Measuring welfare with the use of the *MIMIC* approach: evidence for Poland

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Abstract The growing interest in the concept of using welfare categories as a measure of economic or social development results from the fact that dominant income categories have been replaced by solutions related to individuals' basic, existential and higher-order needs being fulfilled. The transition from analysing the poverty rate category, through the various approaches to material deprivation, to the perception of welfare in economic, subjective, or hidden terms is visible. The main purpose of the study is to estimate the subjective level of welfare of households in Poland. The subjective level of various socio-economic phenomena is often difficult to estimate; therefore, the study uses the approach of structural modelling for the multiple indicators and multiple causes model (*MIMIC*), which assumes the presence of a latent variable. The research is based on data from the Social Diagnosis panel study for household level in Poland. Based on the construction and positive substantive and statistical verification of the model the results show that subjectively the best welfare situation was identified mainly for households located in countryside areas, where even the lowest estimated levels of welfare exceed the highest estimated levels for cities of various sizes. Investigating the spatial distribution, the highest levels of subjective welfare were recorded for the Lubelskie and Swietokrzyskie voivodeships, and thanks to moving to a higher spatial data aggregation level (to the sub-regional), a more detailed assessment of spatial units was possible. In further research, individualised voivodeship models will be estimated to capture a more accurate differentiation of the influence of *MIMIC* model variables. A similar direction of analysis is anticipated for sub-regional data.

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Introduction

Welfare is a phenomenon that can be interpreted from various perspectives. One of the most common divisions is between objective and subjective perceptions of welfare (Karabchuk & Sal'nikova 2018). The objective approach is strongly related to the socio-economic conditioning of individuals or households. Some research indicates assessing

welfare based on the level of *Gross Domestic Product* (*GDP*) or in terms of *per capita* (Deaton, 2008; Islam & Clarke, 2002), the economy of scale in consumption (Carletto & Zezza, 2006), households' expenditures (Akerele & Adewuyi, 2011) or assets owned (Sahn & Stifel, 2003). The literature also distinguishes the category of social welfare (or welfare of a state), which is related to the economic background of regions or economies.

Social welfare can be determined by the present value of utility level, net investments and savings, or population size (Hamilton & Atkinson, 2006). Examples can also be found for a subjective approach in defining welfare, which correspond to the concept that quantitative indicators, such as *GDP* or consumption level, should not be perceived as the only appropriate measures of welfare (Fleurbaey, 2009). Here, a variety of alternative measures can be mentioned. For example, OECD (2011) apart from income recommends using determinants related to housing and social conditioning, health state and education level, equilibrium between work and leisure time, as well as environmental and governance issues.

In this context, welfare is often collated with well-being and, especially in the subjective perception, can be assigned with happiness, quality of life, and life satisfaction (Diener, 2009; Fahey & Smyth, 2004; Joshanloo et al., 2018). Subjective well-being measurement was an interest of Zwierzchowski & Panek (2020), who considered how people experience and evaluate their lives as well as the activities within their existence. The set of determinants and indicator variables used clearly indicated that the Authors equate the concept of subjective well-being to the issue of quality of life, with the predominance of psychological feelings. In many studies on living conditions and standard of living, the analysis should be supported by adjusting the level of indicators such as poverty aspects or additional costs related to caring for the handicapped (Islam & Clarke, 2002). In a general sense, the research proposes considering the multidimensionality concerning the quality of life when assessing the well-being of individuals and society (Sen, 1999). Issues that address the problem of giving up goods, benefits or services are common in the literature and are related particularly to the problem of material deprivation (Dhongde et al., 2019; Saltkjel & Malmberg-Heimonen, 2017).

In this paper, the research aim was to measure the level of subjective welfare, depending on the socio-economic and behavioural conditions of Polish households. In the literature, less attention is paid to studies that focus on aspects of perceiving the individual welfare level objectively and subjectively at the same time. This prompted us to estimate the relationship between welfare level and the ability to make both basic and selected supplementary needs meet. To verify the impact of directly unobserved welfare on household decision-making behaviour towards income security and meeting the needs latent variable modelling was implemented—a technique that was designated primarily to investigate the hard-to-measure nature of most socio-economic phenomena. This feature was the obvious motivation in order to measure something that is in its nature unmeasurable or perceived indirectly.

The paper is structured as follows: firstly, an overview of the literature in the field of welfare and associated phenomena is presented. Subsequently, the characteristics of the data and the methodology are described. The third part includes results and discussion, while in the final part, concluding remarks are formulated.

Welfare and making persons' needs meet

The welfare

Welfare in economics is framed by various concepts that have evolved over time. Economists, mainly neo-classical (see e.g., Kot et al., 2004) paired welfare with the utility of a certain basket of goods, benefits and services. In the monetary metric, it is understood as the utility of an income that is required to purchase a set of goods or services. In this context, it is assumed that the higher the income, the greater the welfare (which is perceived as income utility). Even though this theory has evolved in economic and social sciences, it is still frequently combined with the material approach and rarely with the degree of life satisfaction or happiness. The notion that the utilitarian basis of welfare is becoming insufficient is increasingly obvious to contemporary economists. However, according to Sen (1997) it should be associated with welfare economics and as a part of overall wealth, but not as welfare itself.

From the macroeconomic perspective, measuring welfare can be carried out both in monetary and non-monetary terms. *GDP* is often suggested as a typical measure of welfare assigned at the macro level, which describes the aggregate value of goods and final services produced in a specific time period. From the definition of the measure itself, it is impossible to include in *GDP* anything that does not have a fixed price, e.g., work in one's own household or services generated by volunteers. These items are called externalities of production or social discomfort, and they are the consequences of social inequalities. In certain situations, *GDP* is perceived as a reasonable indicator, as its growth usually designates a generally good condition of the economy, e.g., an increase in industrial production, an inflow of foreign investments and an increase in exports. However, in recent years, there has been a significant increase in the number of elaborations that treat welfare in non-monetary terms. In this regard, the following indicators can be proposed:

- *Human Development Index* (*HDI*): a measure that describes the effects of socio-economic development; introduced in 1990 and used for international comparisons in the annual reports of the *United Nations Development Agenda* (*UNDP*); since 2010, the approach was enriched by the life expectancy, the average length of education for children and residents over 25, and *GDP per capita* calculated in accordance with the purchasing power standard (*PPS*);
- *Index of Sustainable Economic Welfare* (*ISEW*): a non-monetary measure of social welfare that considers both the management of mineral resources, social justice, average consumption, and distribution of goods, as well as environmental degradation;
- *Quality of Life Index* (*QLI*): also named as *Where-to-be-born Index*; an indicator reflecting the standard of living and life satisfaction in individual countries more adequately than the *GDP* growth rate or *GDP per capita*;
- *Satisfaction with Life Index* (*SLI*): a macroeconomic indicator that directly measures individuals' level of satisfaction with life, which establishes the relationship between the level of perceived happiness with health, wealth and access to basic education;

- *Human Poverty Index* (*HPI*): a measure of human misery, characterised by poverty level and illiteracy or long-term unemployment.

Looking at the different approaches outlined above, the problem of measuring welfare becomes crucial not only from the technical perspective, but also in the societies where the majority live at a level that significantly exceeds basic material needs. Therefore, the individual perception of welfare refers not only to the level of earnings but also to the quality of interpersonal relations, safety, and the quality of the natural environment. Within the range of issues connected with the research on socio-economic development, the importance lies in reducing poverty and promoting subjective welfare, which result from the impact of policies aimed at limiting inequalities. Glewwe (1991), the United Nations (UNDP 2012), Laskowska & Dańska-Borsiak (2018) go even further, indicating the need to investigate welfare at the household level (or, if possible for the individual, e.g.: Zwierzchowski & Panek, 2020) and that the accuracy of household welfare estimates is related to the characteristics of a household and the conditions in which it operates, including the local environment and the place of residence (Woods et al., 2005).

