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Taxonomic Analysis of Spatial Diversification of Housing in Selected Countries of the European Union

Marcelina Zapotoczna
University of Warmia and Mazury in Olsztyn, Poland

Abstract

This article proposes to employ taxonomic methods to assess the residential situation in selected countries of the European Union. A synthetic measure was used whose construction was based on diagnostic variables which characterise the housing and socioeconomic conditions in the countries included in the study. This measure made it possible to arrange the items under study in a linear manner by residential situation (from the best to the worst). In addition, Ward's method of classification was used to arrange countries in groups with similar residential situations. Similar results were obtained in both classifications for the years 2007 and 2013. The proposed procedure can be used by state authorities to make housing policy decisions.

Keywords: multivariate comparative analysis, synthetic measure, housing market

Introduction

The importance of a place to live for all makes it justified or even necessary to consider the issue of housing not only at the local level, but also at the national and supranational levels. The issue of housing appears in many documents and provisions of international law.[1] This shows the role of the state and its obligations towards its citizens in terms of creating conditions to satisfy the residential needs of all social groups. However, it must be emphasised that housing policy is the responsibility of the member state governments, not of the European Union. Reducing the variations in residential conditions between the EU member states will help to reduce the differences in the living standards between the countries. The multi-functional nature of housing needs is a factor which determines whether they are fulfilled or not, and the availability of a place to live becomes the main criterion in an assessment of social development.

This article proposes to use a multivariate analysis to assess the residential situation in 24 countries of the European Union. Considering the fact that the housing market is affected by a number of factors, both internal and external and qualitative and quantitative, taxonomic methods can be a convenient tool used to arrange and classify the objects described by a number of features. (Foryś 2011) wrote about the suitability of the use of taxonomic analysis to evaluate the housing market. The same author has also demonstrated the usefulness of linear ordering procedures for site selection similar to the process of estimating the value of residential real estate (Foryś 2010). Mazur and Witkowska (2006) pointed out the possibility of a synthetic measure of development and rate the relative level of development for the assessment of residential properties sold in the local market. Gdakowicz and Hozer (2012) used a synthetic measure of development and the method of k-means to evaluate the condition of the local real estate market.

1. See: Art. 25.1 of the Universal Declaration of Human Rights, UNO, Paris 1948; Art. 11.1 of the International Covenant on Economic, Social and Cultural Rights of 19.12.1966 – ratified by Poland in 1997 (Międzynarodowy Pakt Praw Gospodarczych, Społecznych i Kulturalnych otwarty do podpisu w Nowym Jorku dnia 19 grudnia 1966 r., DzU z 1977 r. nr 38 poz. 169); Convention on the Rights of the Child adopted by the UN on 20.11.1989 (Konwencja o prawach dziecka, przyjęta przez Zgromadzenie Ogólne Narodów Zjednoczonych dnia 20 listopada 1989 r., DzU z 1991 r. nr 120 poz. 526), and others.

In the present research, a synthetic measure of development proposed by Hellwig (1968) was used. The design of this measure allows a large set of variables to be replaced with one aggregated variable and to arrange items, from those with the best situation regarding the phenomenon under study to those with the worst situation. The other classification method used was Ward's method, applied using the Statistica software package. The analysis was based on 8 diagnostic variables taken from European Union statistical data (www.eurostat.eu). The synthetic measures were calculated in statistical terms for the years 2007 and 2013. Constructed in this manner, the measures provide a way to grasp the changes in the residential situation in the EU countries selected for the study.

1 A synthetic measure of the residential situation in selected countries

The study was conducted for 24 EU member states. The assessment of the residential situation in the items under study was based on the variables which described housing conditions and those socioeconomic conditions in the countries which affect the situation. The information was taken from an EU statistical data resource (www.eurostat.eu). The accumulated variables were subjected to the selection process in regard to the variability coefficient (V_{si} (%) for the i-th variable was larger than 10%), standard deviation and correlation coefficient (strongly correlated variables were rejected). The set of data selected in this manner was arranged and subsequently standardised. Ultimately, a set of 8 diagnostic variables for the year 2007, and for the year 2013 (i.e., $X_{1\ 2007}$ and $X_{1\ 2013}$, $X_{2\ 2007}$ and $X_{2\ 2013}$, etc.) was adopted for the study:

- percentage of the population living in detached and semi-detached houses
- percentage of the population living in flats which they own
- percentage of the population who use reduced-rent or free-of-charge residential facilities
- percentage of the population living in houses or flats which they own but for which they took out a mortgage
- overpopulation index
- poverty risk index
- serious housing deprivation index
- expense overburden index

