Impact of Consumption Unit's Scale on Credibility of the Income Indicators in the Czech Republic

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Abstract

The comparison of income of a person has to consider the household composition. Additional persons realize economies of scale especially for expenditures related to housing. Therefore, so-called consumption units have been introduced. International scales have been produced by the OECD and Eurostat. The definition of consumption units has an impact on indicators of poverty as consumption units are used when equalized income is estimated. International scales should ensure comparability of results among countries, but they may not be appropriate for conditions in different countries.

The aim of the paper is to prepare methodological background for computation and then to estimate consumption units for the Czech Republic. Results are compared with international scales. In addition, the impact on indicators of poverty is assessed. Income and poverty indicators based on estimated consumption units should assure more accurate results for household's living in the Czech Republic.

Keywords

Consumption units, equivalence scale, economies of scale, household disposable income, poverty threshold

JEL code

D12, D31

INTRODUCTION

One of the important social and statistical issues is to analyze the well-being of households. The main attention is paid to households with low income that may suffer from the lack of food or other basic needs. These households are considered to be in poverty. This term 'poverty' is quite a multifaceted concept and it is associated with the lack of income or with failure to attain capabilities (Sabates, 2008). Problems of poverty are often associated with joblessness. However, some people are at-risk-of poverty even though they work (Šustová and Zelený, 2013).

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Poverty lines are set in two ways: absolute and relative. Absolute poverty lines are based on costs of basic needs (Coudel et al., 2002). This kind of measurement is usually applied for developing countries and the World Bank uses several thresholds[3] (e.g. 1.9 USD in PPP). Relative poverty thresholds are defined in relation to the overall distribution of income or consumption in a country. This approach is common in developed countries. In European countries, the at-risk-of poverty threshold is set at 60% of the national median equivalized disposable income (after social transfer).[4]

Statistical issue is how to define and estimate the median of equivalized disposable income. As the indicator should contain all incomes including social transfers, the only data source is the EU-SILC survey. The average earnings information system and wage statistics cover just wages and salaries. National accounts provide data on total net disposable income, however, no information on probability distribution is available.[5] In addition, the term 'equivalized' is supposed to be defined. Motivation may be seen in including composition of household into account. Some expenditures are directly linked to persons, such as expenditures on food, restaurants. However, other expenditures do not depend on the number of persons in household. They are rather connected to the dwelling itself, e.g. expenditures on rent, energy, maintenance. Households consist of two or more members realize economies of scale. The fact should be taken into account by applying scales of consumption units.

Consumption units can be defined as follows: 'A weighting system assigning a coefficient to each member of the household and used to compare standards of living between households of different sizes and compositions. With this weighting, the number of people is converted into a number of consumption units (CU)'.[6] It means that the first household member (usually an adult) is always considered as a base of this scale with the weight (or consumption unit) equal to one. Consumption units for the next members is may be found in range <0;1>. Currently, two main scales produced by international organizations are applies, see the following table:

Consumption units	OECD	Modified OECD
The first adult in the household	1.0	1.0
Other adults in the household	0.7	0.5
Children in the household	0.5	0.3

Source: Lapáček (2013)

International scales ostensibly ensure comparison of results among countries. However, it has not been proved yet that economies of scales are the same or very similar in all countries. It can be argued that the structure of consumption expenditures, which probably determines economies of scales, differs. The aim of the paper is to estimate consumption units in the Czech Republic. Subsequently, estimated results are compared with international scales and the impact on indicator of poverty is expressed.

1 MAIN PUBLICATION IN THE FIELD

Besides the above mentioned scales (OECD scale, modified OECD scale) other research has been carried out. Many consumption unit's scales were prepared, especially for the purpose of international comparison. Some of them are published by Chanfreau and Burchardt (2008). The most important are

[3] <http://povertydata.worldbank.org/poverty/home>.

[4] <http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:At-risk-of-poverty_rate>.

[5] National accountants are grateful users of data from social statistics and data about domestic households are very often used as a benchmark for non-residents, see Šimková and Langhamrová (2015).

[6] <https://www.insee.fr/en/metadonnees/definition/c1802>.

the Square root designed by Luxemburg Income Study (LIS), and the Oxford scale originally recommended by OECD. The second one already considered the different needs among household members in relation to demographic characteristics of people. In this time, the most common scale is the modified OECD scale prepared by Hagenaars, De Vos and Zaidi (1994), which is derived from the Oxford scale and primarily used by Eurostat. These scales were designed by experts of European or other international institutions in order to apply the common approach in all countries. It may ensure comparability of data on the standard of living among countries.

