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Measurement of Subjective Well-being under Capability Approach in Poland

Abstract: As a part of the European Statistical System, a general concept of measuring the quality of life was presented, defining its dimensions and partial indicators. The methodological objective of the study is to operationalize the measurement of subjective well-being(SW-B). The proposed method of measuring SW-B is based on the above concept, while incorporating the Sen's capabilities approach. The operationalization was performed using the MIMIC model. This model incorporates both observable functionings (SW-B indicators) and socio-demographic characteristics of individuals (conversion factors). The two sets of variables are linked through the latent capabilities, which are interpreted as the SW-B measures. Empirical analysis of the SW-B in Poland in 2015 was conducted using EU-SILC data. Characteristics influencing the SW-B were identified. The SW-B depends mostly on self-perceived health and material deprivation. Moreover, higher values of SW-B were observed for those who work, have 1–2 children and are highly educated.

Keywords: SEM, subjective well-being, MIMIC, capabilities approach

Introduction

Research on the Subjective well-being (hereafter: SW-B) has a long history initiated by Greek philosophers. However, the widespread interest in this field has been commenced in the sixties of the last century when the concepts such as the SW-B and quality of life appeared as an alternative to the dominant goal of social development which was the increase of material level of living. Since then, SW-B and quality of life have been the subject of many studies in various research disciplines such as economics, political sciences, sociology, psychology, philosophy and medical sciences. (Kot 2004; Phillips 2006; Panek 2016). In recent years, the interest in the SW-B has increased even further, as it turned out that the correct assessment of the phenomena may contribute to monitoring the economic, social and health conditions of populations and influence policy decisions (Krueger et. al. 2009).

The concept of quality of life was for decades synonymous with material wealth. Rates of economic growth were the main criterion for assessing social progress. Within this mindset, a Scandinavian approach to measuring the quality of life was developed. It was influenced by the work of Jan Drewnowski (1970) and studies of Richard Titmuss (1968, 1974) on the British welfare state. Prosperity in this approach was understood as the availability of

resources such as money, assets, knowledge, psychic and physical energy or social bonds, enabling individuals to shape their living conditions in a controlled and conscious manner (Erikson 1993: 72–3). Moreover, the external conditions of life of individuals were considered as the basic elements determining well-being. This does not mean, however, that the subjective aspects of well-being were not taken into account. However, due to the fact that subjective type assessments depend on the level of aspirations of individuals, they cannot, according to this approach, be suitable criteria for conducting social policy, for which the measurement of well-being is primarily carried out.

From the point of view of the law of diminishing marginal utility of income, a discussion about the limits of economic growth and its impact on social development and the natural environment has developed. The law of decreasing usefulness formulated by H. Gosse (1983) proves that the marginal benefit (usefulness) of each subsequent unit of good consumed is smaller than the marginal benefit of the previous unit of this good. What's more, above a certain limit, owning another good not only results in an ever smaller increase in satisfaction with its possession, but can even lead to a decrease in the level of utility. In this context, the disadvantages of a purely objective perspective of social development have become apparent.

A major breakthrough in this area was the development of the American approach to measuring quality of life, which has been formulated in the 1970s. The precursors of this approach were Angus Campbell, Philip E. Convers and Willard L. Rodgers (Campbell and Converse 1972; Campbell, Converse and Rodgers 1976). They defined prosperity as the level of satisfaction of individuals from their lives. Therefore, objective symptoms of quality of life are just means to achieve satisfaction from life. In addition, the quality of life should be holistic as it depends not only on the properties of individuals (biological, mental and social) but also on the environment in which they function. According to this approach, the ultimate goal of social development does not refer to the objective characteristics of the quality of life but the subjective well-being of people.

The idea of economic well-being as the only goal of social development has been replaced, and in principle extended, by a multi-dimensional concept of quality of life. This notion covers also non-material aspects of the life situation such as health, social relations or the quality of the natural environment. Moreover, it incorporates the subjective self-assessment of life situation. In other words, the concept of well-being has been enriched with a non-economic dimension. Thereafter, the quality of life began to be assessed both on the basis of objective characteristics—living conditions—and subjective assessments of these living conditions, or more broadly, a subjective assessment of overall life experience. From the perspective of the European Statistical System the landmark was the expert report co-authored by Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi titled "Report by the Commission on the Measurement of Economic Performance and Social Progress" (Stiglitz et. al. 2009). Following this report, more and more attention has been paid to the subjective well-being within the European Statistical System.

The major contribution of this paper is a proposition of a novel approach toward measuring the subjective well-being (hereafter: SW-B), which is based on the Eurostat recent recommendations with respect to measuring the SW-B and A. Sen capabilities approach. Under the proposed approach heterogeneous ways of maximizing the SW-B are taken into

account, resulting from both different individuals' capabilities and preferences, as well as the diversity of living conditions which depend on the stage of development and social customs in which they live. This method allows for obtaining group and synthetic indicators of SW-B for different socio-demographic and economic groups of the studied population. Moreover, the method allows for empirical verification of hypotheses about potential objective factors influencing the values of the SW-B. In the operationalization of the capabilities approach, multiple indicators and multiple causes (MIMIC) model was used.

The paper includes an empirical illustration of the proposed methodology. The proposed model was used to estimate the relative levels of SW-B in Poland in 2015 on the basis of the EU-SILC survey database. The aim of the empirical part of this paper is to resolve two issues. Firstly, identify which of the observable objective conditions affect the SW-B in a statistically significant manner. Secondly, to conduct an empirical analysis of SW-B in Poland based on the proposed methodology.

Measuring the Subjective well-being under the Capability Approach

Subjective well-being

Subjective well-being (SW-B) is focused on how people experience and evaluate their lives as a whole as well as specific domains and activities within their lives. The debate on the definition, identification and measurement of SW-B has been ongoing for decades. During the past decade, following the Stiglitz report (2009), the interest in the SW-B grew considerably not only among researchers and academics but also policy makers, national statistical offices and the media.

Different approaches to the category of subjective well-being are used, as they depend on the adopted theoretical model of the category. The model can generally be hedonistic or eudemonistic (Ryan and Deci 2001). The first of these has its source in the philosophy of Aristopus of Cyrene. In the hedonistic approach, subjective well-being is considered in terms of life satisfaction. The measure of subjective well-being is the balance of emotional experiences and the level of satisfaction with one's own life. Sometimes the assessment of satisfaction with specific aspects of life is included in the hedonistic concept of subjective well-being (Diener et al. 1999). The eudemonistic model is based on Aristotle's philosophy. In this approach, subjective well-being is considered in terms of possessing and striving for valuable attributes of life.

The pioneering works on the SW-B, relevant to the current ongoing discussion, have been written by Norman Brudburn (1969) and Frank Andrews (1976). Brudburn has changed the paradigm related to understanding negative and positive affects. According to Brudburn the two affects are independent phenomena rather than the opposite ends of the same dimension. Therefore, any empirical research aimed at measuring SW-B should contain tools for measuring both of these dimensions independently.

Frank Andrews laid foundation for the use of subjective, self-reported indicators in empirical social research. He advocated the use of subjective indicators of the quality of life. His works have validated the use of empirical research in the measurement of the

SW-B and, moreover, the incorporation of the SW-B dimension into general quality of life assessment.