For the purpose of construction of a synthetic measure, destimulants were transformed into stimulants, by taking the reverse values of the variables. The synthetic measure of the residential situation in this study was constructed with the use of the measure proposed by Hellwig (1968). The values of the measure were calculated for each object under study and for two time points (i.e., the years 2007 and 2013). The measure was calculated from the formula:

$$D_i = 1 - \frac{c_{i0}}{c_0}, \tag{1}$$

where $c_0 = \bar{c}_0 + 2s_0$, with: $\bar{c}_0$—mean distance c_{i0}, s_0—standard deviation for the distance c_{i0}, c_{i0}—distance to the standard, which is adopted as the abstract point P_0, whose coordinates are the highest for each variable.

Owing to the transformation of destimulants into stimulants, the values of the synthetic measure lie within the range of [0,1]. The closer the value of d_i was to 0, the worse the residential situation in the country was due to the variables adopted for the study. On the other hand, the closer the value of di was to 1, the better the residential situation was in the country. The values of the synthetic measure di, for the EU countries under study, for the years 2007 and 2013, are shown in table 1.

The d_i index allowed a country to be positioned in the hierarchy of countries taken for the study. The values of the measure indicate very high spatial differentiation of the residential situation in the years under study (tab. 1). Considering the average level of di, it can be observed that the residential situation in the countries under study deteriorated (the mean value of the synthetic measure was lower in 2013). Moreover, it is noteworthy that the differences in the synthetic measure in 2013 are smaller and that the position of the countries under study in the hierarchy of the set changed. The best residential situation in 2007 was observed in Cyprus (0,675) and in Malta (0,587), because di reached the maximum value in those countries. The values of the diagnostic

Tab. 1. EU countries arranged according to Hellwig's measure of development (d_i) in the years 2007–2013

Country	$d_{i\,2007}$	Position	$d_{i\,2013}$	Position
Poland	0,002	24	0,128	22
Latvia	0,070	23	0,134	21
Romania	0,153	22	0,066	24
Lithuania	0,157	21	0,338	8
Bulgaria	0,183	20	0,199	17
Czech Republic	0,203	19	0,323	9
Estonia	0,207	18	0,311	10
Hungary	0,230	17	0,076	23
Iceland	0,233	16	0,183	19
Slovakia	0,242	15	0,212	16
Sweden	0,323	14	0,155	20
Italy	0,360	13	0,290	13
Netherlands	0,364	12	0,261	14
Denmark	0,385	11	0,192	18
Norway	0,386	10	0,251	15
Slovenia	0,389	9	0,566	2
Austria	0,397	8	0,302	12
Spain	0,400	7	0,308	11
France	0,450	6	0,426	5
United Kingdom	0,456	5	0,428	4
Finland	0,473	4	0,389	7
Portugal	0,537	3	0,406	6
Malta	0,589	2	0,478	3
Cyprus	0,675	1	0,634	1

Source: calculated by the author on the basis of data from www.eurostat.eu

variables which described the quality of residential conditions in these countries were the best. The percentage of population living in overcrowded houses was the lowest (Cyprus 1,6%, Malta 4,2%).[2] Moreover, severe residential deprivation in these countries affected less than 1,0% of the population. Another factor with a positive effect on the residential situation in Cyprus and Malta in 2007 was the lowest percentage of people whose housing-related expenses exceeded 40% of equivalent disposable income (Cyprus 1,7%, Malta 2,5%). The worst residential situation, shown by the value of the synthetic factor, was observed in countries in which the values of the diagnostic variables, describing the quality of residential conditions, were the highest. These included Poland, Latvia, Romania, Lithuania and Bulgaria. The over crowdedness indexes for these countries were the highest (Latvia 60%, Romania 56,3%, Lithuania 52,5%, Poland 52,3%, Bulgaria 51,1%). Moreover, the percentage of the population affected by the risk of poverty in these countries is the highest (Poland 69,6%, Bulgaria 63,6%, Romania 60,8%, Lithuania 57,3%, and Latvia 56,6%) and serious residential deprivation affected the largest part of the population (Romania 31,8%, Poland 25,9%, Latvia 25,2%, Lithuania 21,9% and Bulgaria 18,2%). The proportion of households whose housing-related expenses accounted for more than 40% of the equivalent disposable income was the highest in these countries. After six years — i.e., in 2013, the highest value of di, and, consequently, the best residential situation, was noted for Cyprus (0,634) and Slovenia (0,566). The change of the position of Slovenia resulted from a considerable improvement of the variables which described

