A C T A U N I V E R S I T A T I S L O D Z I E N S I S
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SPATIAL DISTRIBUTION OF WILLINGNESS TO PAY FOR HEALTH SERVICES OF HOUSEHOLDS IN POLAND

Abstract. The purpose of this article is to demonstrate the spatial distribution of willingness to pay for health services of households in Poland, on the example of voluntary health insurance. With the ability to identify a household in the databases of the Social Diagnosis, on the basis of which the research was conducted and with the use of multivariate analysis techniques, the article indicates the similarities in household structure in terms of the willingness to pay, as well as the socio-economic factors.

Keywords: willingness to pay, spatial diversity, health care, multinomial logit model, cluster analysis.

I. INTRODUCTION

The use of quantitative methods is typical in the analysis of the sphere of social and economic life. The need to implement the quantitative analyses also concerns the health care sector. Such techniques are widely used to help make decisions which are difficult from a social point of view for instance whether or not to fund a certain health package. The main aim of this article is to recognise the spatial diversity of the willingness of households in Poland to pay for health benefits on the basis of voluntary health insurance. The analysis also assumes that the willingness to pay, described by many factors, varies among voivodships, changes in time and, at the same time, demonstrates similarity at spatial and temporal dimensions.

Statistical data show that expenditure on health grows continuously, while financial resources of the payer are at the relatively stable and, at the same time, insufficient level. The burden of creating a feeling of the health safety rests directly on patients. This process can be observed, for example, in increase of the amount of funds spent *out-of-pocket* for essential health services. The situation of scarcity of resources forces patients to seek additional ways of health care financing, for instance, by purchasing voluntary, supplementary health insurance. Most of the average expenditures on health – related purposes

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of Polish households (Table 1) increased significantly from year to year. Quarterly on average, the highest expenses type observed among Polish households were those connected with services for ambulatory health care (550 PLN for 2011), followed by the purchase of drugs (375 PLN in 2011). Informal payment perceived as gratitude gifts or "kickbacks" through, which patient attempted getting a better or faster medical service (for instance, greater interest in problems of the patient, the higher concern about his health condition, the possibility of choice of a surgeon, etc.) amounted on average to 311 PLN. The mean value of fees in a public hospital did not exceed 300 PLN, and the amount of gifts of sincere gratitude for the care already obtained, averaged on 142 PLN in 2011.

Table 1. Percentage of households that spend money on health care – quarterly data and the average amount of these expenses in the years: 2007, 2009 and 2011

Category of expenditure	Drugs and medicines			Services for ambulatory health care			Informal payments as gratitude gifts		
Year	2011	2009	2007	2011	2009	2007	2011	2009	2007
Percentage of households	87	89	87	39	35	32	1.7	1.3	1.8
The average amount of PLN spend	375	379	307	550	524	384	311	308	265
Category of expenditure	Gifts as an evidence of sincere gratitude			Fees at a public hospital					
Year	2011	2009	2007	2011	2009	2007			
Percentage of households	1.6	1.9	2.4	2.1	1.6	1.7			
The average amount of PLN spend	142	136	114	285	198	119			

Source: J. Czapiński, T. Panek (eds.) [2011], Social Diagnosis 2011, Objective and subjective quality of life in Poland, Warszawa, p. 125.

Increases in average household expenditures on goods and services in the field of health care showed that people tend to spend more and more money from their own pockets in order to secure their health safety. Finally, a consideration should be made about the top amount, to which a household is willing to pay extra for certain healthcare products and services. For this type of question, assessing the willingness to pay levels (WTP) may be used.

II. METHODOLOGY

In analyses of the costs of health care and assessment of obtained health outcomes, initially human capital approach was used. This approach had its drawback – it was impossible to use this type of analyses for the economic evaluation of health care programs. The interest of researchers focused on a method of estimating the willingness to pay. The method involves the study of choices, made by the individual consumer – the patient makes a choice between health and wealth. That is the reason, why some call this method "a technique that reveals consumer's preferences" [Orlewska E., Nowakowska E. (2004)].