A psychological theory of SW-B has been summarized by Diener (1984). The SW-B has been divided into three subcategories, namely positive and negative affect and general assessment of life. Diener stated that the three proposed components of SW-B represent distinct constructs, which even though closely related, should be understood separately.

In the European Social Survey a concept of SW-B was adopted which combines the hedonic and the eudemonistic approaches. At the same time it leaves out the category of evaluation of specific aspects of life in SW-B. Subjective well-being is understood as how people feel and how they function, both on a personal and a societal level, and how their lives as a whole are evaluated (Huppert et. al. 2009, 2013).

More recently, the triadic conceptualisation of the SW-B has emerged. The three categories of SW-B are referred to as evaluative, experienced and eudaimonic well-being (National Research Council 2013). Evaluative well-being refers to judgments of how satisfying one's life is. These judgments, in turn, should be applied to specific areas of life, constituting sub-domains of evaluative SW-B such as satisfaction with relationship, health, professional career, etc.

Experienced well-being refers to people's emotional states and sensations such as pain or arousal. It also comprise feelings of sense or pointlessness of life which are somehow interconnected with emotional states. The experienced well-being is often divided into positive (joy, happiness) and negative (stress, pain, anxiety) experiences which somehow correspond to Diener's positive and negative affects.

The eudaimonic well-being is focused on perceptions of meaningfulness, sense of purpose, and the value of life. It is somehow interconnected with the evaluative and experienced well-being, but still is considered to constitute a distinct dimension of the phenomena. The most commonly used assessment of eudaimonic well-being refers to individuals' overall assessments of meaning and purpose in life.

These components are not entirely independent. The three categories may be thought of in terms of a continuum, with real time assessments of experience, emotional states and sensations at one end (the shortest time-frame) and overall evaluations of life satisfaction, purpose or suffering at the other end (the long-run perspective). The three categories of SW-B provides empirical researchers with a theoretical guide for constructing Surveys' questions aimed at measuring SW-B.

Due to the specific focus on the subjective aspects of well-being, definitions of SW-B typically exclude objective conditions such as material conditions or health, although these can influence ratings of SW-B. Specifically, wealth of individuals increase their SW-B significantly for the higher income classes, while lower incomes do not hinder SW-B in a similar manner, and the overall influence of incomes on SW-B is weaker than people generally believe (Aknin et. al. 2009). Moreover, the well-known Easterlin Paradox (1974) was coined on the empirical observations that while happiness do vary among people with different levels of incomes in a given time period, it does not elevate as average incomes grow over time. This may suggest that the variation in subjective happiness comes not from the pure level of absolute incomes as much as from the inequalities among individuals.

Health is another factor considered as a significant determinant of SW-B. In literature, there is evidence of substantial correlations between health, in particular self-reported state of health and SW-B. However, as objective measures of health (such as the number of days on sick-leave) are less strongly associated with SW-B, it is speculated, that the relation may be bidirectional, and people with higher SW-B tend to overrate their health, while people in low mood may tend to underrate their health status. Moreover, there is empirical evidence from epidemiological studies, that the higher SW-B does influence health in the long run, as persons with higher values of SW-B contract severe diseases less frequently and live longer (Diener, Chan 2011).

However, it is generally speculated that genetic factors are the most important determinants of the differences in SW-B in general population. A wide range of personality traits seem to influence the SW-B, specifically, the traits from the five factor personality model. While neuroticism is associated with poorer SW-B, the other four traits, namely extraversion, agreeableness, conscientiousness and openness to experience tend to increase the values of SW-B. Weiss et. al. (2008) even found that subjective well-being was genetically indistinguishable from personality traits such as neuroticism, extraversion and conscientiousness. According to various empirical studies, these traits are inherited in up to 50% of their total variability, meaning that the differences in SW-B associated with them are also genetically determined up to a similar level of variability (Bouchard 2001).

The concept of capabilities

The concept of capabilities was developed by A. Sen in a series of books and journal articles (1985, 1992, 1999, 2010). His concept has been synthetized by many authors, including Alkire (2002) and Robeyns (2003). Unlike other philosophical approaches focused on people's happiness, which are concentrated over desire-fulfilment, incomes, consumption or fulfilment of basic needs, the Sen's capability approach is concerned with people's capabilities, which describe what people are actually able to do and to be.

The whole concept is based on the assumption that every person chooses a certain lifestyle from a set of different lifestyles that he can achieve. Sen (1999) uses the concept of "freedom" to describe a process in which people voluntarilly choose a way of living among different available opportunities they encounter. Therefore, low quality of life results from the lack of freedom to choose a satisfying way of living. Thus we should understand an observed low value of SW-B not just as a manifestation of low self-assessment of well-being, but rather as a deprivation of the freedom to undertake life activities which would eventually lead to higher values of SW-B.

Within his approach, Sen defines capabilities and functionings. Capabilities are potential ways of being and doing that are accessible. The set of capabilities available to an individual is limited by both the objective external factors and individuals' characteristics. Functionings are the actual beings and doings of a person. They may be understood as observed and realised way of living of an individual. Functionings constitute a manifestation of choices individuals undertake while determining their life course. According to Sen (1987) functioning is an achievements, whereas capability is the ability to achieve. Functionings are more directly related to the current situation of individuals, whereas ca-

pabilities cover the notion of freedom to choose among real opportunities. Functionings describe the actual status of life achieved by the individual, such as being healthy or educated, while capabilities express potential possibilities of achieving such a status, that is, the possibility of living in health or being able to achieve a given level of education.

Critical to the capability approach is the recognition of human heterogeneity which results in people choosing different ways of living from a common capabilities' set. Transforming the capabilities into the ways of functioning, requires according to I. Robeyns (2003), introduction of the concept of conversion factors. There are three types of conversion factors, namely personal conversion factors (e.g. metabolism, physical condition, gender, knowledge or intelligence), social conversion factors (culture, social policies and social hierarchies) and environmental conversion factors (state of the environment). Conversion factors form a set of various characteristics that trigger the transformation of available resources into achieved functioning.

In the context of analysing inequities, individuals must have equal opportunities to function in the way they prefer (Sen 2010). Having equal opportunities, people have the freedom to determine their capabilities, that is, their potential ways of functioning and to maximize their quality of life in accordance with them by realising subjectively optimal functionings. However, this does not mean, that in a perfectly equal society all people will live the same lives, as their chosen functioning will depend on their individual conversion factors. Therefore, individuals with comparable levels of capabilities related to the SW-B may differ significantly in various areas and sub-dimensions of SW-B, which is reflected by differences in basic SW-B indicators' values.

Measuring quality of life within the EU

Within the European Union, a lot of research has been conducted on the sustainable socio-economic development, including the quality of life and SW-B. In subsequent treaties of the European Union, we observe an increasingly visible display of the awareness of necessity to balance between economic development and social progress, while preserving the natural environment and cultural heritage. In 1992, "improving the quality of life of residents" was mentioned as one of objectives of the Treaty of Mastricht. Treaty of Lisbon of 2007 indicates an increase in quality of life as one of the main directions of EU action. The European Commission Communication "Beyond GDP" (Commission of European Communities 2009) and the Stiglitz Committee report on improving the tools for measuring economic efficiency and social progress were of key importance for developing the concept of measuring quality of life (Stiglitz, Sen and Fitoussi 2009). The purpose of the report was to identify GDP limitations as an indicator assessing economic performance and social progress, as well as to assess the possibility of using alternative instruments and to promote discussions on how to correctly present statistical information. The report underlines the importance of using correct measures of economic and social processes as well as it points out that in order to correctly evaluate social progress, it is necessary to include the quality of life of the society in the relative measures. The report gave impetus to the movement of identifying and measuring the SW-B (National Research Council 2013).

