ECONOMIES OF SCALES IN EU HOUSEHOLD CONSUMPTION – SOME REMARKS BASED ON A COUNTRY-LEVEL ANALYSIS

Hanna Dudek
Department of Econometrics and Statistics
Warsaw University of Life Sciences – SGGW
e-mail: hanna_dudek@sggw.pl

Abstract: Economies of scale in household consumption generally occur as a result of joint consumption of public goods. In order to analyze this phenomenon expenditure shares on housing, which can be treated as a representative of the public good, and expenditure shares on food - representing private goods - are examined. The data used in this study come from the Eurostat database and cover the period between 2004 and 2012. Estimation of panel data models reveals that a large drop in food shares in post-communist countries was mainly due to rising household incomes. It is also found that an increase in housing shares was affected by the rising price of housing relative to other consumer prices in the EU-countries. Reducing differences in the considered components of expenditure structures make use in EU common equivalence scale in 2012 more reasonable than in 2004.

Keywords: economies of scales, households, the EU countries, panel data,

INTRODUCTION

People live in households of different size and composition. Taking into account their consumption behaviour one can state, that in order to attain the same standard of living two individuals living together generally require less money than two individuals living single. The reduction is not proportional because they benefit from economies of scales due to the jointness of consumption. For example, sharing the accommodation, heating and so on and so forth generates economies of scale. In order to take into account economies of scales in comparison of well-being across households of different sizes and compositions the so-called equivalence scales are usually applied. They may be interpreted as parameters informing how much money more/less a household of a given type needs to reach

the well-being of a household of another type [Szulc 2004]. A wide range of equivalence scales exist, many of which are described in [Buhmann et al. 1988; Schröder 2004; Dudek 2011]. The choice of a particular equivalence scale depends on assumptions about economies of scale in consumption as well as on assessments of the needs of different individuals such as children and adults. To the most commonly used scales belong the so called OECD scales. The original OECD scale (also called 70/50 scale or 'Oxford scale') was recommended in the 1980s for possible use in countries which had not established their own equivalence scale. This assigns a weight of 1 to the first household member, of 0.7 to each additional adult and of 0.5 to each child. The Statistical Office of the European Union (Eurostat) adopted in the late 1990s the so-called 'OECD-modified' equivalence scale. This scale[1] (also called 50/30 scale) states that the first adult should be assigned a weight of one, subsequent adults are assigned a weight of 0.5 and children 0.3. It should be mentioned that with the accession of 10 new countries to the European Union in 2004 some experts reported an inadequacy of using a common scale for all Member States [Dennis, Guio 2004; Szulc 2004]. Reported concerns were related to differences in the country-specific structures of consumption expenditure.

Households consume a variety of goods, which can be broadly classified as public and private goods. Economies of scale are generated by the presence of household public goods [Perali 2003]. Such goods can be consumed jointly by several individuals within the household where the satisfaction derived by one person does not reduce that obtained by another[2]. In the opposite to a public good, a private good is defined if it cannot be shared or consumed jointly by more than one person [Dunbar, Lewbel, Pendakur 2013]. If all goods are private, cost of living rises in proportion to the number of people in the household, while if all goods are public, such costs are unaffected by the size of households. This arguments support the intuitive notion that, in very poor economies with a high share of the budget devoted to food (which is almost entirely private) the scope for economies of scale is likely to be small. In other settings where housing (which has a large public component) is important, economies of scale are likely to be larger [Deaton, Zaidi 2002].

The economies of scales depend on the proportion of public versus private goods in the household. This proportion can vary over time and across countries. Therefore, there is a need for empirical researches about this phenomenon. They allow for a deeper insight into the issue of economies of scale in the EU household consumption.

---

[1] OECD-modified equivalence scale was first proposed by Haagenars et al. [1994].

[2] In reality many goods are partly shared, e.g., an automobile may be used by a single household member part of the time, and by multiple members at other times [Dunbar, Lewbel, Pendakur 2013].

In the paper country-level analysis using Eurostat database is undertaken. In order to study such a complex phenomenon as economies of scale the expenditure shares on food (representing private goods) and the expenditure shares on housing (representing public goods) are considered. To the potential determinants of households behaviour belong: incomes, demographic characteristics and price indices [Deaton, Muellbauer 1980; Rusnak 2007]. The objective of this study is an empirical verification of influence of these factors on households expenditure shares on food and housing.

