University of Economics in Prague

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Subjective Well-Being and Individual Material Situation in Four Countries of Central Europe

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Year of defense:	2019

I declare that I carried out this doctoral thesis

„Subjective Well-Being and Individual Material Situation in Four Countries of Central Europe“

independently, and only with the cited sources and literature.

In Jindřichův Hradec, …………………... 2019

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signatures

Ph.D. THESIS TOPIC

Author of thesis: **Ing. Jan Švorc, MBA**

Study programme: Economics and Management

Field of study: Management

Topic: **Subjective well-being and individual material situation in four countries of central Europe**

Guides to writing a thesis:

1. The research goal of the thesis is to explore associations between the material situation and the subjective well-being of individuals living in Czechia, Slovakia, Poland and Hungary.
2. Review literature on the topic of associations between the material situation and the subjective well-being of an individual.
3. Perform the basic statistical analysis of the problem using real data from the 3rd and 4th wave of the European Quality of Life Study.
4. Analyze the problem using probabilistic graphical models, namely using Bayesian networks. Build a Bayesian network model based on your expert knowledge gained from literature. Build other Bayesian network models using the real data from the third and fourth wave of the European Quality of Life Study. Compare these models.

Length of thesis: 50-150 pages

Selected bibliography:

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2. CLARK, A. E.; FRIJTERS, P.; SHIELDS, M. A. Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles. Journal of Economic Literature, 2008, 95-144.
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Title:

Subjective Well-Being and Individual Material Situation in Four Countries of Central Europe.

Abstract:

The general goal of our research is to explore the association between the subjective well-being (SWB) and the subjective and objective measures of the individual material situation in the four post-communist countries of central Europe (the Czech Republic; Hungary; Poland; and Slovakia). Material situation is measured by income; relative income compared to others as well as to one's own past; perceived economic strain; financial problems; material deprivation; and housing problems. The analysis is based on an empirical data from European Quality of Life Study. First, the associations were analyzed using appropriate statistical methods (Welch t-test and ANOVA for unequal variances). The results show that a better material situation is associated with improved SWB in all examined countries with only few exceptions. The hypotheses on the association of SWB with income and economic strain were not confirmed in Hungary. The hypotheses on the association with the relative income compared to others were not confirmed in Slovakia. Also, the hypothesis that the life satisfaction is associated with the income was not confirmed in case of Slovakia. The subjective financial situation relative to most people and the subjective economic strain seem to be especially important factors. Bayesian networks as a graphical representation of the relations among SWB and the material situation were constructed in five versions. They were compared using the BIC criteria, the SWB prediction accuracy, and compared with the ordinal logistic regression (OLR). The expert knowledge as well as three different algorithms (greedy, Gobnilp, and Tree-augmented Naïve Bayes) were used for learning the structures. Network parameters were learnt using the EM algorithm. The expert model parameters were also learned using OLR. The expert version with OLR parameters best predicts SWB (the prediction accuracy of 41%). The Gobnilp model, Markov equivalent to the greedy model, is BIC optimal. Differences between BIC optimal and expert versions are discussed. We conclude that the objective material conditions influence SWB rather indirectly through the subjective situational assessment of the material conditions.

Keywords:

Subjective Well-Being, Income, Economic Strain, Material Deprivation, Bayesian Networks.

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1 Introduction

Social sciences turned their attention to the subjective well-being (hereinafter referred also as "SWB") about a half century ago when the first studies on SWB were conducted (Gurin et al., 1960; Andrews and Withey, 1974; Campbell et al., 1976 in Blore et al., 2011). It can be assumed that that the attractiveness of the topic is driven by the fact that the vast majority of people all over wish to either maintain or increase their sense of happiness and satisfaction, the two key components of SWB. It is hard to imagine anyone intentionally seeking to be unhappy.

The topic is interdisciplinary being researched by sociologists[1], psychologists and economists, where each of these disciplines has a specific scientific competence, looks at the topic from a different perspective and offers various answers, whereas their models reflect mainly their own needs and understanding. For example, the economists use the concept of SWB to approximate the utility when investigating the consumer behavior in their models. The perspective of this dissertation is primarily economic and sociologic. Since the psychological aspects of SWB are very important, they are not omitted in the review.

The great deal of the scientific discussion has been held in terms of factors associated with SWB. Factors related to income and individual material situation form one of the obvious groups. Throughout the human history, prophets, philosophers and clerics have mostly warned that material wealth is detrimental to the people's life, happiness and salvation[2]. On the contrary, the people mostly think happiness and satisfaction are directly linked with the wealth. Modern researchers have also proved that the material aspects of life somehow matter, yet their findings are sometimes surprising.

Since the contemporary hedonic society tends to seek comfort in, so called, consumerism, better understanding of the association between SWB and the variables related to the material living conditions such as income, wealth, and material deprivation might be valuable. It is the purpose of my research project to extend this understanding in the context of central Europe.

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[1] Veenhoven (2008, p. 44) noticed that *"SWB is no great issue in sociology"* and it is rarely mentioned in the sociological textbooks and journals. The reasons for that are pragmatic, ideological and theoretical based on the author.

[2] It is out of the scope of my dissertation to examine how theology and philosophical schools treat happiness and satisfaction. Strawn (2012) provided the conference essays of what we can learn about the pursuit of the happiness from The Bible – one of the most important sources of the religiosity in our civilization.

1.1 Thesis goals

In general, the research goal of the thesis is to explore the associations between the individual material situation and SWB of individuals living in the post-communist central Europe.

In particular, goals of the thesis are:

1. To analyze the associations between SWB and variables approximating the individual material situation on empirical data using appropriate statistical methods.
2. To build a probabilistic graphical model in the form of a Bayesian network showing the relations among SWB and the variables of the individual material situation based on the expert knowledge gained from the literature.
3. To learn models of SWB and the individual material situation in the form of a Bayesian network using selected structure learning algorithms based on the empirical data and compare the models using selected criteria.

Following these goals the research questions are defined as follows:

1. Are high-income households happier/more satisfied than low-income households in central Europe?
2. Is happiness/satisfaction associated with the subjective evaluation of one's own current financial situation in central Europe?
3. Is happiness/satisfaction associated with the perceived economic strain in central Europe?
4. Is happiness/satisfaction associated with the objective measures of the individual material situation, such as material deprivation, financial problems and housing defects in central Europe?
5. What structural relations of conditional independence exist among SWB and the variables of the individual material situation?

The material situation is examined only in context of an individual or a household in this research. The economic performance of nations and countries[3] and its influence over SWB is out of the scope of this dissertation.

1.2 Thesis structure and contribution

The thesis is divided into the six chapters. After this introductory chapter a thorough review of existing research literature and relevant theories on topic as a base

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[3] Measured, for example, by Gross Domestic Product (GDP).

for statistical and probabilistic analysis themselves is made in Chapter 2. The review is carried out with the special regards to the material aspects of SWB, yet a revision of other correlates and theories is performed in order to understand SWB in its complexity. SWB and its components are defined for the purpose of this dissertation in the very beginning of the chapter. The next section shows how SWB is treated in the mainstream economic theory and the special sections are dedicated to other theories of SWB, namely psychological. The chapter also provides a review of the most important factors related to SWB: demographic factors (age; gender; marital status; religion; physical health); social factors (education; occupation; social relationships); personality factors (extraversion; neuroticism; self-esteem; optimism; purpose-in-life); and wider environmental factors (culture; governance; inflation; unemployment; climate etc.). The definitions important for the analysis made in the further chapters are provided by the end of the chapter. Following the above outlined research questions hypotheses are formulated based on "state-of-the-art" review made in this chapter.

The analysis is divided into two stages. In Chapter 3, the hypotheses of SWB and its association with the variables of the individual material situation are examined based on the empirical data using the appropriate statistical methods. The description of data, measures, and analytical methods as well as the results are provided within the chapter. This chapter deals with the first four research questions.

The last research question is examined in Chapter 4. In this chapter, the expert version of a Bayesian network displaying SWB and the relations with and among the variables of the individual material situation is presented and compared with machine learnt models. Again, the description of data and measures is presented. A short introduction to the Bayesian networks is provided for those unfamiliar with this technique. The expert model and the three benchmark machine learnt models are tested using the selected criteria (Bayesian Information Criterion and prediction accuracy of SWB).

The results are discussed and the causal and diagnostic inference is demonstrated in Chapter 5.

The research results presented in Chapter 3 has recently been published in "Sociológia", a journal published by the Institute for Sociology of Slovak Academy of Sciences (Švorc, 2018). The progress in the analysis of SWB and its relations with the individual material situation using Bayesian network described in Chapter 4 was published in the conference proceedings of the 11th Workshop on Uncertainty Processing (WUPES) in June 2018 (Švorc and Vomlel, 2018). One more article

concerning on the Bayesian networks application in the social research will be submitted under the conditions of the project nr. 17-08182S supported by the Czech Science Foundation in 2019.

The original contribution of this dissertation is:

- The confirmation of the association of SWB with seven measures of the individual material situation in central European context.
- An application the Bayesian networks as a modelling tool for the concept of SWB[4].

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2 Literature review

People normally tend to link their well-being with external factors such as income, health etc. It is probably more attractive to be young, rich and healthy than old, poor and sick, whereas the earlier research often supported this view. Wilson (1967 in Diener et al., 1999, p. 294) broadly reviewed the then literature on SWB and concluded that happy person is *"young, healthy, well-educated, well-paid, extroverted, optimistic, worry-free, religious, married person with high self-esteem, job morale and modest aspirations, of either sex and of a wide range of intelligence"*. Even this single straightforward conclusion gives us some idea about various factors related to the well-being. While the earlier research tended to describe rather the demographic correlates, later research placed the greater emphasis on the understanding the processes underlying the well-being and stressed psychological factors (Diener et al., 1999). Psychologists place the importance in determining the well-being on subjective variables such as aspirations, whereas economists typically tend to emphasis the importance of objective conditions in determining the well-being (Easterlin, 2006). The particular importance of a given factor is hence unequal depending on whom analyzes it.

This literature review aims to provide the reader with the broad overview of the theories related to SWB and factors associated with SWB. The scope of the review goes intentionally far beyond the economic theories and material factors examination in order to demonstrate SWB is a very complex phenomenon being influenced by a number of various factors, where only a small piece is researched in this paper.

2.1 Defining subjective well-being

Defining SWB may be challenging. There are many terms somehow similar to the well-being: happiness, life satisfaction, welfare, wellness, quality-of-life, prosperity, mental health status, pleasure, health and others. Furthermore, the well-being often appears with the adjectives as psychological well-being, economic well-being, social well-being, mental well-being, emotional well-being, and last but not least subjective well-being. Each of the adjectives may shift the meaning of the core term "well-being" substantially. The unexperienced reader can quickly get confused.

The well-being as a standalone word became widely known and important when it appeared in the WHO definition of health. WHO defines health as *"a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"*. This definition is part of Constitution of World Health Organization signed in 1946 (World Health Organisation, 2014, p.1). Since released it has neither been

changed nor amended. Based on the definition the terms health and well-being (social, mental and physical) are equivalent; they describe the same thing.

Generally speaking, the well-being is quite uneasy to define. Although the research on the well-being has boosted over the past decades, the question of the definition still remains unanswered (Dodge, et al., 2012). There still exists no universally accepted definition of the well-being. The concept of the well-being is interdisciplinary, it lies on the edge of the sciences of psychology; sociology; economy; possibly neuro-biology; and maybe others. Hence the researchers obviously tend to stress the perspective of their own scientific discipline. Based on the authors the economic mainstream tend to determine the well-being solely by the objective conditions, while psychologists tend to stress personality traits impacting one's happiness. Some researchers distinguish the well-being from other categories such as happiness and life satisfaction clearly and strictly, while others use them either synonymously or interchangeably. It largely depends on nature of their scientific domain.

Terms such well-being, happiness and life-satisfaction are fairly well sorted in psychology. Diener (1984) distinguished the available definitions of the well-being and the happiness to the three distinct groups in his review. Firstly, the well-being can be defined normatively (objectively); there are standards (desired ideal state), externally given and usually mediated either by the philosophy or by the religion. From this perspective, the well-being / the happiness is not subjective, but it is assessed based on some external criteria (one will be happy when the criteria are met). Obviously, these might differ based on cultures and eras. Clearly, the subjective assessment of one's own life plays here no role.

Secondly, the well-being can be defined subjectively – it is based on the self-evaluation of one's life in positive terms. The criteria are not given externally. They are set by the each evaluating subject itself and are based on one's own idea about what is good in life. Clearly this type of definition suits well to the purposes of this research, because the well-being depends solely on the individual assessment.

The third general type of definition is more about the happiness and is based on emotions. Diener referring to Bradburn (1969) defines the happiness as the dominance of positive affect over negative one. The happiness is determined either by the experience of mostly pleasant emotions or by an individual predisposition to the positive emotions. The term "affect" includes both moods and emotions and they represents people's on-line evaluations of events that occur in their lives (Diener et al, 1999). Following Andrews and Withey (1974) Diener distinguished three general components of SWB: positive affect, negative affect and life-satisfaction judgement. There is still some debate over the independence of positive and negative affects, but

researchers mostly agree that these two are in essence separate factors. Life-satisfaction includes the satisfaction with the life as a whole as well as with the various aspects of life such as job satisfaction, family satisfaction and so on.

Based on this background, Diener et al. (1999, p. 277) defines SWB as *"a broad category of phenomena that includes people's emotional responses, domain satisfactions, and global judgements of life satisfaction"*. SWB is rather *"a general area of scientific interest rather than a single specific construct"* for the authors. In other words, SWB is *"person's cognitive and affective evaluation of his or her life"* (Diener et al., 2002a, p. 63). What is important to mention in this context is that SWB is based on a subjective judgement. It means it is based on self-evaluation of emotions, life-domains and the life as a whole. Nobody else can falsify the subjective opinion on one's own life. It is all about how an individual likes his/her own life. Conditions causing the pleasant experience for one person may make other people unhappy, which will lead to different emotions and different subjective judgement of the life-domain. On the other hand, people are able to adapt to bad conditions and cease to see their unfortunate situation. Because of that *"self-reports of satisfaction with life, with income, or health are given little weight"* noted Deaton (2008, p. 69).

Having this Diener's structure of SWB, the terms SWB, happiness and life-satisfaction are well demarcated form the psychological point of view. SWB is the broader concept consisting of the components of life-satisfaction and happiness. Sometimes the term cognitive well-being can be met; it mostly means the cognitive component of SWB such as the judgement of one's life satisfaction. Happiness is a surplus of positive affect over negative one. Positive and negative affects together are sometimes referred as emotional (or affective) components of SWB or emotional well-being or affective well-being. The affective component of SWB includes the experience of positive and the absence of negative emotions (affect). Lucas and Gohm (2000, p. 291) state that *"people are said to have high SWB if they feel satisfied with their condition of their lives (cognitive well-being) and experience frequent pleasant emotions and infrequent unpleasant emotions (affective well-being)"*.

Although Diener's definition of SWB is widely used in the literature, mainly psychologic, some authors propose different view. For the Dutch sociologist Veenhoven (2008) the overall happiness is synonymous with the life satisfaction as well as with SWB. Veenhoven conceptualize the happiness as *"the degree to which an individual judges the overall quality of his life favorably"* (Veenhoven, 1984, p.22). He sees the life satisfaction as an overall judgement of one's life, where this judgement is based on both *"cognitive comparisons with standards of the good life (contentment) and affective information from how one feels most of the time (hedonic level of affect)"*

(Veenhoven, 2008, p.45). On the other hand there are authors explicitly distinguishing one from another. Haller and Hadler (2006) sketched five different approaches to the explanation of happiness. Happiness could be seen as

- a stable trait of individual;
- a consequence of the objective life situation;
- a utility function of an individual;
- a result of comparison processes with others; and
- a persistent national or cultural characteristic.

In their analysis the authors strictly distinguish the happiness from the life satisfaction, where the happiness resulted from the positive experience (with stress to close social relationship) and the life satisfaction is an outcome of an individual evaluations of discrepancy between material and social aspirations, expectations and achievements.

Some authors accent primarily the psychological aspects of the well-being and they use the term psychological well-being instead of SWB. For our purposes we will understand both terms equivalent. Ryff and Keyes (1995) structured the psychological well-being into the six dimensions:

- self-acceptance;
- environmental mastery;
- positive relations;
- purpose in life;
- personal growth; and
- autonomy.

The self-acceptance means feeling positively about one's past life and about oneself including all positive and negative qualities. The environmental mastery means the ability to use the raising opportunities and to manage one's everyday life effectively. The positive relations include both satisfying relations with others as well as empathy and interest in other's welfare. The purpose of life means *"the belief that one's life is purposeful and meaningful"* (Ryff and Keyes, 1995, p.720). The dimension of the personal growth is related to the past and the future course of one's life towards the goals in life. The autonomy is related to independence; self-determination; setting one's own personal standards; and ability to resist to social pressures. All these dimensions proposed by Ryff and Keyes may be understood well as the correlates of the psychological well-being.

Based on Ryan and Deci (2001) the concept of the well-being refers to the optimal psychological functioning and experience. This definition is based on, so called, hedonic view on the well-being. Distinguishing between hedonic and eudaimonic

dimensions is another conceptualization of well-being (Ryan and Deci, 2001; McMahan and Estes, 2011; Deci and Ryan, 2008). Based on Ryan and Deci (2001, p.142), there have been formed two *"relatively distinct, yet overlapping perspectives and paradigms"*. First one is usually referred as "hedonism". Under this perspective the well-being consist of pleasure and happiness. Within this perspective, we can define the happiness as *"presence of positive affect and the absence of negative affect"* (Deci and Ryan, 2008, p. 1)[5]. This view has its roots in ancient Greek philosophy that has later been followed by many philosophers and schools. Utilitarian philosophers could stand as an example. The eudaimonic perspective (Waterman, 1993) is that the well-being is more than just the happiness. This concept is based on Aristotle philosophy explained in his Nicomachean ethics. This concept of the well-being rather than the happiness (life satisfaction) means actualizing one's human potential (Ryan and Deci 2001). Based on these authors, the eudaimonic well-being is the process of the realization of one's true self and living the way how one inherently intend to live rather than about the outcome and the end-state. The research on well-being and happiness is mostly aligned with the hedonic dimension. In this paper we also stick to hedonic conception of the well-being rather than to the eudaimonic one.

The scientific debate in the field of SWB concerns also on the question whether SWB is a trait or a state (Diener, 1984). Considering SWB as a state means that high SWB is caused by a number of happy moments in one's life. In this view the happier and the more positive moments an individual experiences the higher is the rise of his SWB. The theories on this side of the debate are called "bottom-up" theories. To the contrary, SWB understood as a trait means that people experiencing certain events in their life interpret them positively or negatively according to their state of mind. High SWB in this view does not mean feeling happy, it is rather an inherent propensity to react positively to things or events. So called "top down" theories are based on this view. Top-down and bottom-up models will be discussed in more depth later on.

While psychologists came up with the various frameworks in order to define SWB, economists seem to be somehow more relaxed in defining it. Richard A. Easterlin, an economist sound for his famous Easterlin paradox (which will be discussed later), could stand as an example. In one of his latest articles (Easterlin, 2015, p.283) he stated that *"the term subjective well-being encompasses a variety of measures of feelings of well-being – happiness, life satisfaction, ladder-of-life – which are treated here*

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[5] Three-dimensions of SWB described above (Diener et al., 1999), i.e. life satisfaction, positive and negative affects fall into this perspective.

as interchangeable". A standalone question is the relation of SWB and utility as it is used in the economic theory. This question is discussed later.

The happiness-related economic research tend to assume that there is only a single continual spectrum of well-being and ill-being, where "perfect well-being" is one extreme and "perfect ill-being" is exactly the opposite extreme on the same scale. It seems it is not necessarily the case. Assuming there is only one continuum of well-being / ill-being could be the reason, why the economic literature on the ill-being is much scarcer than the literature of the happiness and the well-being. The psychological literature is, not surprisingly, more aware of this phenomena. Lee and Oguzoglu (2007) modelled positive and negative well-being and found that while past ill-being had significant effect on current well-being, there was no support found for the reverse relationship. Even more importantly, the factors affecting well-being and ill-being are not symmetric, they rather seem to be the distinct dimensions. Headey et al. (1985) also asked themselves whether well-being and ill-being constitute the different dimensions or they are just simple opposites. Based on the Australian quality-of-life panel study, it appeared that the sets of measures for well-being and ill-being formed distinct, although not completely different (orthogonal) dimensions. The authors reported that people having scored high on the well-being do not necessarily score low on the ill-being, and vice versa.

It should be clear from this short introduction to the terminology that, although there exist commonly used concepts of well-being, happiness and life satisfaction, there are no universally accepted definitions. For the purpose of this piece of research the accepted definitions are the following.

Definition 1: Subjective well-being is a person's cognitive and affective self-evaluation of his or her life (Diener et al., 2002a).

Definition 2: Happiness is the dominance of the positive moods and emotions over the negative ones (Bradburn, 1969).

Definition 3: Life satisfaction is a person's global judgement of the conditions of his or her life as a whole[6].

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[6] Hereinafter the life satisfaction is also referred only as „satisfaction".

2.2 Subjective well-being and the economic theory

After an attempt to define SWB was made, the theoretical background for studying SWB should be examined. As a starting point the relevant pieces of the economic theory are reviewed in this section.

2.2.1 Utility

When studying SWB from the economic point of view, the concept of the utility cannot be omitted. Let us investigate this concept first. The term has appeared in early 18th century in works of, so called, moral philosophers[7]. Jeremy Bentham is considered the founder of the philosophy of utilitarism. In his masterwork "An Introduction to the Principles of Morals and Legislation" (Bentham, 2009, p. 14), first published in 1789, he provided his definition of the utility in the following way: *"By utility is meant that property in any object, whereby it tends to produce benefit, advantage, pleasure, good, or happiness, (all this in the present case comes to the same thing) or (what comes again to the same thing) to prevent the happening of mischief, pain, evil, or unhappiness to the party whose interest is considered".* Bentham also suggested that every action whatsoever should be approved (or disapproved) by the principle of utility. Bentham himself was not an economist[8], but his great successor, John Stuart Mill was one of the first true political economist and he promoted the utilitarian concepts and principles in his economic thoughts. Put simply, in this period the meaning of the utility was quite close to how we understand SWB today (with regards to the different objective living conditions). The happiness in our sense seems to be one of the important component of this classical utility[9].

The understanding of the utility has change in late 19th century when William Jevons, Carl Menger and Léon Walras came up with the marginal measures[10]. They started using the marginal utility to explain the consumer behavior. Based on the

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[7] The philosophers whose main domain was the utility were called "utilitarians" or "utilitarian philosophers".

[8] Bentham was philosopher and jurist. He is one of those, who helped to establish the political economy as a science independent of the philosophy.

[9] Such utility is clearly very different from the usefulness, although the terms are often used synonymously.

[10] This development of the economic theory is usually referred as "the marginal revolution". Based on the work of earlier mathematicians (Daniel Bernoulli) and economists (for example W. H. Gossen), Jevons, Menger and Walras came up with their theories of marginal utility completely independently. The marginal revolution is one of the greatest changes of paradigm in the economic theory in its history (if not the greatest ever).

marginal utility theory the market value of goods and services is given by the marginal utility and not by the total utility[11]. Briefly explained, the total utility is the total satisfaction a consumer gets from the consumption of all the units of goods consumed within a given period of time whereas the marginal utility is the extra satisfaction gained from consuming one extra unit of a good within a given period of time (both definitions taken from Sloman and Hinde, 2007). Consuming more and more units increases the total utility (up to a certain level of the consumption where the total utility is at the maximum), but each additional extra unit brings less additional utility than the previous one[12].

In the marginal utility theory the utility is understood as a sort of subjective satisfaction, pleasure or usefulness gained from the consumption of a good or a service, whereas the consumers make their choice to maximize their utility. The two important features of this concept of the utility need to be mentioned in our analysis. Firstly, the marginal utility theory explains the consumer behavior and not the utility. The utility is just the instrument used for the explanation how consumers allocate their scarce resources among goods and services. In other words, it is the instrument helping to understand the consumer preferences. The theory tells us little about the utility as such. The utility is only a scientific construct in this theory. Secondly, the utility and hence the value of goods and services for the consumer is subjective. It is not defined, for example, by the production costs. Consumer value is defined by the utility[13].

The measurement of the utility has been a big issue since the concept was introduced. Utilitarians and most classical economists believed in the cardinal utility. It means, that the utility can directly be measured and hence compared. Unfortunately they provided no description how to do it. It appeared later that the key information needed for the consumer's behavior analysis is whether the utility gained from the consumption of a good is greater than the utility gained from the consumption of another good. The claim „A is preferred to B" is sufficient for the description of consumer preferences and for the analysis of the demand. It is not necessary to know the exact difference of the two utilities[14].

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[11] This finding also provides the answer to Adam Smith's contemplation over the low price of water as the commodity unnecessary in terms of the survival as compared to the very high price of diamonds. (It is usually referred as the "paradox of value" or "the diamonds and water paradox".)

[12] This is called the principle of diminishing marginal utility or the law of diminishing marginal utility. It could be proved that the decreasing curve of the marginal utility of a good defines the individual demand curve for that good.

[13] The word „usefulness" may also be used in this context.

[14] This ordinal utility approach has been later adopted by most economists.

When cardinal utility approach is denied, the utility obviously cannot be summed up and the total utility of all people in a given time and place is not known. In the absence of the measurement we can hardly establish the maximum total utility (it basically means total welfare or total SWB) of the society. The famous Italian economists Vilfredo Pareto, who was one of those not believing in the idea that utility can either be summed or compared interpersonally[15], formulated the criteria known as Pareto optimum[16] in order to resolve the problem of the total utility in the society.

2.2.2 Income

I think that the view of the utility as the instrument for consumer preferences description still dominates in the contemporary economic mainstream. Still, the principle of diminishing marginal utility might have wider applications. In this section the relation between the income in the absolute terms and SWB as a measure approximating the individual utility is examined.

The relation between the income and SWB is very complex (Dolan et al., 2008) and the findings are sometimes surprising. People tend to think they become happy when they get rich. This belief is widespread and illusory (Kahneman et al., 2006). They pointed out that *"most people believe that they would be happier if they were richer, but survey evidence on subjective well-being is largely inconsistent with that belief"* (Kahneman et al., 2006, p.1908). Hence, the relation between the income and SWB is not as straightforward as one would expect[17].

The scientific evidence on the relation between the income and SWB is immense. The reviews of the evidence are provided eg. by Larson (1978 in Diener, 1984, p. 553); Diener (1984); Diener et al. (1999). It makes little sense to repeat them all and only some aspects of the relationship is worth mentioning. Overall, the researchers mostly suggest that money has a positive, yet diminishing effect on SWB (Dolan et al., 2008, p. 97; Diener and Ryan, 2009, p. 398). It sounds logical and is in accordance with the principle of diminishing marginal utility. This principle can be applied for the income as well. The more money an individual earns the lower will be the utility from the last unit of money (marginal utility). Increased money has the great effect

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[15] It means that the subjective utility of a consumer cannot be compared with subjective utility to another consumer.