A. Sen's theory of capabilities has become an inspiration for the debate within the European Commission "GDP and beyond" on the need to supplement the GDP index with additional indicators that would take into account social and environmental aspects of development in order to set more coherent and comprehensive policy directions. The necessity of this type of activities was indicated in the European Commission's Communication ('Out of GDP'—measuring progress in a changing world) (GDP and beyond—Measuring progress in a changing world). The report of the Commission on the Measurement of Economic Performance and Social Progress, more commonly known as the Stiglitz Commission report (Report of the Stiglitz-Senate), was a milestone in the development of the concept of measuring the quality of life within the European Union.

The increase in the quality of life and social cohesion is also one of the important objectives of the EU 2020 strategy (Commission of the European Communities 2010). Improvement of the quality of life of Poles by ensuring stable and high economic growth is also the main goal of the Polish Long-term National Development Strategy until 2030 and the Medium-Term National Development Strategy 2020 (Bielak 2015).

The EU and its Member States have developed and for many years applied a wide range of social and environmental indicators, which often were nested within the sustainable development indicators systems. In 2011, the Initiative Group for Measuring Progress, Prosperity and Sustainable Development was established at the initiative of Eurostat and the French National Institute for Statistical and Economic Research (INSEE). This group developed the concept of measuring the quality of life within the European Statistical System (Eurostat 2011a and 2011b) and proposed domains of quality of life and indicators of quality of life in its various domains (Eurostat 2017). The structure of the quality of life proposed by Eurostat in its annual quality of life studies was adopted by the Polish Central Statistical Office (Szukiełojć-Bieńkuńska 2017).

In the report of the Expert Group on Quality of Life of the European Commission (2017) the SW-B has been proposed as one of the nine dimensions of overall quality of life. Moreover, it has been divided into three subdomains, with accordance with the triadic conceptualization of the SW-B. The report contains also a complete set of observable indicators, which should be applied in empirical measurement of the phenomena.

Operationalization of the subjective well-being measurement as part of the capability approach

The operationalization of the quality of life measurement as part of the capability approach is a complex process. A Sen in its Tanner Lectures (1980) argues that the right approach to the assessment of quality of life should not only accurately measure the natural complexity underlying the concept of quality of life (the criterion of reference accuracy) but also take into account the possibility of its application in empirical assessment (criterion of suitability).

A. Sen attempted to operationalize this measurement (1985) based on the capabilities and functioning. The starting point was the vector of goods (resources) in the possession of the unit, enabling them to function (Basu and López-Calva 2010). Based on the work of Gorman (1968) and Lancaster (1966) A. Sen used the fact that goods can be transformed into properties of goods—an individual can use the properties of owned goods to achieve

certain functionings—the chosen ways of beings and doings. At the same time, the individual has the freedom to choose, within the framework of the possessed goods and its set of possibilities. In general, the bigger the set of available resources the greater freedom is enjoyed by individuals. A. Sen advocated measuring latent capabilities, which reflect the scope of freedom, rather than observed functionings for the purpose of assessing quality of life:

> … human beings must have equal possibilities and equal opportunities in order to function. In this perspective the attention is moving from the means to real opportunities and the freedom of being and doings. With equal opportunities people have the freedom to express their capabilities, potentially reach the functionings and accordingly wellbeing. In this context in order to measure quality of life the focus has to rely on the measurement of the capabilities to function rather than on the achievements. (Sen 2010: 148)

The idea behind is that a policymaker should not attempt to design and constrain people's live in order to optimize values of some abstract indices. He should strive to provide population with a broad set of available ways of living to choose from and leave the optimisation process to the individuals' choices.

We believe, that the capabilities approach can be successfully applied to measure the SW-B, and more generally, quality of life as part of the concept developed in the EU. Using capabilities approach it is possible to measure levels of unobservable potential quality of life and SW-B, which correspond to capabilities, rather than being focused solely on observable indicators. Following A. Sen, we propose to assess the individuals' levels of well-being by estimating values corresponding to their capabilities rather than realized functionings. In other words, the broader set of resources and possibilities is available to an individual, which is reflected in the capabilities' values, the higher level of well-being he can achieve, regardless of the actual, realised functioning.

The proposed approach is consistent with Sen's concept of freedom—as we are interested in measuring potential rather than actual results. Within this approach we are capable of taking into account the differences in individual resources, possibilities and preferences, as well as cultural diversity both between EU countries and within each of these countries, thus enabling for comparative empirical analysis. For example in some cultures feeling happy may be regarded as being childish or immature. Therefore individuals may consciously restraint from undertaking activities which would result in the momentary happiness, but somehow undermine their well-being in a longer run as their self-assessment could suffer. In other words there may be a trade-off between experienced and eudaimonic or evaluative well-being and different people may find it optimal to locate themselves at different points of available spectrum. We believe, that as social researchers we should be focused on their potential to choose the way of living of their choice rather than the actual, realised well-being in any given moment of time.

In order to fully operationalize the capabilities approach, this paper proposes to apply a multi-indicator and multiple causes model (MIMIC), which is a special case of the structural equation model (SEM) (Bollen 1989; Konarski 2009; Brown and Moore 2012) for the operationalization of the quality of life measurement. The MIMIC model was formulated by R. M. Hauser and A. S. Goldberger (1971), and then popularized by K. G. Jöreskog and A. S. Goldberger (1975), who gave it a currently functioning name and presented its detailed assumptions as a special case of the SEM. J. Krishnakumor and P. Ballon (2008) pointed at the SEM approach as the most suitable tool for estimating capabilities that are

not directly observable. It also allows the assessment of the impact of external determinants on latent capabilities (characteristics of individuals, environment).

Due to the complex nature of quality of life, its different aspects are usually difficult to directly observe and therefore we call them latent variables. In case when a given phenomenon is not directly observable and measurable, variables called indicators are used to measure it indirectly. The indicator is an observable and measurable property of the latent phenomenon. In the context of the current study, the subjective well-being should be seen as a latent, unobservable trait, though possible to estimate through a set of observable indicators. Moreover, the MIMIC model allows for the simultaneous use of determinants of the latent variable along with its indicators.

The operationalization of measurement of SW-B within the MIMIC model can be presented as follows (Krishnakumar 2007): capabilities representing the SW-B are unobservable endogenous latent variables. However, they can be estimated based on two sets of variables. Firstly, the set of selected indicators, which can be interpreted as realised functioning, allows for the construction of the reflective part of the model. The formative part of the model is constructed based on the individuals' personal, social and environmental exogenous characteristics, which are interpreted as the conversion factors, which strengthen or weaken the capabilities and influence the process of transformation of capabilities into achieved functioning.

The starting point for determining the form of the MIMIC model for measuring the SW-B should be the identification of relevant indicators of the phenomena, which is variables measuring capabilities available within the European Statistical System (ESS). The partial indicators of SW-B, which represent in the model the achieved functioning of individuals, are clearly defined in the report of the European Commission (2017). On the other hand, the exogenous characteristics of individuals (conversion factors) are not defined and should be adopted according to their availability and adequacy.