The present welfare value is a result of past decisions that allows for accumulation in human and physical capital stocks; however, they cannot be estimated directly. Therefore, there are solutions that can estimate the impact of unobservable (indirect) determinants of welfare, among which the latent modelling can be successfully applied. While the complexity of socio-economic relations and the progress of globalisation increases, discussions and research are undertaken to seek new measures of social development and economic growth. The latter category is relatively obvious to measure because the characteristics are easily quantified. However, it is much more problematic to measure socio-economic development, which includes, among others, the economic situation and improvement in the advancement of social life. The measurement method and its accuracy and correctness can be questionable here, which may further lead to suboptimality in decision-making and irregularities in the functioning of society and economic performance.

Perception of socio-economic development and other limitations led to rising of welfare economics,

which as a term was firstly formulated by Pigou (1912) and further developed as *Economics of Welfare* (Pigou, 1920) to imply a distinction between gaining satisfaction from fulfilling the needs and desires. Objectively, it defined basic human needs include hygiene, nutrition, education, and leisure. On the other hand, desires refer to things which are wanted at a certain time. Therefore, some of the notions of welfare are not quantifiable, and hence measurable, which makes it impossible to estimate the national average level of welfare, or even to run interpersonal/individual comparisons. Data obtained through interviews could provide in-depth information on a given issue, however, it could prevent researchers from capturing the causes of a given phenomenon.

This leads to another difficulty in measuring subjective welfare, i.e., the "human factor". Participants in social research are not always competent judges of their own situations. Responses to questions about satisfaction with life or their perception of its quality may differ, depending on their mood at time being surveyed. Thus, they might not relate adequately to life in general. Contemporary welfare economics gives a foundation for social and economic state policy, therefore the definition of social and individual welfare had to evolve. For instance, in neoclassical economics, social welfare is the sum of the utility of individual income in society (Zaremba, 2016). It focuses mainly on improving the efficiency of resource allocation to maximise social welfare at the aggregated level, and it considers the issues of an optimal taxation system or how to organise an efficient economy.

Identifying and meeting the needs

Pigou (1920) indicated that a society is closer to the optimum welfare when national income is at a stable and high level and fairly distributed. Multinational studies and comparisons most often indicate that the population's financial situation is assessed by analysing the amount and structure of acquired income, and based on this information, poverty indicators can be estimated. A similar scheme of analysis was implemented by Dhongde et al. (2019), who combined social deprivation with well-being and income poverty, pointing out the importance of welfare analysis in group divisions. This approach results from, often used, income as a measure of financing living needs.

However, households can also meet their needs by selling assets or increasing their debts level. In addition, there are numerous reservations about income-based indicators, which emphasise that it is not easy to obtain complete, reliable information on the population's current income. For all these reasons, it is also obligatory to incorporate non-monetary measures into the analysis, such as material deprivation, which could provide a broader context and make it possible to capture the multidimensionality of the welfare (Ministry of Family & Social Policy, 2018).

In various studies, economists replace the phrase "desire" with the category of preferences, which is not just a terminological change. In contrast to desire, preferences are comparative. This can be illustrated by an example: If an individual is faced with the choice of *A* and *B*, only one of the options may be preferred, although both may be desirable. Therefore, the act of choosing is a process of revealing preferences, which in fact is a result of the overall welfare perception level. Following the subjective context of welfare analysis, material deprivation is a term related to satisfying individuals' needs, which indicates the percentage of households that cannot afford to meet 4 out of the 9 of following basic needs (Eurostat, 2021): pay their rent, mortgage, or utility bills; keep their home adequately warm; face unexpected expenses; eat meat or protein regularly (depending on what type of diet was mainly preferred and what products were consumed in each household); go on holiday; have a television set; be equipped with a washing machine; own a car; use a telephone. If data is available, the material deprivation rate can be calculated for individual or household levels. It can be determined by gender, age, material and health status, self-defined current economic status and educational attainment (Guio et al., 2012; Saltkjel & Malmberg-Heimonen, 2017). Calculations of material deprivation are rarely made for an individual level due to limitations resulting from multi-sources and institutional data origin (Smętkowski et al., 2017). With the assumption of variability in the individual dimensions of deprivation performs as one of the most important determinants for the construction of the *MIMIC* model, examples mostly consider five areas (inner dimensions) of deprivation: population income, employment, living conditions, education, access to goods and services. In

this paper, a similar scheme was followed, which resulted in the calculation of the household material deprivation rate (Dhongde et al., 2019). The questionnaire of data source (the Social Diagnosis) contains adequately constructed part of questions related to the fulfilment of basic needs included in the definition of material deprivation. Because the dimensions of the determinants are strictly defined, material deprivation is not an exhaustive list of needs that a household is forced to give up. For that reason, the renouncement rate was estimated and appended into the analysis, which included other areas/aspects of everyday life (including social activity, access to cultural activities, medical services, advanced housing equipment, or different media) where a household stop participating (Guio et al., 2012). It should be noted that additional information on the intensity of households giving up services and benefits are not included in the material deprivation variable. Consequently, the variable of renouncement rate was proposed that includes giving up the following: cultural activities, including visits to the cinema, theatre, opera, philharmonic, concerts, museums, or exhibitions, buying books or press (newspapers), participating in holiday trip, camps and other family excursions, health services, despite the need to receive them.

All considerations on the fulfilment of the needs, material deprivation or welfare itself should not be associated with the feeling of life satisfaction, positive or negative experiences such as: happiness, confidence or sadness, which more often represent the subjective well-being. In this context the concepts of well-being and welfare should be distinguished.

The list of indicators was based on subjective categories of variables, which included variables illustrating the degree of improvement/deterioration in the fulfilment of needs relative to temporal antecedents, as well as the ratio of income held to the potential level of income needed to meet needs. The Social Diagnosis database additionally allowed to estimate the propensity to save rate, variable which in fact considered the necessity to maintain a certain level of financial security for the households. Combined with the other mentioned subjective welfare indicators, it allowed to recognise each side of decisions made by households: the need to save while meeting basic and additional needs.

Welfare as an unobserved category

The literature often perceives welfare as an unobserved category, which cannot be explicitly defined or measured. Studies commonly associate hidden welfare with the outcomes of the state's social policy (Howard, 1997). This indicates to estimate the overall welfare level within the latent variable approach. In our paper, we distinguished between the category of hidden welfare and the unobserved factors that may be related to, for example, being counted or operating in the shadow economy (Almenar et al., 2020), gender, geographic affiliation (Arbache et al. 2010), academic achievements (Tsai et al., 2017), or customers' behaviour (Chen & Jiang, 2019). This issue also concerns the economic conditions that do not always determine the choices made at the individual or household levels (Diener & Biswas-Diener, 2009). In this paper, we indicate that the decisions made at the household level may have a subjective background, which binds the act of selecting or preferences with a perceptible level of welfare. This points to a complex structure, which prompted us to research the unobservable nature of welfare that goes beyond the traditional, mostly monetary perception of the issue. As a result of the evolution of the approaches, more non-economic aspects and factors should be considered to determine increases in the overall welfare level, which might be a combination of direct and intangible prosperity.

