

Rethinking equivalence scales in the measurement of extreme poverty: evidence from Poland

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Abstract

This paper examines the measurement of extreme poverty in Poland, focusing on the role of equivalence scales. The key research question is whether the original OECD equivalence scale, currently used by Statistics Poland, is consistent with the scale effects implied by the construction of the subsistence minimum across different household types. Using a one-parameter power equivalence scale, extreme poverty rates are recalculated under alternative assumptions based on anonymized microdata from the 2023 Household Budget Survey. The results indicate that the original OECD scale shows stronger economies than the one embedded in the subsistence minimum values, leading to substantial differences in the estimated extreme poverty rate. These findings underline the importance of a careful selection of equivalence scales in official poverty statistics, as methodological choices directly influence poverty assessment and the targeting of social policy.

Key words: equivalence scale, extreme poverty, subsistence minimum, household composition, poverty measurement.

1. Introduction

Equivalence scales are analytical instruments used to compare the economic situation of households that differ in size and demographic composition. They reflect how a household's structure affects its cost of living (Statistics Poland, 2025). Simple per-capita measures of disposable income or total expenditure are inadequate for this purpose, as they ignore economies of scale arising from shared housing, joint household management, and collective consumption. To illustrate, consider a single-person household and a four-person household, each with a monthly disposable income of PLN 5,000 per person. At first glance, a four-person household might appear to be in a stronger financial position. A per-capita comparison would suggest identical living standards. However, due to economies of scale in consumption, the larger household

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does not need to spend four times as much as the single-person household to achieve the same level of well-being.

Equivalence scales provide a more accurate basis for comparing the economic situation of households with different size and compositions. They are used in interpersonal and interhousehold comparisons of well-being in the measurement of social welfare, economic inequality and poverty (Lewbel & Pendakur, 2008). Formally, an equivalence scale is a measure of the cost of living of a household with a given size and demographic composition relative to that of a reference household, assuming both households attain the same level of utility or standard of living (Lewbel & Pendakur, 2008). In most applications, a one-person household serves as the reference unit and is assigned a scale value of one. Nevertheless, some studies adopt multi-person households as the reference, depending on the research objective (Koulovatianos et al., 2005).

While the importance of equivalence scales is widely acknowledged, their selection remains a major challenge. Different scales can lead to markedly different poverty rates and inequality measures (Coulter et al., 1992b; De Vos & Zaidi, 1997; Dudel et al., 2021). This issue is particularly salient in the measurement of extreme poverty, where poverty thresholds are defined in absolute terms and closely linked to basic needs.

This study addresses the research question of whether the original OECD equivalence scale, applied by Statistics Poland (GUS) in estimating extreme poverty, is appropriate. Specifically, it examines whether the scale effect implied by this scale is consistent with that embedded in the construction of the subsistence minimum across different household types. Using anonymized data from the 2023 Household Budget Survey, equivalence scales are approximated by a one-parameter power function, and extreme poverty rates in Poland are recalculated under alternative parameter values.

The paper contributes to the literature by enhancing the methodological foundations of extreme poverty measurement and by providing empirical evidence relevant for official statistics and social policy in Poland.

2. Equivalence scales

Various approaches to estimating equivalence scales can be broadly classified into expert-based (normative) and empirical (statistical) scales (Dudel et al., 2021; Szulc, 2006). Expert-based scales rely on normative judgments, typically formulated by expert panels or policy institutions, regarding the relative needs of different household types. Empirical scales, by contrast, are derived from statistical analyses of household expenditure or income data, aiming to capture actual consumption patterns and economies of scale.

Each approach has distinct advantages and limitations. Expert-based scales are transparent and easy to apply, making them well-suited for standardized applications

in official statistics. However, they risk oversimplifying household needs and overlooking heterogeneity in consumption patterns. Empirical scales, by contrast, offer greater flexibility and context-specific relevance but require high-quality data and strong identifying assumptions, making them methodologically more demanding. Table 1 summarizes the main features of both approaches.