2. [In the journal (in both Polish and English texts) European practice of number notation is followed — for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style). Furthermore in the International System of Units (SI units), fixed spaces rather than commas are used to mark off groups of three digits, both to the left and to the right of the decimal point. — Ed.]

the quality of residential facilities, i.e. the percentage of the population living in overcrowded flats decreased by 24,3 percentage points; the percentage of the population at risk of poverty decreased by 23,7 percentage points and the severe residential deprivation decreased by 5,8 percentage points. In 2013, the worst residential situation, shown by the di index, was again noted in Romania ($d_i = 0{,}066$), in Poland ($d_i = 0{,}128$) and in Latvia ($d_i = 0{,}134$). The group of countries with the worst residential situation was joined by Hungary ($d_i = 0{,}076$), where the residential conditions were seen to deteriorate.

The process of arranging the countries showed that 2 of them occupied the same position due to the value of di. These were Italy and Cyprus, which means that the residential situation in Cyprus was still the best considering the variables adopted for the study. Meanwhile, the residential situation in Italy (13th position in the ranking) did not change. The largest movement up the ranking was observed for Lithuania (13 positions up); the Czech Republic (10 positions up), Estonia (8 positions up) and Slovenia (7 positions up). These are the countries with the greatest improvement of the residential situation in terms of the variables taken for analysis. Deterioration of the residential situation and, consequently, movement down the ranking, was recorded in the case of Denmark (7 positions down), Hungary and Sweden (6 positions down) and Norway (5 positions down). The percentage of the population at risk of poverty and in the percentage of households which spent more than 40% of their equivalent disposable income to satisfy their residential needs increased in these countries. The ranking positions in 2007 and 2013 and their changes, as shown by the value of the synthetic variable, are presented in figure 1.

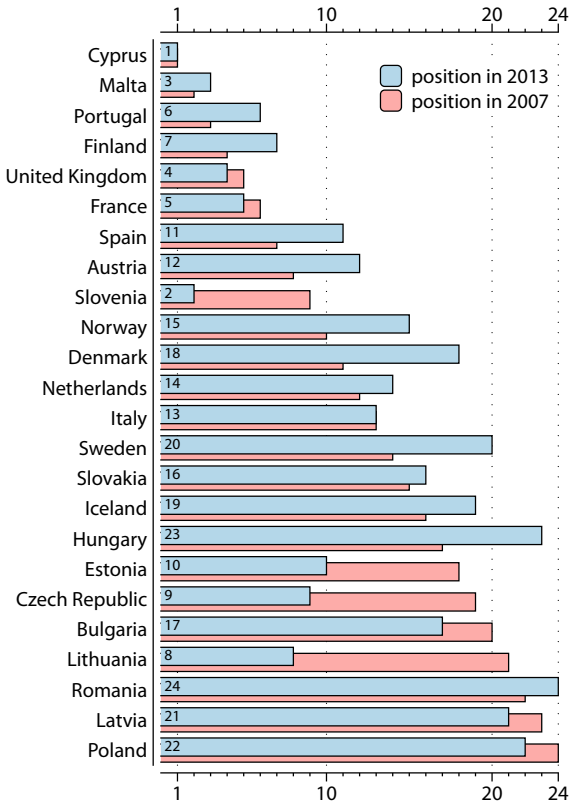

Fig. 1. Ranking positions of countries by the value of the synthetic measure of the residential situation (positions in 2013 are additionally denoted numerically on the bars)

2 Forming groups of countries with similar housing conditions

There are many methods of grouping objects with respect to synthetic variables or a synthetic index (Foryś 2008; Jajuga 1993; Walesiak 2011; Zeliaś 2000). This paper presents the results of forming groups of countries with similar residential situations, using Ward's method with Euclidean distance, which aims to minimise the sum of square deviations inside clusters, resulting in clusters

with the minimum diversity. This method is regarded as highly effective, although it aims to create small clusters (Stanisz 2007, 122). The result of grouping based on the set of diagnostic variables taken for the study is shown in figures 2 and 3. An analysis of the dendrograms reveals some regularity in the grouping of the countries. The results of the classification are shown in table 2.