Welfare, especially in subjective terms, does not have a single accepted definition of its perception. However, it should be noted according to Mankiw and Taylor (2015, p. 266) definition, the subjective welfare determines to what extent people feel happy—this takes into account how they evaluate their work and leisure opportunities. Objective welfare, on the other hand, involves assessing the quality of life using a variety of indicators, e.g., education level, measures of living standards. Marciniak et al. (2013, p. 274) indicates that welfare (or well-being-possessed assets), levels of health and education, individual activity including work, political and governmental activities, social connections and relationships, environment issues (current and future conditions), economic and physical uncertainties (risks). In this sense, the proposed modelling and construction of the structural model corresponds to the definition of subjective welfare, difficult to estimate explicitly.

This led us to select a model that allows estimation of a vaguely defined component expressed in the form of a latent variable such as *MIMIC* model.

Data and methodology

Dataset

The research used data obtained from the Social Diagnosis (www.diagnoza.com) panel study, which is based on the objective and subjective measurements of the quality of life at both, the individual and household levels in Poland. The latest available data was collected in 2015 and published in mid-2017. The study was held regularly every 2 years; however, the research was recently suspended. For that reason, there are no up-to-date data available. Thus, we decided to use this dataset for sample representativeness (achieved for the Nomenclature of Territorial Units for Statistical Purposes (NTS-2nd level) and the scope of the information gathered. The sampling procedure used in the study ensures the assumed sample size and its representativeness on a national scale and in the following distinguished classification cross-sections of households: socio-economic group distinguished on the basis of the main source of livelihood, household type determined on the basis of the number of families and type of biological family, class of place of residence, province of residence, economic activity. The representativeness of the data according to these cross-sectional classifications was also a reason for conducting research on a national level with the possibility of transferring the obtained results to other, representative data structures, e.g., provinces

or places of residence. Other databases such as European Union Statistics on Income and Living Conditions (*EU-SILC*), were also considered, but they did not meet the scientific expectations of the considered model, i.e., geographic affiliation of households at 2nd and 3rd spatial data aggregation level.

The dataset consisted of nearly 26 thous. households, of whom 43% worked. However, a significant fraction were retirees. This structure is equivalently similar when looking at the sources of income of the households, among which the vast majority are earnings from work and pension transfers (Table 1).

Considering all variables (indicators and determinants), total missing data accounted for approx. 53%. The final data set consisted of 15094 households. Analysing the personal structure of the research sample, one in four households was a childless married couple, while one in eight constituted a family with no more than two children. What is worth emphasising is the fact that every fifth household in the analysis was non-family single unit. This may be crucial from the point of view of differentiating features used in the *MIMIC* model, which significantly affect the level of perceived subjective welfare, such as having a complete family.

One in ten households was a single parent. Balance in the distribution of the household sample structure is important from the perspective of for example the income poverty level (Table 2). Within the framework, the concept of material deprivation and meeting the supplementary needs is embedded, which are strictly defined as a forced inability (rather than giving up by choice) to meet some of the needs connected with, e.g., maintaining proper housing conditions, coverage of unexpected expenditure or

Table 1 The summary of economic background of research sample

Socio-economic group of households	Valid percent	Source of household's income	Valid percent
Employees	43.9	Employees	40.5
Farmers	6.3	Farmers	4.9
Self-employed	4.5	Employed on their own account	3.6
Retirees	35.4	Retirement transfers	32.0
Pensioners	6.3	Pensioners	4.7
Living on unearned sources	3.7	Living on ungained sources	3.0
		Several equally important sources for farm support	11.3

Source: own elaboration

Table 2 The summary of social and living background of research sample

The biological family types	Valid percent	Place of residence	Valid percent
Marriage without children	23.7	Cities with a population of 500 thous. and more	8.8
Marriage with 1 child	15.6		
Married couple with 2 children	14.1	Cities with 200–500 thous. inhabitants	8.6
Marriage with 3 + children	5.9		
Single-parent families	10.8	Cities with 20–100 thous. inhabitants	7.1
Multi-family	7.5	Cities with a population of 100–200 thous	19.5
Non-family single	21.2	Cities with less than 20 thous. inhabitants	12.7
Non-family dormitories	1.2	Countryside	43.2

Source: own elaboration
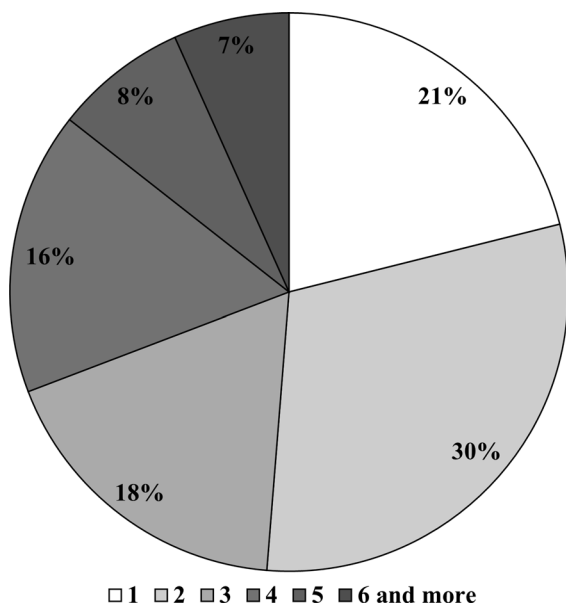
Fig. 1 Sample structure of households' size. *Source*: own elaboration

being able to afford a week's holiday for all household members. The structure of household members (Fig. 1) indicates that the most in the study were two-person and one-person households. Every third household has three or four people.

Method

The *MIMIC* model is a particular case of the general *Structural Equation Model* (*SEM*), and in its original/simplified form, it defines a structural relationship between one endogenous latent variable (unobservable component) and several observable characteristics. Jöreskog & Goldberger, (1975) defined the *MIMIC* model as a multiple indicators and multiple causes model.

The main objective of the *MIMIC* analysis is to assess the consistency of the theoretical model. In this case, the model presents the relationships between unobservable/latent variables that measure subjective welfare and observable exogenous variables (the determinants of welfare) and observable endogenous variables (i.e., partial indicators) (Fig. 2).

The *MIMIC* model can be illustrated by its path's character with a simple graph that presents the separate parts (sub-models) and the connections between its components. The analysis is preceded by formulating a model that defines the relationships between hidden and observable variables postulated by the researcher. Structural modelling often occurs when information is incomplete. The starting point for empirical research is the differentiation of factors that divide the latent variable into two main groups of variables/factors: observable indicators and non-observable causes. The construction and estimation method of the *MIMIC* model assume that the variables defined as indicators and determinants interact only through the unobserved/latent variable. For that reason, the latent component is often a hypothetical construct, especially when *MIMIC* modelling is used to capture the impact of an individual's behaviour in decision-making processes.