Table 1. Key characteristics of expert-based and empirical equivalence scales

Characteristic	Expert-based scales	Empirical scales
Data Requirements	Low; base on expert knowledge or policy conventions	High; require detailed, high-quality household data
Flexibility	Low; usually uniform across populations and contexts	High; can be tailored to specific populations, or time periods
Complexity	Low; easy to apply and understand	High; require advanced statistical methods, such as econometric modeling, and strong identification strategies
Policy relevance	Strong for standardized comparisons and official statistics	Strong for context-specific analysis and nuanced poverty assessment
Limitations	Risk of oversimplifying needs and ignoring household heterogeneity	Methodologically complex; sensitive to model assumptions about behavior, preferences, and resource allocation.

Source: own work.

In expert-based approaches, household needs are defined by specifying minimum requirements for goods and services (Schröder, 2004). The most widely used scales of this type include the LIS scale, the original OECD scale, and the modified OECD scale.

In these approaches, household needs are typically assessed by experts who specify the minimum requirements for goods and services necessary to attain a given standard of living (Schröder, 2004). The most well-known and frequently applied scales of this type include the LIS (Luxembourg Income Study) scale, the original OECD (Organization for Economic Co-operation and Development) scale, and the modified OECD scale.

The LIS scale is defined as

$$S_{LIS} = \sqrt{N}, \tag{1}$$

where N is the number of persons in the household. The original OECD scale is given by

$$S_{70/50} = 1 + 0.7(a - 1) + 0.5c, \tag{2}$$

while the modified OECD scale takes the form

$$S_{50/30} = 1 + 0.5(a - 1) + 0.3c, \tag{3}$$

where a denotes the number of adults in the household and c is the number of children under the age of 14.

Expert-based equivalence scales are widely applied in official statistics. For instance, Statistics Poland (GUS) uses the original OECD equivalence scale for expenditure-based poverty measurement, whereas Eurostat relies on the modified OECD scale within its income-based poverty measurement framework. The widespread use of OECD scales reflects their practicality and suitability for standardized comparisons across populations and over time. In this respect, the OECD equivalence scales play an important role in ensuring international comparability, which constitutes a legitimate and key objective of official statistics.

Alongside expert-based approaches, the literature proposes a wide range of methods for estimating empirical equivalence scales (Biewen & Juhasz, 2017; Bishop et al., 2014; Coulter et al., 1992b; Donaldson & Pendakur, 2004; Dudel et al., 2021; Kot, 2015; Schröder, 2004; Szulc, 2009). Despite this extensive methodological development, scholars consistently emphasize that no universally accepted method exists for deriving a “correct” equivalence scale (Coulter et al., 1992a; Kot, 2015). As a result, researchers typically rely on a range of complementary approaches. In the Polish context, empirical scales have been estimated using diverse methods by Kot (2023), Kalbarczyk-Stęclik et al. (2017), Morawski (2018), Szulc (2014), and Ulman (2012), among others.

The literature indicates that equivalence scales depend on household income or total expenditure levels. Cross-country studies (Bishop et al., 2014; Kalbarczyk-Stęclik et al., 2017; Kot, 2023; Mysíková et al., 2022) find that economies of scale tend to be larger in Western European countries than in Southern or Central and Eastern European countries. More generally, equivalence scales tend to be lower in wealthier countries than in poorer ones (Calvi et al., 2023). This pattern reflects differences in consumption structures: in poorer countries, where food accounts for a larger share of household budgets, economies of scale are more limited because food is primarily a private good (Calvi et al., 2023; Deaton & Paxson, 1998).

Empirical analyses conducted within individual countries (e.g. Garbuszus et al., 2021; Kot, 2023; Pendakur, 1999) further demonstrate that the so-called independence-of-base (IB) assumption is typically rejected. This assumption posits that equivalence scale values are invariant with respect to household welfare, typically measured by income or consumption. In practice, empirical results indicate that equivalence scale values decline as income or expenditure rises (Donaldson & Pendakur, 2004; Kot, 2023). Consequently, applying income-independent scales such as the OECD scales may lead to biased assessments of poverty.

Against this background, the remainder of this paper examines equivalence scales for extremely poor households in Poland in 2023. As extreme poverty in Poland is defined in relation to the minimum subsistence level, the following section explores this concept.