[16] In the sense of satisfaction (happiness) the allocation of goods (services) is optimal in the society if the there is no way to increase the satisfaction of an individual by the re-allocation of goods (services) without the decrease in the satisfaction of another individual in the same or greater extent. There can be many Pareto optimal situations, not just single one.

[17] Positive influence may be outweigh by the fact that family; leisure; hobbies etc. may be suffered from the earning high income.

on SWB of a poor person, because his utility increases a lot. On the other hand, the value of an additional dollar is negligible for a rich person, so the effect of the increased money on SWB will also be negligible. Hence the effect of the income of the individual on SWB weakens with his overall wealth. The study of Diener et al. (1985 in Diener and Ryan, 2009, p. 398) is in line with this marginal utility theory. It showed that the wealthiest Americans experience only slightly higher SWB than an average American and 37% of them experience even lower SWB that the average American. Two studies were performed in the paper of Diener et. al. (1993), whereas the declining marginal utility to money appeared in case of the US sample, but not in the between-country data (dataset comprised of 39 countries). The classical economic theory tends to ignore the influence of the individual personality on the one's utility, but there are authors suggesting the marginal utility of the income significantly depends on the individual personality. For example, Boyce and Wood (2011) showed that the increase of the household income causes the increase in the satisfaction in the greater extent to people with higher levels of the dutifulness. Similarly, Diener and Biswas-Diener (2002) concluded that the materialism seems to correlate inversely with the life satisfaction. People who place high value on money tend to be less satisfied with their lives. The idea that the positive association of the income with SWB ceases when the basic needs are met is a special case of this situation. Conversely, people who place high value on the love instead of money tend to be satisfied more.

Kahneman and Deaton (2010) investigated separately the influence of the income on cognitive and emotional aspects of SWB and suggested that the effect of the income differs from one to another. They found that both emotional and cognitive well-being rise with the income. While the cognitive well-being (the life satisfaction) rises steadily with the income, the emotional well-being does not rise beyond the annual income of circa 75 thousand USD. The authors hence conclude that *"high income buys life satisfaction but not happiness"*(Kahneman and Deaton, 2010, p. 16,489). Similarly, Mentzakis and Moro (2009) found that the higher absolute income increases SWB up to certain point. More importantly, the rich feel only "fairly happy". It seems that absolute income does not buy all levels of happiness. If one wants to be completely happy, the good income is not a sufficient condition. The authors conclude that *"high-income groups are less likely to belong in the highest SWB level"* Mentzakis and Moro (2009, p. 147).

Some researchers (Boes and Wiknelmann, 2010; Lee and Oguzoglu, 2007; Headey et al., 1985) suggest that the income effect might be asymmetric. It means that income is associated with the well-being in different way than to the ill-being. It seems

that well-being and ill-being constitute one single dimension in this context neither. Boes and Wiknelmann (2010) identified that the increase of the income has little effect in terms of the increase of the satisfaction, but might have substantial effect on the decrease of the dissatisfaction.

The income affecting SWB is a causality commonly shared among people as well as some researchers. Some studies suggest that a causation may also be reverse i.e. a higher level of SWB predicts better income and greater work enjoyment. To provide an example, the longitudinal study performed by Diener et al. (2002b) shown that the students with higher cheerfulness (self-rated at the college entry) reported the higher income in their job 19 years later, were more satisfied with their jobs and were less likely unemployed regardless to the occupation. Lyubomirsky et al. (2005) provided a research review and referred on several other studies suggesting happier people earn more than unhappy people.

2.2.3 Relative income

The early research on SWB and its relation with the material circumstances was mostly limited to the role of the income in absolute terms. It became apparent later that the income *"is not the only or necessarily the best indicator of material standard of living"* (Headey and Wooden, 2004, p.1) and the alternative direct and indirect measures based on wealth, consumption and deprivation were introduced later.

There are studies suggesting that the relative income rather than the absolute income matters. Some authors argue that *"the impact of income or other resources depends on changeable standards such as those derived from expectancies, habituation levels, and social comparisons"* (Diener et. al., 1993, p. 195). It means that the additional income has no effect on SWB if the income of the people in the reference group also increase (Dolan et al., 2008). Put simply, people compare their income to the income of other people and there is the association of their happiness with their income relative to the income of others[18]. It means that the increase of everyone's income does not cause the increase in people's happiness on average. This suggested, for example, Clark et al. (2008). The authors talk about the comparison to others and the comparison to oneself in the past. Clark and Oswald (1996) found that reported

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[18] In this context the term relative deprivation also appears. The relative deprivation is the *"gaps between the individual's income and the incomes of all individuals richer than him"* (D'Ambrosio and Frick, 2007, p. 498). The relative deprivation was originally conceptualized by Runciman (1966 in D'Ambrosio and Frick, 2007, p. 497) in the following way: "We can roughly say that [a person] is relatively deprived of X when (i) he does not have X; (ii) he sees some other person or persons, which may include himself at some previous or expected time, as having X, (iii) he sees it as feasible that he should have X".

satisfaction levels of 5000 British workers in their sample are inversely related to the comparison wage rates. Based on data from German Socio-Economic Panel (GSOEP) Dittmann and Goebel (2010) identified that the life satisfaction of an individual in Germany is lower when he lives in a neighborhood with the socioeconomic status higher than his/her own and vice versa. Ferrer-i-Carbonell (2005, p. 998) performed the analysis also on GSOEP and found, inter alia, that *„income of the reference group is about as important as the own income for individual happiness"*, where the larger the one's income is compared with the reference group's, the happier is this individual. Moreover, the comparison is asymmetric and mainly upwards. It means that an above average individual (measured by the income) is not happier than the reference group, while SWB of a poorer individual is negatively influenced by the fact of the income being lower than the reference group. Luttmer (2005) matched empirical data on the individual income and SWB with the local average of the income and found that the self-reported happiness is negatively affected by the higher earnings of the neighbors. Again, if the income of an individual is lower than the average income in his community, it will reduce the level of the happiness. The negative effect of higher incomes in the neighborhood on the happiness is strongest of those, who are most socialized in the community. The negative effect is most likely caused by the interpersonal preferences. The author says that people have *"utility functions that depend on relative consumption in addition to absolute consumption"* (Luttmer, 2005, p. 963).

Finally, based on the data from European Social Survey for 19 countries including both Western and Eastern Europe Caporale et al. (2009) found the evidence of the negative effect of the reference income on SWB. It is interesting that separately taken data from Eastern Europe countries shown different pattern. At this case the reference income impacted SWB positively[19]. It means lower than the reference income of an individual affected his SWB positively. The authors concluded that in the stable environment the reference income serves as a measure for the comparison, while in less stable environment (eg. during the rapid development) the reference income is viewed as a promise of one's future situation.

On the other hand, there are studies not supporting the importance of the relative income. Diener et. al. (1993) performed two empirical studies[20] and their data consistently suggested there is no influence of the relative standards on the effects of the

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[19] This is called „Tunnel effect". It is my hypothesis that this effect took place in the Central Europe after the fall of the communism. I can provide no scientific evidence for this assertion.

[20] One international study across 39 countries and one longitudinal study across the US.

income on SWB. *"Neither social comparison, adaptation, nor expectancies seemed to influence SWB"*(Diener et. al., 1993, p. 217). The authors admitted that such findings were a bit unexpected and offered the hypotheses for the lack of effects for the relative standards. For example, the social comparison has only a brief effect and does not influence the long term well-being.

Following the two different types of standards the relative income may be defined in the following way for the purpose of further analysis.

Definition 4: Relative income compared to others is a person's subjective perception of his or her own current income compared to most people in the country.

Definition 5: Relative income compared to past is a person's subjective perception of his or her own current income compared to his or her own income 12 months ago.

2.2.4 Easterlin paradox

With some exemptions the research reviewed in Section 2.2.3 has shown the importance of not to consider the effect of the income to SWB only in the absolute terms. The reference income is also important component of the economic theory commonly known as Easterlin paradox (Clark et al., 2008). The American economist Richard A. Easterlin has launched the modern economic discussion over the relation between the happiness and the income in his empirical study on the economic growth and the human happiness (Easterlin, 1974). Based on the empirical evidence he proposed, that there is a noticeable positive association of the income with the happiness within a given country. But the picture is quite different from the international perspective. The reported level of the happiness on average was not associated with the national income per head. At least in countries, where the income per head is sufficient to cover the basic needs. Shortly, people in a rich country are not on average happier than people in a poor country (given that the basic needs are met), but within a given country the income and the reported happiness is associated. In the literature, this paradox has been later called Easterlin paradox.

This paradox still continues to be debated (Diener et al., 2013). Furthermore, according to the Easterlin, there is no correlation between the increase in the national product per person and the increase in the average reported happiness over the long-term. Twenty years later, Easterlin (1995) reacted to the criticism of his research (e.g. Veenhoven, 1991) and refined his original conclusion to be more accurate. He confirmed his original statement that within a country those with higher incomes are, on average, happier. It is not that new. The second conclusion is that the raising the incomes of all does not increase the happiness of all. That is because, so-called,

"material norms" increase in the same proportion as the income of the society. When the country becomes richer, higher level of the material well-being becomes normal. Easterlin's arguments are in essence in line with the conclusions of researchers related to the reference income we explored in Section 2.2.3.

Over more than four decades of the debate there are papers both confirming and declining the Easterlin paradox. There are plenty of sound and less sound papers that agree with Easterlin. Blanchflower and Oswald (2004) studied the happiness in the US and Great Britain. Based on their paper, the average level of the happiness in the US declined over past 25 years, while the life satisfaction in the UK is approximately stable over the period (the data cover the period of increasing material prosperity from early seventies to late nineties). These findings provide some support to the Easterlin's hypothesis for the period quarter of a century later. The authors provided other findings – among others they found that the higher personal income is generally associated with the higher happiness and that people care about their income in relative terms too.

The studies critical to Easterlin paradox also emerged. Based on the trend data on the average happiness on 21 nations from mid-seventies till 1996, Hagerty and Veenhoven (2003) challenged Easterlin and showed that increasing national income goes with increasing national happiness, whereas the short-term effect on the happiness is greater than the long-term effect. They also found a positive correlation of the happiness with the economic growth. Easterlin disputed this criticism in his later reply (Easterlin, 2005), while Veenhoven and Hagerty (2006) came up with further evidence inconsistent with Easterlin paradox based on the trend data for the years 1946-2004. The authors explained the source of their different view, but insist on the conclusion that *"average happiness has increased slightly in rich nations and considerably in the few poor nations"*(Veenhoven and Hagerty, 2006, p. 421) during the given period. Furthermore, the number of happy life years caused by the extended average longevity has increased.

Finally, Easterlin posed the question whether there is the evidence showing economic growth leads to an increased happiness (Easterlin, 2015). His answer is, unsurprisingly, no. Based on the evidence from developed, less developed and transition countries he concludes that the happiness and the income are not related in the long term, while the short term fluctuations in the happiness and the income are positively associated. Because of the confusion the short and long term trends, some authors may suggest the positive relation of SWB and GDP in the long term too. In other words they suggest that the richer countries are on average happier, which is not true according to Easterlin.

The most serious criticism of Easterlin paradox came from Stevenson and Wolfers (2008). They identified a clear positive link between the average level of SWB and national income per capita across the countries under their study. The study also identified the association of the economic growth with the rising happiness. The authors concluded that the happiness is determined clearly by the absolute income while the role of the relative income is limited. Still, it is the pure statistical correlation and it does not mean that there is a causal relationship, the authors claimed. Furthermore, they found no evidence of a satiation point beyond which there is no further increase of SWB. This last conclusion was later confirmed by the authors in further study (Stevenson and Wolfers, 2013), in which they showed, that the relationship between the well-being and the income does not diminish as the income rises. Although no satiation point was found the authors claimed it might exist, but remained not yet reached.[21] Based on their extensive literature review Diener and Biswas-Diener (2002) also concluded conversely to Easterlin: they identified small correlation of the reported SWB with the income within the nations while the correlation of the wealth of the nations with their mean SWB was found large. Diener et al. (2013) has recently participated on the debate on the relation between the rising income and SWB of the nations. They used the data from 2005 to 2011 for more than 800 thousands individuals across 135 countries. The study showed that the changes in GDP were associated significantly only with the life evaluation while changes in the household income has significant effect to the life evaluation as well as the positive and negative feelings. There are some mediating factors affecting the association of the income with SWB suggested: optimism about the future, person's material welfare accompanying the increase of the income and person's satisfaction with his finances. Diener and Seligman (2004) made a note that the differences in SWB are caused by the factors such as social relationship and job enjoyment rather than by the income in the wealthy societies.

2.2.5 Wealth

It is clear that there are disputations among the researchers on the exact pattern of the association of the relative income with SWB in both short and long term as well as within and among countries. Some authors suggest that the measures of the wealth other than the income should be employed in order to get a better picture.

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[21] Compare with the results of Kahneman and Deaton (2010) who found that the emotional well-being does not rise beyond the annual income of circa 75 thousand USD in the US.

Bellani and D'Ambrosio (2011, p. 68) noted that *"income matters but also other factors are important in explaining differences in well-being"*. Headey and Wooden (2004) remarked that the variables mostly examined were limited to the income, which pushed them to research for the combined effects of the disposable income and the wealth on SWB. They found that the household's wealth (net worth) *"appears to matter at least as much as income"* Headey and Wooden (2004, p.17). The authors explained that the wealth might be important because it provides the economic security, which many people value highly and suggested that other measures such as the consumption should be employed in the models.

Similarly, Christoph (2010) talks about "material situation" and discusses various direct and indirect measures. Following Ringen (1988) income together with savings, assets and other financial measures are the indirect measures, because they are *"merely proxy for the living standard actually achieved"* Christoph (2010, p. 481). It seems that although the income is by far the most popular measure, it is not the single one to be taken into account. Adapted from Andress and Lipsmeier (2001), Christoph (2010) distinguish three approaches to measure the material situation: resource approach; consumption approach; and standard-of-living approach. The resource approach uses the indirect variables such as income wealth etc., the consumption approach relies on the data on expenditures (direct measures) and the standard-of-living approach uses the measures such as items owned, activities pursued etc. Clearly, there is a pool of other measures than the income and the research focused on the association of SWB with these measures is much scarcer. There is the simple idea behind that it is not the income itself which makes people happy. What makes them happy is actually the consumption of goods and services they previously acquired for money they earned and social and leisure activities they can undertake thanks to the money they have (Whelan, 1992).

Another mediators were proposed by Johnson and Krueger (2006). They found that the association of one's actual wealth with the life satisfaction is completely mediated by the perceived financial situation and control over life. If one perceives his financial situation good, it protects his life satisfaction regardless to his true wealth. It is about neither absolute nor relative wealth, the key is the individual perception. Furthermore, the available financial resources of an individual help protect the life satisfaction from external shocks. Wealthy people, obviously, are better protected because they have spare resources available for the case of loss of either regular income or substantial part of their assets.

2.2.6 Material aspirations

Furthermore, the relation of the income and SWB may be affected by income aspirations (material aspirations). Easterlin (2001) concluded that the material aspirations increase together with the income over the life course. SWB, generally, rises with the income, but inversely with the material aspirations. The rise of the income causes the rise of SWB on the one hand, but also the rise of the material aspirations on the other hand. The rise of the material aspirations affects negatively SWB and erase the positive effect of the rising income. People tend to want more and more throughout their lives, which negatively affects their SWB (SWB would otherwise gain from the increase of the income). Similarly, Stutzer (2004) empirically tested the effect of the income aspirations on people's utility operationalized as reported satisfaction with life. He founds that, ceteris paribus, higher income aspirations reduce people's utility measured by the satisfaction with life. The author offers two explanations for that: processes of adaptation and social comparison. Firstly, the increase of the income initially provide additional pleasure at the beginning, but the effect disappear, because people get used to the new income level. Secondly, the relative income position rather than the absolute level of income matters, because people tend to compare themselves with others in the community, as already discussed. Stutzer talks about *"socially comparative or even competitive processes in consumption"* (Stutzer, 2004, p. 3). This view is in line with the previously referred Easterlin paradox, because people within a rich country are adapted to their material standards and the simple fact that they are richer than people in a poor country cannot make them happier. People in the poor country have their own standards they are adapted to. To conclude on material aspirations, Ryan and Dziurawiec (2001) found the negative relationship of the life-satisfaction with materialism[22] in Australia. People high in materialism were less satisfied with their lives as a whole, with their standard of living, family lives and other life domains than those low in materialism.

2.2.7 Material deprivation

The material deprivation is another indicator potentially useful when analyzing the relation between SWB and the material circumstances. The idea of the material

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[22] Materialism could be understood as the individual orientation to possession and acquisition (Ryan and Dziurawiec, 2001) in this context.

deprivation was pioneered by the team of Peter Townsend (Townsend, 1979; Townsend et al., 1986) having suggested the material deprivation indices for measuring inequalities and Carstairs and Morris (1989) in England for the explanation of differences in mortality. Since then, the concept of the deprivation and related indices have been common in the research on poverty as well as in the research on social and material exclusion in economic and sociological literature. Still, they have rather scarcely been used in happiness research.

Very broadly speaking, people are deprived if they do not have something they want. It could be love; social contacts; money; consumption of diverse merchandise etc. The deprivation is hence a multidimensional phenomenon. Whelan et al. (2001, p. 358) noticed that the *"deprivation is a widely used term that is often applied without definition of the underlying concept"*. (Layte et al., 2001, p. 44) defined it *"as the enforced lack of possessions, activities or amenities through lack of resources"* and for Ahrendt et al. (2015, p. 633) it *"concerns the inability to afford items that are considered essential"*. In the series of articles Whelan and his colleagues talk about the life-style deprivation (Whelan, 1992; Whelan et al., 2001; Layte et al., 2001; Whelan and Maitre, 2007). Whelan (1992) performed an analysis of the dimensions of the life-style deprivation. They identified a set of items or activities widely regarded as necessities where their enforced absence is described as primary deprivation. The secondary deprivation includes the enforced absence of possessions and activities which are not socially sanctioned as necessities. The housing items are the third distinguished group of the items and their absence is termed the housing deprivation. Whelan et al. (2001) examined 24 household items which could serve as indicators of the life-style deprivation and clustered them into five groups that are consistent across countries:

1. Basic life-style deprivation (essential items as food; clothing; holiday once a year; replacing worn-out furniture; and the experience of late payments).
2. Secondary life-style deprivation (less essential items such as car; phone; color television; microwave; and dishwasher).
3. Housing facilities (essential items such as bath/shower; indoor flushing toilet etc.).
4. Housing deterioration (defects such as leaking roof; dampness; rot etc.).
5. Environmental problems (noise ; pollution ; inadequate space etc.).

Material deprivation and SWB

The obvious question is whether the material deprivation as the objective measure is related to SWB as the subjective measure of the individual well-being. This relationship was investigated, for example, by Bellani and D'Ambrosio (2011). The

authors reported that the association between SWB and the deprivation is much stronger than between SWB and the individual income[23]. Ervasti and Venetoklis (2010) empirically analyzed SWB and its determinants among the unemployed based on the European Social Survey (ESS) data from 21 countries and stressed the importance of the financial strain for the well-being of the unemployed. Based on the authors the deprivation theory tend to place emphasis primarily on the psychological factors and ignores the financial strain aspect. They pointed that *"the decline of well-being among the unemployed is not always a consequence of lack of work per se. Rather, the financial strain associated with unemployment causes the decline of well-being"* (Ervasti and Venetoklis, 2010, p. 136).

Material deprivation and income

The poverty research is quite interested in the nature of the relation between the material deprivation and the household income. It is commonly assumed that there is a close relationship between the income and the material deprivation as the lack of resources caused by the low income results in the lack of something considered to be a necessity. However, the research often suggest that the discrepancies between the income and the material deprivation exist, it seems that those having the low income and those scoring high in terms of the material deprivation are not necessarily the same people (Berthoud and Bryan, 2010). Studies suggesting that there are low income households not experiencing deprivation as well as households not living in poverty but suffering from the deprivation (measured by the non-monetary indicators) are summarized, for example, in Whelan et al. (2001). In their longitudinal study Berthoud and Bryan (2010) found that the underlying link between the long-term low income and long-term deprivation is close. On the other hand, an increase in the income is not necessarily accompanied with the proportionate decrease of the deprivation (the dynamic link). The authors concluded that the correlation of the deprivation with the income exists, but its strength is not that great.

Fahey (2007) posed the question who is poor in the EU. He clustered 25 member states and three candidate states (Bulgaria and Romania were both candidates at that time) in four groups and found that in each cluster the lower the income the higher the proportion of the deprived people. Same pattern was identified in case of

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[23] The correlation between SWB and the deprivation was 0.4 and the correlation between SWB and the income was about 0.16 on average among nine EU countries (former EU15 without Austria, Finland, Luxembourg, Sweden, Germany and the UK).

the other two indicators of housing defects and financial problems. The other question was how the people's subjective feelings about their financial situation are linked to the objective conditions and the answer is that, in each cluster, those more deprived in objective terms are the those people who also feel more deprived. Layte et al. (2001) focused on the relation between the income and the life-style deprivation internationally. They suggested that the relation vary across countries due to the welfare-state policies. Some welfare states allow the process the authors call "decommodification" that enables the *"smooth income flows"* (Layte et al., 2001, p.43). Basically, the social security programs economically support people having lost their income due to the, for example, unemployment and this support, in turn, moderate the deprivation.

Whelan et al. (2001) provided reasoning why the income and the material deprivation may relate loosely. The reasons may be the length of time the low income persists, the existence of other resources (savings etc.), the different view of what is necessary, and other social and economic processes may influence the relationship between the current income and the deprivation. Their analysis of income, deprivation, and economic strain was based on the data for twelve European Union countries from the first wave of the European Community Household Panel Study (ECHP) conducted in 1994. The study suggested that the relationship of the income with the deprivation *"was generally weakest in the richer countries where the level of deprivation is lowest, and strongest where it is highest"* (Whelan et al., 2001, p. 370) and that the economic strain (the perceived ability to make ends meet) is impacted by both the income and the deprivation whereas the effect of the deprivation is stronger. The structure of the deprivation is consistent across examined EU countries. Conclusions for the five deprivation dimensions as outlined above (basic life-style deprivation; secondary life-style deprivation; housing facilities; housing deterioration; and environmental problems) are drawn. There is a weak relationship between the income and housing and environmental dimensions whereas basic and secondary dimensions are impacted more strongly by the income than the other three dimensions. The conclusions can be generalized across countries.

Based on European Quality of Life Survey (EQLS) data for EU25 plus 3 candidate states at that time (Romania; Bulgaria; and Turkey) Whelan and Maitre (2007) later confirmed the earlier finding that the relationship between the income and the life style deprivation is relatively weak, whereas the income plays more important role in the poorer regions as a predictor of the deprivation. The association between the deprivation and the perceived economic strain is the strongest in 12 richest EU countries and in all other EU regions is just a bit weaker.

To conclude, the material deprivation is a multidimensional phenomenon having been used predominantly in the poverty research so far. It is related to the income (although rather weakly it seems) as well as to SWB. The deprivation measures can be constructed as the objective indicators as well as the indicators based on subjective feeling. As the income is considered rather an indirect measure in terms of SWB, the material deprivation may play the role of a mediator standing between the income and SWB.

For the purpose of the further analysis the material deprivation and the perceived economic strain are defined the following way.

Definition 6: Material deprivation is a person's inability to afford items that are desired by that person.

Definition 7: Perceived economic strain is a person's perceived inability to make ends meet[24].

2.3 Other theories on Subjective well-being

The economic theories outlined in Section 2.2 seem to be able to explain only a part of the whole picture of SWB. Not surprisingly, psychological theories emphasize rather the importance of personality and temperament. Brief review of some of the most prominent psychological theories of SWB is provided in this section in order to better understand the psychological dimension of the well-being. The comprehensive summary of such theories is provided by Diener (1984) and updated in Diener et al. (1999) and Diener and Ryan (2009).

Sections 2.3 – 2.7 provide with the overview of the broad range of non-economic theories and factors associated with SWB. Although the scope of this research is limited to the material situation, the review is provided because the non-economic factors are important to understand SWB in depth. The reader interested only in economic aspects of SWB can skip this review.

2.3.1 Goal and need theories

Based on, so called, telic theories or endpoint theories (Diener, 1984), the high SWB is achieved when a certain goal in one's life is reached or need is fulfilled. They include both need theories and goal theories. The need theories generally suggest there are certain inborn needs which have to be fulfilled in order to achieve the well-

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[24] The terms economic strain, financial strain, economic stress and financial stress are all used synonymously.

being (Diener and Ryan, 2009). An example of a need theory is empirically derived Self-determination theory of human motivation and personality proposed by Ryan and Deci (2000). This theory accents personal inner resources of personal self-development and suggest that there are three basic needs – the need for competence, the need of relatedness and the need of autonomy. The competence is about the ability to deal effectively with the environment, the relatedness means having the close social relationships and belonging to a social group, and the autonomy is the need to control one's own life. Satisfying these basic needs across the life span is essential for personal growth and integration, social development and, most importantly for us, personal well-being. Another example of the need theory could be the six-dimensional concept of the psychological well-being proposed by Ryff and Keyes (1995) which has already been mentioned earlier in this review.

The goal theories suggest that people are consciously seeking certain goals, which result in the high well-being when fulfilled (Diener and Ryan, 2009). Michalos (1980) could be an example of such the approach. Based on the path analysis he confirmed models where the satisfaction is a function of a perceived goal-achievement gap in many life domains. The goal-achievement gap is a function of the comparison with the status of the average people and the comparison with the best previous experience. Taken from newer studies, Messersmith and Schulenberg (2010) performed the longitudinal study on the relations between young adults' goal achievement in educational, marital and parental domains, continued goal striving over time, and subsequent well-being during the transition to the adulthood. The pattern of the relations between the individual's goal achievement and the well-being varied by the goal content. There was a positive relation between the well-being and the completion the given goal in educational and marital domain, but not parental domain. Significant relations between the long term goal striving and the well-being was also identified.

2.3.2 Activity theories

Human activity is closely connected to the personal goals. Some theories emphasize that the happiness is influenced by the process of realization the individual goals rather than the fulfillments those goals themselves. The achieving the end-point itself is not as important in terms of the happiness. These theories are called activity theories. Based on such theories *"happiness is a by-product of human activity"* (Diener, 1984, p. 564). The activity in this context does not mean just working. It is the activity in broader terms including exercise; sport; hobbies; religious rituals etc. The idea that the human activity may generate happiness seems to be very old. Diener (1984) goes back to Ancient Greece and pointed out that for Aristotle the happiness comes

from the activity if it is performed in an excellent manner. It implies that not every activity can bring the happiness. Csikszentmihalyi (1975 in Diener, 1984, p. 564) came with a *"theory of flow"* which is an example of a modern activity theory. The flow is a word used by the author for the state of deep and joyful engagement, interest and concentration on a given activity. Flow experience is *"the state of total involvement in an activity that requires complete concentration"* (Csikszentmihalyi, 1999, p. 821). The author also use the synonym "autotelic experience" – the kind of experience worth doing for its own sake. Based on the theory, a person becomes bored if the activity is too easy while the anxiety will result when the activity is too difficult. Only in case the challenge of a task roughly match the skills of the person, the activity becomes joyful. It is either boring or gloomy otherwise. Csikszentmihalyi (1999) suggested that the happiness is dependent on whether the individual is capable to gain the flow from whatever he does.