2.1. Extracting the preferences

At the aggregated level, hidden preferences are determined based on the choices made by a research group according to its desires of different profiles of goods/services. For each potential "buyer", the choice of level of utility is defined by a deterministic component (which expresses the hidden structure of preferences at the aggregated level) and a random component (random component expresses the kind of differences in perception, buyer's attitudes, or, according to the theory, it contains other immeasurable factors) [McFadden (1986)]. Therefore, the value of utility one assigns to the alternative can be expressed by a function (1):

$$U_i = V_i + \varepsilon_i, \tag{1}$$

where: U_i – unobservable, actual level of utility for alternative i, V_i – observed level of utility, ε_i – random component.

The probability of the alternatives and of the set of all possibilities can be estimated by the multinomial logit model [McFadden (2000)]:

$$P_K(i) = \frac{\exp(V_i)}{\sum_{j \in K} \exp(V_j)}, \tag{2}$$

where: K – set of choice alternatives $K=\{1, \ldots, M\}$, P – individual probability levels of selecting i-alternative.

The main axiom of the probability used to develop a base model is known as the operational independence from irrelevant alternatives (IIA), which specifies that the ratio of the probability of choosing one alternative over the other (both of the alternatives are on non-zero probability of selection) is independent from

adding or removing of an additional alternative in the choice set [Louviere, Hensher, Swait (2000)]. The unobservable components are independent with identical distribution and each of them has its own unique mean value.

The level of observed utility V does not depend on the individual; it describes the hidden value of the utility of the population, while V_j – level of utility for all j choice possibilities belonging to set K is estimated based on a sample by maximum likelihood method. The demand for the service is formed by aggregating participant's individual demands. The willingness to pay should determine the value of a good/service expressed in monetary equivalent. That is why the terms "willingness to pay" and "level of marginal utility" are often used interchangeably [Milewski (2002)].

2.2. Cluster analysis

Cluster analysis is a discipline in multivariate statistical methods. It allows classifying (group) data into meaningful structures or classes by analyzing the similarities in the examined areas. Cluster analysis methods lead to objects partitioning into relatively homogeneous groups. These objects are similar to each other in accordance to a specific similarity measure and, at the same time, identified with the distance between them. Classification process is conducted on the basis of the variables characterizing the objects. Cluster analysis can be used to explore the structure of the population without any explanation. Applications of the methods are associated with taxonomic description of the object, as well as with the construction of the classification and the search for hidden data structures. This type of analysis allows detecting whether the received classifications show some regularity and make a simplification of the data set to the mean values of each group [Stanisz (2007)].

The most commonly used methods for grouping spatial objects in the economic trials are agglomeration methods. These methods assume that an object (for instance, a voivodship, a poviat or a commune) is a separate class. Then, these classes are combined gradually in a sequential manner to obtain a separable, hierarchical clustering. The agglomeration stops when all objects are included in a class.

Clustering can be based on minimization of the sum of squared deviations of any two clusters. The method can be very effective, although it tends to create clusters of small size, but on the other hand, it gives full control over the resulting number of groups and presents the most natural clusters of the objects.

III. DATA BANK

The main core of the research was conducted on the basis of the Social Diagnosis for years 2003, 2005 and 2007. For individual data, multinomial logit models (MNL) were tested and estimated what eventually allowed calculating the probabilities of selecting the specified alternative of additional health insurance, depending on the characteristics such as: socio-demographic factors, individual characters regarding to health state and economic status. This, allowed estimating and testing the goodness of model for sample data, and then on the regional level, on the basis of values of the WTP determinants, the levels of probabilities were calculated. In each case, average regional values of a factor were used.

Next, for comparison purposes methods of statistical multivariate analyses were used. As a base for cluster analysis, the agglomeration method was used.

IV. RESULTS

Some research hypotheses were assumed at the beginning of the analysis:

– multinomial logit model is possible to use in establishing willingness to pay probabilities;

– the willingness to pay is spatially and temporary diverse;

– it is possible to identify the similarities of willingness to pay spatial distribution in time.

As it was stated previously, to assess preferences of buying additional health insurance the multinomial logit model was used. The possible explanatory variables were selected from Social Diagnosis data banks and chi-square dependence tests indicated the factors dependence towards the endogenous variable. Consequently, the set of explanatory variables was established, and for the purpose of the research it consisted of: total medical expenses incurred during the year, percentage of resignation from health benefits, net income *per capita* in the household, the occurrence of adverse health symptoms.