Formally, the MIMIC model equation for the SW-B have the following form:

$$y = \Lambda\eta + \varepsilon \tag{1}$$

$$\eta = \Gamma x + \psi \tag{2}$$

where:

y—vector of observable endogenous variables (symptoms of SW-B represented by partial variables),

Λ—vector of factor loadings of endogenous variables,

η—a latent endogenous variable, which will be interpreted as a composite indicator of SW-B,

ε—vector of error terms, the error term in this context consists of a classical measurement error and, moreover, specific variability of a given indicator, which is not shared with other indicators of SW-B, and therefore, does not influence the estimates of the SW-B measure,

Γ—vector of coefficients of latent variable to observable exogenous variables x, defining the pattern of structural relations in the MIMIC model,

x—vector of observable exogenous structural variables, which are interpreted as capabilities or objective causes for SW-B,

ψ—error terms in the equation for latent SW-B variable. It can be interpreted as a part of variability of SW-B, which does not depend on objective, observable causes.

Empirical Analysis of the Subjective well-being in Poland in 2015

Data source

The basis of the analyses carried out as part of this study were data from the European Survey of Income and Living Conditions carried out by the Central Statistical Office in 2015. The main objective of this study is to provide comparable data for EU countries regarding the living conditions of the population. At the same time, the data from this study are to be the primary source of information for the assessment of the quality of life in EU countries within the European Statistical System. The EU-SILC survey is based on representative random samples of households and persons aged 16 and more included in these households.

In the EU-SILC study conducted by the Central Statistical Office, a two-stage sampling scheme with different probabilities of selection on the first stage was applied. First stage units (JPS) were census enumeration areas and second-degree housing units. The study covered all households inhabited in randomly selected apartments. Units of the first degree were stratified according to voivodships before the drawing, and then inside voivodships according to the class of the town. Finally, 12,183 households and 25,830 people aged 16 and more took part in the survey.

The results obtained in the study are generalized through appropriate weighing to the provincial and nationwide level. The integrated weight system (more specifically, the sum of weights) of households and individuals reflects the size of the entire population of households and people in Poland.

In 2015 the Polish EU-SILC Survey Questionnaire contained a module focused on the general well-being. Within this module the following questions have been identified as indicators of SW-B, which clearly correspond to the indicators proposed in the EU Commission report:

1. How satisfied with your life are you in general? (Overall life satisfaction),
2. How much do you feel what you do in life is worthwhile? (Assessing whether life is worthwhile),
3. How often during the last month have you felt depressed? (Negative affect),
4. How often during the last month have you felt nervous? (Negative affect),
5. How often during the last month have you felt sad? (Negative affect),
6. How often during the last month have you felt calm? (Positive affect),
7. How often during the last month have you felt happy? (Positive affect),
8. How often during the last month have you felt full of life? (Positive affect).

The first variable measures the evaluative well-being, the second variable is focused on the eudaimonic well-being, while the rest of variables measure different aspects of experienced well-being.

Variables created on the basis of these questions were used as symptoms of SW-B in the MIMIC model. On the other hand, we used several characteristics of individuals,

which were used in the formative part of the MIMIC model, as conversion factors for SW-B. These characteristics were: age, gender, household equivalent income, educational attainment, monetary poverty, material deprivation, five binary indicators of the size of the place of residence, number of children, household size, unemployment, economic activity, retirement, being a student, perception of crime and pollution in the neighbourhood, self-perceived health, unmet medical needs. The definitions of these symptoms are given in an appendix.

Identification of number of hidden dimensions

In order to identify if the studied problem is one- or multi-dimensional, a classical exploratory factor analysis was conducted using all the eight indicators of SW-B. It turned out that the first factor explained almost 95% of common variation among the eight variables, meaning that the phenomena can be considered as one-dimensional. In other words, we may limit ourselves to a single latent variable in the MIMIC model.

Estimating the MIMIC model

All estimation procedures were conducted using the SEM module within the Stata 15 program. Parameters of measuring sub-model were estimated using the maximum likelihood method. The results of these estimates are presented in Tables 1–2 and on Graph 1.

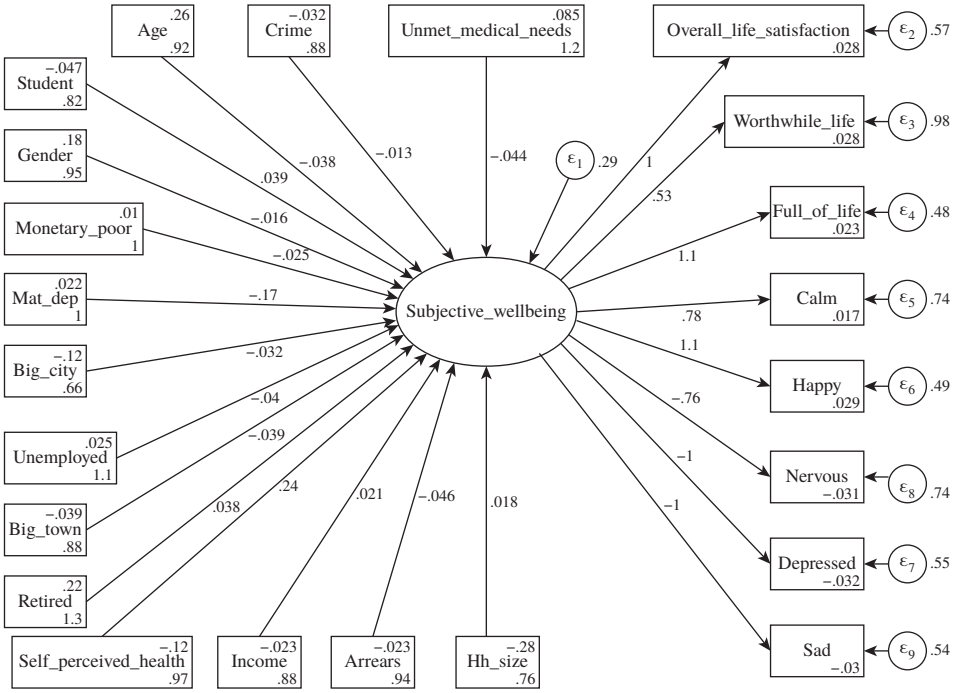
It should be noted that the method of constructing the MIMIC model for SW-B was determined by solutions adopted as part of the operationalization of the concept of measuring the individual dimensions of the quality of life proposed by Eurostat. In other words, we assess the degree of coherence of the concept of measuring the SW-B proposed by Eurostat with the observed data obtained from the EU-SILC study. The values of the MIMIC models' adjustment measures indicate that the model fits well. It means that the list of indicators proposed by Eurostat experts in the area of SW-B is well suited to measure the phenomena.

Table 1 contains results of estimation of the formative part of the MIMIC model, that is estimates of parameters in the regression equation which constitutes the latent variable. These parameters are estimated after standardisation of all the variables, that is their values are comparable and interpretation similar to interpretation of factor loadings in classical factor analysis. Therefore, higher values indicate, that a given determinant is more important in shaping the overall SW-B values, whereas the lack of statistical significance may suggest, that a certain variable does not influence the overall SW-B. The value of R^2 in this equation is equal to 0.35 (compare Table 3), which means that the variance of the SW-B can be explained in 35% by observable exogenous characteristics using a linear regression model. Therefore, the vast majority of the SW-B differences among individuals is caused by other, probably unobservable factors.

