch.	19.69	19.56	29.75	30.13

Source: own calculations on the basis of panel data received from Polish CSO.

Table 8. The depth of poverty for distinguished family types

Household types	The size of income gap for given poverty lines (in %)			
	A	A1	B	B1
All households	21.7	34.1	21.1	32.6
C	18.4	43.8	19.1	38.2
C+1	20.4	38.9	20.5	38.3
C+2	20.9	29.0	20.1	29.2
C+3	21.5	29.8	20.7	29.8
C+4	26.3	35.1	23.8	33.9
M/F+ch.	23.0	42.6	22.6	41.6

Source: own calculations on the basis of panel data received from Polish CSO.

Results presented in Table 8 suggest that the size of income gap depends mostly on translation indicator: choice of base for poverty threshold demarcation seems to be far less important. Income gaps are very similar for lines A and A1 and, respectively, B and B1.

4. Conclusions

One of the basic requirements of EUROSTAT for public statistics of countries joining the European Union is the use of modified OECD equivalence scale type 0.5/0.3. This scale should be used for calculations of equivalent incomes, that are the base for analyses of poverty and social exclusion.

In this paper, the authors have tried to compare the shape and parameters of equivalent income and expenditure for two OECD scales. Presented results indicate that the change of the OECD scale (from original to the modified) causes the flattening of the distributions. This involves changes in location parameters, whereas the parameters describing variation, inequality of income and skewness remain on

the same level. The only exception is the distribution of equivalent expenditures – in this case the change of scale caused huge increase in coefficient of skewness.

Higher values of all location parameters for modified OECD scale could suggest that households are in a better financial condition than it arises from the results obtained for the original scale. Such shifts in location parameters of equivalent income and expenditure distributions cause changes in measured extent and depth of poverty. Presented comparisons indicate that use of the modified scale will not provide significant changes in identifying families being at the highest risk of poverty. However, it considerably influences the estimation of fraction of people that are in danger of poverty – because of decrease in poverty rate. It especially concerns families with many children, which are in relatively the worst financial condition and should be a focus of social policy.

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ZASTOSOWANIE SKAL EKWIWALENTNOŚCI DO POMIARU UBÓSTWA

Streszczenie

Celem artykułu jest analiza wpływu wyboru skali ekwiwalentności na estymację zasięgu ubóstwa. Analiza jest dokonana w kontekście zmian standardów w polskiej statystyce publicznej zgodnie z zaleceniami EUROSTATU. Otrzymane wyniki sugerują, że zmiana oficjalnie stosowanej oryginalnej skali OECD na zmodyfikowaną nie wpłynie przypuszczalnie na oszacowanie zasięgu ubóstwa. Jednak dużo większy wpływ zaobserwowano, analizując odsetek ludzi zagrożonych ubóstwem.