The basic hypothesis of the *MIMIC* model is that the covariance matrix of observable variables is a function of the model parameters. If the adopted model correctly reflects the reality and its parameters are known, then the observed (empirical) covariance

Fig. 2 The basic structure of the *MIMIC* model. *Source*: based on Farzenega & Buehn (2009, p. 14)
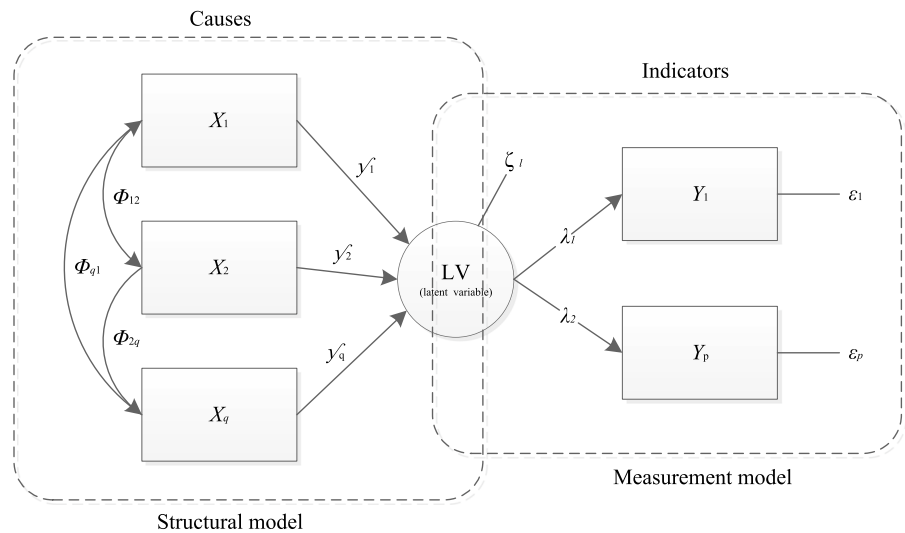
matrix would be accurately reproduced by the adopted theoretical model—it would correspond to the covariance matrix in the population (the covariance matrix of observable variables, expressed as a function of the parameters of the adopted theoretical model).

Krishnakumor & Ballon, (2008) indicated that the SEM model is the most appropriate tool for estimating capabilities that are not directly observable while allowing the assessment of the impact on the possibilities of external determinants (characteristics of individuals, their conditioning or environmental issues). Krishnakumor, (2007) points out the usefulness of the MIMIC model for the operationalisation of the alternatives approach, stating that being able to say something about opportunities is important, but so is indicating how to increase them and support social development. Zygen, (2013) indicates that MIMIC model helps to explain and understand the background and motives of human behaviour. Behaviours that are always based on human emotions and ethical values that cannot be analysed without understanding the factors influencing and shaping them. Structural modelling enables the construction of models in which both indirect and direct structural relationships between observable and unobserved variables is acceptable.

The *MIMIC* model represents the next step in explaining the phenomenon under study, as it not only indicates that observable variables are a manifestation of directly unobservable approaches, but that there

are also other endogenous variables that influence directly unobservable factor(s). The *MIMIC* model consists of two sub-models, a structural model and a measurement model (Jöreskog & Goldberger, 1975):

- The structural model defines the path analysis, making it possible to determine cause-effect relationships (covariance) between the explanatory variables, as follows:

$\eta_l = \mathbf{\Gamma x} + \boldsymbol{\zeta}_l$, where: η–the latent variable, $\mathbf{x} = (x_1, x_2, \ldots, x_q)$–a q vector of x_i potential causes of η, $\mathbf{\Gamma}$–factor loadings; vector of structural model coefficients estimating the "random" relationship between external factors and their differentiation, $\Phi = (\Phi_{1q}, \ldots, \Phi_{2q})$–the covariance between variables (causes);

- The measurement model represents the results of the factor analysis allowing for the calculation of the loads of individual factors that are affected by the latent variable:

$\mathbf{y} = \mathbf{\Lambda_y}\eta_l + \boldsymbol{\varepsilon}$, where: $\mathbf{y} = (y_1, y_2, \ldots, y_p)$–the vector of indicators, $\boldsymbol{\varepsilon} = (\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_p)$–the vector of error/disturbances, Δ–the vector of regression coefficients.

The basic assumption of the *MIMIC* model is the lack of correlation between the residuals ζ and exogenous variable $xE(x\zeta^T)$ with the expected value of ζ being equal to zero ($E(\zeta) = 0$). All unobservable and observable variables are expressed as deviations from their average values. For each

dependent (endogenous) and independent (exogenous) variable in a given structural equation, the structural coefficient (γ) determines the amount of change in the dependent variable with a unit change in the independent variable and other independent variables that are constant. The factor loadings (λ_y) are not identical to those obtained in the factor analysis; they are the regression coefficients that define the expected change in an observed variable for a unit change in the size of the latent variable.

In the literature, examples can be found regarding the suitability of the *MIMIC* approach for solving problems from the unobservable categories (Husain et al., 2021; Makananisa et al., 2020; Wang et al., 2021). Among the most frequently mentioned drawbacks of this type of modelling are the instability of the results, the problematic selection and measurement of variables used in the model, and the need to create reference points that make it possible to estimate the phenomenon. Moreover, the design and estimation method of the *MIMIC* model assumes that the variables classified as indicators and determinants interact only through the unobserved variable, which may be unacceptable, because it may be contrary to the theory of economics to consider the specific cases of the measures used. It can thus be concluded that the method is biased and susceptible to both manipulation and misinterpretation (Breusch, 2005). Dell'Anno & Schneider, (2006) emphasise that the estimates resulting from the adopted *MIMIC* model are subjective and depend on the quality of the database used and the decisions made by the researcher himself. They also indicate that the *MIMIC* model is not suitable for estimating economic issues, such as the shadow economy, or for analysing data in dynamics terms. They also question the reliability of the causes and indicators in explaining the variability of the standard deviations and the ambiguous meaning of the latent variable. For this reason, *MIMIC* modelling is thought to be more of a confirmatory technique rather than an exploratory one, which means that it tends to determine whether an adopted model is valid rather than being used to identify a suitable model. Therefore, the theoretical construct that defines a latent concept could include socio-economic development or the welfare state.

Model design

The starting point in the construction of the *MIMIC* model was the assumption that subjective welfare can be described indirectly, by defining the indicators of welfare and the factors that determine them. Under this assumption, the latent variable simultaneously illustrates the real relationship between the observed effects and causes. When designing the model, it was assumed that overall subjective welfare is influenced by factors related to economic conditioning and it is also a derivative of family or social background. This approach is consistent with the views on taking into account additional conditions of a household or an individual. Documents from Eurostat Agendas on material deprivation or social exclusion indicate that the feelings of happiness or fulfilment depend directly on the professed principles, set of values or strength of the family more than the monthly income (Cutillo et al., 2020; Menyhert et al., 2021; Nolan & Whelan, 2010; Zwierzchowski & Panek, 2020). That was the reasoning behind the proposed set of indicators and determinants for estimating the subjectively perceived welfare of Polish households (Table 3). The set of variables was formulated based on other examples found in the literature, however due to different perception of the issue of welfare, we propose distinctive *MIMIC* model path impact. Some of the determinants used in modelling are convergent with the variables used for instance in Zwierzchowski & Panek, (2020), however the biggest difference could be identified among indicatorial side in which we focused on the fulfilment of the needs and income security levels, whereas the mentioned Authors connected the latent variable with the perception of feelings such as happiness, sadness, life fulfilment. In this context, both models capture different aspects of subjective prosperity.