The dependent variable was five-dimensional, with possible options such as: 1 – additional health insurance for no more than 100 zł, 2 – additional health insurance from 100 zł to 250 zł, 3 – additional health insurance from 250 zł to 500 zł; 4 – additional health insurance for more than 500 zł. Base category for the MNL was option 0 – a person having no interest in buying additional health insurance.

Three separate MNL models for each time period were calculated, and the general form for a couple of options was assumed as follows:

$$\begin{aligned}
\ln\left(p_{option1}/p_{option0}\right) &= \beta_{10} + \beta_{11} * X_1 + \beta_{12} * X_2 + \beta_{13} * X_3 + \beta_{14} * X_4 \\
\ln\left(p_{option2}/p_{option0}\right) &= \beta_{20} + \beta_{21} * X_1 + \beta_{22} * X_2 + \beta_{23} * X_3 + \beta_{24} * X_4 \\
\ln\left(p_{option3}/p_{option0}\right) &= \beta_{30} + \beta_{31} * X_1 + \beta_{32} * X_2 + \beta_{33} * X_3 + \beta_{34} * X_4 \\
\ln\left(p_{option4}/p_{option0}\right) &= \beta_{40} + \beta_{41} * X_1 + \beta_{42} * X_2 + \beta_{43} * X_3 + \beta_{44} * X_4
\end{aligned} \quad . \quad (3)$$

where: X_1 – net income *per capita* in the household, X_2 – total medical expenses incurred during the year, X_3 – noticeable, undesirable health – related events, X_4 – percentage of resignation from benefits.

For estimating the MNL models maximum likelihood method was used. It should also be considered that conducted research is not a spatio-temporal analysis, so no panel approaches were tested. Necessary estimations of model parameters and odds ratios were conducted in SPSS v. 21. After calculating MNL models test for goodness of fit of the model was performed. In each case (time period), McFadden's Pseudo-R^2 indicated that the introduction of the variables into the model improved the probability of matching data and the significance of likelihood ratio indicated that the final model, outperformed the null model (with constant variable only) [Gruszczyński (2010)] – the results of an example of MNL model used in research are presented below in Table 2.

Interpretation of the parameters coefficients should be made in correspondence to the base category – not interested in buying additional health insurance. For example, the parameter's value standing for the *per capita* income variable (X_1) $\beta_{11} = 0.0005$ (exp (β_{11}) = 1.000461) indicates the odds ratio equal to 0.0461% for income *per capita*. This means that when income increases by 100 PLN probability of choosing option 1 over the lack of interest will increase by about 4,61%, *ceteris paribus*. McFadden's Pseudo-R-sq=0,051 indicates that the introduction of the variables into the model improved the probability of matching data. The significance of likelihood ratio test indicates that the final model outperforms the null model (only constant).

Having estimated and tested the MNL models, mean values of the explanatory variables were calculated on regional level. Then, the probabilities of each possible choice from (0 – not interested in buying an additional health care insurance to 4 – wants to buy additional health insurance for more than 500 zloty) from the choice set has been calculated. On the basis of the probabilities ratios for 2003, 2005 and 2007, agglomeration methods were used. The values were standardized and Euclidean distances for Ward's method were estimated. This led to the results of the division of voivodships into clusters of similar probabilities of additional health insurance purchase (Fig. 1).

Table 2. Example results for MNL model for year 2007

Parameters coefficients						Goodness of model	
Variables		B	Odds ratio	% change	Sign.	Model	Criterion –2 loglikelihood
Option 1 – additional health insurance for no more than 100 zloty	const	–1.5165			0.000		
	X_1	0.0005	1.000461	0.046	0.000	Only const	8983.783
	X_2	0.0001	1.000085	0.009	0.000		
	X_3	–0.3222	0.724528	–27.547	0.023	Final	8510.575
	X_4	–1.7451	0.174632	–82.537	0.000		
Option 2 – additional health insurance from 100 to 250 zloty	const	–3.6244			0.000	Test LR	
	X_1	0.0009	1.000948	0.095	0.000		
	X_2	0.0001	1.000144	0.014	0.000	Chi–sq	Significance
	X_3	–0.7192	0.487129	–51.287	0.018		
	X_4	–4.0435	0.017536	–98.246	0.000	473.208	0.000
Option 3 – additional health insurance from 250 to 500 zloty	const	–5.1560			0.000		
	X_1	0.0008	1.000829	0.083	0.000	Pseudo R–sq	
	X_2	0.0002	1.000197	0.020	0.000		
	X_3	–1.7567	0.172616	–82.738	0.006		
	X_4	1.3731	3.947694	294.769	0.016	Cox and Snell	0.076
Option 4 – additional health insurance for more than 500 zloty	const	–4.2787			0.000		
	X_1	–0.0021	0.997873	–0.213	0.014	Nagelkerke	0.096
	X_2	0.0000	1.000009	0.001	0.958		
	X_3	0.5820	1.789684	78.968	0.516	McFadden	0.051
	X_4	0.8284	2.289582	128.958	0.388		
Base category is option 0 – not interested in buying additional health insurance							