2.3.3 Relative standards theories

Relative standards theories is quite a broad group of theories. They are common in an assertion that SWB is a result of a comparison between an actual situation and a certain standard. The standard might be one's past; goals; ideas; other people etc. (Diener and Ryan, 2009). Broadly speaking, if the standard conditions are exceeded by the reality, SWB will be boosted. If the standard is not achieved, the level of SWB is affected negatively. The effects of the comparison with the certain standards have already been discussed form the economic point of view. The review of the relevant psychological theories would also be useful. In his broad review Diener (1984) labelled such theories as judgement theories.

For example, the level of SWB is affected when an individual is unable to fulfill the goals over the life course. In other words, the real life being not in line with one's expectations; aspirations; needs; wishes; life plans; and so on may influence SWB. The theories related to this phenomenon are usually referred as discrepancies theories. Michalos (1985) and Higgins (1987) could stand as examples of such approach. For example, the theory proposed by Michalos (1985) is called "Multiple discrepancies theory". It postulates that SWB is a function of the perceived discrepancies that arise from the comparison in various domains. To be more concrete, based on this theory happiness and satisfaction are *"functions of perceived gaps between what one has and wants, relevant others have, the best one has had in the past, expected to have 3 years ago, expects to have after 5 years, deserves and needs"* (Michalos, 1985, p. 347). He empirically tests the hypotheses based on the theory being able to explain 49% of the variance in the happiness and 53% in overall satisfaction and 50% or more in 7 out of 12 domains satisfaction. The results indicated that the self-want discrepancy

is the most influential one to SWB. Still, the strongest predictors of SWB seem not to be the perceived discrepancies, but self-esteem and social support (Blore et al., 2011).

Another subgroup of relative standards theories are social comparison theories. Based on these theories, proximate others plays a role of a standard of the comparison. If they are better off, one's happiness is enhanced and if they are worse off, the happiness is worsened. Such theories have already been touched in this chapter. For example, the comparisons with average folks is a variable influencing perceived goal-achievement gap in the path analysis performed by Michalos (1980). Emmons and Diener (1985b) performed a study on the impact of various psychological processes on satisfaction with various life domains. The social comparison as well as the positive affect were found to be the strong predictors of the satisfaction across the most life-domains. The results of the study are compatible with Michalos' Multiple discrepancies theory, because the strong predictors are self-want discrepancy and social comparison in this theory (Michalos, 1985). If the positive affect is assumed to be the result from the fulfilling needs, the study basically confirms the predictions of the theory.

Social comparison means *"how the person believes he or she compares to proximal others in the domain"* (Freedman, 1978 in Emmons and Diener, 1985b, p. 158). Two of the most discussed domains are personal income and overall material situation, probable because the differences in income and material situation among the people are easily visible and measurable. Many studies are available on the influence of the relative income, where some authors support the idea that income in relative terms is more important than in absolute terms. This topic was discussed in depth in Section 2.2.3.

Another standard of the comparison may be one's past. In case people prosper currently better than in past, they will be happy and vice versa. Adaptation theories include this type of comparison. For example, Brickman et al., (1978) examined the past, current and expected future happiness of lottery winners and accident victims and found that the past level of the happiness is often used as a standard to evaluate the current level of the happiness.

In modern research of SWB the idea of the adaptation to certain conditions is a central component (Diener et al., 1999). It is not contradictory to common sense to say that both favorably and adverse life events such as lottery win; promotion; divorce; disease; loss of job; or death of close friend impact the person's SWB. The literature agrees on this view. Similarly, one would agree that the sense of the unhappiness following an adverse event is not never-ending. In most cases the baseline

of the happiness is recovered after some time or, at least, partly recovered. Similarly in the case of positive life circumstances. *"The immediate affective responses to significant life events inevitably fades"* over time (Myers and Diener, 1995, p. 16). Based on the adaptation theories people have the capacity to adapt to significant life events both adverse and favorable. The authors stated that the process of the adaptation is actually the explanation, why factors such as health, income and personal attractiveness do not have long lasting effect on the happiness although they are apparently important for people. The adaptation also helps explain the frequently observed phenomenon that those poor or disadvantaged demonstrate no significantly lower level of the happiness than the fortunate people.

First coherent general theory of this type was adaptation level theory (Helson, 1964 in Brickman et al., 1978). The adaptation level theory offers two main reasons why an individual receiving *"extreme stroke of good fortune"* (Brickman et al., 1978, p. 918) will not be happier that anyone with no such fortune: contrast and habituation. Contrast is about a shift in level of adaptation upwards. The fortune event (for example win the lottery) causes that the new pleasures are achievable (better car; better house etc.) while the ordinary pleasures suddenly bring less joy. Hence, the higher joy caused by the new pleasures is compensated by the lower joy of the old pleasures. Process of the habituation causes that the additional pleasure experienced due to the fortune event cease to have the impact on one's happiness because the winner become accustomed to it. The additional pleasure becomes a new standard over time. Similar principles are relevant vice versa in the opposite case of adverse events. Following this theory, Brickman et al. (1978) conducted a study with 22 lottery winners, 22 controls and 29 paralyzed accidents victims and basically confirmed the theory. They found that the lottery winners were on average happier than the victims, still they were not in general happier than the controls and showed significantly less pleasure from the ordinary day-to-day events. The authors also made sure that there is no effect of pre-existing differences in terms of the happiness between lottery winners and controls. The temporal effect of the life events was confirmed, for example, by Suh et al. (1996). Based on the 2-year longitudinal data the study identified that the only life events occurred during previous 3-months affect the life satisfaction and both positive and negative affect when personality controlled. The adaptation level as well as the adaptation process seem to be highly individual (Diener et al., 2006). For example, Mancini et al. (2011) identified some specific patterns of the individual variation in response to three major life events (bereavement, divorce, and marriage). Moreover, individuals experiencing many adverse events are not affected much by an additional bad event while people who often experience the positive events gain less from an additional event (Diener et al., 2006). Diener et al.

(1999) pointed out that the adaptation must be distinguished from coping, where the coping is the active and conscious process and the adaptation is rather the automatic biologically determined process.

The above described process of habituation is frequently referred as hedonic treadmill or hedonic adaptation. The hedonic adaptation gives rise to the situation of mythical Sisyphus, who pushes the big stone up the steep hill and fail to reach the summit every occasion. The effect of hedonic treadmill causes that life events and circumstances, no matter whether good or bad, affect the happiness only temporarily, because people quickly adapt back to *"hedonic neutrality"* (Diener et al., 2006, p. 305). The hedonic neutrality is caused by the fact that, as the time proceeds, an individual standard moves to the new level as a reaction to the particular life event. The higher happiness caused by the certain life circumstances hence cannot be achieved permanently due to the fact of the adaptation. Hence, people fail trying to increase happiness by simply collecting good events (for example by acquiring more and more luxury commodities). The term hedonic treadmill was first used by Brickman and Campbell (1971 in Diener et al., 2006) and the idea of the treadmill adaptation was at first empirically tested in Brickman et al. (1978) as discussed above. The model of hedonic treadmill has then been largely accepted, but the need to renovate it has appeared recently. Diener et al. (2006) suggested five compact revisions to the model. First, they suggested that the individual baseline happiness (often called set point) is not hedonically neutral[25]. Authors documented that the most of the people seem to feel happy most of the time. For example, Diener and Diener (1996) documented that the mean SWB is above neutral throughout the world[26]. The idea of non-neutrality is in the opposition to the original treadmill theory. Secondly, Diener et al. (2006) suggested that the baseline happiness (set-points) vary across individuals and depends partly on personality and temperament. Thirdly, the authors suggest that an individual might have more than one baselines (set points), because SWB is seen to be composed from the multiple components and these components[27] may move in different directions. In contradiction to the original model, fourth revision suggest that the baseline happiness is not stable over time. The original model proposed that significant events can only have short term impact on the level of the happiness, while the long term happiness remains unaffected. The authors suggest that the adaptation process cannot necessarily be complete and the new baseline can be established as a

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[25] Hedonically neutral means that if there are no emotionally significant events, people are neither happy nor unhappy.

[26] With the exception of very poor societies.

[27] Positive affect, negative affect and life satisfaction.

result of life circumstances. Lastly, people differ in terms of the rate and the extent of the adaptation to the same events. While some individuals may change their set point as a reaction to a particular event, others may not.

2.3.4 Dynamic equilibrium theory (set point theory)

In Section 2.3.3 baseline happiness as well as set point were the often used terms. They could be theoretically framed by "Dynamic equilibrium theory". During eighties, Headey and Wearing (1989) examined linkages between personality, life events, well-being and ill-being and outlined dynamic equilibrium model. In this model, every individual has certain moderately stable normal level of SWB and life events (both favorable and adverse). This level is called the equilibrium level. The equilibrium level is predisposed by stable personality traits of neuroticism; extraversion; and openness to the experience and can be predicted based on age and personality. SWB changes only if the life events diverge from the equilibrium. Hence, according to this theory, the influence of the life events on the SWB exists. Significant life event has the capacity to influence the SWB, but personality traits cause SWB to converge back to equilibrium. The dynamic equilibrium theory is sometimes termed set-point theory, because the terms equilibrium level, baseline level and set point are mostly understand synonymously (Headey, 2006).

The theory is largely dependent on the finding that *"most people, most of the time, have stable levels of SWB"* (Headey, 2006, p. 370). There are findings in the contradiction to this basic point of the theory. It seems that the major life effects such as marital changes, unemployment etc. are associated with the long lasting changes in the life satisfaction after these life events. Longitudinal rather than cross-sectional studies are suitable to uncover such phenomena. The studies of Lucas et al. (2003) and Lucas (2005) could stand as examples for such the findings in terms of the marital status. Both studies have already been presented earlier in Section 2.4 on demographic influences. Based on 18-year longitudinal data Lucas (2005) examined people's reactions and adaptation to a significant life event – divorce. He found that the satisfaction shifted back over time after the initial breakdown caused by the divorce, but it does not completely return to the baseline (set point). The study showed that people who stayed married are on average happier than those divorced. The association between the satisfaction and the divorce was observed although pre-existing differences between the married and the divorced also play the roles. The long lasting changes of the happiness were reported in case of loss of job and loss of spouse. Lucas et al. (2004) examined the unemployment effect in 15-year longitudinal study in Germany and confirmed the set-point theory with an exception: individuals on average did not completely return to their initial baseline level. Again

then, their set point seemed to be moved due to the adverse life event, even they were re-employed again. In 17-year longitudinal studies Fujita and Diener (2005) found that the life satisfaction baseline levels of 24% of respondents changed significantly from the early baseline (first 5 years) to the last 5 years. It hence seems that the long term levels of SWB change for some individuals over long time.

Although the baseline levels of SWB (set point) shows moderate stability over time according to the set-point theory, the above studies suggest that significant life events have the potential to influence SWB even in medium or long term. The authors also suggested that dynamic equilibrium theory required a revision. In the light of the new findings, Bruce Headey, the co-author of the theory, reflected them in his follow ups and admitted that SWB set-points of a minority of the individuals substantially changed as a result of the significant events and the theory needs further revisions (or even replacement), because some new findings cannot be simply dismissed as exceptions (Headey, 2006; Headey 2008; Headey, 2010). In Headey (2010) the author identified that the permanent changes in the set-point reported 14–30% panel members over 20 years.[28]

2.3.5 Bottom-up theories

The term "bottom-up" in connection to the theories of SWB was firstly used by Diener (1984). This term has become quite frequently cited in the psychological literature since that. Bottom-up theories is quite a broad group of theories. They are common in the assumption that the happiness is a state rather than a trait (see the debate in Section 2.1 dedicated to the definition of SWB) and this state of the happiness is a collection of many particular pleasures. These pleasures, if frequent enough, result in the overall sense of happiness. The greater the collection, the higher the level of the happiness, basically. Hence, a happy life is *"merely an accumulation of happy moments"* (Diener, 1984, p. 565). The philosophy of hedonism could be an ancient example of an approach of this type. The earlier research in the field was focused rather this bottom-up way. The examined bottom-up factors were demographic characteristics; external events; and life circumstances, whereas researchers investigated how these factors influence SWB. Diener et al. (1999) referred to Wilson's idea that if basic and universal human needs are fulfilled, the individual will be happy. The research supports this idea only partly. Clearly, external objective factors, life circumstances as well as other situational influences play their role in overall

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[28] Depending on the definition of the long term change in life satisfaction measures.

level of the individual SWB, but the size of their effect seems to be rather small. For example, Argyle (1999 in Diener et al., 1999) states that the external circumstances account for approximately 15% of the variance in reported SWB. Lykken and Tellegen (1996, p. 186) stated that *"neither socioeconomic status, educational attainment, family income, marital status nor in indicant of religious commitment could account for more than about 3% of the variance in well-being"*.

2.3.6 Top-down theories

The term "top-down" in connection with SWB was also introduced by Diener (1984). In contrast to bottom-up theories, the theories in this group assume that the individuals have the propensity to experience things in a certain way, positive or negative, and this propensity determines the way how they interact with the environment and the way how life events and circumstances are interpreted by the individual. The happiness is inborn, it is the trait influencing the way how the person react to the external events and circumstances. It is not the state caused by the external factors. According to this approach people enjoy the pleasures, because they are in nature happy, while the objective factors are only some sort of preconditions for being happy. Top-down approaches hence stress the importance of the personality.

2.4 Demographic factors

The brief review of most relevant economic and psychologic theories was made in in Sections 2.2 and 2.3. The analysis of the main factors associated with SWB is provided in order to obtain even better insight. We start with the demographic factors in this section.

Batches of studies were undertaken on demographic factors influencing SWB. Researchers gradually came to the conclusion that demographics are actually not too responsible for the variability in SWB. For example, Diener (1984, p. 558) stated that *"demographic variables rarely account for more than a few percent of the variance in SWB and taken together probable do not account for much more than 15% of the variance"*. Costa et al. (1987) stated that the examined demographic and other situational variables (age; race; sex; income; education; marital status) combined can account for only 4-6 % of the variance in SWB. Argyle (1999) or Lykken and Tellegen (1996) concluded more or less similarly.

Solely for the purposes of this analysis age; gender; marital status; religion; and physical health are considered demographic factors. Other factors somehow connected to the demography (e.g. income, health and education) are present in other sections.

2.4.1 Age

Age is probably one of the first factors one would come with no hesitation up when thinking of the factors impacting SWB. Most people would confirm that being young is (ceteris paribus) better than being old, where the word "better" could sound synonymously with the word "happier". People also believe some periods of their lives are notably unhappy, for example, the period of the midlife crisis (Myers and Diener, 1995). Not surprisingly, the situation is more complicated. The literature on the relation between SWB and age yields confusing and contradictory results (Horley and Lavery, 1995). There is little agreement on how happiness varies over the life course (Easterlin, 2006).

Early studies mostly confirmed this lay opinion that younger people were in general happier than old people (Diener and Ryan, 2009). The authors cited number of studies confirming this conclusion. For example, Wilson (1967 in Lucas and Gohm, 2000, p.295) mentioned in their review that *"age does have an effect on avowed happiness with younger individuals reporting higher happiness than other individuals"*. In opposite, later studies showed that the life satisfaction increase or, at least, does not decrease with the age (for example Horley and Lavery, 1995; Herzog and Rodgers, 1981).

Charles et al. (2001) in their longitudinal study found that the younger and the middle-aged adults showed a stability for the positive affect while older people showed a small decrease over time. The negative affect decreased with the age for all generations and the rate of decrease weaken within the group of oldest people. Mroczek and Kolarz (1998) examined the effect of the age on the happiness defined by both positive and negative affect. The authors concluded that older people are happier than the other adults when the well-being is defined by the positive affect. The effect of the age on the well-being was linear among men, but accelerated among women. This general relationship persists even when confounding variables such as gender; marital status; education; stress; personality; and psychical health are controlled. The two of those variables interacted the relationship between the age and the affect among men. Introverted more that extroverted men demonstrated a stronger relationship between the age and the positive affect. There was no association of the age and the well-being defined by negative patterns among women and

unmarried men. The relationship was linear and negative for the married men, where married men seem to be less and less happy with the increasing age.

Later studies suggested that the relationship between the age and SWB (or happiness) is not simply linear and proposed various curved line pattern. Mroczek and Spiro (2005) concluded based on their longitudinal study that the life satisfaction keeps increasing till the age of 65 and then declines with the proximity of death (inverted U-relationship). The authors remarked significant individual differences in the rate of change, while some of the individuals did not change at all with their age. The authors concluded that *"those, who study happiness...should note that satisfaction with life changes with life for a great many people"* (Mroczek and Spiro, 2005, p. 200).

The similar conclusion about the curve shape reached Easterlin (2006). He identified that the life cycle happiness is the net outcome of the ambiguous movements of four main life domains (family life; financial situation; work; and health). The happiness seems to increases slightly from age of 18 to midlife (around age of 50) and decreases slowly then again, while the overall satisfaction results from the satisfaction with particular life domains. Up to age of circa 50 the satisfaction of the family life and work outweigh the other factors and causes the slight increase in the total happiness. After the midlife the satisfaction with family life, work and health start decreasing causing a decline in the happiness. This decrease is moderated by the satisfaction with the financial situation, which tend to increase with the age.

On the other hand Blanchflower and Oswald (2008) followed with their earlier studies up and argued that the relationship between the age and the psychological well-being is U-shaped throughout the lifetime reaching its minimum in the middle age. The structure of the curve is fairly similar across the world. The authors examined the effect holding other factors such as income and demographic variables constant (ceteris paribus assumption). They also pointed out the importance of cohort effects[29] and suggested some reasoning for the U-shape pattern.

Some other studies also concluded on U-shaped curve. For example, Stone et al (2010) focused on the psychological well-being and found the evidence of U-shape relationship with the age. The authors use two measures: global well-being, which assesses one's overall judgement about his or her life (including personal aspirations; achievements; current situation etc.) and hedonic well-being, which assesses an affective state (having components such as happiness and distress). Based on the

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[29] In this context the term is used to describe the variation of SWB arising from the fact that people of different age may have been born in particularly good and bad times.

dataset on more than 340 thousands US respondents the authors reported that the global well-being as well as the positive hedonic well-being (consisting from two items of enjoyment and happiness) showed all U-shaped patterns with the nadir located around the age of 50. It means the positive hedonic components as well as the global well-being decreases till the age of 50 years and then start rising again. The negative hedonic items showed different patterns. The items of stress and anger steeply declined from the age of early 20's for over the whole remaining life. The patterns of sadness was essentially fairly constant, while worry increased through the middle age and then declined again. There is no consistent relationship between age and SWB when examined internationally (Diener and Ryan, 2009). In poorer countries the decline of SWB with age is much more rapid than in rich countries (Deaton, 2008, in Diener and Ryan, 2009, p.397). To conclude, it seems the age does influence SWB, but the research results in terms of the pattern are mixed.

2.4.2 Gender

Unlikely the age, gender seems to play no role in terms of SWB. Starting again with Wilson (1967 in Lucas and Gohm, 2000), we get his conclusion there is no effect of sex on avowed happiness. He states the happy individual was "of either sex" (see above the whole conclusion). Diener and Ryan (2009) also observed in their overview that men and women do not substantially differ in terms of average SWB. It rather seems that the difference is in terms of intensity. Fujita et al. (1991) reported there is less than 1% of the variance of the happiness accountable to gender, but over 13% of the variance in the intensity of emotions. The authors concluded the positive affect of women is more intense compared to men, but is balanced by their higher negative affect. Still, the average SWB of the men and the women shows little comparative difference (Diener and Ryan, 2009). Although Wood et al. (1989) found women report greater happiness and life-satisfaction compared to men, the gender effect remains small even among the married respondents. The authors also remarked that women more largely tend to report more extreme positive and negative emotions than do men. To conclude, it seems gender does not have substantial effect on average SWB.

2.4.3 Marital status

Being married is one of the attribute helping to improve one's avowed happiness for Wilson (1967). Based on data from three U.S. national surveys Glenn (1975) observed that married persons report substantially greater global personal happiness than divorced; widowed; separated; and never-married persons, whereas the differences were greater for females than for males. Haring-Hidore et al. (1985)

synthetized 58 empirical studies made to date and concluded that there is a weak positive association of people's SWB with the marital status. In other words, married people perform only slightly better in terms of SWB than the others. This findings does not imply any causality. The marriage as such may make the people happier, but also the reverse influence is possible. The people more satisfied with their lives may be more likely to be married. It was also remarked that the relation between SWB and the marital status was stronger in studies with younger samples and in the earlier studies. An explanation for relatively weak impact of the marriage to the average SWB is that married people are those more satisfied than others long before their marriage (Diener and Ryan, 2009).

Lucas et al. (2003) build up on the adaptation theory. Based on this theory individual's SWB is boosted as a reaction to the marital transition, but then is adapted back to the baseline level. Adapted people are hence not more satisfied when married than they were prior to the marriage. Using the large sample in longitudinal study of 15-years, the authors examined the effects of the marital transitions on the life satisfaction and proved the adaptation process. Obviously, there were substantial individual differences in the adaptation to the marital changes observed. Those having strongly reacted after the marriage were still above the baseline years later. Also, individuals with the opposite patterns of SWB were observed. Similarly, strong decline in SWB happens as a reaction to the widowhood followed by relatively slow adaptation. Widows and widowers were less satisfied with their lives than they were before the event, which was caused by the strong initial reaction and a long-lasting adaptation process.

Because the longitudinal study was used in this research, the authors had the opportunity to explore the adaptation process over 15 years. It was remarked that the cross-sectional samples may include the individuals having experienced recent marital transition. These individuals are not yet adapted, which may result in greater difference in reported SWB between married and unmarried individuals.

Diener et al. (2000) explored marital status and SWB cross-culturally and found that the relationship is very similar across the globe with only small variations. They confirmed the consistency for marriage and divorce trends and their relationship to SWB.

The adverse side of the marriage was researched, for example, by Lucas (2005). While the marriage apparently increase SWB, the divorce cause the decline in SWB. The negative effect of the divorce is on average stronger than the positive effect of the marriage. Divorcees often do not recover the baseline level of SWB over time. (Lucas, 2005 in Diener and Ryan, 2009).

There is mixed evidence on the effect of presence of children on SWB (Dolan et. al., 2008). Based on Haller and Hadler (2006) having children significantly raise the life satisfaction but has no significant effect on happiness. The authors offer the possible explanation for that. First is that bringing children up is accompanied by lots of day-to-day work, worries and burdens. Secondly, children leave their parents later anyway when grown up. As one of my friends said, having children and bringing them up is one of those activities one does not like doing, but is happy afterwards when it is done. Bellani and D'Ambrosio (2011) identified, inter alia, that having kids is associated weakly and negatively, still significantly, with the life satisfaction. Dolan et al. (2008, p. 107) reviewed the literature on effect of having children under relatively negative circumstances (divorced mother, a child requiring more than average care, poverty etc.) and concluded that *"children seem to be additional challenge to well-being"* at that case. To conclude, it seems the marital status is associated with SWB, but the pattern is dependent on the circumstances.

2.4.4 Religion

The researchers are quite consistent in the conclusion that the religious involvement is generally positively related with SWB in Western countries. The geographical location should be narrowed in this case, because our conception of what is good and bad is heavily based on Judeo-Christian ideals and religious organizations as mentioned by Ferriss (2002). He found that the happiness is associated with denominational preference, doctrinal preference and with frequency of attendance at religious services. Ellison (1991) reported direct and substantial positive influence of the religious certainty on the well-being, while effects of religious attendance and private devotions are only indirect. The author also mentioned denominational differences. Traditional affiliates reported the lower life satisfaction than various nondenominational groups such as liberal Protestants; Mormons; and Jehovah's Witnesses etc. Such variations were not observed in case of the happiness.

Ardelt (2003) examined the relation between the religiosity and SWB in the old age. More importantly, she identified different effect of intrinsic and extrinsic aspects of the religiosity on SWB. Based on Donahue (1985 in Ardelt, 2003, p. 57) the intrinsic religious orientation is a *"meaning-endowing framework in terms of which all of life is understood"*, while the extrinsic orientation is *"religion of comfort and social convention, a self-serving, instrumental approach shaped to suit oneself"*. It is a little surprise that only the intrinsic religious orientation is positively related to SWB while the extrinsic religiosity is negatively related to SWB.

Steger and Frazier (2005) suggested the meaning of life as a mediator in the chain between the religiousness and the life satisfaction. Moreover they found that the meaning of life also mediate one's everyday religious practice and his well-being. Clark and Lelkes (2005) identified that religious people report higher life satisfaction and have less variation in the life satisfaction. They also identified that the effect on the life satisfaction is achieved by the church attendance of one month or more frequent. Four years later Clark and Lelkes (2009) performed the analysis of the spillover effects of the religiosity and identified that people in more religious regions are on average more satisfied. This spillover holds on religious as well as non-religious people in particular region. Hence, the religiosity affects the satisfaction positively on both individual and collective level. In opposite to this view, Ardelt (2003) concluded that the frequency of the religious activities is unrelated to SWB. Belief in God as well as frequency of church attendance have *"strong and easily distinguished linkages to life satisfaction"* (Helliwell, 2003, p.13).

Diener and Ryan (2009) pointed out, that the situation at the national level might be inconsistent with the findings at the individual level. Some of the most religious nations were those with the very low levels of the well-being while those nations reporting highest levels of the well-being were not very religious. Based on this short review it seems that religiosity can surely be associated with higher levels of SWB.

2.4.5 Physical health

One would with no hesitation assume the relation between the physical health and SWB. The good health is one of the prerequisite for avowed happiness according to early Wilson's definition of happy person (Wilson, 1967). Later studies very mostly confirms this view. Dolan et al. (2008, p. 100) summed in their review up that *"studies consistently show a strong relationship between SWB and both physical and psychological health"*. Roysamb et al. (2003) reached the similar conclusion. They found rather strong relation between SWB and the perceived health among young adults, while the relation between SWB and musculoskeletal pain was moderately or negatively related. No relation was identified between SWB and the allergic disorders. It hence seems that not all dimensions of the physical health are associated with SWB.

More than elsewhere the question here is whether the high level of SWB is a result of the good health or the good health depends on SWB. Shields and Wheatley-Price (2005) concluded that recent acute illness were associated with the significant reduction of the psychological well-being reported by a patient and the effect of such sudden illness has much more greater adverse effect than the ongoing psychical health problems. Oswald and Powdthavee (2008) provided the longitudinal evidence

of the recovery of SWB after an individual become disabled. This recovery is in many cases difficult and the adaptability may not be complete in many cases.

On the other hand, the studies such as Cohen et al., (2003) and Danner et al. (2001) identified the effect of the positive emotions to the health and the longevity. Danner et al. (2001) investigated the old handwritten autobiographies of 180 young Catholic nuns and compared their length of life. The positive emotional content of these early-life autobiographies was strongly associated with the nun's longevity some 60-70 years later. Cohen et al. (2003) assessed more than three hundred volunteers of various age for their emotional profile and subsequently administered two types of common cold. Monitoring shown that for both viruses those positive emotional profile was associated with greater resistance to both types of colds.