The highest values of estimated parameters are associated with two variables—self-perceived health and material deprivation (compare Table 1). That means that these two variables, out of the whole analysed set, are the strongest observable determinants of SW-B. The variables which have a positive effect on SW-B are better self-perceived health, higher incomes, fact of being a student or a retired person and bigger household size. The

Figure 1

Estimated MIMIC model. Only variables with statistically significant parameters' estimates have been retained



variables that can be associated with lower SW-B are: older age, monetary poverty and material deprivation, living in a big town or big city, being unemployed, having unmet medical needs, being in arrears and living in a neighbourhood with high perceived criminal activity. Out of the considered set of potential determinants the following proved not to influence the SW-B in a statistically significant manner: living in a small city, medium town and small town (as compared to rural areas), perception of pollution in the neighbourhood and economic activity.

Table 2 contains estimates of the reflective part of the MIMIC model. In other words, it contains estimates of parameters in linear regression models of particular symptoms on latent SW-B variable. Each equation contains a single explanatory variable—SW-B and a constant term. The latent variable does explain variability of all proposed symptoms in a statistically significant manner. The reflective part of the model should be interpreted mainly on the basis of the R^2 statistics, as they inform on the extent to which each symptom of SW-B may be explained by the constructed latent variable. The highest values of R^2, equal to about 50%, were observed in the equations for five variables—being happy, being sad, being depressed, being full of life and overall life satisfaction (compare Table 3). That means that the variance of these five variables can be explained up to 50% using the SW-B latent variable in a linear model. The lower values of coefficient of determination were observed for three variables, namely: being calm and being nervous ($R^2 = 0.26$) and living

Table 1

Parameter estimates in the formative (structural) part of the MIMIC model

Variable	Coefficient	Std. Err.	z	P>z	95% Conf. Interval
Age	−0.038	0.008	−4.84	<0.01	[−0.054;−0.023]
Gender (being a female)	−0.016	0.005	−3.53	<0.01	[−0.025;−0.007]
Household size	0.018	0.005	3.22	<0.01	[0.007; 0.028]
Student	0.039	0.005	7.09	<0.01	[0.028; 0.050]
Unemployed	−0.040	0.004	−9.1	<0.01	[−0.048;−0.031]
Retired	0.038	0.005	7	<0.01	[0.028; 0.049]
Self perceived health	0.244	0.006	39.38	<0.01	[0.232; 0.257]
Unmet medical needs	−0.044	0.004	−10.43	<0.01	[−0.052;−0.036]
Equivalent income	0.021	0.006	3.71	<0.01	[0.010; 0.031]
Arrears	−0.046	0.005	−9.52	<0.01	[−0.056;−0.037]
Monetary poverty	−0.025	0.005	−5.18	<0.01	[−0.034;−0.015]
Material deprivation	−0.166	0.005	−31.01	<0.01	[−0.177;−0.156]
Big_city	−0.032	0.006	−5.73	<0.01	[−0.043;−0.021]
Big_town	−0.039	0.005	−8.15	<0.01	[−0.048;−0.029]
Crime	−0.013	0.005	−2.77	0.01	[−0.022;−0.004]

a worthwhile life ($R^2 = 0.11$). The higher values of SW-B were, on average, associated with higher values of variables such as being happy, being calm, being full of life, overall life satisfaction and living a worthwhile life. At the same time the higher values of SW-B were associated with lower values of three variables describing lower mood, namely: being sad, being depressed and being nervous.

Table 2

Estimates of the reflective (measurement) part of the MIMIC model

Equation	Variable	Coefficient	Std. Err.	z	P>z	95% Conf. Interval
Overall_life_satisfaction	Subjective wellbeing	1	(constrained)			
	Constant term	0.028	0.007	4.09	<0.001	[0.015; 0.042]
Worthwhile_life	Subjective wellbeing	0.532	0.012	42.68	<0.001	[0.507; 0.556]
	Constant term	0.028	0.007	3.72	<0.001	[0.013; 0.043]
Full_of_life	Subjective wellbeing	1.093	0.013	83.86	<0.001	[1.068; 1.119]
	Constant term	0.023	0.007	3.31	0.001	[0.009; 0.036]
Calm	Subjective wellbeing	0.775	0.013	61.73	<0.001	[0.751; 0.800]
	Constant term	0.017	0.007	2.35	0.019	[0.003; 0.030]
Happy	Subjective wellbeing	1.076	0.013	82.9	<0.001	[1.050; 1.101]
	Constant term	0.029	0.007	4.14	<0.001	[0.015; 0.042]
Depressed	Subjective wellbeing	−1.001	0.013	−75.9	<0.001	[−1.027;−0.975]
	Constant term	−0.032	0.007	−4.56	<0.001	[−0.045;−0.018]
Nervous	Subjective wellbeing	−0.764	0.013	−60	<0.001	[−0.789;−0.739]
	Constant term	−0.031	0.007	−4.42	<0.001	[−0.045;−0.017]
Sad	Subjective wellbeing	−1.018	0.013	−76.6	<0.001	[−1.044;−0.992]
	Constant term	−0.030	0.007	−4.32	<0.001	[−0.043;−0.016]

Table 3 contains information on the part of variance of the latent variable and all the symptoms explained within the estimated MIMIC model.

Table 3

Predicted variance in the MIMIC model

Dependent variables	Variance				
	fitted	predicted	residual	R-squared	mc
Observed					
Overall_life_satisfaction	1.01	0.44	0.57	0.44	0.66
Worthwhile_life	1.10	0.12	0.98	0.11	0.34
Full_of_life	1.01	0.53	0.48	0.52	0.72
Calm	1.01	0.26	0.74	0.26	0.51
Happy	1.00	0.51	0.49	0.51	0.71
Depressed	0.99	0.44	0.55	0.44	0.67
Nervous	1.00	0.26	0.74	0.26	0.51
Sad	1.00	0.46	0.54	0.46	0.68
Latent					
Subjective_wellbeing	0.44	0.15	0.29	0.35	0.59

Subjective well-being in Poland

As the values of SW-B were estimated for all individuals in the database, it was possible to conduct a comparative analysis of SW-B in Poland. The values of SW-B were standardized. Firstly we have run a kernel density estimation of SW-B in the general population (compare Figure 2). It turned out that the distribution has a left-side asymmetry (skewness is equal to –0.59). Moreover, the distribution is leptokurtic (kurtosis equal to 3.4), meaning that it has got a much higher propensity to produce outliers than the normal distribution. As a result, the hypothesis of the distribution being normal has been rejected using both skewness and kurtosis normality tests ($p < 0.001$). These two characteristics of the distribution combined may suggests, that the data contain a considerable number of outliers with low values of SW-B.

Moreover, a series of comparative analysis of SW-B among various strata was conducted. Figure 3 presents a kernel regression of SW-B on age in general population. As it turned out, on average, the SW-B does decrease over age in an almost linear manner. However, there are two points in life, where that decrease is slower or even the SW-B increases temporarily. That is the age around 30 and around 60–65 years old. The increase in SW-B around 60–65 years old can be probably explained by the retirement age being set at this value. People, who retire from work tend to experience a sudden surge in SW-B. The increase in SW-B around 30 years is on average weaker and its causes are less clear. It can be probably linked to the progression in the professional career and the following improvement of the financial situation or a birth of a child.