Next to these approaches, other methods taking into account the country specific needs could be used on national level. Buhmann et al. (1988) presented the general approach based on survey data on consumption expenditures. The recommendation for preparing the scales by regression analysis of survey data is to specify the power relation between the household size and total expenditures. The larger is the equivalence elasticity *e*, which varies between 0 and 1, the smaller are the economies of scale assumed by the equivalence scale. The relation between needs and size could be expressed by the equation (Buhmann et al., 1988).

The other variables, than the household size, should be considered within the equation of household expenditures. The most important equations are presented in the following chapter and considered in this analysis. According to Van der Gaag and Smolensky (1982), it is necessary to distinguish between household with and without children. The impacts on families with children by considering the economies of scales should be higher than on household of adults. The equivalence scale should reflect both economies of scale and differences in household characteristics. Given the household size, elasticity will decrease with the number of children (Schwarze, 2003). According to Dudel (2015) the estimates of nonparametric bounds on equivalence scales for couples with one child and childless couples as reference are between (1.16, 1.46), so the consumption unit for the child should range from 0.16 to 0.46. The affected indicators taking into account equivalence scale are all income indicators based on personal income level, all income inequality indicators and, finally, also poverty rates indicators (Förster, 1994).

The consumption unit's scale is the important factor affecting the indicators comparing the living conditions of households. The assessment of consumption units impacts primarily the income indicators. Considering the consumption units instead of members in household increases the average personal income, the income per consumption unit (equivalised income) will be higher than income per capita. The equivalence scale changes distribution of income and thereby the income inequality and all of indicators dependent on income, especially the poverty threshold and at-risk-of-poverty rate. According to De Vos and Zaidi (1997) the poverty threshold is very sensitive on equivalence scale, because it depends on number of consumption units which dispose with the total household income.

The aim of the paper is to estimate the equivalence scale of consumption units, appropriate for the conditions of households in the Czech Republic. Estimates are based on expenditures of Czech households and they have not been calculated yet. The reason is that current equivalence scales used by Eurostat or OECD may not be appropriate for Czech households. Developed methodology and estimates equivalence scale of consumption units are presented in the article. Finally, the impact on poverty indicators is discussed.

2 DATA AND METHODOLOGY

The estimation of economies of scale by each household is prepared on data from the Household Budget Survey (HBS), which collects information about household expenditures (CZSO_HBS, 2014). The impact of choice of consumption unit's scale on income indicators is provided. The data of income are taken from national version of Survey on Income and Living conditions (EU-SILC) conducted by the Czech Statistical Office (CZSO_SILC, 2014).

2.1 Assessment of household expenditure

This HBS is conducted by the Czech Statistical Office every year with the sample size of around 3 000 households. It provides data on expenditures and consumption structure of private households. The aim of the survey is to produce statistics on consumption, expenditures and income of all members of household, data on household composition, furnishings and other economic characteristics of household. Data are collected monthly, however, the results are published annually. The most important household characteristics should be defined for estimation of equation of household expenditures. They can be found in OECD guidelines.

Buhmann et al. (1988) defined crucial household characteristics that mostly influence their consumption and structure of expenditures. The number of household members taking into account the number of children is the main factor. The explanatory variables in regression analysis are the number of adults and the number of children meaning up to 14 years. This age limit was chosen according to recommendation of the OECD experts preparing the consumption unit's scales (Chanfreau and Burchardt, 2008). Household budget survey in the Czech Republic provides data enabling to estimate the consumption unit based on expenditure of households and their characteristics.

According to Van der Gaag and Smolensky (1982) the expenditure of households should be modeled by some equation. The simplified version of equation of expenditure is as follows:

$$q = a_o + a_i, \tag{1}$$

where q is total expenditure amount, a_0 is the expenditure of one person's household (base), a_i are the specific differences of expenditure for household type i (households with specific demographic structure i) in relation to one-person's household. The next step is to quantify the system of weights for each specific household type i by using the parameter d_i, which could be derived from Formula (1) as follows:

$$d_i = a_i/a_o. \tag{2}$$

Thereafter, it is possible to assign to each specific household i the number of consumption units m according to the following formula (Van der Gaag and Smolensky, 1982):

$$m = 1 + d_i. \tag{3}$$

The first equation could be estimated using regression analysis. The type of regression function should correspond with real shape of function of total expenditures that could be estimated by data exploring. In household budget survey, there is a variable 'household size' that is considered as continuous because the number of months spent in specific household is taken into account. Due to the above, the method of linear regression could be used including significant input variables, as it is treated for example in analysis by Bishop (2015). The regression coefficients mean the expenditures increase by addition of further household member.