It is noteworthy that countries moved only to the neighbouring groups, i.e. ones between which there were no large bonding distances. Slovenia, which moved from group 3 to group 1, ending up in the 2nd place in the ranking according to the value of di, was an exception. There was a high probability that the items would be classified into the same groups in the years under study. There were three countries with the best parameters of residential conditions in group 1. On the other hand, group 3 included items with the worst residential situation. This group comprised the countries which accessed the EU in 2004 and 2007. Italy, which has been in the EU since 1957, is an exception. Cyprus, occupying the first place in the ranking according to the value of d_i,

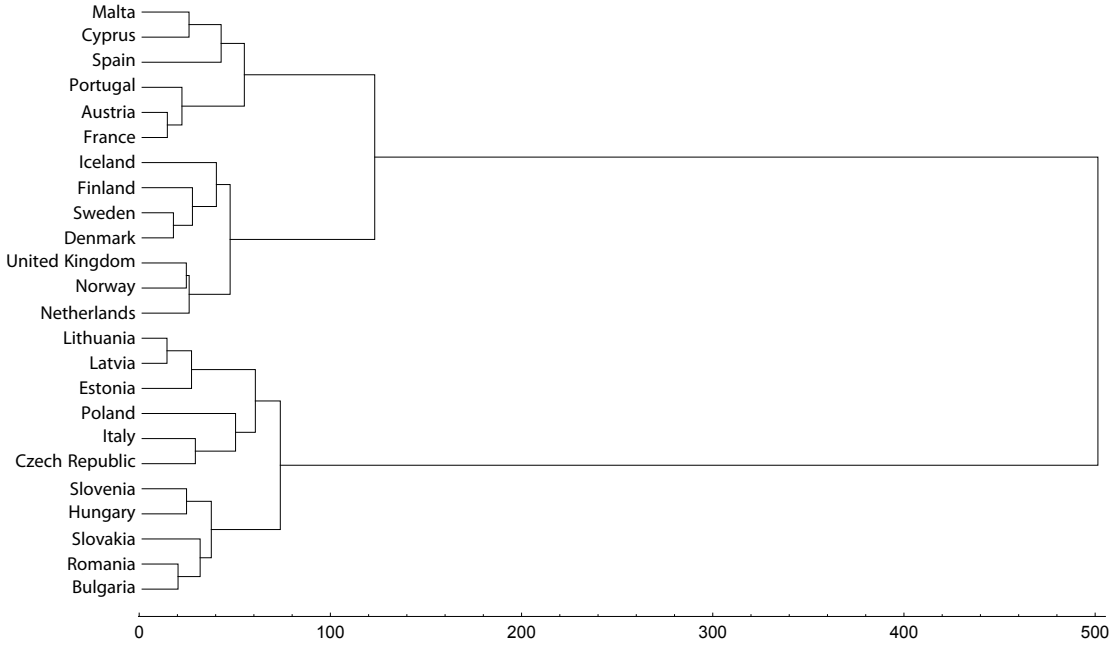

Fig. 2. Grouping countries by Ward's method — dendrogram for year 2007

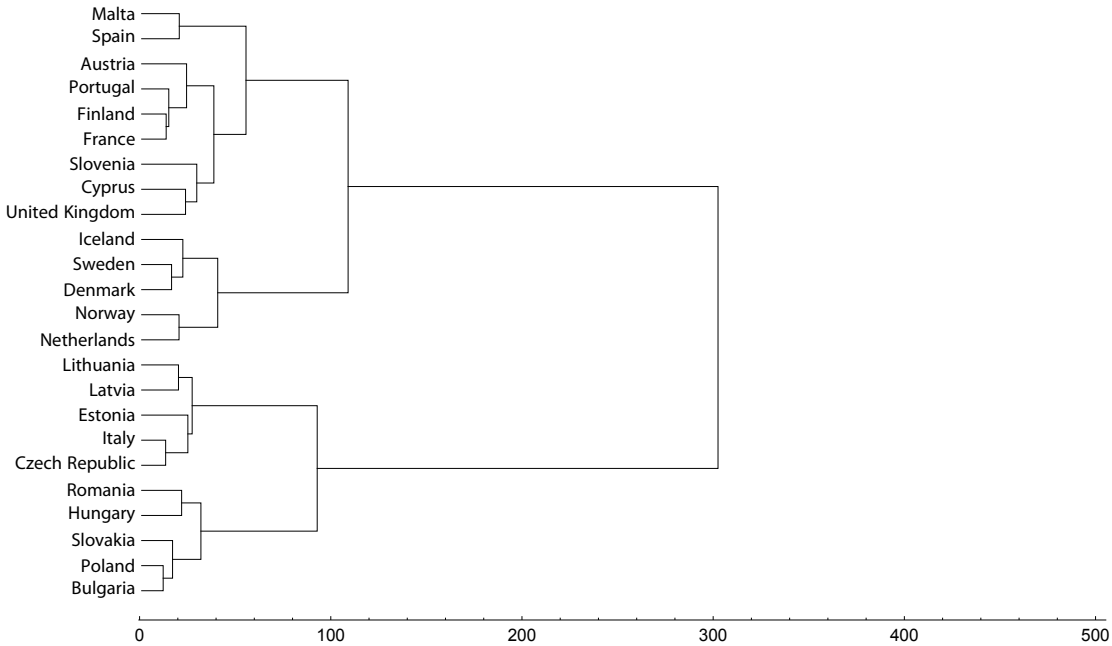

Fig. 3. Grouping countries by Ward's method — dendrogram for year 2013

Tab. 2. Classification of countries by Ward's method

Groups	2007	2013	Countries repeated in groups
Group 1	Portugal, Austria, France, Malta, Cyprus, Spain	Slovenia, England, Cyprus, Austria, Portugal, Finland, France, Malta, Spain	Portugal, Austria, France, Malta, Cyprus, Spain
Group 2	Norway, England, The Netherlands, Iceland, Finland, Sweden, Denmark	Norway, The Netherlands, Iceland, Finland, Sweden, Denmark	Norway, the Netherlands, Iceland, Denmark
Group 3	Lithuania, Latvia, Estonia, Poland, Italy, Czech Republic, Slovenia, Hungary, Slovakia, Romania, Bulgaria	Lithuania, Latvia, Estonia, Czech Republic, Romania, Hungary, Slovakia, Poland, Bulgaria	Lithuania, Latvia, Estonia, Poland, Czech Republic, Hungary, Slovakia, Poland, Bulgaria

was the only country which was not classified into group 3 and which accessed the EU in 2004. Classification by the Ward method gave the same results as the classification with the use of the synthetic measure of the residential situation.

Summary