Source: developed by Author on the basis of Social Diagnosis 2007 statistical data.

In 2003, the division of voivodships consisted of 5 clusters. The first consisted of 6 regions: Łódzkie, Mazowieckie, Podlaskie, Śląskie, Pomorskie and Zachodniopomorskie. The second one consisted of 4 objects: Świętokrzyskie, Lubelskie, Wielkopolskie and Warmińsko-mazurskie, while the third consisted of 3 voivodships: Opolskie, Małopolskie and Podkarpackie. The fourth cluster consisted of 2 regions: Lubuskie and Dolnośląskie, the last – fifth cluster was a one-piece group, which was Kujawsko-pomorskie.

In 2005, the division of voivodships also consisted of 5 clusters. The first – consisted of 6 regions: Pomorskie, Zachodniopomorskie, Warmińsko-mazurskie, Kujawsko-pomorskie, Wielkopolskie and Lubuskie, while the second consisted of 4 objects: Dolnośląskie, Świętokrzyskie, Małopolskie and Podlaskie, the third consisted of 3 voivodships: Lubelskie Opolskie and Śląskie. The fourth cluster consisted of 2 regions: Łódzkie and Podkarpackie, the last – fifth cluster was again a one-piece group, which was Mazowieckie.

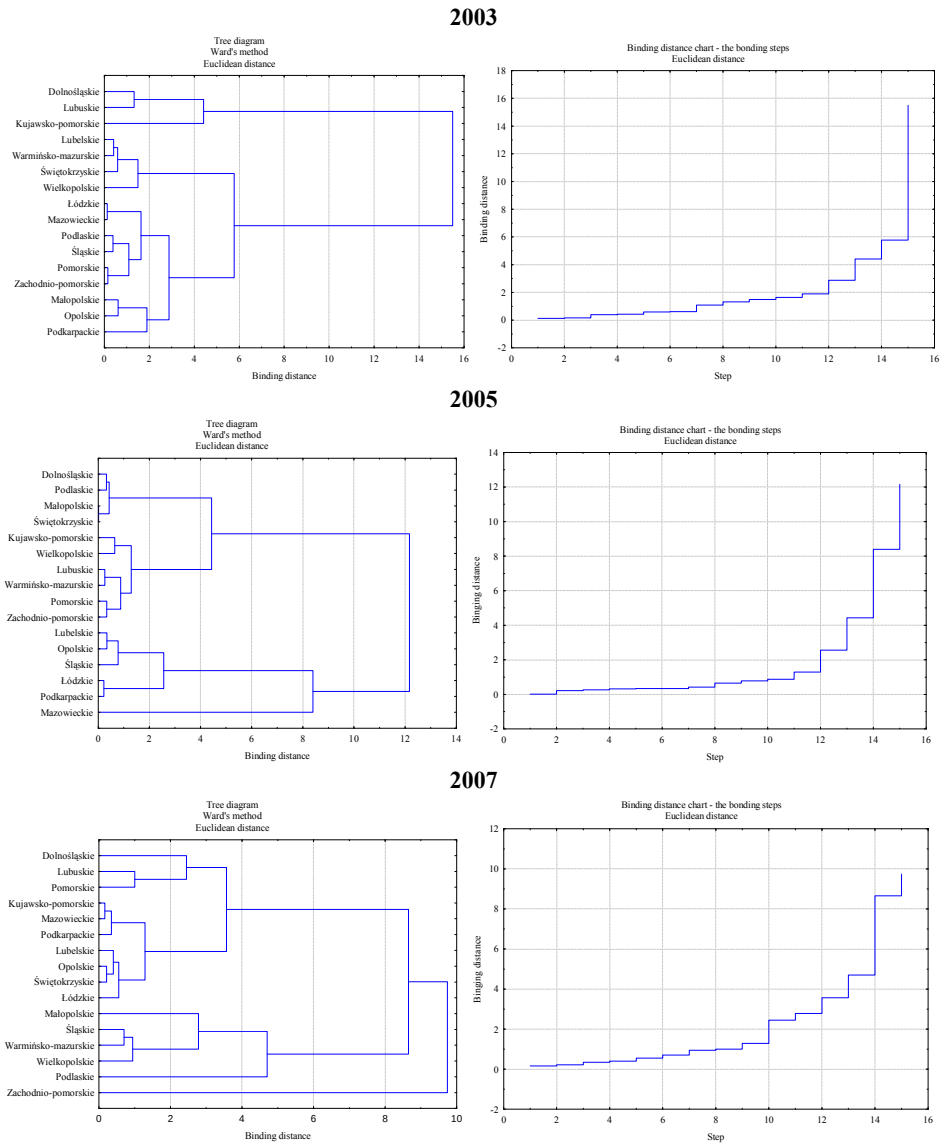

Figure 1. Tree diagrams and binding distance charts for probabilities of selecting additional health insurance

Source: developed by author, on the basis of Social Diagnosis 2003, 2005, 2005 data in Statistica.

The most differentiated, as far as the probabilities of willingness to pay for additional health insurance was the year 2007. Clustering revealed 7 groups four of which were one-element groups viz. Małopolskie, Zachodnio-pomorskie, Dolnośląskie and Podlaskie. The most numerous cluster consisted of 7 voivodships: Opolskie, Łódzkie, Świętokrzyskie, Kujawsko-pomorskie, Podkarpackie, Mazowieckie and Lubelskie. There was one two-element cluster and one three-element. The former one consisted of: Lubuskie and Pomorskie and the latter one consisted of Śląskie, Warmińsko-mazurskie and Wielkopolskie. Maps below (Fig. 2) indicate the spatial distribution of identified by the agglomeration method clusters in the analysed time frames.

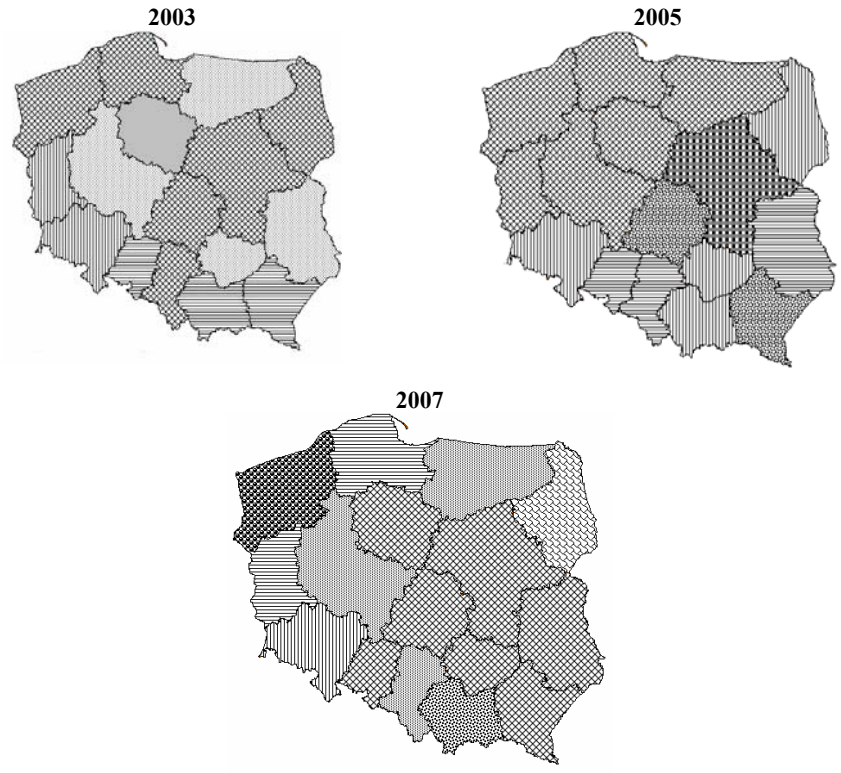

Figure 2. Clusters for Polish voivodships in 2003, 2005 and 2007

Source: developed by author in GeoDa.