3. The subsistence minimum

In Poland, minimum subsistence levels are used as thresholds for measuring extreme poverty. These levels are defined using the basic needs method, also referred to as the “basket” method, which specifies the minimum level of consumption necessary for survival. The subsistence minimum includes only fundamental existential needs such as food, clothing, hygiene, and housing, along with the educational requirements of school-age children (Deniszczuk & Sajkiewicz, 1997). This threshold, also referred to as the biological minimum, marks the point at which consumption becomes so limited that it poses a biological risk to human life and impairs psychophysical development (Kurowski, 2022). Accordingly, it covers only those expenditures that are strictly essential for sustaining life.

Minimum subsistence levels are calculated by the Institute of Labor and Social Affairs (IPiSS) for six types of employee households and two types of retired households. The annual average values established for 2023 are presented in Table 2.

Table 2. The minimum subsistence levels (average monthly values in 2023, in PLN)

Specification	Employee households (household sizes and types)						Retired households (sizes and types)	
	1 (M+W)/ 2	2 M+W	3 M+W+ YC	3 M+W+ OC	4 M+W+ YC+ OC	5 M+W+ YC+ 2OC	1 (M+W)/ 2	2 M+W
Food	377.93	755.86	1077.60	1204.23	1525.97	1974.34	328.21	656.43
Housing	398.80	564.55	813.84	813.84	1069.69	1322.16	398.80	564.55
Education	0	0	6.44	80.93	87.37	168.30	0	0
Clothing and footwear	35.35	65.85	98.08	102.51	134.73	171.39	35.35	65.85
Healthcare	15.10	26.10	61.73	42.00	76.61	92.33	23.88	43.66
Personal hygiene	30.95	61.33	76.30	84.63	99.63	123.13	27.17	53.78
Other expenses	42.91	73.68	106.70	116.41	149.70	192.58	40.67	69.21
Total	901.04	1547.38	2240.69	2444.55	3143.69	4044.23	854.08	1453.49

Source: IPiSS (2024). Symbols: M – man aged 25-60, W – woman aged 25-60, (M + W)/2 – average expenditure for a household consisting of a man and a woman, YC – younger child aged 4-6, OC – older child aged 13-15. In the case of retired households, the symbols M and W denote men and women over 60, respectively.

An important feature of the minimum subsistence structure is the dominant role of food expenditures. In nearly all household types, with the exception of single-person retired households, food accounts for approximately 40–50% of total spending. As food is a necessary good and largely non-shareable, it is relatively insensitive to economies of scale. Consequently, a high proportion of food in total expenditure indicates that extremely poor households have limited scope to benefit from economies of scale.

To quantify the economies of scale associated with the subsistence minimum, the corresponding equivalence scale is approximated using the method described in Section 4.

4. Methods and data

The equivalence scale corresponding to the subsistence minimum levels is approximated using a one-parameter power scale of the form

$$S = N^e, \quad (4)$$

where e denotes the elasticity of scale with respect to the household size (Ayala & Jurado, 2011; Coulter et al., 1992a; Hunter et al., 2003), and N is the household size, defined as the number of individuals in the household.

By construction, $e=0$ corresponds to the case of maximum economies of scale, while $e=1$ means no economies of scale, with income or expenditure calculated on a per capita basis. Higher values of parameter e therefore indicate lower economies of scale, reflecting a smaller degree of resource sharing within the household (Buhmann et al., 1988).

As shown in the literature, any arbitrary equivalence scale S can be closely approximated by a single-parameter power scale (Buhmann et al., 1988; Coulter et al., 1992a). Specifically, if the scale is expressed as in formula (4), taking logarithms yields

$$\ln(S) = e \cdot \ln(N), \quad (5)$$

which allows the parameter e to be estimated using a linear regression model without an intercept, with $\ln(S)$ as the dependent variable and $\ln(N)$ as the independent variable. Buhmann et al. (1988), analyzing 34 equivalence scales across multiple countries, reported that the correlation coefficients between $\ln(S)$ and $\ln(N)$ were close to unity. Their findings indicate that any arbitrary equivalence scale can be effectively approximated by the one-parameter power scale. In the present study, the same approach is applied to estimate the parameter e corresponding to the equivalence scales under examination.

Next, equivalized total expenditures (Y^{ekw}) are computed as

$$Y^{ekw} = \frac{Y}{S}, \quad (6)$$

where Y is total household expenditure and S is the equivalence scale.