By the end of this section, we can add one little notice from Myers and Diener (1995, p. 13). Health is similar to wealth, *"its absence can breed misery, yet having it is no guarantee of happiness"*. Thus, the health might be rather sort of a hygiene factor according to famous Herzberg's (1966) two factors theory.

Clearly, the relation between SWB and the health is two way. Generally, people showing the positive emotions are, on average, at the lower risk of the bad health. On the other hand, the adverse events with the impact to the health during the lifetime (eg. illness, injury) may impact SWB significantly whereas the full recovery is not certain.

2.5 Social factors

Certain social factors are often grouped and analyzed together with various economic factors under the umbrella term of socio-economic status. Based on the definition of American Psychological Association (2015) socioeconomic status is commonly conceptualized as the *"social standing or class of an individual or group. It is often measured as a combination of education, income and occupation"*. In this chapter, social factors of education; occupation; and social relationships are examined whereas the income was explored in Section 2.2.2.

2.5.1 Education

Common sense would bring several reasons why people with lower IQ (or less educated) might be happier and vice versa. Michalos (2008) poses the question whether the education influences the happiness and warns about the definition and the operationalization of the ideas of "education", "happiness" and "influencing". There may be lots of different answers to this one single question.

The education is one of the attributes of a happy person for Wilson (1967). Studies mostly show weak positive correlation of formal education of an individual with his SWB (Diener and Ryan, 2009). For example, Witter et al. (1984, p. 165) concluded based on their meta-analytic synthesis that the education is *"small but positive contributor to adult SWB"* accounting for 1 to 3% of the variance. The authors identified that the relation is stronger in samples of women and in samples of older respondents.

At least part of the relation between the education and SWB seems to be mediated by other variables. Much of the relation is due to the correlation of the education with occupational status and with income (Diener et al., 1999). Researchers also frequently investigate the influence of the formal education to the income inequality. Based on the empirical evidence covering a broad range of countries for the long period of 1960-1990 De Gregorio and Lee (2002) identified that higher educational attainment and more equal distribution of the education make the income distribution more equal. Babones et al. (2007) confirmed the relation between the education and the income inequality and found that the correlation of the education with the income inequality is just about the same in all periods of 1960-2000.

Other mediators may also take place. For example, more educated people seems to be more distressed than less educated when the groups are unemployed (Clark and Oswald, 1994 in Diener et al., 1999). If the education leads to higher expectations and aspirations that cannot be met due to the unemployment, the distress of educated people is higher and hence SWB lower.

To conclude, the direct relation between the formal education and SWB is rather weak. The education seems to have rather indirect effect to SWB through mediating factors such as income, status, aspirations and expectations.

2.5.2 Occupation

The literature considers number of occupation-related variables associated with SWB: type of work; unemployment; hours worked; commuting (Dolan et al, 2008); job satisfaction; job morale etc. Most of people spends considerable part of the life at work and hence the relation between one's SWB and the satisfaction with the profession is highly probable. Work is the important life-domain and job satisfaction is one of the components of the overall life satisfaction (Diener et al., 1999).

Some researchers hypothesized the idea that people in some professions are happier than others. For example, Blanchflower and Oswald (1998) found that self-employed reported higher levels of job and life satisfaction than employees. Alesina

et al. (2004) reported significant positive effect of the self-employment on the individual happiness, but only for the rich people. Moreover, interesting differences were found between European countries and US from the perspective of the political spectrum in the study. Unlikely in the US the self-employment increases the happiness for the left wing subsample only in European countries, but it has no effect on the right. Bardasi and Francesconi (2003) concluded that the atypical employment in Britain[30] did not have adverse health consequences, but job satisfaction was reduced for seasonal/casual workers and higher for part-timers by contrast. Still, the evidence is insufficient to draw clear conclusion about the relation between type of work and SWB (Dolan et al., 2008).

Stutzer and Frey (2008) found that people in Germany with longer commuting time largely reported lower satisfaction with lives on average than non-commuters. Today, commuting becomes quite normal phenomenon in Western countries, because of the increasing specialization and the unemployment. People willing to have jobs appropriate to their qualification and interest must often commute, because they simply cannot find such jobs close to their home and they refuse to move. Commuting *"seems to encompass stress that does not pay off"* for many people (Stutzer and Frey, 2008, p.363).

The evidence is relatively clear that the employment is better than unemployment from the point of view of SWB. The unemployment appears to be the primary economic source of unhappiness (Oswald, 1997). Strong negative correlation of the unemployment with various measures of the well-being has been confirmed by empirical research (Clark, 2009). One would suppose that. Based on Clark and Oswald (1994) those unemployed showed much lower levels of the mental well-being that people in work. Comparing with divorce or marital separation is the employment worse in terms of lost utility units. Other conclusions are that (i) young people as well as people from high-employment areas are less distressed from the unemployment and (ii) those unemployed for a long time were less distressed from the unemployment that those, who had lost their jobs recently. Based on data of German Socio-economic panel (GSOEP) for West Germany before re-unification, Winkelmann and Winkelmann (1998) found that the satisfaction is substantially and significantly impacted by the unemployment controlling various individual characteristics. Factors such as age and reasons for the job termination did not seem to influence

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[30] Part-time employment and temporary employment including both fixed terms contracts and casual (seasonal) jobs.

significantly the effect of the unemployment. Moreover, the non-monetary costs (distress and deprivation for example) exceed the monetary costs arising as a result of a loss of the income due to the unemployment. Cost of unemployment is the topic also for Hill (2000), because he studied the relative costs of the inflation and costs and gains from the disinflation. He showed that employed people are, on average, by far happier that people looking for a job and remarked that the policy of disinflation does not consider the effect it may have on SWB through the higher unemployment. Other researchers concluded similarly on the unemployment effect on SWB. DiTella et al. (2001, p. 340) showed that *"people appear to be happier when inflation and unemployment are low"*. Clark (2003) found that SWB of those unemployed correlated positively with the unemployment in the reference group (it might be a partner; household; neighborhood etc.). Especially for men. The author refers to the social norms in labor market: if the unemployment becomes "normal", it is much less distressing for people. Based on the 15 years longitudinal study Lucas et al. (2004) confirmed the applicability of set-point theory on the case of unemployment. According to that theory people reacted strongly when became unemployed, but their SWB recovered over time towards the original level. Still, regardless the later re-employment, SWB did not shifted back completely to the initial level on average. Moreover, previous experience with the unemployment did not moderated the strong reaction to a new event of the unemployment comparing to people who were not previously unemployed. The negative influence of unemployment on SWB seems to be long term. Helliwell and Putnam (2004, p.1440) concluded their section on the employment this way: *"unemployment is thus likely to represent much more than a loss of income, perhaps reflecting the loss of workplace social capital as well increases in family stress and individual loss of self-esteem"*.

Clear conclusion can be drawn from this section: unemployment is detrimental with no doubt to SWB, which is also fully in line with common sense.

2.5.3 Social relationships

High SWB has been consistently correlated with the high level of sociality (Diener and Ryan, 2009). The association of SWB with the relations with other people is a two way, there seems to be a causal loop. People with the high baseline SWB usually have more supportive and closer relationships with others than those having lower SWB, but the causality works the other way round too. The levels of SWB of people, who have more friends and greater family, tend to be higher. Supportive relations are clearly a causal factor of high SWB (Diener and Ryan, 2009). For example, Umberson et al. (1996) found the evidence on the association of the supportive relations with the low level of the psychological distress for women and men, while strained

relationships were associated with the higher level of distress of both gender. Based on meta-analysis Pinquart and Sörensen (2000) identified that quality and quantity of social contacts of elderly people are associated with SWB, where, in general, the quality of their social contacts showed stronger association with SWB than does the quantity of social contacts. The quantity of the contacts with friends seems to be more important for SWB than the quantity of contacts with adult children for the elderly people, whereas the quality of contacts with the adult children plays more important role in the life satisfaction than the quality of contacts with the friends. Simply, the elderly people appreciate good relationships with their adult children, even if they meet themselves infrequently, as well as having lot of friends around them. Helliwell and Putnam (2004) explored the social context of SWB and found that the social capital measured by family; friends; workplace; neighborhood; religious; and community ties is "strongly linked" to SWB. These forms of the social capital seem to be associated with both happiness and life satisfaction directly as well as through the impact on the health. Haller and Hadler (2006) confirmed the hypothesis that people with close relationships (married people; people with children; people active socially and religiously) are significantly happier than those staying outside of such relations. Dittmann and Goebel (2010) performed an analysis on an effect of various neighborhoods aspects on the life satisfaction and found that it is far most strongly affected by the social contacts than by other aspects. *"People who are in closer contact with their neighbors are more satisfied with their lives"*, authors concluded (Dittmann and Goebel, 2010, p. 511). Simply, it seems that people are happier when they have other people around themselves and social interaction are among the most enjoyable points of the day (Kahneman and Krueger, 2006 in Diener and Ryan, 2009). The well-being within its social context is sometimes referred as social well-being. Keyes (1998) distinguish five dimensions of the social well-being: social integration (how an individual is embedded into the society and the community); social acceptance (what is the individual's picture of the others and the society); social contribution (the evaluation of one's social value); social coherence (the perception of the quality of organization and operation of the social world); and social actualization (the individual belief in the potential and the progress of the society). The social well-being is then based on the satisfaction in its five dimensions.

Quite a few research was made on the association of volunteering with SWB. Thoits and Hewitt (2001) examined the relationship between volunteer works and six components of the personal well-being, happiness and life satisfaction among them. The relation between the volunteerism and the well-being seems to be reciprocal. The authors concluded that the volunteer work and each of the six measured factors of the well-being influence mutually one another: people with the higher levels of the

well-being spend more hours in voluntary works and the volunteer service hours significantly increase the well-being[31]. Greenfield and Marks (2004) claimed that the psychological well-being of older people suffers due to, so called, the role identity absences in particular life domains such as the partnerships and the employment. Such people reported more negative affect and less purpose in life, but beginning a formal volunteer is associated with more positive affect and protect from low levels of purpose in life due to less role identity absences. Based on data from German Socio-Economic Panel (GSOEP) Meier and Stutzer (2008) empirically investigates whether volunteering individuals are more satisfied with their lives. The authors also promoted the idea that the association of SWB and the volunteering is a loop process: high level of SWB has the positive effect on number of volunteer service hours, which increase SWB in turn. Basically the study concludes that the volunteering is rewarding for the volunteers in terms of higher life satisfaction, but also the reverse causation takes place: people satisfied with their lives rather become the volunteers. By chance there was an opportunity for the large unique natural experiment, because of the collapse of East Germany and re-unification. In former East Germany was the volunteering quite common but many civic structures for the volunteers disappeared with the breakdown of the industry after the re-unification. The volunteers were forced to quit and the volunteering dropped dramatically. The life satisfaction of those, who had to stop volunteering after the re-unification, decreased substantially[32]. This and other results of the study support the causal view of the volunteering positively affecting the life satisfaction.

While the social relationships and the volunteering affect SWB positively in general, there are studies suggesting that giving informal unpaid care for other people is associated rather with lower SWB scores. We saw that the working for others could be beneficial for the individual well-being, but SWB is affected negatively if the the autonomy is lost due to the must of giving care to, for example, old or disabled (child; spouse; relative etc.) family member. Then it has a negative effect on SWB. As Ryan and Deci (2001) mentioned, fulfillment the need of autonomy is essential to life satisfaction and psychological health. Marks et al. (2002, p. 657) examined how one's psychological well-being is affected by switching into an episode of the caregiving activity. They showed that *"transition to caregiving for primary kin (child, spouse etc.) is associated with increase in depressive symptoms"* for both women and men in the US. Still, there were some (rather rare) positive effects in selected cases. Details for

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[31] Significant increase was found in measures of happiness; life satisfaction; mastery and physical health.

[32] The authors admitted there might be other interfering factors such as the higher unemployment after the re-unification

different kin are provided by the authors. For example, women who started giving care to a child reported greater autonomy. On the other hand, such women reported also higher levels of the hostility. Wives giving care to their disabled husbands reported lower level of autonomy and purpose in life. The men who had transitioned to the child caregiving episode reported also lower level of personal mastery and happiness. The caregiving to the biological parents in the household was associated with more hostility, less autonomy and personal growth for women as well as with the decline in the happiness. Hirst (2003, p. 336) states that *"heavy involvement in caregiving is often associated with symptoms of anxiety and distress"*. He found that in Britain carers showed higher rates of the psychological distress than non-carers, where the differences between the carers and the non-carers were higher for women than for men (women seem to suffer from giving unpaid informal care even more). Health gap between the carers and the non-carers is wider for those living with person they care for or those giving care for more than 20 hours. The study refined his earlier conclusion two years later (Hirst, 2005). He concluded that the psychological well-being of heavily involved carers is affected worst when the caregiving episodes start and at the end. Risk of the carers distress increases with the amount of time devoted to the giving care and the health of carers may be negatively affected even after the termination of the caregiving episode. Van den Berg and Ferrer-i-Carbonell (2007) attempted to establish the monetary value of the informal unpaid care provision using the well-being valuation method. Unsurprisingly, they identified based on the empirical analysis that *"there is a negative effect of the hours of provided care on the informal caregiver's wellbeing"* Van den Berg and Ferrer-i-Carbonell (2007, p. 1,236). To conclude this part of the analysis, provision of unpaid informal care affects carer's SWB negatively in most cases.

2.6 Personality factors

When researchers came up to the conclusion that the demographic and the other objective factors account for only a little variance in SWB, they turned their attention to inner personal factors.

Personality is one of the most consistent and strongest factors predicting SWB (Diener et al.. 1999). Based on their study on twins Lykken and Tellegen (1996) estimated that about 44% to 52% of the variance in SWB can be explained by the genetic variations and, moreover, almost 80% of the long term (10-years) SWB is heritable. Another study on genes influencing SWB was performed by Weiss et al. (2008) and concluded that the genetic influences are common to SWB and the personality traits. Although Diener et al. (1999) brought some reasons to be careful in

terms of the heritability of SWB, he concluded there was some influence on SWB due to the genetic pre-dispositions and the estimates for the size of this effect varied widely. *"Evidence on genetic influences on well-being is powerful"* (Inglehart and Klingemann, 2000, p. 165).

Dozens of definitions of the personality could be found in literature, probably because the personality is quite uneasy to be characterized. It is out of the scope of my dissertation to review the definitions of the personality in depth and just an examples of an influencing definitions are provided. The personality could be defined as *"a more or less stable and enduring organization of a person's character, temperament, intellect and physique"* (Eysenck, 1970 in Vittersø and Nilsen, 2002, p. 91). The personality could be described with personality traits. Lots of theories are available, but the theoretic mainstream most often operates with five basic and dominant traits[33]. These big traits are neuroticism, extraversion, openness to experience, agreeableness and conscientiousness (Vittersø and Nilsen, 2002). This model of the personality traits is widely used and is probably the most influencing one. The evidence was gained showing that the stable personal characteristics are more useful predicting the individual well-being than life circumstances (Costa et al., 1987).

The attributes of extroversion, optimism, free-worry, high self-esteem and modest aspirations appear in Wilson's (1967) definition of a happy person. Other earlier studies on the personality-related correlates of the happiness listed various factors such as self-esteem, social involvement, ego (Wessman and Ricks, 1966 in Costa and McCrae, 1980), optimism, warmth, emotional stability, sociability, self-insight (Smith, 1961 in Costa and McCrae, 1980). Still, most frequently cited Big 5 personality traits related to SWB are extroversion and neuroticism. They will be examined in Section 2.6.1.

2.6.1 Extraversion and neuroticism

Both these traits are consistently being identified as the best predictors of SWB by many studies while the other three factors of Big 5 model (agreeableness, openness and conscientiousness) were mostly found less important in terms of the influence on SWB (Costa and McCrae, 1980) than extraversion and neuroticism. Costa and McCrae (1980) tested the hypothesis that some personality traits influence the positive affect while the others influence negative affect. They proposed a causal model

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[33] These five traits are often referred to as "Big 5" or "Five Factor Model".

of the personality traits influencing positive and negative affect on SWB, where extraversion (sociability, tempo, vigor and social involvement) predicts the positive affect while neuroticism (anxiety, hostility, impulsivity, psychosomatic complains) predicts the negative affect. The two dimensions are subjectively balanced and the net result is SWB at a certain level (measured as morale, life satisfaction, hopefulness or happiness).

This model of two different sets of the personality traits influencing positive and negative affect separately was supported, for example, by Emmons and Diener (1985a) and stressed in revision by Diener and Ryan (2009). Hotard et al. (1989) found introverted people with good social relationship reporting SWB essentially in the same extent as did the extraverted people. Only introverts with the poor social relationships and neurotic introverts reported low SWB. The strength of the social relationship seemed to be a strong predictor of SWB for only introverted people. The relation of SWB and the extraversion was strong only among highly neurotic individuals with the poor relationships. Hayes and Joseph (2003) reported that extroversion and neuroticism best predicted the happiness (measured by the Oxford Happiness Inventory (Argyle et al., 1989)) and neuroticism and conscientiousness best predicted the life satisfaction measured by Satisfaction with Life Scale (Diener et al., 1985a). Vittersø and Nilsen (2002) confirmed that the neuroticism is the more important predictor of SWB than the extraversion (it explains eight times as much of SWB variance as explains the extraversion), where the neuroticism most largely influence the negative affect and the extraversion largely and uniquely influence the positive affect. A possible explanation for the influence of the extraversion on SWB is based on the findings that extraverts rather than introverts more often participate on social activities and enjoy them. Argyle and Lu (1990) found that about a half of the greater happiness of the extraverts can be explained by their greater participation on the social activities. Another explanation offered Lucas et al. (2000). They suggested that the extraverts enjoy more positive affect (i.e. their SWB is higher) because of their greater reward sensitivity. They tend to seek for social situations simply because they are more rewarding for them. Hence, the sociability of the extraverts *"may be a by-product of reward sensitivity"*. (Lucas et al., 2000, p. 452).

Schimmack et al. (2004) also confirmed the relationship between the extraversion and the life satisfaction as well as between the neuroticism and the life satisfaction. Their study highlighted that more specific personality traits may be useful to examine in order to get the more comprehensive picture. Six subscales for the neuroticism (anxiety, anger, depression, self-consciousness, impulsivity/immoderation and

vunerability) and six for the extraversion (warmth/friendliness, gregariousness, assertiveness, activity, excitement seeking and positive emotions/cheerfulness) were employed. While all the subscales of the neuroticism were negatively correlated with the life satisfaction, only warmth, gregariousness and the positive emotions were positively correlated with the life satisfaction. They performed a set of analyses and found that the depression and the positive emotions/cheerfulness were the strongest and most consistent predictors of the life satisfactions. These facets predicted the life satisfaction *"above and beyond extraversion and neuroticism"* (Schimmack et al. 2004, p. 1,066). They seems to be better predictors than the neuroticism and the extraversion themselves.

Abbot et al. (2008) performed a longitudinal study on the relations between the personality in early life and SWB in midlife. The traits of extraversion and neuroticism were assessed on a sample of women in the age of 16 and 26 (ages of adolescence and early adulthood) and then the psychological well-being was assessed three decades later in age of 52 (midlife). The influence of the individual differences in extraversion and neuroticism in early life on the psychological well-being in midlife was identified. The extraversion was generally associated with higher psychological well-being in all six Ryff's dimensions while the neuroticism with lower psychological well-being in all dimensions. While early extraversion had direct effect on psychological well-being without any mediators throughout the life course, the effect of the neuroticism on the psychological well-being is mediated almost entirely by the emotional adjustment.

Even other recent studies support neuroticism and extraversion as the predictors of different measures of SWB (Lyubomirsky et al., 2006; Schimmack et al, 2002, Furnham and Petrides, 2003; Gutiérrez et al., 2005). To end up this section of the analysis of the personality correlates, the study of Harrington and Loffredo (2001) is to be mentioned. The authors investigated the relationships between the psychological well-being and the life satisfaction at the one side and four Myers Briggs Type Indicator dimensions (Myers et al., 1985). Not surprisingly the extraverts scored higher in both psychological well-being and life satisfaction than the introverts. Intuition rather than sensing types displayed higher psychological well-being and judging types scored better than perceiving types. The fourth dimension (Thinking – Feeling) remained insignificant.

2.6.2 Self-esteem

Self-esteem is quite frequently cited personality correlate of SWB. High level of self-esteem was one of the attributes of a happy person in early Wilson's definition

(1967). Happiness and self-esteem seem to be highly correlated (for example Lyubomirsky et al., 2006). Diener and Diener (1995 in Baumeister et al., 2003), one of the very influential international studies on self-esteem and happiness, found that the happiness is substantially interrelated with the self-esteem, where the self-esteem appeared as the strongest predictor out of the several examined factors. Yet, the influence of the self-esteem does not seem to be universal across cultures. Diener and Diener (1995) found that the correlation was strong in individualistic cultures, but not in collectivistic cultures. Furnham and Cheng (2000) compared the empirical evidence with lay theories on the relation between the happiness and six factors and found self-esteem, extraversion and neuroticism to be direct predictors of the happiness, where the self-esteem was the most dominant one. Karatzias et al. (2006) examined self-esteem and affectivity as predictors of the happiness among secondary school pupils in Scotland and identified that total well-being as well as self/others well-being can be best predicted by home self-esteem while school self-esteem was the strongest predictor of the psychical well-being.

2.6.3 Optimism

The optimism is another personality-related variable often mentioned in the connection with SWB. The optimism is most often defined as *"generalized positive outcome expectancies"* (Chang et al., 1994, p. 144). Optimistic people *"expect things to go their way and generally believe that good rather than bad things will happen to them"* (Scheier and Carver, 1985, p. 219) while pessimistic people believe in the opposite way. In their meta-analytic review Alarcon et al. (2013) found that the optimism can be empirically distinguished from each of the Five Factor Model traits. It is another dimension of the personality. The optimism is hence redundant with neither neuroticism nor any other Big Five traits. Also, the optimism should be distinguished from hope. On the other hand, the authors pointed out that the optimism overlapped considerably with resilience and self-esteem. Lay opinion on the relation between the optimism and SWB suggests that optimistic people would rather have higher levels of SWB. Literature basically supports this view. Chang et al. (1997) identified that both optimism and pessimism (found to be separate constructs) significantly correlates with the life satisfaction even after positive and negative affectivity is controlled. Wrosch and Scheier (2003) discussed the relation between the personality and the quality-of-life and identified that SWB as well as the good health is facilitated by dispositional optimism, where the dispositional optimism is defined as *"a relatively stable generalized expectation that good outcomes will occur across important life domains"* (Wrosch and Scheier, 2003, p. 64). In this view, the optimism is understood as personal disposition; it is time unlimited and not related

to the momentary individual situation. It is the stable general tendency of an individual rather than a reaction to a particular event. More recently, literature reviews has appeared (Carver et al., 2010; Alarcon et al., 2013) and confirmed that the optimism was positively related to psychological well-being, happiness and life satisfaction and *"higher levels of optimism have been related prospectively to better subjective well-being in times of adversity or difficulty"*(Carver et al, 2010, p. 879). Diener et al. (1999) mentioned in their review that positive illusions such as unrealistically positive self-perceptions, over-optimistic views of the future may also enhance SWB.

2.6.4 Meaning and purpose in life

The importance of the meaning in life was first promoted by Austrian psychiatrist Victor Emanuel Frankl (Frankl, 1959; Frankl, 1962), the founder of logotherapy and existential analysis. The meaning in life has been lasting topic in the research discourse since that and is commonly viewed as an important component of the good life (King et al., 2006). Meaning in life can be defined as *"a sense of one's life having a purpose or investing time and energy into the attainment of cherished goals"* (King et al., 2006, p. 179). For Reker and Wong (1988 in King et al., 2006, p.179) the meaning in life is experienced by an individual if he or she has a sense of coherency in his or her life. In Ryff's six dimensional model of psychological well-being (Ryff and Keyes, 1995) the meaning of life (purpose of life) consists one of the basic dimensions. Sense of directedness, goals in life, feeling of meaning are important attributes of an individual scoring high in this dimension of the psychological well-being according to Ryff and Keyes. Various other studies in this field are available. For example, Reker et al. (1987) studied life purpose and other five life attitude dimensions across life span. The life purpose together with future meaning and life control were found to predict the psychological well-being while existential vacuum, goal seeking and death acceptance predicted psychological (and physical) discomfort. Zika and Chamberlain (1987) found that the meaning in life consistently predicted positive well-being, while the effects of other examined personality variables (locus of control and assertiveness) were less consistent among college students. Later on, same authors (Zika and Chamberlain, 1992) examined populations of mothers at home with small children and elderly adults and found strong positive correlation between the meaning in life and positive dimensions of the well-being such as life satisfaction, psychological well-being and positive affect, and negative correlation with psychological distress and negative affect. Debats (1996) concluded that the meaning in life is a clinically relevant construct from the point of view of psychotherapy and has predictive power to both positive and negative aspects of the well-being of the clinical population. The author stated that the sense of the meaning in life plays a crucial

role in one's mental health in the clinical population. It hence seems there is a causal influence of the meaning in life on the psychological (mental) health instead of simple correlation between the two variables. Similar conclusion was reached by Mascaro and Rosen (2005) on a non-clinical population (college students). King and Napa (1998) examined folk perceptions of a good life as a function of the experience of meaning in life, happiness and wealth on two samples (college students and community adults). The meaning in life as well as the happiness were found essential to the folk judgement of the good life in both samples whereas the wealth seemed to be rather unimportant (the wealth has little relevance for the judgement of the good life for community adults and is largely irrelevant for the college students). Compton (2000) identified that the correlation between scores of the meaningfulness and SWB were significantly greater than the scores of other predictors, where all other examined predictors (self-esteem, locus of control, optimism and positive relations) also displayed significant correlations with all three variables of SWB (affect balance, life satisfaction and happiness). Moreover, the author hypothesized a model for the prediction of SWB where the meaningfulness is a mediating factor between other examined personality variables and SWB. King et al. (2006) performed a set of six studies on the positive affect and the experience of the meaning in life and concluded, among other conclusions, that positive affect and meaning in life are strongly related, where the positive affect enhances the experience of meaning in life. Thoits (2012) found that the well-being is affected by salient identity through the purpose and life meaning within the population of volunteers of a national wide, non-profit, self-help organization. The perceived meaning in life is found to be the mediating mechanism through which the well-being is influenced by the volunteer role identity salience.

To finish up the section on the meaning in life we also need to mention the relation to the religiosity even if the association of the religiosity and SWB has already been examined within this review earlier. Religious commitment seems to play a certain role in reinforcing the sense of the meaning in life as the world's traditional great religious systems incorporate doctrines on the life-meaning within themselves. The religion may hence provide a source of meaning and purpose for people (Petersen and Roy, 1985). They found that only the religious salience out of five examined religiosity measures (religious salience, church attendance, orthodoxy, religious comfort beliefs, and orientation to the other world) had a significant independent effect on meaning and purpose in life.