DATA

The data for the analysis are taken from the European Union statistics office – Eurostat. They are the shares of expenditure on different goods in the household final consumption expenditure. In Eurostat database household consumption expenditures are broken down into twelve main categories by a system known as COICOP[3] classification. In the paper we focus on the percentage of total spending that households in each Member State dedicated to each of two items. The first one relates to food and non-alcoholic beverages and the second one – to housing, water, electricity, gas and other fuels. In short, we call this ratio 'the food share' and 'the housing share' respectively[4]. For the analysis the panel data analysis is used. Such data refer to data containing time series observations of a number of individuals. In our analysis the time span covered is from 2004 to 2012 and the study encompasses the 27 EU Member States.

The analysis includes the following Member States: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, the United Kingdom, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria and Romania. The first 15 of the above countries (shortly named EU-15) formed the EU before 2004, the subsequent 12 countries mainly from Central and Eastern Europe (CEEC) joined in 2004 and in 2007.

As potential determinants of the expenditure shares following variables are taken into account:

- median of equivalised[5] net income in PPS (Purchasing Power Standard),
- average household size,
- annual average price indices with the base period in 2004: index for food and non-alcoholic beverages, index for housing, water, electricity, gas and other fuels; index for all items HICP (Harmonised Index of Consumer Prices).

---

[3] COICOP stands for Classification of Individual Consumption by Purpose.

[4] Both shares relate to the spending at current prices as % of total household consumption expenditure.

[5] 50/30 equivalence scale was applied.

There are some gaps in the Eurostat dataset, especially concerning Bulgaria, Greece, Lithuania and Romania. In such cases missing values were interpolated using linear trend.

METHODS

Using panel data on the EU countries we specify the following equation:

$$y_{it} = \alpha + \mathbf{x}_{it}\boldsymbol{\beta} + u_i + \varepsilon_{it} \tag{1}$$

where y_{it} is dependent variable,

$\quad\quad\mathbf{x}_{it}$ – row vector of the time-varying explanatory variables,

$\quad\quad\quad i$ indexes country and t indexes year,

$\quad\quad\alpha$ – intercept,

$\quad\quad\boldsymbol{\beta}$ – column vector of slope parameters,

$\quad\quad u_i$ – is an individual country-specific effect[6], $u_i \sim IID(0,\ \sigma_u)$, i=1, 2,…,N,

$\quad\quad\varepsilon_{it}$ – idiosyncratic error term[7], $\varepsilon_{it} \sim IID(0,\ \sigma_\varepsilon)$, i=1, 2,…,N, t=1, 2,…,T.

The idiosyncratic error term ε_{it} is assumed to be uncorrelated with the explanatory variables and with the individual country-specific effect. The assumptions about u_i help to determine what kind of panel model should be estimated. In the absence of the individual effect pooled OLS estimator can be applied.

The fundamental distinction is between models random and fixed effects (shortly named RE and FE respectively). The key consideration in choosing between these approaches is whether u_i and $\mathbf{x}_{it}$ are uncorrelated which is an assumption of the RE model [Wooldridge 2002]. To test this assumption Hausman specification test is applied. Since FE is consistent when u_i and $\mathbf{x}_{it}$ are correlated, but RE is inconsistent, a statistically significant difference is interpreted as evidence against the random effects assumption. If the null hypothesis that the individual effects are uncorrelated with the other regressors is rejected, a fixed effect model is usually favoured by applied researchers over its random counterpart[8].

---

[6] We can think of u_i as representing the effects of all the time invariant variables that have not been included in the model.

[7] In panel data regression the error term $w_{it} = u_i + \varepsilon_{it}$ consists of two components: an 'unobserved heterogeneity' component u_i and an 'idiosyncratic' component ε_{it} denoting the remainder disturbance [Baltagi 2005].

[8] It should be noted that the differences in the estimates of fixed effects and random effects models in finite samples can originate from different sources, therefore results of Hausman test should be interpreted with caution. For example, FE estimator may also be inconsistent due dependence of time-varying explanatory variables and idiosyncratic error term (see for example [Ahn, Low 1996]).

Fixed effects are compared with pooled OLS regression by the F test, while random effects are examined by Breusch and Pagan test (LM test). If the null hypothesis is not rejected in either test[9], the pooled OLS regression is favoured.

RESULTS

There were great disparities in patterns of households' expenditures across countries and time. Housing, water, electricity, gas, other fuels were amongst the most important consumption items for the majority of EU households in years 2004-2012. In many countries shares of the budget devoted to them exceed 20% and in almost all countries they increased during the period in question, as Figure 1 shows.