On the basis of equivalized total expenditures, poverty rates are subsequently calculated. The reference household is assumed to be a one-person employee household. A household was classified as poor if its equivalized expenditure fell below the established poverty threshold.

The poverty rate H (headcount ratio), defined as the percentage of individuals living below the poverty line, is calculated as

$$H = \frac{\sum_{i=1}^n U_i \cdot N_i \cdot weight_i}{\sum_{i=1}^n N_i \cdot weight_i}, \tag{7}$$

where U_i is a binary variable equal to 1 if the i -th household is classified as poor, and 0 otherwise, N_i denotes the number of individuals in the i -th household, and $weight_i$ is the survey weight assigned to the i -th household.

In this study, the survey weights (MN_kal) are derived from the 2021 National Census of Population and Housing, conducted by Statistics Poland. As documented in Statistics Poland (2024a), these weights are obtained through calibration procedures that adjust the sample to match the population’s age and gender distributions.

The poverty rates are calculated using data from the 2023 Household Budget Survey (HBS), a nationwide survey conducted annually by Statistics Poland on the basis of a random sample of households. In 2023, the HBS covered a total of 28,089 households.

5. Results and discussion

To assess the impact of household composition on basic living costs, Table 3 reports equivalence scales derived from the minimum subsistence levels for various household types, as listed in the last row of Table 2. The reference household is a one-person employee household, for which the equivalence scale is set to one. For all remaining household types, the equivalence scale values are calculated by dividing their respective minimum subsistence levels by 901.04, which corresponds to the minimum subsistence level of the reference household. This approach enables a straightforward comparison of how differing household sizes and compositions affect the resources required to attain the minimum standard of living.

Table 3. Equivalence scale implied by minimum subsistence levels

Household type	Demographic composition	Minimum subsistence level [PLN]	Equivalence scale (S)	Household size (N)
1-person employee household	(M+W)/2	901.04	1	1
2-person employee household	M+W	1547.38	1.72	2
3-person employee household	M+W+YC	2240.69	2.49	3

Table 3. Equivalence scale implied by minimum subsistence levels (cont.)

Household type	Demographic composition	Minimum subsistence level [PLN]	Equivalence scale (S)	Household size (N)
3-person employee household	M+W+OC	2444.55	2.71	3
4-person employee household	M+W+YC+OC	3143.69	3.49	4
5-person employee household	M+W+YC+2OC	4044.23	4.49	5
1-person retired households	(M+W)/2	854.08	0.95	1
2-person retired households	M+W	1453.49	1.61	2

Source: own work based on IPiSS (2024). The symbols *M*, *W*, *YC*, and *OC* are defined in Table 2.

Using the data from the last two columns of Table 3, the elasticity of scale parameter with respect to the household size is estimated by means of a linear regression model without an intercept, where $\ln(S)$ is the dependent variable and $\ln(N)$ is the explanatory variable. For comparison, the parameter e is estimated for the original OECD scale among extremely poor households, using HBS microdata with survey weights and assuming a reference household poverty threshold of PLN 901.04. The estimation results for the elasticity of scales with respect to the household size are reported in Table 4.

Table 4. Estimation results for the elasticity of the scale parameter

Elasticity of scale	Estimate	Standard error	t-statistics	95% confidence interval		R-squared
				lower limit	upper limit	
Implied by minimum subsistence	0.882	0.026	33.944	0.820	0.943	0.994
Original OECD scale	0.790	0.001	620.430	0.788	0.793	0.998

Source: own work.

The results indicate that the original OECD scale is associated with a lower value of the elasticity parameter e , corresponding to stronger economies of scale. This finding means that the original OECD scale assumes a greater degree of resource sharing within households than is suggested by the structure of the subsistence minimum.

To illustrate the consequences of this difference, simulations are conducted using the Stata package and the 2023 HBS microdata for a range of values of the scale elasticity parameter. In all simulations, the extreme poverty threshold is set at PLN 901.04, corresponding to the minimum subsistence level of a one-person employee household. The resulting relationship between the elasticity parameter and the extreme poverty rate is depicted in Figure 1.