Figure 4 presents the kernel regression of the SW-B on equivalent incomes. The SW-B, on average, rises as equivalent income grows. This growth is particularly rapid for individuals with low and average equivalent incomes. The SW-B seems not to depend on income for the rich, who experience the equivalent income of PLN 15000 and more. This finding contradicts the research of Aknin et al. (2009), who stated, that the SW-B depends on incomes only for the higher income groups and not so much for the poorer individuals.

Figure 2

Kernel estimation of SW-B density function in general population of Poland

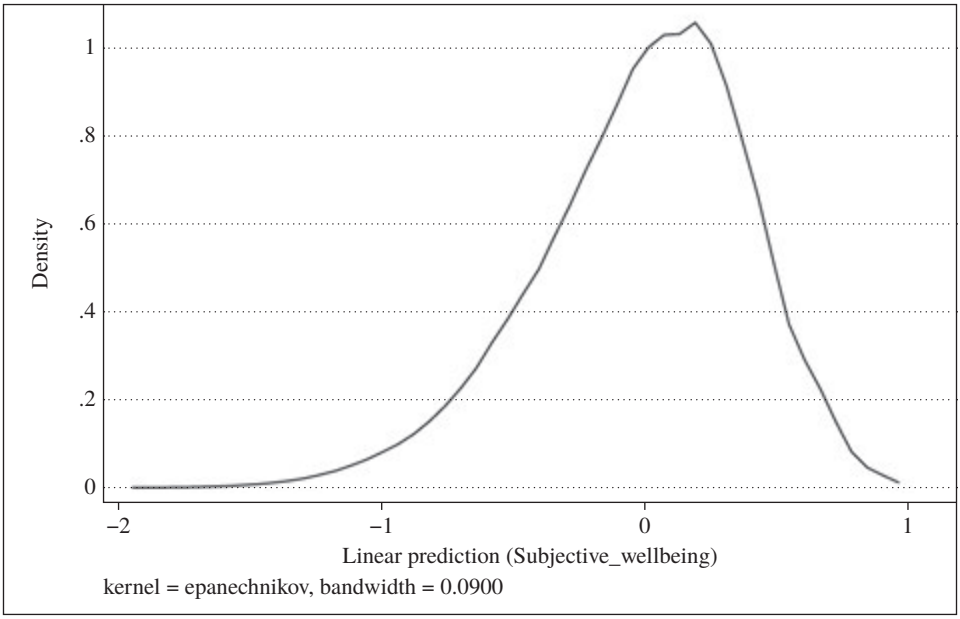


Figure 3

Kernel regression of SW-B on age

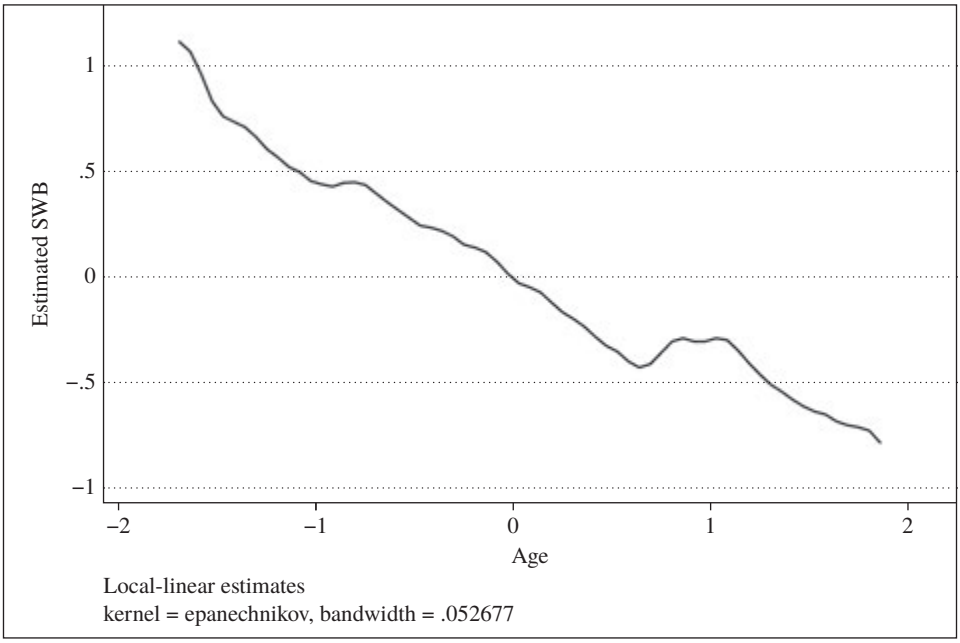


Figure 4

Kernel regression of SW-B on equivalent incomes

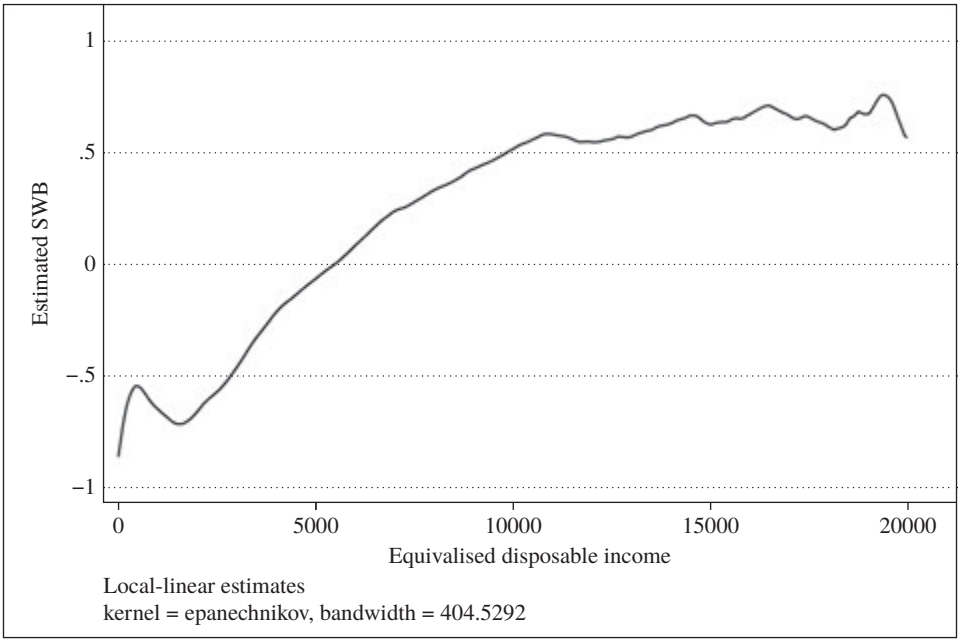


Table 4 contains estimated means and medians of standardised SW-B in certain categories. It shows how on average SW-B differs among individuals with certain traits, however, it should not be seen as a source for causal interpretations, as no cofactors were taken into consideration. For example, the difference in SW-B among people with different educational attainment may not be due to the education itself, but rather material conditions, which are strictly related to the highest educational level attained. In each category a Kruskal-Wallis one-way analysis of variance was performed in order to assess whether the differences across distinguished groups were statistically significant.

First of all, the SW-B differs significantly for people having different number of children. What is interesting—this dependence is not linear, as the average SW-B for people who don't have children is similar to those who have four or more children. The median value is even lower for those who have 4+ children as compared to childless individuals. The highest values of means and medians were observed for those having one or two children.