We can conclude the whole section of the personality factors with the statement that the personality traits of extraversion and neuroticism as well as other factors such as optimism, self-esteem and meaning in life play important roles for the long

term SWB. The personality shows some of the strongest relation with SWB (Diener et al., 1999). It seems that the personality traits matter in the long term, while life circumstances and events play the role rather in the short term.

2.7 Wider environmental factors

The group of diverse wider environmental factors seems to have some effect on SWB. Culture, degree of democracy, political orientation, criminality, human rights, inflation, unemployment, urbanization, nature environmental condition are some of those frequently mentioned. Some of the factors are out of direct control of an individual while others are common to the whole nation (e.g. democracy, culture).

2.7.1 Culture differences

The differences in SWB across nations and cultures are frequently researched topic. The differences among countries and nations have already been touched earlier in this review when Easterlin paradox was discussed. Diener and Diener (1996) examined nationally representative samples of 43 nations and found that generally there is the positive level of SWB throughout the industrialized societies over time. The mean SWB was above the neutral point in 86% societies (including the countries such as Brazil, Egypt, Mexico and Thailand). On the scale from 0 (most unhappy) to 10 (most happy) the mean of the nation's means was 6.33. In other words, people across the world are mostly happy with the only possible exception of the very poor societies, where the basic needs are not met. In order to get the picture of SWB in societies with no industrialization Biswas-Diener et al. (2005) focused on rarely studied unindustrialized societies living in materially primitive conditions – Kenyan Maasai, Amish in the United States and Inughuit in Greenland. Although there were some differences in reported happiness, satisfaction and affect, they all reported positive levels of life satisfaction, domain satisfaction (varied depending on life circumstances) and frequent positive emotions rather than negative ones despite their relatively poor living conditions. People reported they were happy, but not overwhelmingly. 84% of all participants scored above neutral. It is the result resembling to industrialized countries. Biswas-Diener and Diener (2006) examined SWB in societies where only a few basic needs are satisfied: homeless people in Calcutta (India) and in California and Oregon. As one would predict, SWB of such people is low, but the homeless in Calcutta showed higher levels of the life satisfaction (they scored above neutral) than the homeless in the United States (their mean life satisfaction was below neutral) even if the access to shelter, medical care, employment etc. is better in US than in India. All the three samples scored above neutral on the

majority of domains except material satisfaction, income, housing, privacy and health (only Calcutta sample).

Inglehart and Klingelmann (2000) mentioned that basically all historically Protestant societies score relatively high levels of SWB despite the most of the people does not regularly attend churches anymore. Moreover, historically protestant countries, which were later under the communists rule (East Germany, Latvia, Estonia), showed higher levels of SWB comparing to former communist countries with no protestant tradition.

Some authors point out that there are the differences between individualistic and collectivist cultures. Diener and Diener (1995 in Diener and Ryan, 2009, p. 399) identified that the self-esteem is a strong predictor of SWB in the individualistic cultures, but not in the collectivist cultures. Schimmack et al. (2002) found that extraversion and neuroticism influenced the hedonic balance (balance of positive and negative affect) in the same extent in both individualistic and collectivist cultures, but hedonic balance was a stronger predictor of the life satisfaction in the individualistic (United States, Germany) than in the collectivist (Japan, Mexico, Ghana) cultures. Hence culture moderates the influence of the personality traits on the cognitive component of SWB (life satisfaction).

Although there are some universal factors related to SWB across cultures, cultural differences in terms of SWB are evident to exist (Diener and Ryan, 2009). It seems there are lots of research to be done, but the general idea that SWB might be affected by the culture need to be taken in account.

2.7.2 Democratic governance

Four central European countries examined in this dissertation are all democracies. The democratic governance is hence common to all individuals within the sample. Still, it would be useful to briefly analyze the influence of the governance. Higher levels of the democracy are usually expected to generate policies that are more in line with the preferences of median voters and it leads to their higher SWB (Dorn et al., 2005). The often used laboratory for the research on the effect of political institutions and democracy is Switzerland, because its federal structure of 26 cantons gives variation in the political institutions and direct popular rights (Dolan et al., 2008). Frey and Stutzer (2000a) performed an empirical cross-sectional studies on a representative sample of cca 6 thousand Swiss households and concluded that the institutions of direct democracy such as initiatives and referenda as well as local autonomy are associated with the greater citizen's happiness. Furthermore, the higher level of happiness is partly due to the utility derived from the political process itself and not only

due to the favorable political outcomes. Both factors *"systematically and sizably raise self-reported individual well-being"* (Frey and Stutzer (2000b, p. 918).

Their results were later challenged by Dorn et al. (2005) and Dorn et al. (2008). Dorn et al. (2005) performed the analysis also by the cantons in Switzerland, but also used different dataset (Swiss Household Panel) and controlled for the culture differences (language variables were used as a proxy for the culture). They found that the personal happiness is not significantly impacted by the levels of the direct democracy in different cantons when the cultural differences among the Swiss cantons are controlled for. While German speaking part of Switzerland showed no relationship between the democracy and the perceived happiness, in French speaking part the democracy was positively related to the perceived happiness. The analysis of Swiss cantons was supplemented with an international cross-sectional analysis covering 28 countries, where highly significant relationship between the democratic governance and SWB was identified. The interesting point is that the effect of the democracy on the life satisfaction is smaller in transition countries than in countries with long term tradition of democracy.

Inglehart and Klingemann (2000) examined the data from World Value Surveys and identified that the level of SWB in a given society is closely associated to the flourishing of the democratic institutions. The correlation coefficient between these two variables is as high as 0.78. While the simple relationship is hard to challenge, the conclusion over the causal direction is not so straightforward. The authors see attractive the idea that better democratic institutions cause higher levels of SWB as it advocates the democracy as a way to the happy life. By contrast to such a causality the authors suggested the examples of completely opposite evolution in Weimar Germany, Russia after 1991 and China. Despite the process of democratization, the levels of SWB fell strongly in cases of the first two. There were factors that surpassed the possible effect of the democratic governance. On the contrary, there is no democracy in China but the population shows pretty high levels of SWB. The authors conclude that the democracy *"probably makes some contribution to human happiness"* Inglehart and Klingemann (2000, p. 180). Similarly, Owen et al. (2008) identified that the democracy itself as well as the opportunity to participate in political process and democratic constitutional structure are positively correlated with SWB (after controlling individual and country characteristics). On the other hand both competitiveness of executive recruitment and constrains on executive power are not significant in terms of SWB. The strong positive association between the happiness and the levels of democracy (measured by the combination of the indicators such as electoral process, pluralism, the functioning of government, political participation,

political culture and civil liberties) was found by Veenhoven and Berg (2013) in their study on the modernization. Although it is traditionally assumed that causal direction goes from the democracy to the happiness, some researchers suggest the opposite direction: happy and satisfied population is prerequisite for the democracy (Weiner, 2008).

2.7.3 Inflation and unemployment

The inflation and the unemployment are traditionally seen as related (at least in short term) in the economic literature. This relation is usually described with Philips curve in the mainstream economic theory. This curve, empirically derived by William Phillips (Phillips, 1958) from historical data, shows trade-off between the rates of unemployment and the corresponding rates of the inflation in short term (the relationship was not observed in long term). The effect of the unemployment has already been examined in the chapter on social factors with the clear conclusion that *"unemployment has a strongly depressing effect on happiness"* (Frey and Stutzer, 2000b, p. 918). While the devastating effect of the unemployment seems to be indisputable, it would be useful to make a brief review of the influence of the inflation too.

The effect of the inflation on the happiness was examined, for example, by DiTella et al. (2001, p. 340), who found that *"people appear to be happier if inflation and unemployment is low"*, where the depressing influence of the unemployment on SWB seem to be greater than the one of inflation (even after controlling the personal characteristics of the respondents). The authors estimated the ratio of 1.7:1 of the increase in the inflation to the employment[34]. Similarly, Graham and Pettinato (2001) identified that the inflation had the significant negative effects on the happiness in US, UK and Latin America. Wolfers (2003) examined the effects of the economic volatility on SWB and found the evidence that the volatile inflation as well as the unemployment undermined the measures of SWB such as life satisfaction, happiness, where the effect of the inflation seemed to be rather smaller than the one of the unemployment. DiTella end McCulloch (2005) confirmed that SWB is negatively correlated with both the inflation and the unemployment after controlling for various personal and country-specific influences and added that the right-wingers seemed to be more concerned on the inflation comparing to the left-wingers who tend to care more about the unemployment. Similar findings of different impact of the inflation on right and left wingers on SWB was reached also by Alesina et al.

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[34] It means that the increase in the inflation of 1.7 percentage-point has the equal effect on the happiness as the increase of a percentage-point in the unemployment.

(2004). The inflation was worse for the life satisfaction of the right wingers while the inequality was worse for the life satisfaction of the left-wingers.

The conclusion to be drawn from this short analysis is that both the inflation and the unemployment have the negative effects of SWB, where SWB seems to be more damaged by the unemployment than by the inflation.

2.7.4 Political view

As seen in Section 2.7.3 the intensity of the effect of the inflation and the unemployment on SWB differs between the right and left wingers. Still, the research on relation between the political view and SWB is not widespread (Dolan et al., 2008). Nevertheless, a study on the political persuasion and the happiness has recently appeared (Napier and Jost, 2008). The authors performed three studies on the representative data from US and nine other countries and found that the right wing (conservative) orientation is associated with the higher SWB comparing to left-wing (liberal) tendency and suggested the ability to rationalize the economic inequality as a mediator between the two variables. The conservatives are stronger in this ability of the rationalization of the inequality – they are, better than the liberals, able to accept the fact of the economic inequality emerging from a fair, legitimate system, and make it a part of their belief of how things work. It explains why the conservatives are, on average, happier than the liberals around the world based on the authors.

2.7.5 Climate and pollution

The changes in the natural environmental can hardly be called into the question nowadays. Pollution, global warming, ozone hole and their impact on the existence of the human being are widely discussed. How these factors affect SWB?

The research on this topic seems to be rather limited. Welsch (2002 in Dolan et al., 2008) provided some evidence of detrimental effect of the pollution measured by the level of the nitrogen dioxide on the overall happiness. A study of Rehdanz and Maddison (2005) is focused on the differences in the self-declared levels of the happiness to the climate conditions. It is one of the few recent studies that is aware of the future changes in the happiness distribution caused by the changing climate. They found that although the happiness is not significantly affected by the precipitation, the climate does have the substantial effect on the self-reported happiness. Whereas higher mean temperature in the coldest month increase the happiness, higher mean temperature in the hottest month decrease the happiness. It is hence not surprise that the people in the low latitude countries would on average suffer from the climate changes in terms of the happiness. The happiness of people in the limited number of

high latitude countries (Canada, Scandinavian countries) might profit from the climate changes on the other hand. Becchetti et al. (2007) also found the evidence that several climatic factors such as rain, fog, temperature and wind are linked to the life satisfaction, but did not support fully the conclusion of Rehdanz and Maddison (2005). Instead of they found that the life satisfaction decreases average number of foggy days and average maximum wind speed. On the other hand the effect of the precipitation is hump-shaped. The life satisfaction increases with the number of rainy days up to peak of 110 days a year and then starts dropping. On the other hand, the relation of the life satisfaction and the temperature is U –shaped, where the minimum level of people satisfaction is 63 degrees Fahrenheit (approx. 17 degrees Celsius). This results indicated that the global warming will not necessarily have a negative effect on the human happiness at a worldwide level.

Ferrer-i-Carbonnel and Gowdy (2007) researched the relation between individual attitudes to the environmental degradation (the loss of environment quality) and SWB in Britain. Two such attitudes were examined – ozone pollution and species extinction. They found that the concern about the ozone pollution is negatively associated with SWB while the concern about species extinction is associated positively. The authors also suggest that, rather than the pollution itself, it is the individual preoccupation with the pollution, which affect SWB. Significance and direction of both correlations remain unchanged even if additional variables are employed. It plays no role whether or not the person lives in a polluted environment and whether or not engages in outdoor leisure activities. Similarly, neither the region where the person lives nor the personality traits are important.

Happiness and life satisfaction have started to be used for the purposes of the environmental valuation recently as an alternative to the standard valuation techniques. This novel nonmarket valuation approach is based on the modeling individual self-declared happiness as a function of income and environmental conditions. The output of the valuation is to establish the increase of the income necessary to compensate the decline in the environmental quality for an individual. The overview of the method and its applications and issues is provided, for example, by Welsch and Kühling (2009) and Frey et al. (2010). The studies using this happiness / life satisfaction based approach for the environmental valuation can be used to examine the relationship between the happiness and various environmental factors. For example, Welsch (2003, p. 15) has found that *"air pollution plays a statistically significant role as a predictor of inter-country and inter-temporal differences in SWB"* in ten European countries. Similarly, MacKerron and Mourato (2009) found that the life satisfaction

in London is significantly negatively related with both subjectively perceived and objectively measured levels of the air pollution when range of other effects was controlled (personal characteristics, distance from major roads etc.). Luechinger (2009) identified the negative effect of the pollution on SWB in Germany controlling factors such as unemployment, reunification of Germany, rural/urban trends etc. Levinson (2012) remarked that the interviewed people reported lower level of the happiness on days with worse local air pollution situation in US. Finally Ferreira et al. (2013) found a significant negative impact of the Sulphur dioxide pollution on the self-reported life satisfaction in Europe.

The factors analyzed in this section are quite heterogeneous, whereas other environmental characteristics being associated with the level of the individual SWB could certainly be found. It seems than environmental conditions are mostly somehow associated with SWB, but are usually under limited control of the individuals.

2.8 Czech discourse

SWB and its economical connotations are obviously addressed in Czech and Slovak discourse too, whereas psychologists and sociologists rather than economists are mainly focused on it. Kebza and Šolcová (2003) provided an analysis of SWB predominantly from a psychological point of view, whereas Heřmanová (2012) summarized the approaches and main theoretical models of quality of life (QoL) and noted that research on QoL is currently focused mainly on its subjective aspects, and presented models in which subjectively perceived well-being is embedded. Increased importance of subjective perception and evaluation of one's own life in QoL research was also noted by Hamplová (2006). In her earlier study Hamplová (2004) examined the influence of socio-demographic factors on satisfaction, but the association with income and wealth were not in the scope of that work. Večerník and Mysíková (2014) compared the influence of job satisfaction on SWB between eastern and western European countries. Večerník (2014) investigated the micro- and macro-economic aspects of SWB in six central European countries (Austria, Germany, Czech Republic, Hungary, Poland and Slovakia) and identified, inter alia, that the effect of household income on satisfaction is rather weak, although statistically significant. Finally, based on the data of EU-SILC for the Czech Republic, Mysíková and Večerník (2016) found that the relationship between job and life satisfaction are significantly interrelated and suggested the explication for that. They also found that the life-satisfaction is influenced, inter alia, by the economic status and income, whereas the life satisfaction of people having the above-median income is improved of 40% compared to others. A study by Fialová and Štika (2015) assesses well-being

in the Czech Republic and neighboring countries using various established measures including the Human Development Index, which has a component of income (authors concluded that the current well-being in the Czech Republic is moderate among the OECD countries). Comprehensive insight into the relationships between economic theory and happiness was provided by Mlčoch (2007). The author concluded that the relationship between economic prosperity and happiness exists, but there is no simple causality from economic growth to greater happiness. On the other hand, happiness can cause economic prosperity as a by-product.

2.9 Research focus and hypotheses

As apparent from the above analysis, SWB is complex and multidisciplinary topic. Out of this huge number of factors analyzed in this chapter I focus only on those related to the individual material situation in my research.

The individual material situation can be defined several ways using resources, consumption and standard of living approaches as discussed in Section 2.2.5. For our purposes we use the following definition.

Definition 8: Individual material situation is person's or household's income together with savings, assets and other financial resources as a whole serving to satisfy the material needs of the person or household[35].

The research is focused on the situation in central Europe. For the purpose of this research Central Europe means the Czech Republic, Hungary, Poland and Slovakia.

Following the thesis goals and research questions set in the introductory chapter the hypotheses are formulated in this section. Based on the literature review performed in this chapter the hypothesized answers to the first research question are:

Hypothesis 1a: People having the above median income are happier than those having the below median income in central Europe.

Hypothesis 1b: People having the above median income are more satisfied with their lives than those having the below median income in central Europe.

The second research question deals with the subjective evaluation of the individual financial situation comparing to a certain standard. As we saw, the principal standards might be based on the financial situation of others and one's own financial

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[35] The term material situation is used by Christoph (2010) in this context. The terms "wealth"; "material conditions"; "material living conditions; "material well-being"; "material circumstances" etc. describe the same thing and are used synonymously.

situation in past. Four more working hypotheses (for each of the two standards one for happiness and one for life-satisfaction) are set:

Hypothesis 2a: People in central Europe evaluating their current financial situation as better compared to most people in the country are happier than those evaluating it as worse.

Hypothesis 2b: People in central Europe evaluating their current financial situation as better compared to most people in the country are more satisfied with their lives than those evaluating it as worse.

Hypothesis 3a: People in central Europe evaluating their current financial situation as better compared to their own financial situation 12 months ago are happier than those evaluating it as worse.

Hypothesis 3b: People in central Europe evaluating their current financial situation as better compared to their own financial situation 12 months ago are more satisfied with their lives than those evaluating it as worse.

The third research question deals with the perceived economic strain. The hypothesized answers to the questions are:

Hypothesis 4a: People in central Europe who are able to make ends meet easily are happier than those making it with difficulty.

Hypothesis 4b: People in central Europe who are able to make ends meet easily are more satisfied with their lives than those making it with difficulty.

The fourth research question is about material deprivation, defects in housing conditions and financial problems. Six more working hypotheses (two versions for each of the three factors) are set:

Hypothesis 5a: People in central Europe who can afford things if they would like to get them are happier than those who cannot.

Hypothesis 5b: People in central Europe who can afford things if they would like to get them are more satisfied with their lives than those who cannot.

Hypothesis 6a: People in central Europe who are able to pay bills as scheduled are happier than those who are unable to.

Hypothesis 6b: People in central Europe who are able to pay bills as scheduled are more satisfied with their lives than those who are unable to.

Hypothesis 7a: People in central Europe who do not have problems with housing are happier than those who do.

Hypothesis 7b: People in central Europe who do not have problems with housing are more satisfied with their lives than those who do.

The above defined hypotheses are explored in Chapter 3. The last research question deals with conditional independence relations among SWB and the variables of the individual material situation. We seeks the answer to this last question in Chapter 4 on the probabilistic modelling. This part of the research is in nature inductive with a considerable qualitative part and no hypotheses are formulated in this case.

3 Statistical analysis

The hypotheses set in the Section 2.9 are examined using the appropriate statistical methods in this chapter. It is the empirical quantitative research based on deduction[36] in nature.

3.1 Data

The analysis is based on the data of the European Quality of Life Survey (hereinafter referred as "EQLS"), carried out by the European Foundation for the Improvement of Living and Working Conditions, an EU agency monitoring the quality of life in the EU. The study covers a broad range of domains and includes necessary information on happiness; life satisfaction; and material situation. The first survey was conducted in 2003 and it was repeated in 2007, 2011, and 2016. Since introduced, the EQLS is *"widely established tool for documenting and analyzing quality of life in the European Union"* (Ahrendt et al., 2015, p. 626). The EQLS data are frequently used for various analyses of SWB, for example Fahey, 2007; Whelan and Maitre, 2007; Böhnke, 2008; Aldabe et al., 2011; Zagorski et al., 2014; Ahrendt et al., 2015 etc.

For example, Fahey (2007) used EQLS data from 25 EU countries and 3 candidate states in a paper promoting a shift towards an EU-wide poverty indicator. The author clustered the countries into 4 clusters and noticed that people in the lower-income quartile in the richest EU states are still less likely to be deprived and have fewer financial problems and housing defects on average than those in the upper-income quartile in the poorest EU countries. The situation in Europe as a whole in terms of poverty was also studied in the paper by Whelan and Maitre (2007) using EQLS data for income, material deprivation, and economic strain. They suggested income as a more powerful predictor of deprivation in the poorer countries than in richer ones. Still, SWB remained outside of the scope of this study. On the contrary, Zagorski et al. (2014) suggested, using also EQLS data, that national-level income inequality as measured by Gini coefficient does not reduce individuals' overall well-being, subjective health, and financial quality of life (satisfaction with standard of living; subjective poverty; and affordability of goods and services) in advanced societies.

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[36] Deductive approach to research means reasoning from the general to the particular. Under this approach hypotheses are developed based on existing theory and tested in the particular context.

The data from the fourth edition of the EQLS conducted in 2016 (Eurofound, 2018a) are used for the statistical analysis made in this chapter. The only exception is the testing the two hypotheses on the association of SWB with the relative income compared to others, which is based on the data of the third survey of EQLS conducted in 2011 (Eurofound, 2014), as the corresponding question on relative income is not included in the fourth wave of the survey.

The details on the fourth survey sampling and data processing are available in the EQLS Technical and Fieldwork Report (Eurofound, 2018b). The fourth wave was carried out in the entire EU (28 member states) and 5 candidate countries in 2016 by a network of national institutes coordinated by the Kantar Public central coordination team in Brussels. In the four countries of central Europe the data were collected from September 2016 to February 2017. The fourth wave has been the latest completed edition of EQLS.

The statistical population of the study included persons aged 18 and over who reside in the country at the time of data collection. The achieved final sample size after the quality control was 1,014 in the Czech Republic; 1,042 in Hungary; 1,009 in Poland; and 1,019 in Slovakia[37] (4,084 in the four central European countries together). A clustered, multi-stage stratified sample design using random probability sampling procedures at all stages of sample selection was adopted to select the respondents, whereas all members of the survey population had a non-zero probability of being included in the sample.

Sample stratification was based on the two variables: geo-administrative region and level of urbanization. Geo-administrative stratification was designed based on NUTS regions. NUTS2[38] was used in all four central European countries. The stratification according to the urbanization was designed based on DEGURBA[39]. All four central European countries were stratified according to DEGURBA. Primary Sampling Units (PSU's) as the clusters were selected based on LAU2[40] in all four central

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[37] Target sample size was 1.000 in case of each of the four Central European countries.

[38] Nomenclature des Unites Territoriales Statistiques (Classification of Territorial Units for Statistics). NUTS2 represents the regions for the application of regional policies with the population thresholds of 800.000 to 3.000.000 (European Parliament and the Council, 2003).

[39] Degree of urbanization. It distinguishes three levels: "Cities" (or "Densely populated areas", "Towns and suburbs" (or "Intermediate density areas", and "Rural areas" (or "Thinly populated areas") (European Parliament and the Council, 2003).

[40] NUTS3 are subdivided into one or two further levels of territorial units called „Local Administrative Units" (LAU) (European Parliament and the Council, 2003).

European countries[41]. There were 125 PSU's in the Czech Republic; 100 PSU's in Hungary; 70 PSU's in Poland; and 100 PSU's in Slovakia. Only few very remote locations or LAU's with only a few addresses were not covered. The national registers of addresses were used as sampling frames for the selection within PSU's in the Czech Republic, Slovakia and Poland[42]. The ad-hoc sampling frame based on enumeration prior to the data collection through the random walk was used in Hungary[43]. Where more than one household was identified at an address, selection of the household at the address was made in the third step of sampling process randomly and all households at the given address had the same chance to be selected. The last step was the selection of the respondents in the households. There was only one interview per household held where the adult household member with the next upcoming birthday was taken randomly as the eligible respondent.

Given the sample size and the sampling procedures the EQLS samples can be considered representative of the total statistical population to be covered in each surveyed country.

Whereas the relative income compared to others must have been tested based on the data from the third wave of EQLS, the data and sampling procedures adopted in the third wave of EQLS conducted in 2011 need also be described. The description is provided in Chapter 4 together with the description of data and measures used for probabilistic modelling.

3.2 Measurements

Both used editions of EQLS provide the adequate amount of data from the point of view of variables selected. The details on the measures and how they were processed from the dataset are outlined in this section.

The individual material situation includes subjective and objective variables whose association with SWB is expected based on literature.

Definition 9: Subjective variables of the individual material situation are based on a person's subjective perception. They include:
- relative income compared to others;
- relative income compared to past; and

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[41] Six large LAU2s were split into a total of 483 electoral districts in Slovakia.

[42] The coverage was 100% in the Czech Republic, 95% in Poland and near 100% in Slovakia at the time of the fieldwork.

[43] Good quality sampling frame was not available in Hungary. All PSU's in Hungary were enumerated by 88 enumerators well in advance of the main fieldwork.

- perceived economic strain.

Definition 10: Objective variables of the individual material situation are based on objective conditions. They include:
- income;
- financial problems;
- material deprivation; and
- housing problems.

Definition 11: Financial problems mean a person's inability to pay bills as scheduled.

Definition 12: Housing problems mean an existence of defects in a person's housing conditions.

3.2.1 Subjective well-being

Measuring SWB can be a bit tricky as this is highly subjective variable being influenced by the context of the data collection. Probably most widely used approach for measuring SWB is "Satisfaction With Life Scale" (SWLS) designed by Diener et al. (1985a). This scale is based on five statements on life satisfaction as a whole. It should measure overall life satisfaction without respect to any specific domain. Other popular measure is usually referred as Cantrill scale after its author (Cantrill, 1965). It provides an image of a ten step "ladder of life", where the step 0 represents the worst possible life and step 10 the best possible life, and there is only a single question of where on the ladder the respondent feels personally standing at? Watson et al. (1988) developed two 10-item largely uncorrelated mood scales that comprise positive and negative affects. The scale is hence called Positive and Negative Affective Scale (PANAS). Based on the authors, the scales are stable over a 2 months period. The scales do not reflect reasons of the measured affects. Relatively new and complex is Personal Wellbeing Index (PWI), which was invented by researchers in Australian Centre on Quality of Life (International Wellbeing Group, 2013). Surely, there are other available approaches, some of them are quite complex measuring more dimensions of the well-being, for example, Ryff´s scales of psychological well-being (RPWB) (Ryff, 1989).

The measures of SWB defined in the EQLS are not based on the above outlined approaches, but the logic is close to the ladder of life. There is no single question on SWB available in the fourth survey of the EQLS. There are two questions instead, one

on happiness and the second on life satisfaction provided[44]. The EQLS question of happiness is formulated in the following way: "Taking all things together on a scale of 1 to 10, how happy would you say you are?" Code 1 means very unhappy and 10 means very happy on the scale. Similarly, the question of overall satisfaction is: "All things considered, how satisfied would you say you are with your life these days?" Again the scale of 1 to 10 is given, where 1 means very dissatisfied, and 10 means very satisfied. The 10-point scales are not modified for the purposes of the statistical analysis made in this chapter.

3.2.2 Household income

People are often cautious stating their household income. In the EQLS, the question on income is relatively crude (Whelan and Maitre, 2007; Fahey, 2007) and it has quite a high percentage of non-response. Only 2,926 EQLS respondents from the four examined countries out of the 4,084 stated their income in the fourth survey (non-response rate of 28.4%). In both used EQLS surveys the respondents were asked either exact or estimated total net income per month from all sources of all members of the household[45]. The equivalised household income based on purchasing power parity euros is used for the analysis to obtain comparable figures[46]. The equivalised income is provided within the EQLS dataset. The respondents neither stating nor estimating their income are excluded from this test of the relationship between SWB and the level of income[47]. The sample of 2,926 respondents having stated their household income is divided into the quartiles based on the income level for the purpose of the statistical analysis made in this chapter (all respondents having declared their income also stated both their level of satisfaction and that of happiness).