This analysis has shown that a multivariate comparative analysis can be used to assess the residential situation. The taxonomic methods employed in the study made it possible to compare the residential situation even in countries situated a long way from each other. Moreover, multivariate comparative analysis allows items described by many features to be compared, which is of particular importance because of the multi-functional dimension of the housing market. However, it should be stressed that due to the dynamic nature of the housing market, it is not possible to construct a model based on a fixed set of diagnostic variables. The classifications provide the basis for housing policy decision making by state authorities.

References

Foryś, I. 2008. "Wykorzystanie metod porządkowania liniowego do oceny polskiego rynku nieruchomości." *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu. Taksonomia, klasyfikacja i analiza danych – teoria i zastosowania* no. 15 (7):381–389.

————. 2010. "Wykorzystanie metod taksonomicznych do wyboru obiektów podobnych w procesie wyceny lokali mieszkalnych." *Studia i Materiały Towarzystwa Naukowego Nieruchomości* no. 18 (1):95–105.

————. 2011. *Społeczno-gospodarcze determinanty rozwoju rynku mieszkaniowego w Polsce. Ujęcie ilościowe, Rozprawy i Studia/Uniwersytet Szczeciński.* Szczecin: Wydawnictwo Naukowe Uniwersytetu Szczecińskiego.

Gdakowicz, A., and J. Hozer. 2012. "Analiza rozwoju rynków nieruchomości mieszkaniowych w wybranych miastach Polski z zastosowaniem metod taksonomicznych." *Studia i Materiały Towarzystwa Naukowego Nieruchomości* no. 20 (1):123–134.

Hellwig, Z. 1968. "Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę wykwalifikowanych kadr." *Przegląd Statystyczny* (4):302–327.

Jajuga, K. 1993. *Statystyczna analiza wielowymiarowa, Biblioteka Ekonometryczna.* Warszawa: Wydawnictwo Naukowe PWN.

Mazur, A., and D. Witkowska. 2006. "Zastosowanie wybranych mierników taksonomicznych do oceny nieruchomości." *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej* (60):251–258.

Stanisz, A. 2007. *Przystępny kurs statystyki z zastosowaniem Statistica PL na przykładach z medycyny. T. 3. Analizy wielowymiarowe.* Kraków: StatSoft Polska.

Walesiak, M. 2011. *Uogólniona miara odległości GDM w statystycznej analizie wielowymiarowej z wykorzystaniem programu R.* Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego.

Zeliaś, A. 2000. *Taksonomiczna analiza przestrzennego zróżnicowania poziomu życia w Polsce w ujęciu dynamicznym.* Kraków: Wydawnictwo Akademii Ekonomicznej.