In case of education, the highest values of average and median SW-B were observed for individuals with lower secondary education. This is probably caused by the fact, that the average age in this group was lowest and equal to 19 years. This group consists mostly of young people whose main activity is still education and age is strictly correlated with SW-B (compare Figure 3). The average age in other groups was equal to 50 years old. Aside from that particular group, the average and median SW-B grows as educational attainment is higher.

Regarding professional activity status, the highest values were observed for those who worked at the time of interview, while those inactive suffered from significantly lower val-

ues of mean and median SW-B. However, lower values for retired persons may be caused rather by their age that by the mere retirement status, as the fact of transferring to retirement seems to increase temporarily the subjective well-being (compare Figure 3).

Table 4

Average and median values of standardised SW-B for various categories

Category	Average SWB	Median SWB	p-value in K-W test
Number of children in the household			**0.0001**
0	–0.13	–0.03	
1	0.27	0.42	
2	0.29	0.44	
3	0.09	0.17	
4+	–0.19	–0.21	
Educational level			**0.0001**
Primary or lower	–0.75	–0.69	
Lower secondary	0.92	1.10	
Secondary/vocational	–0.05	0.08	
Tertiary	0.48	0.59	
Activity status			**0.0001**
At work	0.36	0.49	
Unemployed	–0.69	–0.56	
Retired	–0.40	–0.35	
Other inactive	0.01	0.09	
Average total	0	0.14	

p-values calculated in the Kruskall-Wallis test.

Figure 5 presents geographical distribution of SW-B in Poland in 2015. The voivodships with the highest values of SW-B were opolskie and wielkopolskie. Relatively high values of SW-B were observed in mazowieckie, kujawsko-pomorskie, świętokrzyskie, śląskie and podkarpackie. Lower average values were observed in pomorskie, warmińsko-mazurskie, lubuskie, dolnośląskie, łódzkie and lubelskie. The lowest values were observed in zachodniopomorskie and podlaskie.

Conclusions

In this paper a method of estimation the values of subjective well-being was proposed. This method is based on both recent EU recommendations concerning measuring the quality of life and Sen's capabilities approach. Technically, it utilises the MIMIC model, which is a special case of structural equation modelling.

In the empirical part of the paper the subjective well-being was calculated for Poland using the proposed methodology. It has been shown, that the subjective well-being depends mostly on two exogenous determinants—self-perceived health and material deprivation. Such a statement has straightforward consequences for social policy. In order to improve the SW-B it is advisable to lift individuals from material deprivation and provide health services and policy which promote healthy lifestyle, so that, in a long run the SW-B should

Figure 5

Geographical distribution of SW-B in Poland

increase. However, the SW-B depends only in 35% on observable characteristics of individuals. The remaining part of its variance is probably dependent on individual genetics and unobservable traits, which is consistent with the literature of the topic.

The distribution of the SW-B in Poland has left-sided asymmetry and is leptokurtic. This is can be attributed to the presence of a certain number of individuals with lower mood, being depressed, etc. The SW-B shows strong dependence on age of individuals—it decreases almost linearly with age, however, there are two local peaks of SW-B at the age of 30 and around 60–65. The SW-B depends also on material wealth, as it grows rapidly as equalised income rises for individuals belonging to the lower-income and middle-income groups. The SW-B seems not to depend on income for the rich, who experience the equivalent income of PLN 15000 and more. This finding contradicts the research of Aknin et al. (2009), who stated, that the SW-B depends on incomes only for the higher income groups.

It was also empirically proven, that the distribution of SW-B differs significantly among individuals with different educational attainment, various number of children and with dif-

ferent professional activity status. The highest values of SW-B were observed, on average, for those who work, have 1–2 children and are highly educated. Moreover, the SW-B shows substantial variability in geographical distribution in voivodships in Poland.

References

Alkire, S. 2002. *Valuing Freedom: Sen's Capability Approach and Poverty Reduction*. Oxford: Oxford University Press.

Aknin, L. B., Norton, M., Dunn, E. 2009. From wealth to well-being? Money matters, but less than people think, *The Journal of Positive Psychology 4* (6): 523–527.

Andrews, F. M., Withey, S. B. 1976. *Social Indicators of Well-being*. New York: Plenum Press.

Basu, K., López-Calva, L. 2010. Functionings and capabilities, w: K. Arrow, A. Sen i K. Suzumura (red.), *Handbook of social choice and welfare*, Elsevier, pp. 153–187.

Berger-Schmitt, R. and Noll, H.-H. 2000. Conceptual framework and structure of a European System of Social Indicators, EU Reporting Working Paper, 9, Centre for Survey Research and Methodology (ZUMA), Social Indicators Department, Mannheim.

Bielak, R. 2015. Jakość życia w świetle strategii rozwoju. Dylematy pomiaru, *Wiadomości Statystyczne* 6: 23–30.

Bollen, K. A. 1989. *Structural Equations with Latent Variables*. New York: Wiley.

Bouchard, T. J., Jr.; Loehlin, J. C. 2001. Genes, evolution, and personality, *Behavior Genetics 31* (3): 243–273.

Brown, T. A. and Moore, M. T. 2012. Confirmatory factor analysis, in: R. H. Hoyle (ed.), *Handbook of Structural Equation Modelling*. New York: Guilford Press, pp. 361–379.

Brudburn, N. M. 1969. *The Structure of Psychological Well-Being*. Chicago: ALDINE Publishing Company.

Campbell, A., Converse, P. (eds.). 1972. *The Human Meaning of Social Change*. New York: Russel Sage Foundation.

Campbell, A., Converse, P. E., and Rodgers, W. L. 1976. *The Quality of American Life: Perceptions, Evaluations, and Satisfactions*. New York: Russell Sage Foundation.

Commission of the European Communities. 2009. *GDP and beyond. Measuring progress in a changing world*, COM (2009), 433, Brussels.

Commission of the European Communities. 2010. *Europe 2020. A strategy for smart, sustainable and inclusive growth*, COM (2010) 2020, Brussels.

Diener, Ed. 1984. Subjective well-being, *Psychological Bulletin 95* (3): 542–575.

Diener, Ed., Suh, E. M., Lucas, R. E., Smith, H. L. 1999. Subjective well-being: Three Decades of Progress, *Psychological Bulletin 125* (2): 276–302.

Diener, E., Chan, M. Y. 2011. Happy People Live Longer: Subjective Well-Being Contributes to Health and Longevity, *Applied Psychology: Health and Well-Being 3* (1): 1–43.

Drewnowski, J. 1970. A Planning Model for Social Development. In: UNRISD, Studies in the Methodology of Social Planning, Geneva.

Easterlin, R. 1974. Does Economic Growth Improve the Human Lot? Some Empirical Evidence, in: P. A. David, M. W. Reder (eds.), *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*. New York: Academic Press, Inc.

Erikson, R. 1993. *Welfare Trends in the Scandinavian Countries*. New York: Routledge.

Eurostat. 2011a. Measurement of the Quality of Life: TF3 Contribution to the Summary Report of the Sponsorship Group, http://epp.eurostat.ec.europa.eu/portal/page/portal/quality_life/publications.