The Table 3 describes only the statistically significant variables of final *MIMIC* model. When constructing the model independent variables such as: the size of a flat, any external help in meeting the needs, household debt, household extra equipment (not included in other variables such as material deprivation) were considered as determinants. All the indicators used in the analysis were of subjectively perceived nature. On the indicatorial side, variables such as opinion on financial situation in the household or perceived ability to afford for day-today expenses

Table 3 Set of variables

Variable	Definition of variable
Indicators (dependent variables)	
LN	Limitation of the current needs—indicator of the overall inability to meet the needs. The higher the values of the ratio are the households more positively are able to assess the fulfilment of their needs
SIL	The ratio of achieved income level to the potentially subjective needed to meet the needs, indicating the surplus or shortage of the achieved income over the level of income enabling the fulfilment of the households' needs—the level of categories equality is represented by the value of unity, e.g. a negative deviation from this level indicates that the level of income is lower in relation to the necessary level of income to make the needs met; similarly, the value of the indicator exceeding the level of unity indicates a sufficient income level to meet the necessary needs
PR	Propensity to save rate—an indicator that illustrates a household's willingness to save, which is directly related to increasing safety in making the needs met
Latent variable	
SW	Unobservable characteristic that represents the subjective welfare
Determinants (independent variables)	
HS	Household size—the number of household members; people included in the household
HES	Economic household status—type of household socio-economic group
PLR	Place of residence—dependently whether household is in the countryside or in the city
BT	Biological type of the family—type of household regarding the family profile, e.g., a childless married couple, single-parent families
RR	Renouncement rate from supplementary benefits—a characteristics that includes other categories, mainly non-financial benefits, that are not related to the issue of material deprivation, e.g., giving up cinema, theatre, opera, philharmonic, concert, museum or exhibition attendance, book or press (newspapers) purchase, holiday trips, camps, other family excursions, and health services despite the need to provide them; higher values indicate the higher intensity of the phenomenon
MDR	Material deprivation rate—a measure that represents the intensity of mainly financial poverty that relates to the failure to meet basic needs (pay rent, mortgage, or utility bills; keep the home adequately warm; face unexpected expenses; eat meat or protein regularly; go on holiday; have a television set; have a washing machine; own a car; use a telephone)—higher values indicate a higher intensity of the phenomenon
	Apart from assessing the severity of the deprivation level, it was also possible to determine when a household was at an increased risk of material deprivation. In further estimations, the material deprivation rate was used as a resulting indicator for *MIMIC* modelling

Source: own elaboration

were also considered but did not meet adequate statistical significance level.

It should be also noted that material deprivation rate, propensity to save rate and renouncement rate were established at the household level, considering opinion of member towards the fulfilment or necessity to meeting the needs.

The differentiation of the variables values also forced the need to verify the differentiation of features at the voivodeship level. This clearly highlighted the differences in the inclinations or capabilities to meet the needs of households, resulting from geographical affiliation and local aspects, which can basically motivate the decision-making of the households (Fig. 3).
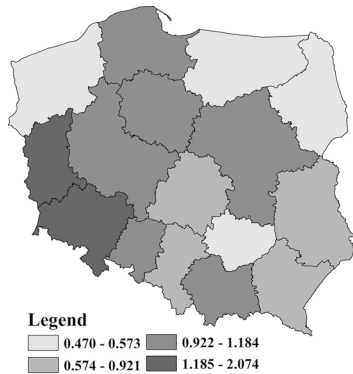
Results and discussion

The best research specification for the *MIMIC* model is presented in Fig. 4. The variables were statistically significant at the $p = 0.05$. The results indicate the direction and the impact of both the independent variables and the latent component.

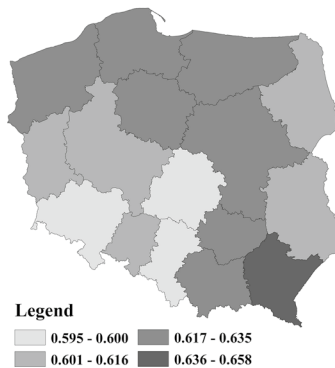**a. Average values of indicators by place of residence**
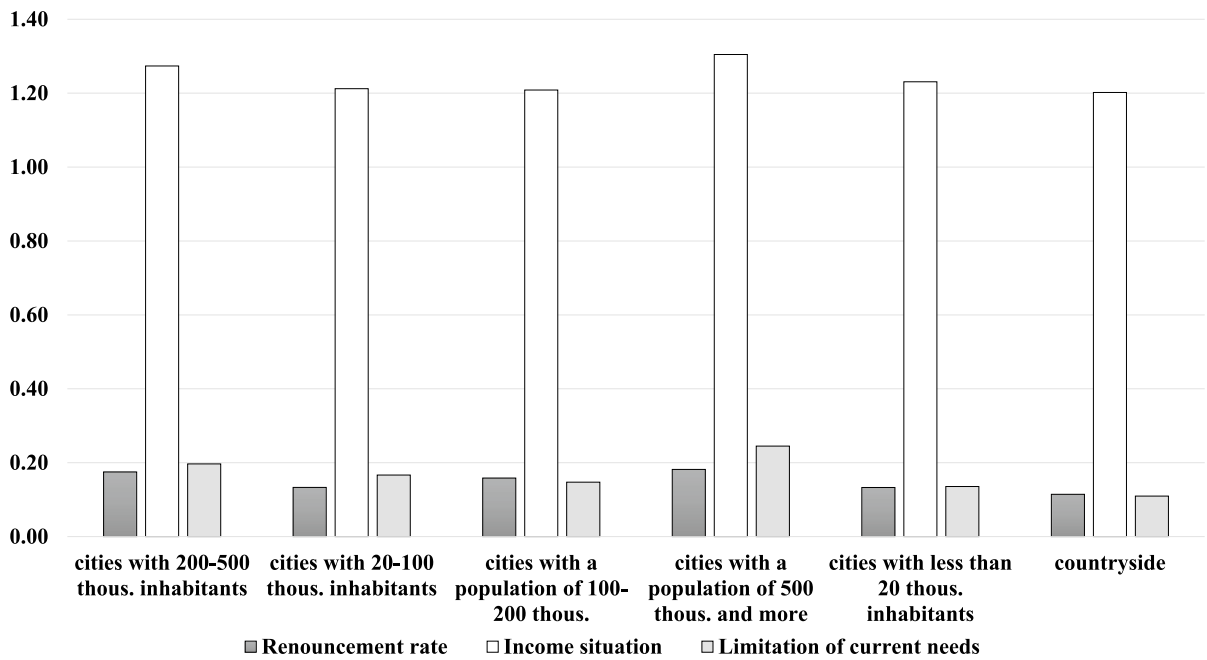
b. Average values of indicators by voivodship

Part1 − Limitation of current needs   **Part2 − Renouncement rate**   **Part3 − Income situation**
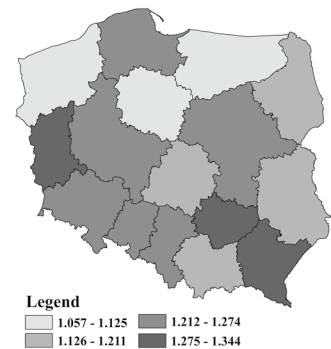

Fig. 3 **a** Average values of indicators by place of residence. *Source*: own elaboration. **b** Average values of indicators by voivodship. *Source*: own elaboration