Figure 1. Housing shares in 2004 and 2012 (% of total expenditures)
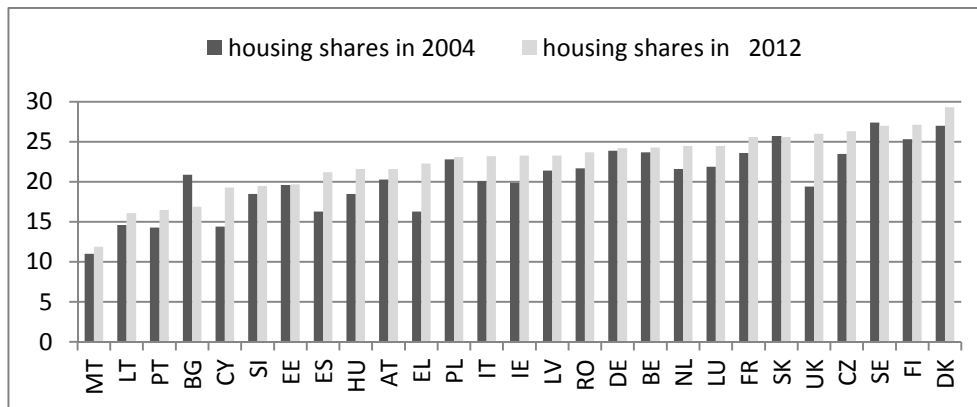
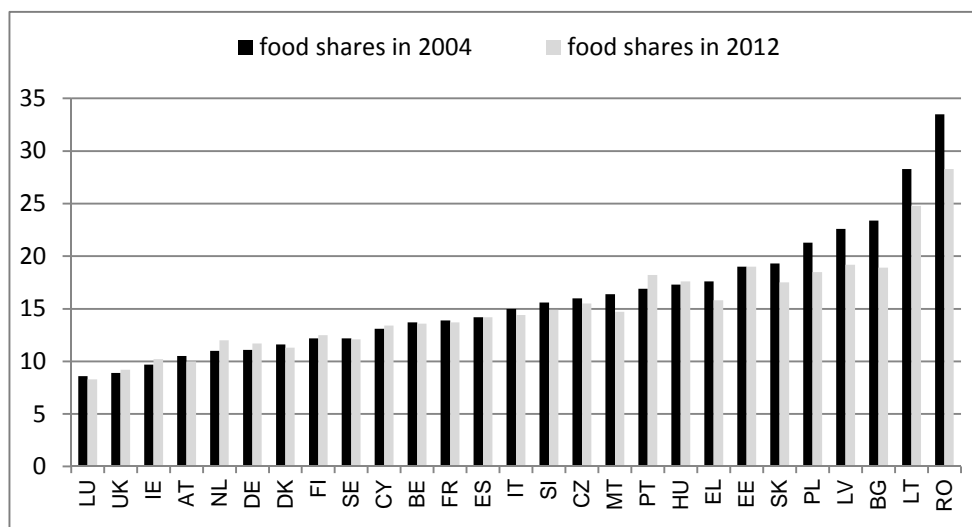Source: own elaboration based on Eurostat data
Country codes: AT: Austria; BE: Belgium; BG: Bulgaria; CZ: the Czech Republic; DK: Denmark; DE: Germany; EE: Estonia; IE: Ireland; EL: Greece; ES: Spain; FR: France; IT: Italy; CY: Cyprus; LV: Latvia; LT: Lithuania; LU: Luxembourg; HU: Hungary; MT: Malta; NL: the Netherlands; PL: Poland; PT: Portugal; RO: Romania; SI: Slovenia; SK: Slovakia; FI: Finland; SE: Sweden; UK: the United Kingdom.

Countries with high shares of expenditures on housing were not only affluent countries of Western and Northern Europe but also certain post-communist countries such as the Czech Republic, Slovakia, Poland, Romania and Latvia. At the opposite pole, especially at the beginning of the period in question, were mainly countries of Southern Europe such as Malta, Portugal, Cyprus, Spain, Greece and Slovenia.

---

[9] The null hyphothesis in Breusch-Pagan test is that variances of individual effects are zero.

Other significant components of expenditure were food and non-alcoholic beverages. There were significant differences across countries and time with respect to them. For example, in 2004 the average households in Romania devoted more than 30% of total consumption to food, while in the most affluent countries, such as Luxembourg and the United Kingdom, the average food shares did not exceed 10% in 2012. This is illustrated in Figure 2.