Eurostat. 2011b. Sponsorship Group on Measuring Progress. Well-being and sustainable development, Final Report, European Statistical System Committee, http://ec.europa.eu/eurostat/documents/42577/43503/SpG-Final-report-Progress-wellbeing-and-sustainable-deve.

Eurostat. 2017. Final Report of the Expert Group Quality of Life Indicators. Meeting of the European Directors of Social Statistics, Luxembourg.

Gorman, W. M. 1968. The structure of utility functions, *The Review of Economic Studies 35* (4): 367–390.

Hauser, R. M., Goldberger, A. S. 1971. The treatment of unobservable variables in path analysis, *Sociological Methodology* 3: 81–117.

Huppert, F., Marks, N., Clark, A., Siegrist, J., Stutzer, A., Vittersø, J., Wahrendorf, M. 2009. Measuring well-being across Europe: description of the ESS well-being module and preliminary findings, *Social Indicators Research 91* (3): 301–315.

Huppert, F., Mickaelson, J., Vittersø, J. 2013. *ESS Round 6. Module on personal and social wellbeing—final module in template. Centre for Comparative Social Surveys*. London: City University London.
Jöreskog, K. G., Goldberger, A. S. 1975. Estimation of a model with multiple indicators and multiple causes of a single latent variable, *Journal of the American Statistical Association 70* (351): 631–639.
Konarski, R. 2009. *Modele równań strukturalnych. Teoria i praktyka*. Warszawa: PWN.
Kot, S. M. 2004. *Rozkłady dochodów, nierówności i dobrobyt w Polsce*, in: S. M. Kot, A. Makowski and A. Węgrzecki (eds.), *Dobrobyt społeczny, nierówności i sprawiedliwość dystrybutywna*. Kraków: Wydawnictwo Akademii Ekonomicznej w Krakowie, pp. 248–280.
Krishnakumar, J. 2007. Going Beyond Functionings to Capabilities: An Econometric Model to Explain and Estimate Capabilities, *Journal of Human Development 8* (1): 39–63.
Krishnakumar, J., Ballon, P. 2008. Estimating Basic Capabilities: A Structural Equation Model Applied to Bolivia, *World Development 36* (6): 992–1010.
Krueger, A. B., Kahneman, D., Schkade, D., Schwarz, N., Stone, A. A. 2009. National Time Accounting: The Currency of Life, NBER Chapters, in: *Measuring the Subjective Well-Being of Nations: National Accounts of Time Use and Well-Being*, National Bureau of Economic Research, pp. 9–86.
Lancaster, K. J. 1966. A new approach to consumer theory, *Journal of Political Economy* 74: 132–157.
National Research Council. 2013. *Subjective Well-Being: Measuring Happiness, Suffering, and Other Dimensions of Experience*. Washington, DC: The National Academies Press.
Panek, T. 2016. *Jakość życia — od koncepcji do pomiaru*. Warszawa: Oficyna Wydawnicza SGH.
Phillips, D. 2006. *Quality of Life. Concept, Policy and Practice*. London: Routledge.
Robeyns, I. 2003. *The Capability Approach: An Interdisciplinary Introduction*. Amsterdam: University of Amsterdam, Department of Political Science and Amsterdam School of Social Sciences Research.
Ryan, R. M., Deci, E. L. 2001. On Happiness and Human Potentials: A Review of Research on Hedonic and Eudaimonic Well-Being, *Annual Review of Psychology 52* (1): 141–66.
Sen, A. 1980. Equality of what? in: S. McMurrin (ed.), *The Tanner Lectures on Human Values* 1. Cambridge: Cambridge University Press.
Sen, A. 1985. *Commodities and Capabilities*. Amsterdam: North-Holland.
Sen, A. 1987. *The Standard of Living*. Cambridge: Cambridge University Press.
Sen, A. 1992. *Inequality Re-examined*. Oxford: Clarendon Press.
Sen, A. 2010. *The Idea of Justice*. London: Penguin Books.
Stiglitz, J. E., Sen, A. and Fitoussi, J-P. 2009. Report by the Commission on the Mauserement of Economic Performance and Social Progress, www.stiglitz-sen-fitoussi.fr
Szukiełojć-Bieńkuńska, A. (ed.). 2017. *Jakość życia w Polsce. Edycja 2017.* Warszawa: Główny Urząd Statystyczny.
Titmuss, R. 1968. *Commitment to Welfare*. New York: Pantheon Books.
Titmuss, R. 1974. *Social Policy: An Introduction*. New York: Pantheon Books.
Weiss, A., Bates, T. C., & Luciano, M. 2008. Happiness is a personal(ity) thing: The genetics of personality and well-being in a representative sample, *Psychological Science 19* (3): 205–210, doi: 10.1111/j.1467-9280.2008.02068.x

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Appendix. Definitions of Potential Determinants of Subjective Well-Being

The proposed MIMIC model utilises a set of determinants of the SW-B. These determinants were proposed taking into account both—the criterion of reference accuracy and the—criterion of suitability. The variables that were present in the EU-SILC study searched for potential determinants of the SW-B. The determinants used in the final MIMIC model were constructed in the following way:

Age—contains information on age of individuals at the time of the interview.

Gender—a binary variable equal 1 for females and 0 for males.

Household equivalent income—a total household disposable income divided by the OECD modified equivalence scale. The OECD modified scale assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child.

Educational attainment—a categorical variable equal 1 for those with primary (or lower) educational attainment, 2 for individuals with lower secondary educational attainment, 3 for individuals with vocational or higher secondary educational attainment and 4 for individuals with higher educational attainment.

Monetary poverty—a binary indicator equal 1 for individuals who lived in households with total equivalent disposable income below 0.6 of median equivalent income.

Material deprivation—a binary indicator based on the Eurostat recommendations towards measuring the phenomena. It is a household characteristics, any individual living in a household that is materially deprived should be considered as materially deprived. It contains information from nine questions from the EU-SILC survey, which assess whether individuals are unable to afford:

- to pay their rent, mortgage or utility bills;
- to keep their home adequately warm;
- to face unexpected expenses;
- to eat meat or proteins regularly;
- to go on holiday;
- a television set;
- a washing machine;
- a car;
- a telephone.

Place of residence—a set of six binary indicators, which point to one of the following sizes of the place of residence:

- Over 500 thousands inhabitants (large city);
- 200–500 thousands residents (small city);
- 100–200 thousands residents (large town);
- 20–100 thousands residents (medium town);
- Towns below 20 thousands residents (small town);
- Rural areas.

The last variable was not directly considered in the model, and therefore, was a point of reference.

Number of children—number of children living in the household,

Household size—Number of individuals living in the household.

Unemployment—a binary variable equal to 1 if a person was unemployed at the time of the interview and 0 otherwise.

Economic activity—a binary variable equal to 1 if a person was economically active at the time of the interview and 0 otherwise.

Retirement—binary variable equal to 1 if a person was retired at the time of the interview and 0 otherwise.

Being a student—binary variable equal to 1 if the person's main activity during the period predeceasing the interview was full-time education and 0 otherwise.

Perception of crime in the neighbourhood—a categorical variable describing the subjective assessment of crime in the neighbourhood.

Perception of pollution in the neighbourhood—a categorical variable describing the subjective assessment of pollution in the neighbourhood.

Self-perceived health—a categorical variable containing a subjective assessment of the respondent's health status.

Unmet medical needs—a binary variable equal to 1 if a person had unmet medical or dental needs.