The impact factor of the regression coefficients was the strongest in absolute values for household size (*HS*). This could indicate that the households' being in subjective welfare depends on the number of members of their household which stays in line with the value of the family approach. The latent variable influences the indicators accepted as the consequences of subjective welfare. The most measurable indicator was the renouncement rate, which covers households needs that are treated as additional, associated with the standard of living including, for instance, cultural activities. The *MIMIC* model results should be assessed as convergent from the perspective of the influence of the subjective welfare coefficient
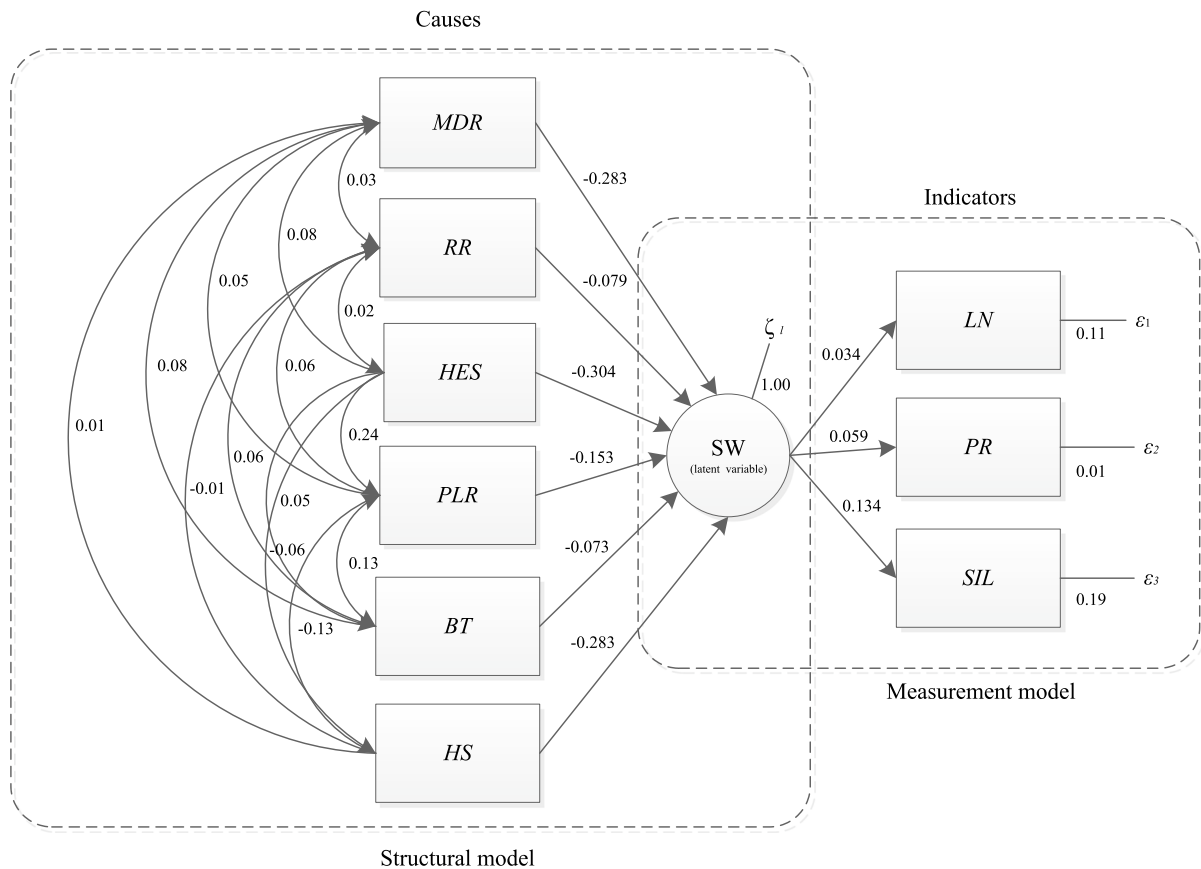
Fig. 4 *MIMIC* model for the subjective welfare of households. *Source*: own elaboration

lowering the limitation in fulfilment of needs (by improving the level of meeting the needs), as well as to increase household income security. The dependence between economic and subjective welfare is in line with the approach to measuring welfare using *GDP per capita* (Saltkjel & Malmberg-Heimonen, 2017), which could indicate that the monetary relationship is a secondary perspective here.

The results of the model indicate the direction and strength of influence of selected predictors on subjective welfare and the latent variable on the given indicators. Considering the coefficients estimates of predictors it could be stated that with the increase of household size the perceived subjective welfare level increases by 0.054. This may contradict the claim that contentment is due to family size although is convergent with the necessity to meet the needs of a larger group of recipients of the household. However, excluding the strictly

financial aspects, households derive more of their welfare from familism, thus experiencing higher levels of welfare when families are fuller. When looking at the variable for the place of residence *PLR* it could be said that with the increase of a city size, the welfare level decreases by 0.153, with the highest assigned level for countryside, here treated as a final category of a variable. Although the variable *HES* has a negative impact on subjective welfare (-0.304), higher levels of welfare were by mean recorded for activities more focused on earning money rather than for those living on unearned sources, i.e., retirees, farmers or pensioners. It is important noting the direction of influence of the determinants, i.e., the rate of material deprivation *MDR*, which determines the inability to meet the basic needs of the household and the renouncement rate of supplementary needs (perceived as higher-order needs) *RR*. In the case of both predictors

considered, an increase in the level of unsatisfied needs, whether classified as material deprivation or as higher-order needs, results in a decrease in the level of perceived subjective welfare. With one-unit increase in subjective welfare, the limitation in making the needs met improves by 0.034 and at the same time the income security of a household advances by 0.059 for propensity rate and by 0.134 for the income ratio. This should be claimed as a positive directional influence of unobservable welfare on the indicator that represent the necessity to save or fulfilment of needs.

Important for the model performance is the list of parameters and indicators estimates present for the standardised approach, which summarises the model in terms of variability of factors for the latent variable measured by standard deviation (Table 4). Looking at the overall level of standardised coefficients, one standard deviation increases in household size leads to a 0.086 standard deviation decrease in subjective welfare. On the other hand, one standard deviation increase in place of residence leads to a decrease of 0.232 standard deviations in subjective welfare. The standardised values of predictors and indicators gives grounds for claiming that among determinants the place of residence and biological family type *BT* have the highest impact on the welfare level. When looking at the indicators of the *MIMIC* model the highest impact of the subjective welfare should be linked with the income security *SIL* and is assigned to propensity rate *PR*. These indications should be considered as expected and confirmed by literature studies

in the field of social policy and consumer's choice theory (Zygen, 2013).

To assess the fit of the achieved *MIMIC* model, Jöreskog's *GFI,* Tucker-Lewis Index *TLI*, and Comparative Fit Index *CFI* were used, followed by the *RMSEA* (Table 5). As already mentioned, because of the χ^2 test's sensitivity to the sample size and its inconclusive indications regarding the decision on the null hypothesis, the results are presented only for formal reasons in the assessment of the model's fit. The number of degrees of freedom of the model amounted to $p = 10$ where a level exceeding $df = 5$ is perceived as indicating a poor model fit (Wheaton, et al., 1977), which might be used here as an argument by ignoring the χ^2 results, which require large cell frequencies for approximation.

Since, the fit indices such as *TFI* or previously mentioned the approximation of the χ^2 are susceptible to sample size or the number of indicators used, it is better to assess the quality of the model with *RMSEA* an indicator that is resistant to these characteristics.

The main characteristics of the model's goodness of fit indicate that the final model is properly fitted to define the subjective welfare levels of Polish households. It is not a universal recipe to estimate unobserved welfare, defined here as subjective. However, the *MIMIC* approach allowed us to present a path to find hard-to-estimate or estimated indirectly characteristics that may have been caused by multiple factors and, at the same time, which may influence other categories. The model could be easily expanded with additional categories: determinants, indicators or

Table 4 The estimated coefficients of MIMIC subjective welfare model

	Estimate	Std. error	z-value	p-value	95% confidence interval		Standardised
					Lower	Upper	
Predictor							
HES	− 0.304	0.095	− 3.185	0.001	− 0.491	− 0.117	− 0.14
PLR	− 0.153	0.029	− 5.309	0.001	− 0.209	− 0.096	− 0.232
BT	− 0.073	0.02	− 3.690	0.001	− 0.111	− 0.034	− 0.153
HS	0.054	0.033	1.631	0.000	0.011	0.118	0.086
RR	− 0.079	0.019	− 4.158	0.002	− 0.325	0.483	− 0.018
MDR	− 0.283	0.099	− 2.876	0.004	− 0.476	− 0.09	− 0.113
Indicator							
LN	0.034	0.011	3.13	0.002	0.013	0.055	0.109
PR	0.059	0.007	8.307	0.001	0.045	0.073	0.516
SIL	0.134	0.017	8.014	0.001	0.101	0.166	0.313