Figure 2. Food shares in 2004 and 2012 (% of total expenditures)

Source: own elaboration based on Eurostat data

Figure 2 highlights a few important facts. It should be noted that the countries of Central and Eastern Europe generally spent a higher proportion on food and non-alcoholic beverages than the 'old' EU Member States. During the period 2004-2012 the decrease in the share of food expenditures could be observed in almost all EU countries. Among the EU-15 countries, these changes are minor, while in the CEEC – more dynamic. Turning to an analysis of country-specific data, one can observe that the southern countries such as Portugal, Spain, Greece and Italy exhibited higher food shares then other EU-15 countries.

The drop of the expenditure shares of food (representing private goods) and growth of the expenditure shares of housing (representing public goods) indicate increasing economies of scale in household consumption. Moreover, as it was proved in [Dudek 2014], the growth rates of these two expenditure shares are inversely correlated with their appropriate initial levels. It means that during the period 2004–2012 the 'catching up' process in the field of economy scale took place. It was also found that standard deviations of food shares and housing shares decreased during the period in question (from 5.9 percent points in 2004 to 4.6 in

2012 and from 4.1 percent points in 2004 to 3.9 in 2012, respectively). This means a reduction of differences in the behaviour of household consumption. The above results give rise to the conclusion that the use of the common equivalence scale in the EU was more reasonable in 2012 than in 2004.

The main objective of this study is identification of determinants of households expenditure shares on food and housing. Many models with different sets of explanatory variables are estimated[10]. Selection of the final models is based on information criteria. Table 1 shows the panel estimation results for the countries analyzed. The results of the tests are also reported. In the second column we indicate the results using as dependent variable the food share; the third column refers to the housing share as dependent variable.

Table 1. Results of estimation of panel data models (1)

Variables and statistics	Food shares	Housing shares
Log of income*d_1	-2.70 (0.33) ***	-
Ratio of price indices for food and for all items	3.54 (1.67) **	-
Ratio of price indices for housing and for all items	-	10.26 (0.84)***
Constant	13.41 (1.62)***	10.04 (0.75)***
R^2	0.98	0.95
F test	397.91***	164.82***
LM test (Breusch and Pagan test)	819.76 ***	787.78 ***
Hausman test	45.46 ***	5.46 **

Source: own calculations.

Standard errors in parentheses. * indicates statistical significance at 0.1, ** at 0.05, and *** at 0.01, d_1 is a dummy variable is that equals 1 if for CEEC and 0 otherwise.

We first test whether or not the panel estimation is preferred to the pooled OLS estimation. Usual F and LM tests confirm that a specification considering individual effects is more appropriate. As can be seen from Table 1, the FE model is probably a better specification than RE, since the Hausman test is significant. As a consequence of this, in table 1 only fixed effects model estimates are presented.

Incomes are found to have a significantly negative effect on food shares only for Central and Eastern Europe countries. It must be emphasized that in almost all EU countries a huge growth of households' equivalised incomes was observed in time in question[11]. However, increment of incomes in the EU-15 did not have a significant impact on food shares. Therefore, Engel law, according to which an increased income leads to a reduced proportion of income spent on food, is

---

[10]It was found that the basic demographic characteristics - household size - was almost time-invariant variable, and thus it was excluded.

[11] This situation also applies to the Baltic countries, where after 2009 there was drop such incomes.

confirmed only for the poorer countries of the EU, which were the CEEC. Since the logarithm of income is included as an explanatory variable, it denotes a decreasing marginal decline in food shares with respect to an increase in incomes in those countries. As it was expected, a ratio of price indices for food and for all consumed items has a positive effect. It should be noticed, however, that changes in this area were rather small in the years 2004-2012, as Figure 3 shows.

Figure 3. The average values of ratios of price indices in all the EU countries
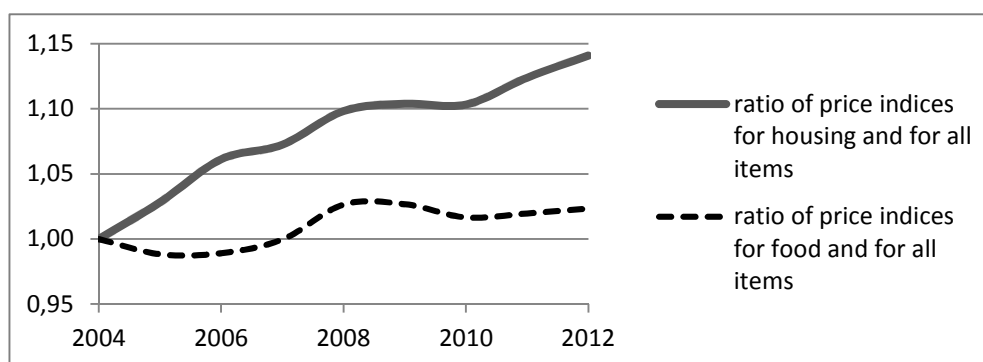
Source: own elaboration based on Eurostat data

Similarly to food shares, it was found that the ratio of price indices for housing and for all consumed items has a positive and significant effect on the housing share. Except Bulgaria, this ratio was greater than unity in all periods and countries. It was increasing in 2004-2012, as it is presented in Figure 3, causing an increase in housing shares. The 'new' Member States were countries with a particularly high growth of housing prices relatively to all consumer items, except Poland and Slovakia, where the increase was moderate.