3.2.3 Relative income

The relative standard derived from the comparison with others is estimated using the EQLS question: "Could you please evaluate the financial situation of your household? In comparison to most people in your country, would you say it is much worse,

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[44] Question 5 on happiness and question 4 on life satisfaction in the fourth EQLS wave conducted in 2016.

[45] Only one interview per household was held.

[46] The income quartiles are the same across all four examined countries; they are not constructed separately for each country. The income is equivalised in order to take the household composition into consideration.

[47] Omission of the respondents not having reported their income may not be a problem in case the values are missing at random (MAR). The income is one of the variable where values may be missing systematically, for example, when rich households are reluctant to state their income. MAR is impossible to be verified statistically and is assumed for the further analysis.

somewhat worse, neither worse nor better, somewhat better or much better?"[48] This variable had to be taken from the third survey of EQLS carried out in 2011-2012, because the fourth survey contained no questions on evaluating one's own financial situation as compared to other people in the country. In the third survey a total of 5,114 out of the 5,298 EQLS respondents from the four examined countries answered the above-mentioned survey question as well as both questions on SWB. No adjustment to this 5-point scale was made for the purpose of the hypotheses testing in this chapter.

The relative standard derived from the comparison with one's own past is approximated with the EQLS question: "When you compare the financial situation of your household 12 months ago and now, would you say it has become better, worse or remained the same?"[49] 4,035 out of the 4,084 EQLS respondents from the four examined countries answered the question as well as the questions on SWB in the fourth wave. No transformation of this 3-point scale was made for the purpose of the hypotheses testing in this chapter.

3.2.4 Perceived economic strain

There is a single question available for investigating whether the income is sufficient to cover each household's necessary expenditures: "A household may have different sources of income and more than one household member may contribute to it. Thinking of your household's total monthly income: is your household able to make ends meet very easily, easily, fairly easily, with some difficulty, with difficulty or with great difficulty?"[50] No adjustments to this 6-point scale were made for the purposes of the hypotheses testing in this chapter, where the data of 3,993 out of the 4,084 respondents having answered the relevant questions were analyzed.

3.2.5 Material deprivation

The EQLS question related to the factor of material deprivation has six sub-questions. Respondents are asked the question: "There are some things that many people cannot afford, even if they would like them. For each of the following things on this list, can I just check whether your household can afford it if you want it?"[51] The list of things includes:

....

[48] Question 57 in the third edition of EQLS.

[49] Question 98 in the fourth edition of EQLS.

[50] Question 88 in the fourth edition of EQLS.

[51] Question 89 in the fourth edition of EQLS.

- keeping your home adequately warm;
- paying for a week's annual holiday away from home (not staying with relatives);
- replacing any worn-out furniture;
- having a meal with meat, chicken, fish every second day (if wanted);
- buying new, rather than second-hand, clothes; and
- having friends or family for a drink or meal at least once a month[52].

All these six items may fall into the basic life-style deprivation indicators according to Whelan et al. (2001).

There are six binary variables (able to afford / unable to afford) as a result. There are neither the option to answer "We have the item" nor the option "We do not want/need this item at the moment". This may cause some confusion to the respondent, still, the question is correct in essence.

In order to test the hypotheses 5a/b these six binary variables are transformed into a single binary variable, where one group of respondents can afford all six things, and the other group cannot afford one to six of them. The respondents who refused to answer any single sub-question one out of the six sub-questions on the affordability of material goods were excluded from the analysis made in this chapter. It is safer to exclude incomplete answers. There remained 3,979 out of the 4,084 respondents having answered all the sub-questions as well as the questions on SWB in the fourth wave to be analyzed.

3.2.6 Financial problems

The EQLS question on the financial problems is: "Has your household been in arrears at any time during the past 12 months, that is, unable to pay as scheduled any of the following?"[53] This question has five sub-questions in the fourth survey made in 2016. These five items are:
- rent or mortgage payments for accommodation;
- utility bills such as electricity, water and gas;
- payments related to consumer loans (including credit card overdrafts);
- payments related to informal loans (from friends and relatives not living in the household); and
- the telephone, mobile and internet connection bills (this last item was added for the last survey).

....

[52] The list of items is the same for both the third and the fourth editions of EQLS.

[53] Question 93 in the fourth edition of EQLS.

Hence, the questions are all on regular monthly payments that most people need to pay[54].

In order to test the hypotheses 6a/b these five binary variables (able to pay bills as scheduled / unable to pay bills as scheduled) are redefined the same way as in the previous case into a single binary variable, where one group contains only the respondents able to pay all the bills as scheduled whereas the second group contains the respondents unable to pay one or more types of the above-listed bills. Again, respondents having refused to answer either a question on the bill payment ability or the questions on SWB are excluded from the dataset[55] for the statistical analysis and there are 3,419 out of 4,084 remaining ones to be analyzed in this chapter.

I think a respondent might get a bit confused in case an item is not relevant to him. For example, when the respondent has no consumer loan. There is no question asking on the objective facticity and only the choices Yes/No/Don´t know/Refusal are available. It is hence probable that some respondents are excluded from the analysis, because they are able to answer neither yes nor no.

3.2.7 Housing problems

The related EQLS question on problems with housing has six sub-questions on six types of common deficiencies of housing:
- shortage of space;
- rot in windows, doors or floors;
- damp or leaks in walls or roof;
- lack of indoor flushing toilet;
- lack of bath or shower; and
- lack of facilities (heating or cooling) to keep a comfortable temperature at home.

Very similar indicators of housing facilities and deterioration are the two groups of indicators of life-style deprivation proposed by Whelan et al. (2001). These two groups are distinct from the group of the basic life-style deprivation indicators according to the authors.

In order to test the hypotheses 7a/b these six binary variables are transformed into a single binary variable where one group of respondents has no problems with their housing, and the other group has up to six problems with it. 26 respondents

....

[54] The experience of late payments is treated as the basic lifestyle deprivation indicator by Whelan et al. (2001).

[55] Another possible approach is to exclude only respondents not having answered a whole set of sub questions on bills payment ability.

who were unable to answer either one or more questions on their housing or questions on SWB are excluded from the statistical analysis. There are hence 4,058 remaining out of 4,084.

3.3 Methods

With respect to the nature of the tested variables either t-tests or single factor analysis of variance (ANOVA) together with multiple comparison tests are used to compare the mean happiness and satisfaction among the groups. In my opinion, the use of these only statistical tests is appropriate and sufficient for examination one-to-one type associations between SWB and defined particular variables of the material situation. A statistical significance level of $\alpha = 5\%$ is used in all tests. The attempt to analyze SWB and factors of material situation in complexity is made in Chapter 4 using Bayesian networks.

The normality assumption cannot be satisfied by definition for Likert-type ordinal scales used in the study. Still, such scales are often treated as continuous variables, and the parametric methods using the assumption of normality can be used for them. Violating the normality does not make the results of parametric tests invalid in many situations (Urdan, 2011), especially for the large samples (Saunders et al., 2009), which is true in this case. Homogeneities of variances[56] are tested statistically using Bartlett's test (Snedecor and Cochran, 1989), where the null hypothesis of equal variances in k samples is tested against the alternative hypothesis that variances are unequal for at least two groups. The results of the test are provided in Appendix 1. This test shows that the null hypotheses of equal variances across groups cannot be supported for most factors. As the assumption of homogeneity of variances seems to be violated in most cases, Welch t-test[57] (Welch, 1938; Welch, 1947) instead of Student's t-test was used for comparing two means and Welch ANOVA for unequal variances instead of classic one-way ANOVA was used throughout the whole further analysis. All the calculations were made in software Openstat (Miller, 2014).

3.4 Results

First, the distribution of both happiness and life satisfaction in the four countries is briefly described and discussed. The distributions of the respondent's happiness

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[56] Homogeneity of variance means that the variance within each of the populations is equal.

[57] Sometimes referred also as unequal variances t-test. Like Student's test it uses t-distribution for statistics testing the null hypothesis that the two population means are equal.

and life satisfaction evaluations on the 10-point scale from very unhappy/very dis-satisfied (point 1 on the scale) to very happy/satisfied (point 10 on the scale) are presented in the tables and graphically (code 98 stands for "Do not know" and 99 for refusal).

As already discussed the ordinal Likert-type scales cannot be normally distributed by the definition. All the distributions clearly lack the symmetry as the respondents tend to evaluate neither their happiness nor satisfaction too low on the scale. All the distributions are hence negatively skewed. Basic statistical measures of the distributions are provided in Table 3 for the happiness and Table 4 for the life satisfaction.

Table 1: Happiness per country – distributions.

Happiness	Scale												Total
	1	2	3	4	5	6	7	8	9	10	98	99	
CZ	5	11	31	47	179	143	231	199	94	72	1	1	1 014
HU	22	25	41	41	160	135	175	235	106	101	0	1	1 042
PL	11	19	26	27	142	93	144	223	107	206	10	1	1 009
SK	18	6	32	44	188	138	184	188	105	114	0	2	1 019
Total	56	61	130	159	669	509	734	845	412	493	11	5	4 084

Table 2: Life satisfaction per country – distributions.

Satisfaction	Scale												Total
	1	2	3	4	5	6	7	8	9	10	98	99	
CZ	14	14	59	61	174	142	221	182	84	63	0	0	1 014
HU	40	26	46	48	186	148	177	233	74	63	0	1	1 042
PL	21	13	27	29	180	106	160	195	112	158	7	1	1 009
SK	37	21	59	58	211	142	198	146	59	85	1	2	1 019
Total	112	74	191	196	751	538	756	756	329	369	8	4	4 084

Figure 1: Happiness per country – distributions.
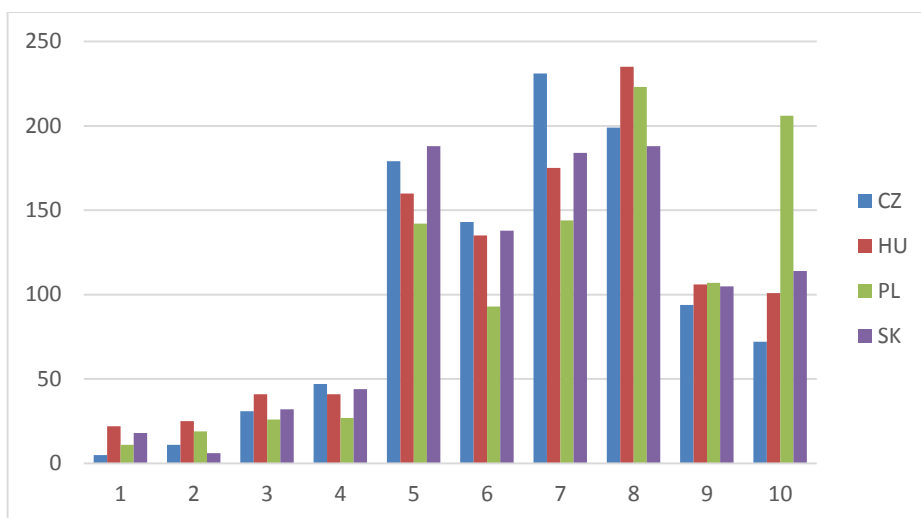
Figure 2: Life satisfaction per country – distributions.
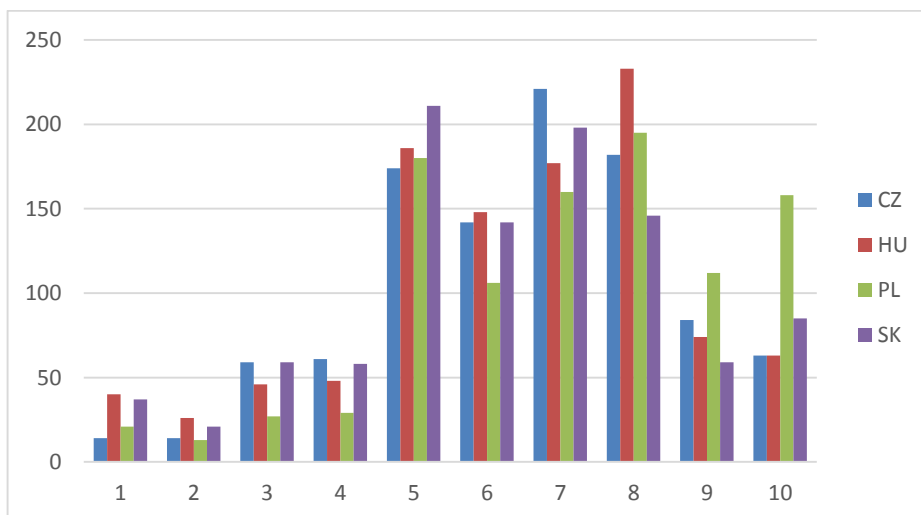
Table 3: Happiness per country – basic description of the distributions.

	N	Mean	Variance	Skewness	Kurtosis
CZ	1 012	6.755	3.358	-0.302	-0.135
HU	1 041	6.761	4.544	-0.578	-0.030
PL	998	7.333	4.599	-0.647	-0.083
SK	1 017	6.831	4.135	-0.384	-0.105
Total	**4 068**	**6.917**	**4.214**	**-0.469**	**4.506**

Table 4: Life satisfaction per country – basic description of the distributions.

	N	Mean	Variance	Skewness	Kurtosis
CZ	1 014	6.483	3.948	-0.358	-0.196
HU	1 041	6.378	4.656	-0.570	-0.012
PL	1 001	7.041	4.663	-0.541	-0.085
SK	1 016	6.230	4.782	-0.302	-0.197
Total	**4 072**	**6.530**	**4.603**	**-0.431**	**6.914**

Tables 3 and 4 exclude no-replies. The means of the happiness are consistently higher than the means of the satisfaction across all the four countries. I believe the conclusion that the people are less satisfied than happy cannot be drawn from this observation, because the two dimensions of SWB describe different things. It is my opinion that it makes little sense to interpret the measures of kurtosis because of the nature of the distributions. All the distributions seems to be rather bimodal with one peak at point 5 (I wonder all those hesitating to state 1 to 4 points for any reasons are cumulated here) and the second peak somewhere on 7 or 8.

The distributions seems not to vary too much across the countries. A strange exemption is Poland, where 20% respondents (206 out of 1,009) assessed their happiness with the highest number of points and 16% respondents (158 out of 1,009) did so in case of the life satisfaction. To the contrary of the other three countries the distribution of both happiness and satisfaction is trimodal in case of Poland. Hence, the average happiness as well as the average satisfaction is noticeably higher in Poland compared to the other three countries. There is no obvious explanation available for that pattern observed in case of Poland based on 2016 EQLS data[58].

3.4.1 SWB and household income

Tables 5-9 show the basic statistics of both happiness and life satisfaction by the income quartiles for all four examined countries together with the results of Welch ANOVA.

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[58] No such pattern appeared in EQLS 2011 (3rd edition) in Poland.

Table 5: SWB with respect to household income quartiles in the Czech Republic.

#	Narrative	N	MEAN	Diff	VAR	Percentile					F	DF	p
						10th	25th	50th	75th	90th			
	Happiness												
1	1st quartile	80	6.09	-	4.08	3.36	4.61	6.00	7.77	8.67	8.1281	280	0.00
2	2nd quartile	163	6.22	0.13	3.00	4.42	5.03	6.09	7.38	8.63			
3	3rd quartile	226	6.89	0.67	3.79	4.52	5.34	7.02	8.26	9.66			
4	4th quartile	216	6.91	0.02	3.11	4.70	5.78	7.06	8.17	9.13			
	All groups	**685**	**6.65**	**-**	**3.53**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	1st quartile	80	5.40	-	5.21	2.58	3.60	5.29	7.05	8.50	13.7484	275	0.00
2	2nd quartile	163	5.97	0.57	3.50	3.53	4.78	5.81	7.40	8.34			
3	3rd quartile	226	6.72	0.75	4.18	3.74	5.25	6.94	8.19	9.43			
4	4th quartile	216	6.82	0.10	3.05	4.56	5.71	7.02	8.02	9.00			
	All groups	**685**	**6.42**	**-**	**4.01**	**-**	**-**	**-**	**-**	**-**			

Table 6: SWB with respect to household income quartiles in Hungary.

#	Narrative	N	MEAN	Diff	VAR	Percentile					F	DF	p
						10th	25th	50th	75th	90th			
	Happiness												
1	1st quartile	253	6.14	-	4.82	2.96	4.82	6.18	7.74	9.05	10.2024	396	0.00
2	2nd quartile	197	6.82	0.68	4.12	4.46	5.48	6.99	8.25	9.47			
3	3rd quartile	151	7.17	0.35	3.43	4.56	5.86	7.60	8.42	9.40			
4	4th quartile	158	7.04	-0.13	4.21	4.60	5.88	7.41	8.35	9.57			
	All groups	**759**	**6.71**	**-**	**4.39**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	1st quartile	253	5.67	-	5.88	2.07	4.16	5.71	7.60	8.73	13.4740	400	0.00
2	2nd quartile	197	6.49	0.82	3.82	4.37	5.17	6.57	7.94	8.93			
3	3rd quartile	151	6.94	0.45	3.63	4.51	5.75	7.21	8.18	9.49			
4	4th quartile	158	6.78	-0.16	3.82	4.46	5.65	7.15	8.11	8.93			
	All groups	**759**	**6.37**	**-**	**4.72**	**-**	**-**	**-**	**-**	**-**			

Table 7: SWB with respect to household income quartiles in Poland.

#	Narrative	N	MEAN	Diff	VAR	Percentile					F	DF	P
						10th	25th	50th	75th	90th			
	Happiness												
1	1st quartile	216	6.81	-	5.18	4.16	5.14	6.94	8.42	9.93			
2	2nd quartile	164	6.91	0.10	5.22	3.63	5.35	7.21	8.57	9.89	12.2322	389	0.00
3	3rd quartile	155	7.81	0.90	4.27	4.86	6.62	8.23	9.51	10.10			
4	4th quartile	191	7.81	0.00	3.74	5.01	6.77	8.04	9.51	10.10			
	All groups	**726**	**7.31**	**-**	**4.83**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	1st quartile	216	6.32	-	5.00	3.56	4.88	6.19	7.88	9.70			
2	2nd quartile	164	6.48	0.16	5.20	3.66	4.95	6.66	8.21	9.41	20.0096	391	0.00
3	3rd quartile	155	7.66	1.18	3.91	4.86	6.48	7.99	9.27	10.03			
4	4th quartile	191	7.58	-0.08	4.38	4.87	6.26	7.86	9.34	10.06			
	All groups	**726**	**6.97**	**-**	**5.01**	**-**	**-**	**-**	**-**	**-**			

Table 8: SWB with respect to household income quartiles in Slovakia.

#	Narrative	N	MEAN	Diff	VAR	Percentile					F	DF	p
						10th	25th	50th	75th	90th			
	Happiness												
1	1st quartile	182	6.00	-	5.31	2.90	4.73	5.67	7.82	9.26			
2	2nd quartile	208	6.66	0.66	4.07	4.30	5.28	6.72	8.07	9.51	14.1412	402	0.00
3	3rd quartile	204	7.22	0.56	2.77	4.88	6.05	7.34	8.36	9.44			
4	4th quartile	162	7.28	0.06	4.75	4.51	5.66	7.65	9.04	9.96			
	All groups	**756**	**6.78**	**-**	**4.40**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	1st quartile	182	5.36	-	5.65	1.97	3.73	5.24	7.07	8.44			
2	2nd quartile	208	6.18	0.82	4.50	3.38	4.90	6.44	7.53	8.67	13.1490	406	0.00
3	3rd quartile	204	6.52	0.34	3.95	4.34	5.09	6.68	7.94	9.19			
4	4th quartile	162	6.81	0.29	5.12	3.74	5.26	7.00	8.58	9.76			
	All groups	**756**	**6.21**	**-**	**5.02**	**-**	**-**	**-**	**-**	**-**			

Table 9: SWB with respect to household income quartiles in central Europe.

#	Narrative	N	MEAN	Diff	VAR	Percentile					F	DF	p
						10th	25th	50th	75th	90th			
	Happiness												
1	1st quartile	731	6.30	-	5.06	3.21	4.86	6.28	7.97	9.54			
2	2nd quartile	732	6.66	0.36	4.15	4.31	5.25	6.70	8.14	9.48	36.1300	1 621	0.00
3	3rd quartile	736	7.23	0.57	3.63	4.68	5.82	7.49	8.59	9.75			
4	4th quartile	727	7.26	0.03	3.99	4.68	5.99	7.54	8.67	9.82			
	All groups	**2 926**	**6.86**	**-**	**4.37**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	1st quartile	731	5.76	-	5.61	2.55	4.50	5.60	7.48	9.02			
2	2nd quartile	732	6.28	0.52	4.28	3.70	4.95	6.38	7.81	8.90	51.4262	1 621	0.00
3	3rd quartile	736	6.91	0.63	4.10	4.39	5.41	7.14	8.31	9.64			
4	4th quartile	727	7.01	0.10	4.13	4.55	5.71	7.21	8.42	9.62			
	All groups	**2 926**	**6.49**	**-**	**4.78**	**-**	**-**	**-**	**-**	**-**			

In summary, the mean happiness as well as the mean life satisfaction rises from a quartile to a quartile in both the Czech Republic and Slovakia, while the means rises only from first to third quartile in Hungary and Poland and a slight decrease appeared between the third and fourth quartiles in Hungary (both happiness and life satisfaction) and Poland (happiness is stable, and satisfaction slightly decreases). Still, the rises between third and fourth quartiles are quite small in case of the Czech Republic and Slovakia. The medians show very similar patterns. The differences in means are smaller between the first and second quartiles than the differences between second and third quartiles in the Czech Republic and Poland (both happiness and life satisfaction) and bigger in Hungary and Slovakia. The medians show the same patterns. Generally, the patterns are ambiguous, but the differences seems not to be very sharp for this first look.

The results of Welch ANOVA showed that the null hypotheses of equal means could be rejected on the selected significance level in the case of all examined countries (country per country as well as together for the whole central Europe) for both happiness and satisfaction. This conclusion only means that some statistically significant differences between groups occurred. To understand where exactly the differences occur, the results of Welch t-tests multiple comparison are shown in Table 10. The letter "Y" stands for a statistical significant difference between the groups in a row.

The complete results of the multiple comparison made in this chapter are presented in Appendix 2.

Table 10: SWB with respect to household income – results of multiple comparison.

Quartiles		Happiness					Life satisfaction				
		CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	2	N	Y	N	Y	Y	N	Y	N	Y	Y
1	3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	3	Y	N	Y	Y	Y	Y	Y	Y	N	Y
2	4	Y	N	Y	Y	Y	Y	N	Y	Y	Y
3	4	N	N	N	N	N	N	N	N	N	N

Given the relevant research question we need to decide what high income households and low income ones mean. The hypotheses predict people having the above median income are happier/more satisfied than those having the below median income. Hence, the pairs 1 to 3; 1 to 4; 2 to 3; 2 to 4 are relevant.

The null hypothesis of equal happiness between the second and third quartiles, as well as between the second and fourth quartiles, cannot be rejected in the case of Hungary. In this country the mean happiness rises most between the first and second quartiles, then it slows down sharply and starts fading between the third and fourth quartiles. The theoretical curve linking the means of happiness in the chart is concave, where the rise of mean happiness between the second and third quartiles is not statistically significant. We hence cannot support Hypothesis 1a that above median income people are on average happier than people with below median income in Hungary. The Hypothesis can be accepted for all other examined countries of the Czech Republic, Poland and Slovakia. The Hypothesis can also be accepted in the case of taking all the countries together.

Assertion 1a: Hypothesis 1a is accepted on 5% significance level for all countries of central Europe except Hungary since Welch ANOVA rejects the null hypothesis of equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the below median and the above median groups.

In the case of the life satisfaction, the differences are statistically insignificant between the second and fourth quartiles in Hungary and the second and third quartiles

in Slovakia. Again, the theoretical curve linking the means of satisfaction in the chart looks concave in Hungary, decreasing between the third and fourth quartiles. Hypothesis 1b cannot be supported for the two countries, and it can be concluded that people in the above median income groups are not on average more satisfied with their lives than those in below median income groups in Hungary and Slovakia. On the other hand, Hypothesis 1b can be supported for the other two countries (the Czech Republic and Poland) as well as for central Europe as a whole.

Assertion 1b: Hypothesis 1b is accepted on 5% significance level for all countries of central Europe except Hungary and Slovakia since Welch ANOVA rejects the null hypothesis of equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the below median and the above median groups.

The observed difference in evaluation of happiness between the first and fourth income quartiles is on average 0.96 on a 10-point scale for all examined countries together (0.82 in the Czech Republic; 0.90 in Hungary; 1.00 in Poland; and 1.28 in Slovakia). Slightly higher differences can be observed in case of life satisfaction (1.42 in the Czech Republic; 1.11 in Hungary; 1.26 in Poland; 1.45 in Slovakia; and 1.25 for all together). It is not that much, considering that the equivalised monthly income of respondents in the first income quartile is up to EUR 648, whereas the fourth quartile starts at EUR 1,297 (almost exactly twice).

3.4.2 SWB and income compared to others

The income of reference groups whatever they might be is one of the two examined benchmark standards the individual may compare his/her own income with. We talk about relative income as compared to others. Tables 11-15 show the basic statistics of both happiness and life satisfaction for all four examined countries together with the results of Welch ANOVA.

Both happiness and satisfaction rise pretty consistently from group to group with only few exceptions. In the Czech Republic, people evaluating their financial situation as "much better" report slightly lower satisfaction with their lives than people reporting a "somewhat better" situation. Still, the difference is statistically insignificant. There are remarkable falls in the reported happiness and satisfaction between the "somewhat better" and "much better" groups in Slovakia[59]. Similarly,

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[59] However it should be noted that there are only 10 respondents evaluating their financial situation much better compared to most people in Slovakia.

medians rises from group to group with the single exception of Slovakia, where medians of both happiness and satisfaction drops between "somewhat better" and "much better" groups. With the exception of Hungary the differences between "much worse" and "somewhat worse" options as well between "somewhat worse" and "neither worse nor better" options are greater than the differences at the positive side of the scale.

In this case, the results of Welch ANOVA also showed that the null hypotheses of equal means is rejected on the selected significance level in the case of all examined countries (separately as well as together) for both happiness and satisfaction. Table 16 shows the summary of the subsequent multiple comparisons and the complete results are presented in Appendix 2.