Source: own elaboration

Table 5 Goodness of fit results for the proposed *MIMIC* model

Fit measure	Value	Criterion rule
Tucker-Lewis Index *TLI*	0.931	The cut-off value was set at the level of *TLI* > 0.90, (Bentler & Bonett, 1980; Tucker & Lewis, 1973)
Jöreskog's *GFI*	0.994	*GFI* > 0.95 Goodness of Fit Index, a measure of fit between the hypothesised model and the observed covariance matrix (McDonald, 1999, p. 84)
Comparative Fit Index *CFI*	0.977	the limit value of the index is *CFI* = 0.90 and concurred with the judgement that a good fit of the model is confirmed by indicator values above 0.95 (Hox, 2002)
RMSEA	0.044	the lower the index value, the better the model fit; the *RMSEA* = 0.08 is assumed as the upper limit, which indicates a good model fit (McDonald & Ho, 2002)
AIC	31,011.800	Information-theoretic measures are intended for model comparisons and not for evaluating
BIC	31,198.878	an isolated model. The smaller the values, the better the final model is fitted (Akaike, 1987, pp. 317–332; Schwarz, 1978)

Source: developed by Authors in Statistica 13.3

even latent variables that could enhance the accuracy of hidden component estimates.

Comparing the construction of the proposed model, for example, with the studies by Smętkowski et al., 2015; Zwierzchowski & Panek, 2020) it can be said that the variables that are present in both models determined the convergent effect on the latent variable. It should be also noted that the authors in their modelling sought more values for the Satisfaction with Life Index (*SLI*) that directly measures individuals' level of satisfaction with life (not the subjective welfare). The biggest difference between the perception of latent variable is the measurement (indicatorial) part of models. We proposed variables describing the decisions made at the household levels that determine the degree of fulfilment of the needs included in material deprivation and supplementary needs, as well as the propensity to save and income relation ratio, which should be identified with the need to ensure a certain necessary level of financial security for the household. In this context, both comparable *MIMIC* models do not perceive the same subjective phenomenon as a latent variable and in fact show different aspects.

Within the concept of perceived welfare's regional character and the theory of regionalism and subregionalism (Gochhayat, 2014), it is essential to investigate how the estimated level of welfare is varied for major spatial units in Poland. The proposed model assesses the level of subjective welfare, a concept that includes aspects of human life such as meeting needs, life satisfaction and family values, which distinguishes it from the economic welfare approach.

Estimates of *MIMIC* model allowed to calculate the levels of subjective welfare—to capture the spatial diversification we used the most common/average value of the determinants gather on the geographic affiliation level. For variables expressed on a nominal scale, the most frequent value was used, while for variables on a ratio scale, the median value was used. This gave us grounds for better perception of the aspects of locality, especially for the subregional (NTS-3) level. The spatial distribution of the values of subjective welfare level for Polish voivodeships divided into four groups of similarity is presented in Fig. 5. The interpretation of the model result is quite intuitive—higher the resulting value is, the higher the level of perceived subjective welfare.

An interesting conclusion is that Lubelskie and Swietokrzyskie (located in the southern-eastern part of Poland), constituted the group with the highest level of subjective welfare. Although other regions, e.g., Podkarpackie, recorded the highest values for the measurement variables (Fig. 3b), this does not translate into a high position for these regions in terms of subjective welfare. Quite similar results with already cited studies were obtained for the next cluster (Group III—see Fig. 5), among which we can distinguish Podlaskie, Opolskie, Malopolskie and Kujawsko-Pomorskie voivodeships. What is quite interesting the subjective welfare does not go hand in hand with the wealth of regions, e.g., for the Mazowieckie, Lodzkie, Slaskie or Pomorskie voivodeship, one could expect high values for the welfare function due to, for example, the possibility of fulfilling needs or the level of earnings. However, the obtained results are gratifying
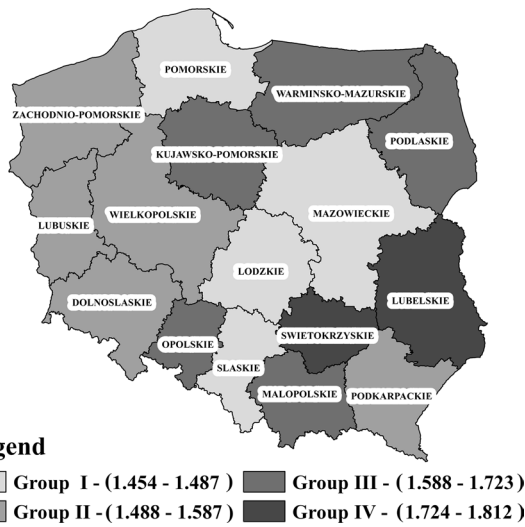
Fig. 5 *MIMIC* model results of households' subjective welfare–spatial grouping for NTS-2 units. *Source*: own elaboration

Fig. 6 *MIMIC* model results of households'–the case of subregional distribution of subjective welfare *Source*: own elaboration

and at the same time confirm the sense of a separation of economic welfare. Additionally, it is known that voivodships with a high level of subjective welfare obtained highly value family qualities, appreciate the historical background and perceive a sense of regional affiliation, and within their administrative borders there are numerous areas recognised as rural, which affects the average higher values of subjective welfare. The distinguishing feature between those perspectives is that the most typical aspects, such as the size of the geographic unit are mentioned. Regionalism is an ideology, a socio-economic and political concept that tries to investigate the regional uniqueness. The sub-regional perspective refers to a spatial unit that is located within or across state borders, and it describes processes that target the increasing independence of a given sub-region from the state.

The spatial differentiation of subjective welfare at the voivodeship level encouraged us to investigate distributions at a higher level of spatial data aggregation. However, due to the lack of household identification for vast number of poviats the social diagnosis database does not fully allow for the transition to the *NTS*-4 level in the analysis of spatial arrangements. Hence, the *NTS*-3 level (sub-regional) was examined. Having in mind the lack of representativeness of the data structure at sub-regional level, the values of the welfare function were estimated in accordance
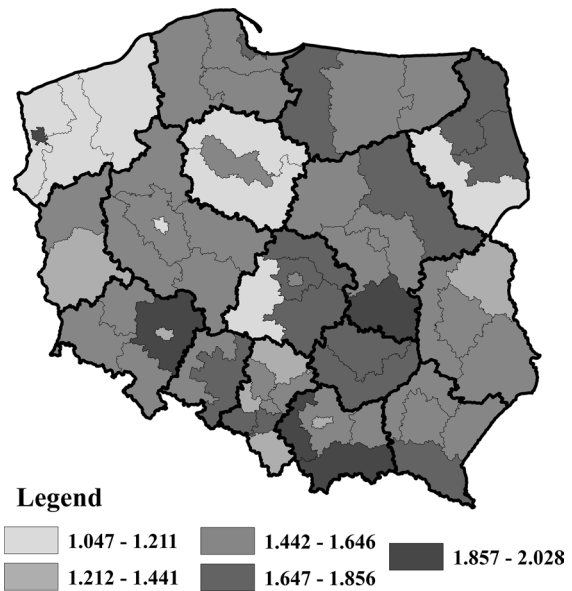
with the proposed *MIMIC* model (Fig. 4). This interest results directly from the definitions of previously mentioned concepts of regionalism/sub-regionalism and the scientific urge to explore the distributions of subjective welfare at a higher level of spatial data aggregation.