2.2 Assessment of income indicators

The EU–SILC is conducted by the Czech Statistical Office as the national version of international harmonised survey. It provides data about income, material and living conditions of households. One of the most important indicators based on the EU–SILC survey is at-risk-of-poverty-rate. It expresses the share of people under poverty threshold computed as the 60% of median national equivalised disposable income. The threshold is affected by choice of equivalence scale of consumption units, which determines the economies of scale realised by household with respect to household size and composition.

It is because this threshold is dependent on whole distribution of equivalised income, which is computed by using chosen equivalence scale. Therefore, not only the number but also the structure of people at-risk-of-poverty depends on used type of scale. This is the reason, why the equivalence scale should be precisely determined.

3 RESULTS

3.1 Regression coefficients of the equation of household expenditure

The household expenditure can be described by Formula (1), which takes into account the type of household. Brázdilová and Musil (2016) proved that expenditures depend on the number of adults and number of children in household, see the following formula:

$$q = b_0 + b_1 * adults + b_2 * adults^2 + b_3 * children, \tag{4}$$

where q stands for expenditure, adult for number of adult members and children for number of children in household. Regression coefficients represent the specific amount of expenditures added for each variable. Parameters of the model are given in the Table 1.

Table 1 Parameter estimates of regression analysis

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|	Standardized Estimate	Variance Inflation
Intercept	–272.6	1 680.3	–0.16	0.8711	0	0
Adult	16 771.0	1 614.1	10.39	<.0001	0.706	16.347
Adult^2	–1 898.4	341.6	–5.56	<.0001	–0.375	16.141
Children	5 029.7	4 814	10.45	<.0001	0.182	1.075

Source: Authors

This whole regression model has Adjusted R-square value equal to 0.184, it can explore just 18.4% of total variability of expenditures. Nevertheless, this is not the aim of this paper. The estimates are given in CZK per month.

The result equation of household expenditure from the regression analysis based on survey data from year 2014 is as follows:

$$q = -273 + 16\,771\ adults - 1\,898\ adults^2 + 5\,030\ children, \tag{5}$$

where q stands for expenditure, *adults* for number adult members and children for number of children in household.

In this case the base of the equivalence scale of consumption units, precisely the one-person's household, could be expressed as follows:

$$a_0 = b_0 + b_1 + b_2. \tag{6}$$

The parameter d_i that allows to find the system of weights of additional household members for each specific household type i could be derived from the Formula (7):

$$d_i = ((b_0 + b_1 * adults + b_2 * adults^2 + b_3 * children) - (b_0 + b_1 + b_2)) / (b_0 + b_1 + b_2). \tag{7}$$

3.2 Estimate of consumption unit's scale

The parameters of result equation allow us to estimate total expenditures for each specific type of household taking into account the household composition. In the Table 2 there is the total number of consumption units in each specific household type. Estimates of consumption units, which belong to further additional member of household based on an increase of expenditure that he or she brings relative to one-person's household, are in the last column. The second adult in household causes the increase of total expenditure in year 2014 by about 76%, for third and following adult it is much less. The first child leads to an increase in total expenditures just about of 34%. Children's demand is not so large as it is for adults. The total expenditure of multi-household with children shows higher economies of scale than multi-households of adults.

Table 2 Estimates of total expenditure (in CZK per month) and system of consumption units by household structure in the year 2014

Household structure	Total expenditure	Number of CU	CU of additional member
1 adult	14 600	1.00	-
2 adults	25 676	1.76	0.76
1 adult with child	19 630	1.34	0.34

Note: CU stands for consumption unit.
Source: Authors

These results should be proved by analysis based on data from the previous five years. Such a regression analysis was carried out with similar values of estimated parameters and similar result equations. There are estimates of means of total expenditures by particular type of household and the weights of the second additional member of household by taking into account the difference between adults and children. The weights for adults seem to be the same for each year, namely 0.76. On the other hand, the weights for children vary between 0.21 and 0.42, the average of previous five year is 0.31. Analysis provides the evidence that the consumption units are stable over the time and the average results should be considered as appropriate consumption units for a household living in the Czech Republic. For additional adults in household, it means weight of 0.75 and for additional child up to 14 years it results on level of 0.3. These units represent the combination of two most frequent used scales, the OECD scale (1; 0.7; 0.5) and the modified OECD scale (1; 0.5; 0.3), which is used by Eurostat for income indicators measurement in each EU country (OECD_project). Based on results of our research, an appropriate consumption unit's scale is (1; 0.75; 0.3) for the Czech Republic. The further adult in household realizes lower economies of scale than it is expected by international scales in the Czech Republic. Otherwise the consumption level of child (up to 14 years old) is just 0.3 of total consumption of one-person's household. The economies of scale are higher for the household with children than for household (with the same household size) of adults.