V. DISCUSSION AND CONCLUSION

The analyses of willingness to pay indicated the spatial diversity in Polish voivodships in time. Although there might be many questions concerning the idea of using one MNL model at the national level and then disaggregating the probabilities in accordance to mean values of explanatory variables, this approach showed that it may be used in searching for similarities of the dependent variable. Typical assumption of the distance of Mazowieckie in comparison to other voivodships, turned out to be accurate only for year 2005. The most spatially diverse year was the 2007.

Although achieved results indicate correct path of analysis, many problems deriving from construction of WTP functions are connected with the survey question itself. Typically, when acquiring information about willingness to pay, researcher can diversify the characteristics of the service/product – price can be perceived as a result of WTP function or can be one of the explanatory variables, towards which consumers have special expectations – high price equals high quality. Furthermore, it is possible to establish qualities of a product or service. Lack of perfect information contributes to the fact that decisions of selecting that particular option should be made under conditions of uncertainty or risk. Whether we talk about risk situation (knowing the probabilities of events occurrences) or uncertainty (not knowing these probabilities), it is hard to consider the person's willingness towards anything (sometimes these probabilities can be determined intuitively). In this paper it was assumed that all the MNL analyses were conducted under the assumption of uncertainty – for instance a variable: noticeable undesirable health- related events may be the foundation for subjective probabilities of these events, when high – showing the higher willingness to protect against the incidents.

On the basis of used data bank, it is not possible to differentiate the additional health insurance with its characteristics. Even the specific question in the Social Diagnosis survey is formed peculiarly. That is the reason why instead of the attributes of the benefit, characteristics of respondents were incorporated. In these occurrences, it is almost impossible to establish the value (in monetary terms) of the additional health insurance most desirable by the respondents, but it is possible to calculate the probabilities of purchasing the benefit in accordance to the individual's socio-demographic and economic characteristics and to the obtained model in estimating the rates of willingness to buy the additional health insurance for multivariate analysis.

Chances of improving the results should be seen in adopting the panel approach in the analysis – this could result in different form of initial MNL model. Also, the evidence from cluster analysis indicates for lower aggregation of geographical data, for instance poviats and search for Moran's I spatial autocorrelation of the probabilities rates.

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PRZESTRZENNE ZRÓŻNICOWANIE POZIOMÓW GOTOWOŚCI DO PŁACENIA ZA ŚWIADCZENIA ZDROWOTNE GOSPODARSTW DOMOWYCH W POLSCE

Wykorzystanie metod ilościowych to obecnie standard w analizach sfery życia społeczno-gospodarczego. Również konieczności implementacji analiz podlega sektor opieki zdrowotnej. Coraz częściej i szerzej, wprowadza się tu techniki ilościowe, które pomagają w podejmowaniu jakże trudnych, zwłaszcza ze społecznego punktu widzenia, decyzji, np. o finansowaniu pewnych programów zdrowotnych, kosztem innych. Ze zbieranych systematycznie danych statystycznych wynika, że wydatki ponoszone na cele zdrowotne ciągle rosną, przy względnie stałym i niewystarczającym poziomie zasobów finansowych płatnika. Zapewnienie pacjentom szeroko rozumianego bezpieczeństwa zdrowotnego zostaje przeniesiona na ich barki, czego wynikiem może być, np. rosnąca ilość nakładów przeznaczanych z własnej kieszeni na niezbędne świadczenia. Sytuacja niewystarczających zasobów zmusza do poszukiwania dodatkowych sposobów finansowania opieki zdrowotnej np. poprzez wykup dobrowolnego, dodatkowego ubezpieczenia zdrowotnego.

Celem artykułu jest wykazanie przestrzennego zróżnicowania gotowości do płacenia za świadczenia zdrowotne gospodarstw domowych w Polsce na przykładzie składki na dobrowolne ubezpieczenie zdrowotne. Dzięki możliwości identyfikacji gospodarstwa domowego w bazach danych Diagnozy Społecznej, na podstawie których prowadzone będą badania oraz wykorzystaniu technik wielowymiarowej analizy, artykuł ma na celu również wskazanie podobieństw struktury gospodarstw domowych zarówno pod względem samej gotowości do płacenia, jak i różnych czynników społeczno-gospodarczych.