Table 11: SWB with respect to relative income compared to others in the Czech Republic.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Much worse	49	5.53	-	3.50	3.13	4.28	5.38	6.79	8.12			
2	S'what worse	238	6.34	0.81	3.26	3.87	4.96	6.47	7.68	8.74			
3	Neither	500	7.39	1.05	2.42	5.14	6.52	7.53	8.44	9.38	29.4877	136	0.00
4	S'what better	167	7.61	0.22	2.34	5.47	6.91	7.84	8.59	9.31			
5	Much better	30	8.00	0.39	2.69	5.50	6.88	8.06	9.56	10.13			
	All groups	**984**	**7.10**	**-**	**3.04**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Much worse	49	4.80	-	5.08	1.32	3.04	5.25	6.40	7.26			
2	S'what worse	238	5.44	0.64	4.86	2.60	3.78	5.42	7.24	8.32			
3	Neither	500	6.74	1.30	3.47	4.13	5.60	6.99	8.07	9.00	30.1564	134	0.00
4	S'what better	167	7.26	0.52	3.35	4.63	6.52	7.65	8.38	9.37			
5	Much better	30	7.20	-0.06	5.96	2.50	6.60	7.88	8.86	9.50			
	All groups	**984**	**6.43**	**-**	**4.48**	**-**	**-**	**-**	**-**	**-**			

Table 12: SWB with respect to relative income compared to others in Hungary.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Much worse	69	5.65	-	7.55	1.88	3.31	5.60	7.78	9.73			
2	S'what worse	218	6.18	0.53	4.80	3.20	4.76	6.31	7.76	9.02			
3	Neither	543	7.19	1.01	3.58	4.75	6.00	7.47	8.42	9.58	24.6387	92	0.00
4	S'what better	130	7.88	0.69	2.86	5.25	7.22	8.10	9.06	9.91			
5	Much better	16	8.81	0.93	3.36	7.10	8.17	9.50	10.00	10.30			
	All groups	**976**	**6.97**	**-**	**4.47**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Much worse	69	4.13	-	6.14	0.99	2.15	3.95	5.40	8.03			
2	S'what worse	218	4.87	0.74	5.01	1.68	3.20	4.89	6.52	7.83			
3	Neither	543	6.19	1.32	4.45	3.18	4.90	6.47	7.74	8.61	39.1351	95	0.00
4	S'what better	130	7.03	0.84	3.77	4.50	5.69	7.52	8.30	9.29			
5	Much better	16	7.88	0.85	2.38	5.30	7.00	8.10	9.00	9.70			
	All groups	**976**	**5.89**	**-**	**5.29**	**-**	**-**	**-**	**-**	**-**			

Table 13: SWB with respect to relative income compared to others in Poland.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Much worse	164	5.60	-	5.69	2.57	3.81	5.36	7.54	8.90			
2	S'what worse	407	6.56	0.96	4.22	3.78	5.04	6.66	8.10	9.38			
3	Neither	1 229	7.49	0.93	2.94	5.14	6.50	7.70	8.66	9.71	68.0382	376	0.00
4	S'what better	308	7.99	0.50	2.70	5.54	7.18	8.15	9.25	10.01			
5	Much better	78	8.64	0.65	1.71	6.90	7.84	8.78	9.75	10.20			
	All groups	**2 186**	**7.29**	**-**	**3.77**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Much worse	164	5.01	-	6.63	1.36	2.90	4.95	7.18	8.39			
2	S'what worse	407	6.14	1.13	4.77	3.17	4.74	6.13	7.81	9.04			
3	Neither	1 229	7.33	1.19	3.31	4.83	6.12	7.58	8.50	9.76	96.0618	387	0.00
4	S'what better	308	7.74	0.41	3.14	5.27	6.81	7.92	9.05	9.95			
5	Much better	78	8.73	0.99	1.29	7.23	7.91	8.80	9.72	10.19			
	All groups	**2 186**	**7.04**	**-**	**4.41**	**-**	**-**	**-**	**-**	**-**			

Table 14: SWB with respect to relative income compared to others in Slovakia.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Much worse	113	5.28	-	4.69	2.43	3.77	5.15	6.61	8.18			
2	S'what worse	237	6.23	0.95	3.28	4.42	4.98	6.13	7.34	8.71			
3	Neither	493	7.27	1.04	2.63	5.00	6.06	7.41	8.40	9.42	36.8777	63	0.00
4	S'what better	115	7.72	0.45	2.38	5.69	6.90	7.88	8.82	9.48			
5	Much better	10	6.70	-1.02	6.23	2.50	5.00	6.50	8.75	9.50			
	All groups	**968**	**6.83**	**-**	**3.58**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Much worse	113	4.31	-	4.32	1.44	2.80	4.59	5.29	6.68			
2	S'what worse	237	5.76	1.45	4.13	3.12	4.24	5.51	7.19	8.71			
3	Neither	493	6.77	1.01	3.19	4.59	5.37	6.87	8.09	9.16	52.8850	63	0.00
4	S'what better	115	7.56	0.79	2.58	5.44	6.60	7.66	8.71	9.62			
5	Much better	10	5.80	-1.76	6.84	2.50	3.75	5.50	8.67	9.17			
	All groups	**968**	**6.32**	**-**	**4.34**	**-**	**-**	**-**	**-**	**-**			

Table 15: SWB with respect to relative income compared to others in central Europe.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Much worse	395	5.51	-	5.44	2.48	3.80	5.31	7.19	8.67			
2	S'what worse	1 100	6.36	0.85	3.94	3.75	4.96	6.43	7.79	9.07			
3	Neither	2 765	7.37	1.01	2.93	5.01	6.33	7.58	8.49	9.58	152.3962	726	0.00
4	S'what better	720	7.84	0.47	2.61	5.48	7.04	8.02	8.98	9.82			
5	Much better	134	8.37	0.53	2.69	5.90	7.63	8.58	9.72	10.19			
	All groups	**5 114**	**7.10**	**-**	**3.76**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Much worse	395	4.63	-	5.79	1.28	2.77	4.68	6.21	8.03			
2	S'what worse	1 100	5.66	1.03	4.91	2.71	4.11	5.56	7.35	8.47			
3	Neither	2 765	6.90	1.24	3.73	4.50	5.58	7.12	8.25	9.38	191.1411	726	0.00
4	S'what better	720	7.47	0.57	3.28	4.94	6.60	7.74	8.65	9.73			
5	Much better	134	8.07	0.60	3.60	5.40	7.47	8.42	9.40	10.05			
	All groups	**5 114**	**6.57**	**-**	**4.77**	**-**	**-**	**-**	**-**	**-**			

Table 16: SWB with respect to relative income compared to others – results of multiple comparison.

Group1		Group2		Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	Much worse	2	Somewhat worse	Y	N	Y	Y	Y	N	Y	Y	Y	Y
1	Much worse	3	Neither w. nor b.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	Much worse	4	Somewhat better	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	Much worse	5	Much better	Y	Y	Y	N	Y	Y	Y	Y	N	Y
2	Somewhat worse	3	Neither w. nor b.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Somewhat worse	4	Somewhat better	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Somewhat worse	5	Much better	Y	Y	Y	N	Y	Y	Y	Y	N	Y
3	Neither w. nor b.	4	Somewhat better	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Neither w. nor b.	5	Much better	N	Y	Y	N	Y	N	Y	Y	N	Y
4	Somewhat better	5	Much better	N	N	Y	N	Y	N	N	Y	N	Y

As the hypotheses 2a/b predict the people who evaluate their financial situation better are happier/more satisfied than the people evaluating it worse, we take only pairs with the opposite meaning as the relevant ones taken into account as the criteria for a decision over the given hypotheses. (The respondents who evaluate their financial situation neither better nor worse are not taken into account for the purpose of testing the hypotheses. The pairs with the neutral option are hence ignored.) Again, the letter "Y" stands for a statistical significant difference between the groups in a row.

The null hypothesis of equal means of the opposite pairs cannot be rejected only in the case of Slovakia (both happiness and life satisfaction). Tests shows that the happiness and life satisfaction of Slovaks evaluating their financial situation as much better compared to others is not significantly different from the other groups. Therefore, Hypotheses 2a and 2b cannot be accepted in the case of Slovakia, but can be accepted in the cases of other examined countries.

Assertion 2a: Hypothesis 2a is accepted on 5% significance level for all countries of central Europe except Slovakia since Welch ANOVA rejects the null hypothesis of equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the "better" and "worse" groups.

Assertion 2b: Hypothesis 2b is accepted on 5% significance level for all countries of central Europe except Slovakia since Welch ANOVA rejects the null hypothesis of

equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the "better" and "worse" groups.

We can check the distributions of the life satisfaction within the groups based on the box-plot chart for Slovakia to understand the situation better.

Figure 3: Life satisfaction with respect to relative income compared to others in Slovakia – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
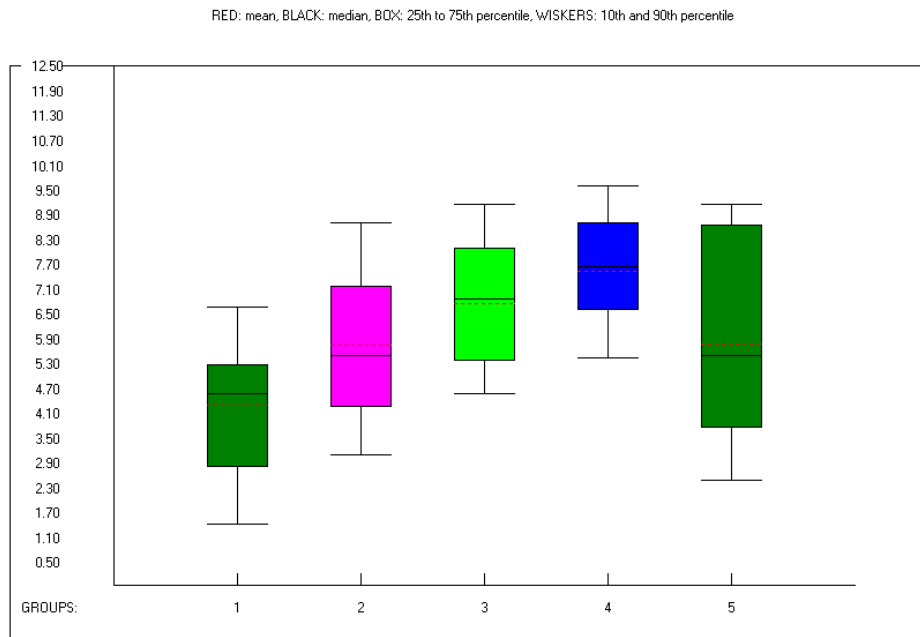
For the first view it is clear that the "much better" group looks somehow strange. The variance is very high compared to the other groups on the scale. In this case EQLS provides us with an insufficient set of data for the analysis, because there are only 10 respondents in this group. It is hardly representative sample of the people with very high subjectively perceived relative income compared to others in Slovakia. There are few outliers and it causes the mean dropped down significantly. The box plot for happiness in Slovakia in Figure 3 (the values on the horizontal axes denote to the income quartiles, the values on the vertical axes denotes to SWB) shows the same pattern.

The samples of "much better" groups are bigger in case of the other surveyed countries and the distributions are, more or less, as predicted. In order to avoid the outer groups with insufficient sample sizes, we tried to merge the samples of the "much worse" and "somewhat worse" groups into the one single "worse" group and the "much better" and "somewhat better" groups into the one single "better" group. The group "neither worse nor better" remained as it was. Then Welch ANOVA and multiple comparison was run again with the three newly defined groups. Unsurprisingly,

ANOVA rejected the null hypothesis of equal means in case of all countries (separately as well as together) for both happiness and satisfaction. The results of subsequent multiple tests are summarized in Table 17.

Table 17: SWB with respect to relative income compared to others – results of multiple comparison 2.

Group1		Group2		Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	Worse	2	Neither w. nor b.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	Worse	3	Better	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Neither w. nor b.	3	Better	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

In this case the people with high relative income compared to others can be considered happier and more satisfied than those with low relative income in all countries. Still, the hypotheses 2a/b must remain unsupported in case of Slovakia and further research is needed. We cannot be sure about those going much better.

3.4.3 SWB and income compared to one's own past

One's own past financial situation as subjectively perceived is another benchmark of the current income evaluation. Statistics and results of ANOVA are summarized in Tables 18 – 22. In this case, people evaluating their current financial situation as better compared to their own financial situation 12 months ago are happier and more satisfied with their lives than those evaluating it as the same in each examined country, whereas the latter group of people is happier and more satisfied than people evaluating their situation worse than 12 months ago in every surveyed countries with no exemption. Same observation can be made based on the medians. The differences of means as well as medians are bigger between the "worse" and "the same" groups than between "the same" and "better" groups in every cases with no exemption.

Table 18: SWB with respect to relative income compared to past in the Czech Republic.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Better	130	7.02	-	4.06	4.07	5.97	7.27	8.35	9.50			
2	The same	720	6.81	0.21	3.21	4.63	5.45	6.92	8.09	9.22	6.5103	244	0.00
3	Worse	155	6.29	0.52	3.31	4.00	4.94	6.30	7.66	8.64			
	All groups	**1 005**	**6.76**	**-**	**3.37**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Better	130	6.72	-	4.62	3.70	5.22	7.05	8.22	9.42			
2	The same	720	6.60	0.12	3.73	4.17	5.25	6.79	7.98	9.10	11.4472	245	0.00
3	Worse	155	5.81	0.79	3.74	3.18	4.35	5.83	7.26	8.33			
	All groups	**1 005**	**6.50**	**-**	**3.93**	**-**	**-**	**-**	**-**	**-**			

Table 19: SWB with respect to relative income compared to past in Hungary.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Better	100	7.55	-	4.51	4.70	6.14	7.96	9.25	10.02			
2	The same	750	6.88	0.67	3.97	4.56	5.48	7.13	8.27	9.43	19.7022	213	0.00
3	Worse	183	5.90	0.98	5.70	2.25	4.33	6.15	7.78	8.81			
	All groups	**1 033**	**6.77**	**-**	**4.53**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Better	100	7.12	-	2.83	4.86	5.93	7.56	8.27	9.08			
2	The same	750	6.58	0.54	4.20	4.08	5.23	6.83	8.04	9.08	33.4438	229	0.00
3	Worse	183	5.23	1.35	5.63	1.68	3.34	5.35	7.01	8.26			
	All groups	**1 033**	**6.39**	**-**	**4.63**	**-**	**-**	**-**	**-**	**-**			

Table 20: SWB with respect to relative income compared to past in Poland.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Better	119	7.92	-	3.25	5.31	6.84	8.05	9.54	10.12			
2	The same	696	7.50	0.42	4.39	4.73	6.04	7.81	9.30	10.06	27.7392	258	0.00
3	Worse	172	6.26	1.24	5.02	3.02	4.82	6.33	7.94	9.37			
	All groups	**987**	**7.33**	**-**	**4.62**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Better	119	7.47	-	3.83	5.04	6.41	7.70	8.90	9.87			
2	The same	696	7.27	0.20	4.44	4.70	5.62	7.54	8.96	9.96	36.5135	256	0.00
3	Worse	172	5.83	1.44	4.27	3.09	4.65	5.60	7.39	8.49			
	All groups	**987**	**7.05**	**-**	**4.64**	**-**	**-**	**-**	**-**	**-**			

Table 21: SWB with respect to relative income compared to past in Slovakia.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Better	91	7.75	-	3.01	5.59	6.61	7.89	9.12	9.97			
2	The same	756	6.91	0.84	3.76	4.60	5.37	7.00	8.31	9.63	24.2250	196	0.00
3	Worse	163	5.96	0.95	5.39	2.71	4.64	5.98	7.66	9.05			
	All groups	**1 010**	**6.83**	**-**	**4.15**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Better	91	7.19	-	4.09	4.76	5.93	7.24	8.64	9.89			
2	The same	756	6.32	0.87	4.19	3.65	4.97	6.47	7.72	9.09	21.7562	190	0.00
3	Worse	163	5.27	1.05	6.63	1.41	3.33	5.22	7.11	8.97			
	All groups	**1 010**	**6.23**	**-**	**4.81**	**-**	**-**	**-**	**-**	**-**			

The null hypotheses of equal means must clearly be rejected in each country based on ANOVA tests. The results of the Welch t-test multiple comparison tests are summarized in Table 23 and the complete results are presented in Appendix 2.

Table 22: SWB with respect to relative income compared to past in central Europe.

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	P
	Happiness												
1	Better	440	7.53	-	3.83	4.90	6.42	7.77	9.04	9.96			
2	The same	2 922	7.02	0.51	3.90	4.62	5.51	7.19	8.40	9.71	71.1129	915	0.00
3	Worse	673	6.10	0.92	4.91	2.93	4.73	6.19	7.78	8.95			
	All groups	**4 035**	**6.92**	**-**	**4.22**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Better	440	7.11	-	3.95	4.60	5.88	7.38	8.44	9.64			
2	The same	2 922	6.68	0.43	4.26	4.22	5.23	6.86	8.14	9.48	91.6612	924	0.00
3	Worse	673	5.53	1.15	5.15	2.50	4.00	5.48	7.18	8.46			
	All groups	**4 035**	**6.54**	**-**	**4.59**	**-**	**-**	**-**	**-**	**-**			

Table 23: SWB with respect to relative income compared to past - results of multiple comparison.

Group1		Group2		Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	Better	2	The same	**N**	Y	Y	Y	Y	**N**	Y	**N**	Y	Y
1	Better	3	Worse	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	The same	3	Worse	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Because the hypotheses 3a/b predict the people who evaluate their financial situation better compared to own past are happier/more satisfied than the people evaluating it worse, the key pair for a decision over the hypotheses is the one comparing people evaluating the situation as better and those comparing it as worse. (The respondents who evaluate their financial situation as the same are not taken into account for the purpose of testing the hypotheses.) Again, the letter "Y" stands for a statistical significant difference between the groups in a row. The "better" group has significantly higher average happiness and higher life satisfaction than the "worse" group; hence Hypotheses 3a and 3b are accepted for every examined countries as well as for central Europe as a whole.

Assertion 3a: Hypothesis 3a is accepted on 5% significance level for all countries of central Europe since Welch ANOVA rejects the null hypothesis of equal means and

subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the "better" and "worse" groups.

Assertion 3b: Hypothesis 3b is accepted on 5% significance level for all countries of central Europe since Welch ANOVA rejects the null hypothesis of equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the "better" and "worse" groups.

3.4.4 SWB and perceived economic strain

The household income is one side of the balance whereas the expenditures constitute the second side. The subjective economic strain measured by the ability to make ends meet ranks from able "very easily" to able "with great difficulty" whereas there is no neutral option. Statistics together with results of ANOVA are summarized country per country and for central Europe as a whole in Tables 24 to 28.

Table 24: SWB with respect to perceived economic strain in the Czech Republic – statistics and ANOVA

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Very easily	43	7.19	-	4.54	4.15	6.19	7.67	8.38	9.78			
2	Easily	146	7.51	-0.32	3.48	5.04	6.36	7.74	8.92	9.84			
3	Fairly easily	389	7.02	0.49	2.82	4.80	5.82	7.11	8.20	9.26	18.9629	159	0.00
4	With some diff.	305	6.50	0.52	2.90	4.55	5.20	6.63	7.64	8.67			
5	With difficulty	92	5.77	0.73	2.82	3.72	4.71	5.50	7.03	7.98			
6	With great diff.	29	4.90	0.87	4.38	2.63	3.25	4.60	6.42	8.05			
	All groups	**1 004**	**6.76**	**-**	**3.36**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Very easily	43	7.53	-	3.92	4.80	6.84	7.79	8.82	9.78			
2	Easily	146	7.35	0.18	4.23	4.74	6.12	7.70	8.87	9.84			
3	Fairly easily	389	6.82	0.53	3.05	4.64	5.52	6.94	8.05	9.13	26.4036	159	0.00
4	With some diff.	305	6.12	0.70	3.23	3.67	4.90	6.26	7.35	8.34			
5	With difficulty	92	5.18	0.94	3.73	2.80	3.79	5.02	6.73	7.88			
6	With great diff.	29	4.38	0.80	4.60	1.47	2.75	4.38	5.94	7.20			
	All groups	**1 004**	**6.50**	**-**	**3.92**	**-**	**-**	**-**	**-**	**-**			

Table 25: SWB with respect to perceived economic strain in Hungary – statistics and ANOVA

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Very easily	15	7.27	-	6.92	3.00	5.08	8.25	9.31	10.00			
2	Easily	98	7.65	-0.38	4.04	4.90	6.46	7.98	9.24	10.01			
3	Fairly easily	253	7.40	0.25	3.49	4.87	6.22	7.68	8.76	9.71	20.6518	112	0.00
4	With some diff.	475	6.74	0.66	3.76	4.53	5.50	6.97	8.08	9.10			
5	With difficulty	124	6.02	0.72	4.35	3.32	4.70	5.94	7.64	8.48			
6	With great diff.	57	4.44	1.58	7.04	1.56	2.27	4.00	5.75	8.93			
	All groups	**1 022**	**6.78**	**-**	**4.54**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Very easily	15	7.60	-	6.40	4.00	5.38	8.13	9.75	10.20			
2	Easily	98	7.41	0.19	3.44	4.78	6.25	7.69	8.73	9.75			
3	Fairly easily	253	7.20	0.21	2.93	4.90	6.07	7.53	8.34	9.28	37.6749	112	0.00
4	With some diff.	475	6.37	0.83	3.65	4.00	5.19	6.54	7.76	8.44			
5	With difficulty	124	5.20	1.17	5.11	1.73	3.79	5.17	6.89	8.16			
6	With great diff.	57	3.67	1.53	5.62	0.98	1.69	3.14	5.18	7.27			
	All groups	**1 022**	**6.40**	**-**	**4.63**	**-**	**-**	**-**	**-**	**-**			

The means of both happiness and life satisfaction rise from group to group. It seems the easier it is to make ends meet, the happier and more satisfied people are in all four countries. There are two exceptions from this pattern. People making ends meet very easily seems to be slightly less happy than people making it only easily in the Czech Republic (0.32 points) as well as in Hungary (0.38 points). Even so, the differences are statistically insignificant between the two groups in these two countries. Also the medians of both happiness and satisfaction rise together with the ability to make ends meet steadily (with an exception between "very easily" and "easily" groups in the Czech Republic). It seems that the differences are greater among the groups of those making ends meet with difficulties (groups 4 to 6) than those making it easily (groups 1-3). It may indicate that once a household escapes the zone of making ends meet with difficulty and starts making it easily, the rises of both happiness and life satisfaction slow down.

Table 26: SWB with respect to perceived economic strain in Poland – statistics and ANOVA

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Very easily	41	8.66	-	3.58	6.68	7.68	9.52	10.01	10.31			
2	Easily	159	8.36	0.30	2.78	6.32	7.52	8.49	9.76	10.21			
3	Fairly easily	358	7.68	0.68	3.30	5.10	6.55	7.91	9.08	9.97	27.0268	200	0.00
4	With some diff.	261	6.87	0.81	4.54	4.40	5.28	6.97	8.35	9.88			
5	With difficulty	102	6.30	0.57	5.26	3.54	4.82	5.83	8.06	9.77			
6	With great diff.	49	5.45	0.85	8.00	1.32	3.15	5.25	7.84	9.52			
	All groups	**970**	**7.36**	-	**4.62**	-	-	-	-	-			
	Life satisfaction												
1	Very easily	41	8.68	-	3.12	6.92	7.83	9.20	9.96	10.28			
2	Easily	159	8.01	0.67	3.13	5.34	7.03	8.18	9.53	10.11			
3	Fairly easily	358	7.53	0.48	3.35	5.00	6.30	7.76	8.93	9.90	35.2490	202	0.00
4	With some diff.	261	6.39	1.14	4.45	4.04	4.98	6.24	8.01	9.34			
5	With difficulty	102	5.88	0.51	4.58	3.10	4.74	5.47	7.29	8.48			
6	With great diff.	49	5.29	0.59	6.46	1.48	3.35	5.23	7.04	8.60			
	All groups	**970**	**7.07**	-	**4.63**	-	-	-	-	-			

Again, the results of ANOVA lead us to the rejection of the null hypotheses of the equal means in case of every country as well as central Europe as a whole and the multiple comparison tests are performed. As the two relevant research hypotheses deal with the differences between those able to make ends meet easily and those making it with difficulty, the pair groups with opposite meaning are the only relevant ones for the decisions whether to accept or reject the hypotheses. It means that the differences between any of the groups 1, 2, 3 ("easily" groups) and any of the groups 4, 5, 6 ("with difficulty" groups) are decisive in terms of the hypotheses. The result of the multiple comparison tests are summarized in Table 29 and the complete results are presented in Appendix 2.

Table 27: SWB and perceived economic strain in Slovakia – statistics and ANOVA

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Very easily	31	8.87	-	2.85	6.05	8.38	9.59	10.04	10.32			
2	Easily	115	7.82	1.05	3.10	5.18	6.79	8.06	9.19	9.95			
3	Fairly easily	198	7.25	0.57	2.89	4.85	6.08	7.45	8.40	9.47	29.2777	189	0.00
4	With some diff.	430	6.80	0.45	3.22	4.65	5.39	6.80	8.09	9.35			
5	With difficulty	161	6.03	0.77	3.98	3.35	4.77	5.93	7.53	8.42			
6	With great diff.	62	4.82	1.21	7.59	1.06	2.60	4.87	6.57	9.43			
	All groups	**997**	**6.82**	**-**	**4.13**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Very easily	31	8.13	-	5.45	5.55	7.42	8.63	9.85	10.24			
2	Easily	115	7.22	0.91	3.21	4.78	5.98	7.37	8.40	9.68			
3	Fairly easily	198	6.85	0.37	3.63	4.53	5.62	7.01	8.16	9.30	29.1235	187	0.00
4	With some diff.	430	6.17	0.68	3.52	3.82	4.96	6.13	7.36	8.55			
5	With difficulty	161	5.38	0.79	5.05	2.62	3.67	5.19	7.01	8.28			
6	With great diff.	62	3.87	1.51	6.90	0.84	1.36	3.75	5.39	7.20			
	All groups	**997**	**6.21**	**-**	**4.77**	**-**	**-**	**-**	**-**	**-**			

Figure 4: Happiness with respect to perceived economic strain in Hungary – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
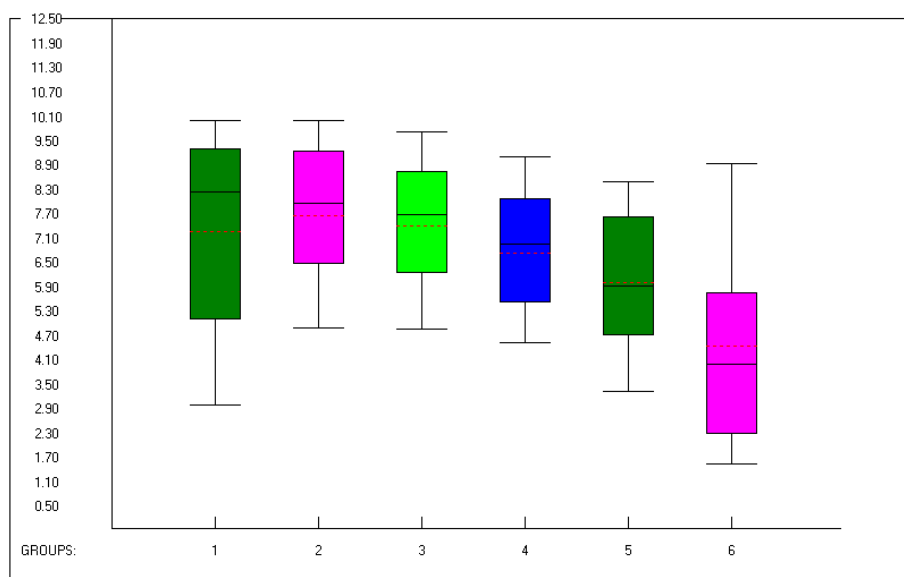
Table 28: SWB with respect to perceived economic strain in central Europe – statistics and ANOVA

#	Narrative	N	MEAN	Diff	VAR	10th	25th	50th	75th	90th	F	DF	p
	Happiness												
1	Very easily	130	8.06	-	4.60	4.94	7.03	8.46	9.81	10.22			
2	Easily	518	7.86	0.20	3.39	5.26	6.82	8.10	9.36	10.06			
3	Fairly easily	1 198	7.33	0.53	3.18	4.89	6.13	7.54	8.56	9.69	89.8224	731	0.00
4	With some diff.	1 471	6.73	0.60	3.57	4.57	5.35	6.83	8.05	9.31			
5	With difficulty	479	6.04	0.69	4.13	3.47	4.75	5.83	7.57	8.49			
6	With great diff.	197	4.88	1.16	7.10	1.36	2.73	4.79	6.78	9.03			
	All groups	**3 993**	**6.93**	**-**	**4.22**	**-**	**-**	**-**	**-**	**-**			
	Life satisfaction												
1	Very easily	130	8.05	-	4.45	5.25	7.23	8.32	9.73	10.19			
2	Easily	518	7.53	0.52	3.60	4.90	6.49	7.77	8.98	9.92			
3	Fairly easily	1 198	7.12	0.41	3.30	4.76	5.84	7.30	8.36	9.50	128.3709	732	0.00
4	With some diff.	1 471	6.26	0.86	3.67	3.86	5.02	6.31	7.60	8.61			
5	With difficulty	479	5.40	0.86	4.75	2.62	4.05	5.22	7.00	8.21			
6	With great diff.	197	4.24	1.16	6.41	1.02	1.97	4.40	5.84	7.64			
	All groups	**3 993**	**6.54**	**-**	**4.58**		**-**	**-**	**-**	**-**			

Multiple comparison tests clarify that the happiness is not equal between the opposite groups in any country except Hungary, where people making ends meet very easily seem to be equally happy as those making it either with difficulty or with some difficulty. Similarly, people making ends meet very easily seem to be equally satisfied with their lives as people making it with some difficulty. It must be noted that the sample size of Hungarian respondents making ends meet very easily is only 15 and the variance is quite high (6.92 in the case of happiness and 6.40 in the case of satisfaction) compared to the other groups. There are certainly re few outliers, especially in the case of happiness. It may be documented by the box-plot provided in Figure 4 (the values on the horizontal axes denote to the income quartiles, the values on the vertical axes denotes to SWB) showing the distributions of the happiness within the groups in Hungary.