3.3 Impact of consumption units on income indicators

Considering the consumption units instead of members in a household it increases the average personal income, so the income per consumption unit (equivalised income) is higher than the income per capita. The impact of applying consumption units instead of the number of members in household on income distribution is discussed by Malá (2015). The equivalence scale changes the distribution of income and thereby the income inequality and all of indicators dependent on income, especially the poverty threshold and at-risk-of-poverty rate. According to (De Vos and Zaidi, 1997) the poverty threshold is very sensitive to equivalence scale, which determines the number of consumption units in each household type.

The at-risk-of-poverty rate for year 2014 would be 12.3% by consideration of income per capita, while this indicator based on equivalised incomes is always lower. The results of this income indicator by using different consumption unit's scales are presented in the Table 3.

Table 3 Total impact of each of consumption unit scales on at risk of poverty rate in 2014

CU scale	Poverty threshold	Number of people below poverty threshold	At-risk-of-poverty rate
Per capita	80 459	1 269 987	12.31%
Modified OECD	118 817	1 002 252	9.72%
OECD	100 080	995 986	9.66%
Estimated CU	101 056	933 583	9.05%

Source: Authors

The consumption unit scales considering higher range economies of scale indicate higher personal equivalised income, thereby higher poverty threshold and more people below this threshold that increases the at-risk-of-poverty rate. The indicator based on modified OECD scale is 9.72%, while for the OECD scale is slightly lower. Consumption units resulting from our research would decrease the at-risk-of-poverty rate on 9.05% as shown in the table. This equivalence scale compared with modified OECD scale decreases the equivalised income for household with more adults because it takes into account smaller economies of scale. This distribution of equivalised income may be probably more equal and the income inequality indicators would be likely lower.

3.4 Impact of consumption units on structure of people below poverty threshold

The choice of equivalence scale affects not only values of indicators, but also their variability. With the change of at–risk-of-poverty rate, the structure of people below poverty threshold is also different. The various groups of people are influenced by consumption unit's scale in different ways. Considering the economic status of people, the most significant changes are observed on one hand for children and, on the other hand, for pensioners because the children live more often in households with more members while the pensioners live often alone. The household size is the most important factor which causes the significance of the impact of equivalence scales. The income situation of multi-households is affected by a determination of equivalence scale at the most, but the change is observed also for one person household. The reason is the movement of the overall income distribution, which causes the relative change ranking all households by their income.

In the Table 4, the comparison of commonly used modified consumption unit's scale and the estimated scale is presented. According to at-risk-of-poverty rate indicator published by Eurostat just 8.6% of people below poverty threshold are children, while pensioners constitute 20%. Using the estimated scale the decrease of number of people the below poverty threshold is observed and their structure by economic status is slightly different. Among them 11.2% are children and only 12.6% pensioners. Children usually live in multi-households, which realise smaller economies of scale according to the estimated scale. Therefore, their income situation is worse in comparison with other household types. More children fall into poverty despite lower threshold. The income situation of pensioners usually living alone remains unchanged. However, they more probably drop out of at-risk-of-poverty. The overlap of person who is below the threshold by both criteria is also observed. In spite of lower number of such people the structure is similar. It varies between both criteria, only for unemployed people and other inactive people is higher than in each other threshold.

Table 4 Structure of people below poverty threshold per different criterion by their economic status in 2014

	Structure of population		Structure of people below poverty threshold (%)		
	Absolute	Relative (%)	Threshold per modified OECD	Threshold per estimated CU	Threshold per both criteria
Children	700 768	6.8	8.6	11.2	10.1
Employee with lower education	1 513 168	14.7	7.2	8.1	7.3
Self-employed	814 990	7.9	5.9	6.5	6.2
Employee with higher education	2 276 663	22.1	4.0	5.1	4.2
Pensioners	2 473 028	24.0	19.9	12.6	13.0
Unemployed	550 009	5.3	24.6	26.7	27.7
Others	1 986 945	19.3	29.7	29.8	31.6
Total	10 315 571	100.0	100.0	100.0	100.0