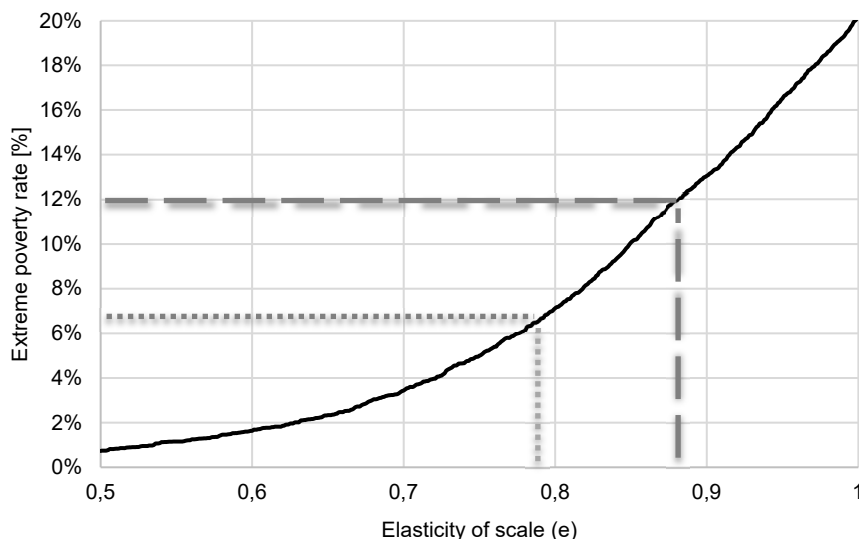


Figure 1. The impact of scale elasticity on the extreme poverty rate.

Source: own work based on HBS data. Note: the dotted grey line corresponds to the elasticity of scale for the original OECD scale, while the dashed line corresponds to the elasticity of scale implied by the minimum subsistence levels (see the values in the second column of Table 4).

Figure 1 demonstrates that the estimated extreme poverty rate is highly sensitive to the choice of equivalence scale. Higher values of the parameter e reduce the equivalized total expenditures of multi-person households, thereby increasing the risk that these households fall below the poverty threshold. As a result, higher elasticity of scale values is associated with higher poverty rates. Specifically, when the equivalence scale implied by the minimum subsistence level is applied ($e=0.882$), the extreme poverty rate is approximately 12%. In contrast, Statistics Poland reports an extreme poverty rate of 6.6% for 2023 (Statistics Poland, 2024b). This estimate corresponds to the application of the original OECD scale, which is associated with an elasticity parameter of $e=0.790$ (see Table 4).

These findings are consistent with earlier research demonstrating that poverty estimates are sensitive to the choice of an equivalence scale (Buhmann et al., 1988; De Vos & Zaidi, 1997; Éltető & Havasi, 2002). However, the present study focuses specifically on the data and methodological framework used to assess extreme poverty in Poland. It therefore provides new evidence on the importance of applying an appropriate equivalence scale when measuring extreme poverty in this context.

The analysis, based on transparent and replicable tools, shows that the original OECD equivalence scale implies stronger economies of scale than the scale derived from minimum subsistence levels. This conclusion is supported by the use of a one-

parameter power scale, which proves to be a very good approximation of the equivalence scales examined.

The study's findings should serve as a stimulus for discussion among experts in the field of poverty measurement and official poverty statistics in Poland.

6. Conclusions

This study provides new insights into the measurement of extreme poverty in Poland. By explicitly linking subsistence minimum values to the implied scale elasticity, it proposes a transparent and empirically grounded framework for examining the consistency of equivalence scales used in this context. The results indicate that the equivalence scale currently applied by Statistics Poland assumes stronger economies of scale than those embedded in the construction of the subsistence minimum. As a result, the extreme poverty rates reported in official statistics are likely underestimated, as the applied scale assumes a relatively high degree of intra-household resource sharing.

From a policy perspective, the results highlight the importance of aligning equivalence scales with the actual living costs faced by households at the margin of subsistence. Since alternative assumptions about household economies of scale yield substantially different estimates of extreme poverty rates, adopting an equivalence scale that more accurately reflects the consumption patterns of extremely poor households can improve both the accuracy and the credibility of official poverty statistics in Poland. In turn, this would enhance their usefulness for the design and targeting of social policy interventions.

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