CONCLUSIONS

There were big differences across countries with respect to economies of scales in the EU household consumption in 2004-2012. In countries such as Luxembourg, the United Kingdom, Denmark, Ireland, Sweden, Finland and Germany expenditures on housing, water, electricity, gas, other fuels were twice higher than expenditures on food and non-alcoholic beverages. One can say that in the years 2004-2012 these countries were characterized by the highest economies of scales among Member States. The opposite situation was in Bulgaria, Romania, Lithuania, Malta and Portugal, where in the whole period in question average households devoted more of their budgets to food and non-alcoholic beverages than to housing, water, electricity, gas and other fuels. Such a large disparities in the ratio of spending on typical public and private goods raises doubts as to the application of the common equivalence scale for all Member States.

During the period 2004-2012 differences in expenditure shares decreased. The drop in the food shares in the CEEC was caused mainly by increase in households' incomes. Changes in these shares in most other EU-countries were rather small. It is also found that an increase in housing shares was affected by the rising price of housing relative to other consumer prices in the EU-countries.

The decrease of the expenditure shares of food and growth of the expenditure shares of housing indicate increasing economies of scale in EU household consumption.

The aim of this study is to provide an overall picture of the changes in two important components of expenditure structures. The future directions of the research will include a microeconometric analysis using individual household-level data. Such an analysis would enable a deeper insight into the issue of economies of scale in the European Union.

REFERENCES

Ahn S. C., Low S. (1996) A refolmulation of the Hausman test for regression models with pooled cross-section time-series data, Journal of Econometrics, Vol. 71, pp. 309-319.

Baltagi B. (2005) Econometric analysis of panel data, 3rd ed., John Wiley & Sons, West Sussex.

Buhmann B., Rainwater L., Schmaus G., Smeeding T.M. (1988) Equivalence scales well-being, inequality, and poverty: sensitivity estimates across ten countries using the Luxembourg Income Study (LIS) Database", Review of Income and Wealth, Vol. 34, pp. 115-142.

Deaton A., Muellbauer J. (1980) Economics and consumer behavior, Cambridge University Press, Cambridge.

Deaton A., Zaidi S. (2002) Guidelines for constructing consumption aggregates for welfare analysis, World Bank Publication nr 14101, Washington DC.

Dennis I., Guio A.C. (2004) Monetary poverty in new Member states and candidate countries, Statistics in Focus, Vol. 12

Dudek H. (2014) Zmiany w zakresie udziałów wybranych wydatków konsumpcyjnych w UE a problem skal ekwiwalentności, Roczniki Kolegium Analiz Ekonomicznych, (in press).

Dudek H. (2011) Skale ekwiwalentności – estymacja na podstawie kompletnych modeli popytu, Wydawnictwo SGGW, Warszawa.

Dunbar G., Lewbel A., Pendakur K. (2013) Children's resources in collective households: identification, estimation, and an application to child poverty in Malawi, American Economic Review, Vol. 103(1), pp. 438-71.

Hagenaars A., de Vos K., Zaidi M.A. (1994) Poverty statistics in the late 1980s: Research based on micro-data, Office for Official Publications of the European Communities, Luxembourg.

Perali F. (2003) The behavioral and welfare analysis of consumption, Kluwer Academic Publisher, Dordrecht.

Rusnak Z. (2007) Statystyczna analiza dobrobytu ekonomicznego gospodarstw domowych, Wydawnictwo AE im. O. Langego we Wrocławiu, Wrocław.

Schröder C. (2009) The construction and estimation of equivalence scales and their uses, in: D. Slottje (ed.), Quantifying consumer preferences, contributions to economic analysis, Vol. 288, Emerald, Bingley, pp. 349-362.

Szulc A. (2004) Poverty measurement in transition countries joining the European Union: a Polish perspective, paper presented at the conference „Aligning the EU Social Inclusion Process and the Milennium Development Goals", Vilnius 26-27.04.2004.

Wooldridge J. (2002) Econometric analysis of cross section and panel data, The MIT Press, Massachusetts.