Source: Authors

Income indicators for various groups of people by their economic status are also dependent on equivalence scale. In the table 5 the value of at-risk-of-poverty rate for each of groups is shown. They differ by applied equivalence scale. Overall rate based on Eurostat's approach for the whole population is slightly higher than the rate resulting from our research. It is caused by considerably higher rate for pensioners, who represent 24% of population. At-risk-of-poverty rate for pensioners is 8.1%, while using the estimated scale it accounts for 4.8%. It is not offset by higher rate for children, which rises from 12.3% to 15%. Other groups of people by their economic status are not significantly affected. It is possible to set the number of people below both thresholds (based on Eurostat scale and on estimated scale). This share of people is slightly lower because of stricter conditions. Overall rate is the same (8.2%) in both approaches. The change in structure of the at-risk-of-poverty people may have an important impact on political decisions in social and family policies.

Table 5 At risk of poverty rate per different criterion of poverty threshold by their economic status in 2014 (in %)

	Rate by threshold per modified OECD	Rate by threshold per estimated CU	Rate by threshold per both criteria
Children	12.3	15.0	12.2
Employee with lower education	4.8	5.0	4.1
Self-employed	7.2	7.4	6.4
Employee with higher education	1.8	2.1	1.6
Pensioners	8.1	4.8	4.5
Unemployed	44.8	45.3	42.7
Others	15.0	14.0	13.5
Total	9.72	9.05	8.22

Source: Authors

CONCLUSION

The determination of consumption unit's scale has a huge impact on evaluation of economic and social conditions of households. Currently, international equivalence scales are applied. There is the advantage that common methodology and equivalence scale is used and results should be comparable. People may also believe that equivalence scale does not differ significantly as societies are similar even in Europe. However, it has been proved that equivalence scale in the Czech Republic is not same to equivalence scale used by Eurostat or OECD.

The OECD scale with weights (1; 0.7; 0.5) is used by OECD for international comparison of countries across the world. The modified OECD scale with stricter weights (1; 0.5.; 0.3) is commonly used by Eurostat for comparisons among European countries. Nevertheless, analysis of households within specific country should respect local conditions.

The estimated consumption unit's scale for the Czech Republic is the following: (1; 0.75; 0.3) based on our research. For additional adult in household should be used the weight 0.75 because his or her value of consumption is on 75% level of the first household member. The economies of scale are just 25% for the household of two members. The consumption level of child in household represents just 30% of value of first adults in a household, so the weight of the child is 0.3. The range of economies of scale for children is similar to that considered in the modified OECD scale.

Using the estimated equivalence scale for Czech households allows us to assess their economic and income conditions more precisely. This consumption unit's scale compared to modified OECD scale decreases the equivalised income for household with more adults because it assumes smaller economies of scale. Total household income is thus distributed between more consumption units. It leads to a change in the income distribution. Subsequently, the at-risk-of-poverty rate falls to 9.1%. Equivalized income distribution based on estimated consumption unit scale is more equal. Consequently, income inequality is lower.

It was proved that households realize not so large economies of scales in the Czech Republic as it is considered in international scales. The consumption level of Czech household depends on household characteristics such as household composition, namely the size and number of children. However, other characteristics were not taken into account. Currently, limited characteristics of households are available in household budget survey. The survey is now being redesigned and it will be merged with EU-SILC. More information about particular household will be available in the future. The challenge for further research subsists in design of more complex model.

Using this estimated equivalence scale for Czech households specifies more precisely assessment of their economic and income conditions. This consumption unit scale compared to modified OECD scale decreases the equivalised income for household with more adults because it takes into account the smaller economies of scale, so the total household income is then distributed between higher value of consumption units.

The choice of equivalence scale affects not only the level of total income indicators, but also the individual indicators for groups of people by their economic status. At-risk-of-poverty rate is lower for pensioners and higher for children based on our research. The consumption unit's scale has also the impact on the structure of people below the poverty threshold. The proper identification of this structure of people at-risk-of-poverty is important for policy makers.

ACKNOWLEDGMENT

The paper has been prepared with the support of the University of Economics, Prague – Internal Grant Agency; project No. IGA 52/2016 "Indicators of Households' Standard of Living with Respect to the Regionalization and Social Groups" and by Institutional Support for Long Period and Conceptual Development of Research and Science at Faculty of Informatics and Statistics, University of Economics, Prague.

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