The transition to a higher level of spatial data aggregation allowed us to identify certain regularities in the distribution of the subjective welfare values. The cities with poviat rights, *i.e.,* large metropolitan centres such as Wroclaw (Dolnoslaskie), Gdansk (Pomorskie), Krakow (Malopolskie) and Lodz (Lodzkie), were identified with lower values of perceived subjective welfare. This conclusion is consistent with the different impact of the economic aspects at the subjective welfare level. However, it can be assumed that these centres mainly perform a gainful function, increasing economic prosperity, whereby households experience a higher level of subjective (non-economic) welfare in the neighbouring areas, helping them, e.g., meet family needs more than it could be done in a large metropolis. As Figs. 5 and 6 show, the differences in the levels of achieved welfare were quite high. If, for example, we focus on Zachodnio-Pomorskie, when analysing the provincial level of welfare, it would be completely overlooked that

the position of this voivodship is determined by the importance of the city of Szczecin, city with one of the highest levels of welfare (1.95). However, opposite relation can be identified in the areas of other voivodeships, such as Dolnoslaskie, Malopolskie or Wielkopolskie for which it is the metropolitan area that shows lower levels of subjective welfare, confirming the realisation of current needs outside urban centres. This fully justifies the necessity to study phenomena at higher levels of spatial data aggregation, otherwise a certain utility and interpretation value of the obtained indications is simply lost. The highest value of average subjective welfare was identified in Radomski subregion (2.032)—a territory of Mazowieckie voivodship, city of Szczecin subregion (1.96), Wroclawski (1.94) for Dolnoslaskie voivodship, Nowosadecki (1.94) and Oswiecimski (1.95) subregions located in Malopolskie were the areas that lifted the overall level of subjective welfare in voivodships. A similar relationship can be identified for Pomorskie voivodship, where Trojmiejski subregion noted one of the highest average levels of subjective welfare (1.76) and in Lodzkie—here among the spatial units with the highest values of subjective welfare apart from the Lodzki (1.83) and Skierniewicki (1.86) subregions the average level of subjective welfare was high. For the poviat subregion of Poznan city and the Poznan metropolitan area the values for the *MIMIC* welfare function were estimated at 1.05 and 1.64, respectively. These regularities might be related to some aspects of the concept of regionalism and the concentration of socio-economic activity in more developed metropolises. These areas provide opportunities for households to pursue their economic welfare goals, enabling them to achieve a desirable level of subjective welfare in neighbouring subregions where households could locate and better fulfil their existential functions, i.e., family development, feeling of belonging to the local community, etc.

The lowest level of the subjective welfare function was obtained for the subregions: Grudziadzki (1.04) located in Kujawsko-Pomorskie, Stargardzki (1.05) in Zachodnio-Pomorskie voivodship, city of Poznan subregion (1.05) in Wielkopolskie and Wroclawski subregion in Dolnoslaskie province (1.07).

For comparison, at the provincial level, the lowest value of subjective welfare was assessed for the Lodzkie (1.45) and Pomorskie (1.46) voivodships, while the highest was identified in the Lubelskie (1.81),

and Świętokrzyskie (1.80) voivodships. Finally, it is worth adding that the estimates of subjectively perceived welfare at the sub-regional NTS-3 level are quite consistent, for example, with the results regarding the Local Human Development Index by public policy input (UNDP, 2012), which might indicate a relationship between the the perceived level of welfare and standard of living, health and life expectancy.

Conclusion

The compilation of the results proves how necessary it is to analyse the levels of different spatial data aggregation and not only from the more advanced perspective of Exploratory Spatial Data Analysis (*ESDA*). Looking at the values obtained only at the voivodship level, more detailed information about the level of the phenomenon for the sub-regional level is lost, which provides valuable information on the conditions of households, their satisfied needs or income security. There are diverse values recorded for different types and sizes of the place of residence. The Social Diagnosis researched households living in the countryside and cities with different numbers of inhabitants (Fig. 7).

The research showed that households in rural areas or in smaller cities were characterised by the highest reported levels of perceived subjective welfare (Fig. 7). This would confirm the concept of rural self-sufficiency in meeting life's needs if, for example, the household was a farm that produced goods mainly for its own use. In rural areas, there is also a different family or neighbourhood culture, which additionally stimulates the level of perceived welfare, although not necessarily in the economic sense, although it may also correlate with a sense of community or sense of bonding in less populated living locations. Mack & Lansley (1985) reached similar conclusions—they confirmed that there is no relationship between the level of income and lack of necessities. It is more the case that households consciously choose to go without a desire rather than being forced to do so for financial reasons (Alkire & Foster, 2011).

It is quite surprising that for the two indicated provinces (Swietokrzyskie and Lubelskie)—spatial objects that, for instance, in Smętkowski et al. (2015) are characterised by high levels of deprivation risk showed the highest level of subjective welfare values.

Fig. 7 The subjective
welfare levels in accordance
with the place of residence.
Source: own elaboration
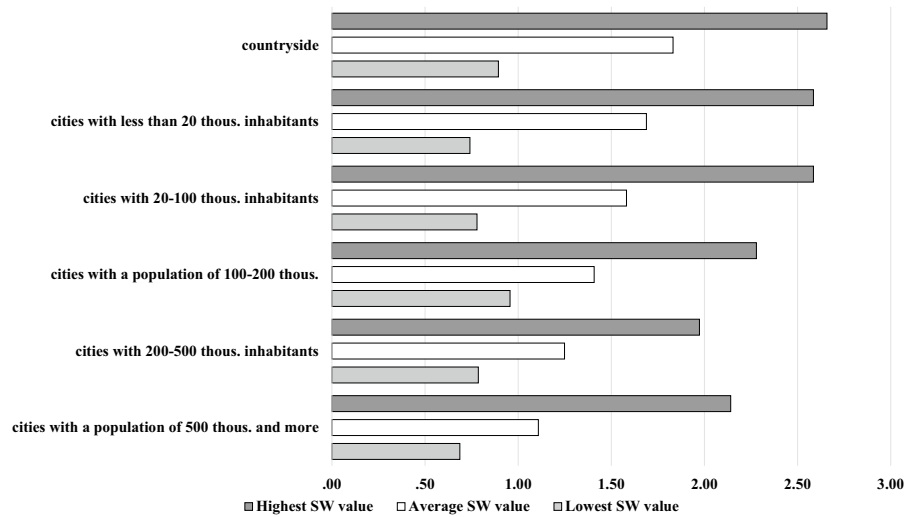
However, the two indicators cannot be merged as the way of defining a complex phenomenon is quite different. The EUROREG (2015, 2017) study focuses on indicators such as income, employment, living conditions, education, access to goods and services—in objective terms. Hence, the proposed subjective welfare function determines prosperity on the basis of other determinants and therefore indicates other aspects of perceived welfare.

Finally, it is necessary to note the limitations that result from both the availability of the database and the *MIMIC* model used. The proposed model was estimated for characteristics that described households in Poland, and the final form of the estimated model was used to determine the values of the subjective welfare index for each household, regardless of geographical affiliation. Conducted research proved that it is beneficial to look at the higher levels of spatial data aggregation. This is especially shown by the example of Zachodnio-Pomorskie and the city of Szczecin, where the interpretation of only the regional level of subjective welfare would hide significant internal spatial differentiation of the subregions belonging to it. Further research would extend the proposed approach by calculating sixteen provincial *MIMIC* models. It would allow to differentiate the value of the welfare index regarding the regional specificity. By comparing the values of the model's coefficients, it would be possible to verify the strength of the impact of individual factors through a latent variable on the value of the proposed indicators. If the results prove to be reasonable, following the scheme, by analogy, 66 sub-regional NTS-3 models should be estimated with a similar concept to compare them with the general and regional models. Such a methodical approach should highlight unique aspects of local communities and how the households living in these areas perceive their subjective welfare.

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