Table 29: SWB with respect to perceived economic strain – results of multiple comparison.

Group1		Group2		Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	Very easily	2	Easily	**N**	**N**	**N**	Y	**N**	**N**	**N**	Y	**N**	Y
1	Very easily	3	Fairly easily	**N**	**N**	Y	Y	Y	Y	**N**	Y	Y	Y
1	Very easily	4	With some diff.	Y	**N**	Y	Y	Y	Y	**N**	Y	Y	Y
1	Very easily	5	With difficulty	Y	**N**	Y	Y	Y	Y	Y	Y	Y	Y
1	Very easily	6	With great diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Easily	3	Fairly easily	Y	**N**	Y	Y	Y	Y	**N**	Y	**N**	Y
2	Easily	4	With some diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Easily	5	With difficulty	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Easily	6	With great diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Fairly easily	4	With some diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Fairly easily	5	With difficulty	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Fairly easily	6	With great diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	With some diff.	5	With difficulty	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	With some diff.	6	With great diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	With difficulty	6	With great diff.	Y	Y	**N**	Y	Y	**N**	Y	**N**	Y	Y

The sample of only 15 respondents in the "very easily" group in Hungary seems not to be sufficient for reliable testing. The hypotheses 4a and 4b cannot rigorously be accepted in case of Hungary, still they can be accepted for the Czech Republic, Poland and Slovakia as well as for central Europe as a whole.

Assertion 4a: Hypothesis 4a is accepted on 5% significance level for all countries of central Europe except Hungary since Welch ANOVA rejects the null hypothesis of equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the "easily" and "with difficulty" groups.

Assertion 4b: Hypothesis 4b is accepted on 5% significance level for all countries of central Europe except Hungary since Welch ANOVA rejects the null hypothesis of equal means and subsequent multiple comparison based on Welch t-tests rejects the null hypotheses of equal means between the "easily" and "with difficulty" groups.

In order to overcome the low sample sizes in the outer groups, we tried to merge the samples of "very easily" with "easily" into the one single group of "easily" and the

samples of "with difficulty" and "with great difficulty" into the one group of "with difficulty". The two middle groups "fairly easily" and "with some difficulty" remained as they were. Then Welch ANOVA and multiple comparison was run again with the four newly defined groups. Unsurprisingly, ANOVA rejected the null hypothesis of equal means in case of all countries (separately as well as together) for both happiness and satisfaction. The results of subsequent multiple tests are summarized in Table 30.

Table 30: SWB with respect to perceived economic strain – results of multiple comparison 2.

Group1		Group2		Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	Easily	2	Fairly easily	Y	**N**	Y	Y	Y	Y	**N**	Y	Y	Y
1	Easily	3	With some diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	Easily	4	With diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Fairly easily	3	With some diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Fairly easily	4	With diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	With some diff.	4	With diff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Taking the transformed groups it seems that the people making ends meet easily are significantly happier and more satisfied than the people making it fairly easily and they are, in turn, happier than the people making ends meet with some difficulty and so on. This observation can be made in all countries except Hungary. In Hungary, the people making ends meet easily and fairly easily seem not to be statistically significantly different in terms of happiness and life satisfaction. These people are significantly happier and more satisfied than people of any of the groups bearing the word "difficulty" in their headings. Still, we consider the hypotheses 4a/b unsupported in the case of Hungary, because we cannot be sure about those making ends meet very easily in Hungary. Further research is needed in this case.

3.4.5 SWB and material deprivation

Tables 31 and 32 present the results of statistically comparing mean happiness and mean satisfaction between the groups of people who would be able to afford all six listed items if they wanted to get them and those who would not.

Table 31: Happiness with respect to material deprivation – comparing means.

	CZ		HU		PL		SK		ALL	
	Able	Unable	Able	Unable	Able	Unable	Able	Unable	Able	Unable
N	471	492	307	687	373	543	425	499	1 576	2 221
MEAN	7.27	6.30	7.57	6.40	8.08	6.90	7.52	6.25	7.59	6.47
VAR	3.13	3.17	3.45	4.63	3.18	4.80	3.26	4.22	3.32	4.31
10th PC	4.89	4.15	5.04	3.34	5.47	4.25	5.00	3.67	5.05	3.80
25th PC	6.25	5.03	6.56	5.01	7.13	5.25	6.30	4.92	6.54	5.04
MEDIAN	7.40	6.31	7.89	6.62	8.25	7.12	7.67	6.21	7.79	6.57
75th PC	8.44	7.55	8.88	7.97	9.62	8.45	8.95	7.76	8.97	7.98
90th PC	9.59	8.59	9.79	9.19	10.15	9.86	9.92	8.99	9.93	9.30
Diff.	0.97		1.17		1.18		1.27		1.12	
DF	959.640		675.295		888.187		921.008		3 628.970	
Welch t	8.489		8.738		8.957		10.031		17.637	
P	0.000		0.000		0.000		0.000		0.000	

Table 32: Life satisfaction with respect to material deprivation – comparing means.

	CZ		HU		PL		SK		ALL	
	Able	Unable	Able	Unable	Able	Unable	Able	Unable	Able	Unable
N	471	492	307	687	373	543	425	499	1 576	2 221
MEAN	7.10	5.93	7.30	5.97	7.84	6.58	6.83	5.65	7.24	6.04
VAR	3.46	3.78	2.78	4.86	3.29	4.76	3.87	5.06	3.53	4.75
10th PC	4.73	3.27	4.92	2.77	5.28	4.01	4.51	2.62	4.77	3.05
25th PC	5.94	4.69	6.53	4.76	6.77	5.05	5.45	4.52	6.07	4.76
MEDIAN	7.25	5.97	7.58	6.04	8.02	6.65	6.97	5.54	7.42	6.05
75th PC	8.37	7.36	8.35	7.66	9.36	8.21	8.18	7.19	8.50	7.64
90th PC	9.52	8.37	9.32	8.49	10.06	9.62	9.56	8.46	9.72	8.84
Diff.	1.17		1.33		1.26		1.18		1.20	
DF	961.000		763.287		880.989		921.354		3 653.892	
Welch t	9.520		10.521		9.485		8.526		18.202	
P	0.000		0.000		0.000		0.000		0.000	

Those able to afford all six examined items are happier and more satisfied than people who are not able to afford one to six listed items in every country. The absolute differences vary from 0.97 points (happiness in the Czech Republic) to 1.33 (satisfaction in Hungary). If measured by the median, the same result is obtained. The differences in medians vary from 1.10 (happiness in the Czech Republic again) to 1.54 (satisfaction in Hungary again). Also, the lower quartile, upper quartile, 10th percentile and 90th percentile are higher for the "able" group in all countries.

Based on the performed Welch t-tests, the null hypotheses of equality in the mean happiness, as well as the mean satisfaction between the two compared groups, are rejected in all examined countries. The alternative hypotheses of different levels of both happiness and satisfaction need to be accepted.

The conclusion is that the people who can afford all the items if they would like to get them are happier and more satisfied than the people who cannot afford all of them (more precisely they cannot afford 1 to 6 out of the 6 named items). The hypotheses 5a and 5b are thus both confirmed for all examined countries as well as for central Europe as a whole.

Assertion 5a: Hypothesis 5a is accepted on 5% significance level for all countries of central Europe since Welch t-tests reject the null hypotheses of equal means between those who can afford all listed items and those who cannot afford one or more listed items.

Assertion 5b: Hypothesis 5b is accepted on 5% significance level for all countries of central Europe since Welch t-tests reject the null hypotheses of equal means between those who can afford all listed items and those who cannot afford one or more listed items.

To understand the topic better, a subsequent analysis is performed. In this analysis the total of 3.797 respondents were divided into three groups – first group of 2.060 respondents include those able to afford all the items together with those unable to afford a single item from the list. This grouping is based on the presumption that the inability to afford only one item out of the six does not mean the respondent is deprived yet. We consider these people not to be materially deprived. The second group of 1.326 respondents includes those unable to afford any two, three or four items out of the six listed ones. These respondents are considered to be weakly deprived. The last group of 411 respondents includes those unable to afford either five or all six items. These respondents are considered to be strongly deprived. The statistics of the defined groups together with the results of Welch ANOVA are provided in Tables 33 and 34.

Table 33: Happiness with respect to material deprivation – statistics and ANOVA.

#	Narrative	CZ		HU		PL		SK		All	
		N	MEAN	N	MEAN	N	MEAN	N	MEAN	N	MEAN
1	0-1 items afforded	603	7.20	412	7.50	499	7.97	546	7.40	2 060	7.50
2	2-4 items afforded	297	6.20	419	6.48	327	6.95	283	6.39	1 326	6.51
3	5-6 items afforded	63	5.44	163	5.63	90	5.70	95	4.94	411	5.46
	All groups	**963**	**6.77**	**994**	**6.76**	**916**	**7.38**	**924**	**6.83**	**3 797**	**6.93**
	Welch F	49.7595		52.4841		51.4623		63.8658		204.8144	
	DF	165		416		227		236		1 052	
	P	0.00		0.00		0.00		0.00		0.00	

Table 34: Life satisfaction with respect to material deprivation – statistics and ANOVA.

#	Narrative	CZ		HU		PL		SK		All	
		N	MEAN	N	MEAN	N	MEAN	N	MEAN	N	MEAN
1	0-1 items afforded	603	6.96	412	7.21	499	7.70	546	6.73	2 060	7.13
2	2-4 items afforded	297	5.84	419	6.11	327	6.57	283	5.63	1 326	6.06
3	5-6 items afforded	63	5.30	163	4.98	90	5.67	95	4.75	411	5.12
	All groups	**963**	**6.51**	**994**	**6.38**	**916**	**7.10**	**924**	**6.19**	**3 797**	**6.54**
	Welch F	46.2678		74.3597		50.9007		44.5425		201.7329	
	DF	163		417		231		235		1 063	
	P	0.00		0.00		0.00		0.00		0.00	

The strongly deprived were found less happy and less satisfied that the weakly deprived, who are, in turn, less happy and less satisfied than the respondents not considered deprived in all examined countries. Table 35 provides the results of the multiple comparison and shows the differences are statistically significant with the single exception. The life satisfaction seems not to be significantly different between weakly and strongly deprived in the Czech Republic (the difference of means is only 0.54 points). Again, the letter "Y" stands for a statistically significant difference between the groups in a row (where the null hypothesis of equal means is rejected based on the test). The complete results of the multiple comparison tests made in this chapter are presented in Appendix 2.

Table 35: SWB with respect to material deprivation – results of multiple comparison testing.

Group1		Group2		Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	0-1 items afforded	2	2-4 items afforded	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	0-1 items afforded	3	5-6 items afforded	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	2-4 items afforded	3	5-6 items afforded	Y	Y	Y	Y	Y	**N**	Y	Y	Y	Y

The result of this subsequent analysis supports the conclusion that the material deprivation is important factor in terms of SWB. The conclusions over the hypotheses 5a and 5b is not challenged.

3.4.6 SWB and financial problems

In this section the group of people who were able to make payments of all five inquired types of household bills as scheduled in the past 12 months is compared with the group of those people who were unable to make timely payments of one to four listed types in the past 12 months. The results of statistically comparing mean happiness and mean satisfaction between the two groups are presented in Tables 36 and 37.

It can be observed that most of the respondents are able to pay all five items as scheduled (approximately 87% in all four countries on average). Those able to make payments of all five listed types of bills timely are happier and more satisfied than those who are in arrears of one to five listed types of bills in every country. The absolute differences vary from 0.64 points (happiness in the Czech Republic) to 1.46 (satisfaction in Poland). The similar result is obtained when measuring by the medians. The differences in medians vary from 0.64 (happiness in the Czech Republic again) to 1.97 (satisfaction in Poland again). Also, the lower quartile, upper quartile, 10th percentile and 90th percentile are higher for the "able" group in all countries with the exception of 90th percentile being lower for the "able" group in case of satisfaction of Slovakia.

Table 36: Happiness with respect to financial problems – comparing means.

	CZ		HU		PL		SK		ALL	
	Unable	Able	Unable	Able	Unable	Able	Unable	Able	Unable	Able
N	115	819	142	688	113	674	58	810	428	2 991
MEAN	6.21	6.85	6.06	6.75	6.42	7.61	5.62	6.91	6.14	7.02
VAR	3.18	3.39	5.19	4.43	5.55	3.82	6.49	3.90	4.95	3.97
10th PC	3.75	4.60	2.65	3.99	3.04	4.90	1.47	4.55	3.03	4.59
25th PC	4.94	5.46	4.63	5.31	4.84	6.34	4.58	5.45	4.76	5.56
MEDIAN	6.37	7.01	6.26	7.06	6.53	7.87	5.30	7.03	6.21	7.22
75th PC	7.32	8.17	7.74	8.24	8.22	9.27	7.29	8.32	7.70	8.40
90th PC	8.32	9.27	8.92	9.40	9.69	10.05	9.53	9.64	9.20	9.69
Diff.	0.64		0.69		1.19		1.29		0.88	
DF	150.203		193.830		139.070		62.001		529.695	
Welch t	-3.600		-3.317		-5.120		-3.786		-7.766	
P	0.000		0.001		0.000		0.000		0.000	

Table 37: Life satisfaction with respect to financial problems – comparing means.

	CZ		HU		PL		SK		ALL	
	Unable	Able	Unable	Able	Unable	Able	Unable	Able	Unable	Able
N	115	819	142	688	113	674	58	810	428	2 991
MEAN	5.83	6.62	5.63	6.48	5.94	7.40	5.05	6.28	5.69	6.67
VAR	3.46	3.97	4.96	4.22	4.90	4.02	7.87	4.53	4.97	4.36
10th PC	3.33	3.94	2.39	3.76	2.98	4.79	1.14	3.38	2.63	3.99
25th PC	4.48	5.25	4.55	5.20	4.67	5.93	2.86	4.94	4.44	5.25
MEDIAN	5.92	6.83	5.74	6.76	5.67	7.63	4.96	6.44	5.65	6.87
75th PC	7.20	8.03	7.22	7.96	7.64	9.04	7.08	7.74	7.28	8.14
90th PC	8.18	9.20	8.37	8.80	9.02	9.98	9.53	9.16	8.55	9.47
Diff.	0.79		0.85		1.46		1.23		0.98	
DF	153.161		193.721		144.471		61.785		539.564	
Welch t	-4.222		-4.153		-6.593		-3.277		-8.602	
P	0.000		0.000		0.000		0.002		0.000	

The null hypotheses of equality in the mean happiness, as well as the mean satisfaction between the two groups, is rejected, and the alternative hypotheses of different levels of both happiness and life satisfaction are hence accepted based on the performed Welch t-tests.

The conclusion is that the people who were able to pay all the listed household bills timely are happier and more satisfied with their lives than those who were not able to make all the payments as scheduled in the past 12 months (more precisely they could not make 1 to 5 out of the 5 examined types of the payments). The hypotheses 6a and 6b are thus both confirmed for all examined countries as well as for central Europe as a whole.

Assertion 6a: Hypothesis 6a is accepted on 5% significance level for all countries of central Europe since Welch t-tests reject the null hypotheses of equal means between those who are able to pay all listed types of bills timely and those who are unable to pay one or more listed types of bills timely.

Assertion 6b: Hypothesis 6b is accepted on 5% significance level for all countries of central Europe since Welch t-tests reject the null hypotheses of equal means between those who are able to pay all listed types of bills timely and those who are unable to pay one or more listed types of bills timely.

Again, the differences among more than two groups can be analyzed in order to obtain the better picture. For the purpose of this analysis the total group of 3.419 respondents was divided into three groups again. First group of 2.991 respondents remained the same. It included only respondents who are able to pay all five items as scheduled in past 12 months. The reason for such an approach is that this group is very large compared to the other groups and adding even more respondents to this group would make it even more dominating. The second group of only 185 respondents includes those unable to pay timely only a single item out of the five listed ones. These respondents are considered to have minor financial problems. The last group of 243 respondents includes those unable to pay timely two or more items out of the five listed ones. These respondents are considered to have the major financial problems. The statistics of the defined groups together with the results of Welch ANOVA are provided in Tables 38 and 39. The results of the multiple comparison is provided in Table 40. The complete results of the multiple comparison tests made in this chapter are presented in Appendix 2.

Table 38: Happiness with respect to financial problems – statistics and ANOVA.

#	Narrative	CZ		HU		PL		SK		All	
		N	MEAN	N	MEAN	N	MEAN	N	MEAN	N	MEAN
1	Able to pay all items	819	6.85	688	6.75	674	7.61	810	6.91	2 991	7.02
2	Unable to pay 1 item	52	6.63	59	6.12	61	6.34	13	5.08	185	6.26
3	Unable to pay 2+ items	63	5.86	83	6.02	52	6.50	45	5.78	243	6.04
	All groups	**934**	**6.77**	**830**	**6.63**	**787**	**7.44**	**868**	**6.83**	**3 419**	**6.91**
	Welch F	9.2788		5.4388		13.0609		11.0143		30.4087	
	DF	86		106		82		26		309	
	P	0.00		0.01		0.00		0.00		0.00	

Table 39: Life satisfaction with respect to financial problems – statistics and ANOVA.

#	Narrative	CZ		HU		PL		SK		All	
		N	MEAN	N	MEAN	N	MEAN	N	MEAN	N	MEAN
1	Able to pay all items	819	6.62	688	6.48	674	7.40	810	6.28	2 991	6.67
2	Unable to pay 1 item	52	6.40	59	5.86	61	5.90	13	4.23	185	5.91
3	Unable to pay 2+ items	63	5.35	83	5.47	52	5.98	45	5.29	243	5.51
	All groups	**934**	**6.52**	**830**	**6.33**	**787**	**7.19**	**868**	**6.20**	**3 419**	**6.55**
	Welch F	12.3973		8.7098		21.8465		7.1405		37.8456	
	DF	88		106		84		26		313	
	P	0.00		0.00		0.00		0.00		0.00	

Table 40: SWB with respect to financial problems – results of multiple comparison.

	Group1		Group2	Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	Able to pay all items	2	Unable to pay 1 item	**N**	Y	Y	Y	Y	**N**	Y	Y	Y	Y
1	Able to pay all items	3	Unable to pay 2+ items	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Unable to pay 1 item	3	Unable to pay 2+ items	Y	**N**	**N**	**N**	**N**	Y	**N**	**N**	**N**	**N**

The respondents with major financial problems were found less happy and less satisfied than the respondents with minor financial problems, who are, in turn, less happy and less satisfied than those having no financial problems in the Czech Republic and Hungary as well as when taking central Europe as whole. In case of the Czech

Republic, the difference between those able to pay all items (no financial problems group) and those unable to pay only an item (minor financial problems group) is statistically insignificant in case of both happiness and satisfaction (0.22 points both). It seems that minor financial problems play no role in terms of SWB in the Czech Republic. Still, major financial problems remain significantly associated with lower SWB in the Czech Republic. There is no statistically significant difference between major and minor groups in Hungary, but both groups are significantly different from the group of respondents with no financial problems.

By contrast, the SWB (both dimensions) of those unable to pay a single item is slightly lower than those unable to pay two and more items in Poland and Slovakia. It seems that people having minor financial problems are less happy and satisfied than people having major financial problems. There is no explanation for such strange phenomenon that could be drawn from the available data and further research must be undertaken. Still, the differences between these two groups are statistically insignificant, whereas the differences with the group of respondents having no financial problems remain statistically significant in Poland as well as in Slovakia.

3.4.7 SWB and housing defects

The problems with housing is the last factor to be examined. In this case the first group includes only the respondents reporting no problems with housing, whereas respondents in the second group report 1 to 6 problems with housing. The results of statistically comparing mean happiness and mean satisfaction between the two groups are presented in Tables 41 and 42.

First of all, it seems that most of the households does not face the housing defects (approximately 81% of them report no problems with housing in all four countries together). The respondents facing no problems are happier and more satisfied than people facing some problems in all four countries, whereas the difference vary from 0.41 (happiness in the Czech Republic) to 1.11 (satisfaction in Hungary). That is not too much. The similar result is obtained when measuring by the medians as well as the other percentiles. The differences in medians vary from 0.28 (happiness in the Czech Republic again) to 1.46 (satisfaction in Hungary again).

Table 41: Happiness with respect to housing defects – comparing means.

	CZ		HU		PL		SK		ALL	
	Exist	Don't exist	Exist	Don't exist	Exist	Don't exist	Exist	Don't exist	Exist	Don't exist
N	158	852	272	767	253	740	101	915	784	3 274
MEAN	6.41	6.82	6.09	7.00	6.77	7.53	6.05	6.92	6.37	7.05
VAR	3.95	3.23	5.48	4.01	5.42	4.19	6.25	3.83	5.32	3.86
10th PC	3.67	4.64	2.64	4.56	3.73	4.79	2.20	4.59	3.17	4.63
25th PC	4.91	5.47	4.68	5.69	5.05	6.24	4.61	5.41	4.84	5.62
MEDIAN	6.66	6.94	6.13	7.33	7.00	7.80	6.15	7.02	6.53	7.24
75th PC	7.81	8.10	7.85	8.36	8.53	9.27	7.94	8.34	8.12	8.41
90th PC	9.05	9.21	9.30	9.52	9.87	10.05	9.38	9.63	9.54	9.70
Diff.	0.41		0.91		0.76		0.87		0.68	
DF	207.289		419.750		393.459		113.949		1 071.196	
Welch t	-2.424		-5.718		-4.630		-3.384		-7.644	
P	0.016		0.000		0.000		0.001		0.000	

In terms of both happiness and satisfaction, the null hypotheses of equal mean happiness, as well as the mean satisfaction between the two groups can be rejected and hence the alternative hypotheses of unequal means need to be accepted based on the performed Welch t-tests. The conclusion is that the people who have no problems with housing are happier and more satisfied with their lives than those who have. Both Hypotheses 7a and 7b are thus confirmed for all examined countries as well as central Europe as a whole.

Assertion 7a: Hypothesis 7a is accepted on 5% significance level for all countries of central Europe since Welch t-tests reject the null hypotheses of equal means between those who have no problem with housing and those who have one or more problems with housing.

Assertion 7b: Hypothesis 7b is accepted on 5% significance level for all countries of central Europe since Welch t-tests reject the null hypotheses of equal means between those who have no problem with housing and those who have one or more problems with housing.

Table 42: Life satisfaction with respect to housing defects – comparing means.

	CZ		HU		PL		SK		ALL	
	Exist	**Don't exist**	**Exist**	**Don't exist**	**Exist**	**Don't exist**	**Exist**	**Don't exist**	**Exist**	**Don't exist**
N	158	852	272	767	253	740	101	915	784	3 274
MEAN	5.97	6.59	5.56	6.67	6.40	7.28	5.43	6.32	5.90	6.69
VAR	5.13	3.67	5.63	4.01	5.28	4.22	6.53	4.52	5.66	4.23
10th PC	2.95	4.08	1.91	4.12	3.43	4.69	1.42	3.45	2.55	4.08
25th PC	4.28	5.26	4.28	5.36	4.93	5.75	3.75	4.96	4.57	5.26
MEDIAN	5.97	6.77	5.50	6.96	6.30	7.53	5.30	6.45	5.80	6.88
75th PC	7.80	7.94	7.46	8.09	8.11	8.90	7.23	7.79	7.74	8.15
90th PC	8.98	9.06	8.43	9.07	9.68	9.92	8.98	9.24	9.12	9.43
Diff.	0.62		1.11		0.88		0.89		0.79	
DF	200.735		415.797		398.385		115.789		1 079.807	
Welch t	-3.185		-6.873		-5.410		-3.387		-8.567	
P	0.002		0.000		0.000		0.001		0.000	

Similarly to the previous two factors of material deprivation and financial problems the subsequent analysis is performed. For its purpose the total group of 4.058 respondents was divided into three groups again. First group of 3.274 respondents remained the same as it was for the initial analysis. It only included respondents having no housing defects. The reason for such an approach is the same as in case of the analysis of the previous factor. This group is large compared to the other groups and adding further respondents would make it even more dominating. The second group of only 456 respondents includes the respondents who have just a single housing defect. These respondents are considered to have minor housing problems. The last group of 328 respondents includes those having two and more housing defects out of the five. These respondents are considered to have major housing problems. The statistics of the defined groups together with the results of Welch ANOVA are provided in Tables 43 and 44. The results of the multiple comparison is provided in Table 45. The complete results of the multiple comparison tests made in this chapter are presented in Appendix 2.

Table 43: Happiness with respect to housing defects – statistics and ANOVA.

#	Narrative	CZ		HU		PL		SK		All	
		N	MEAN	N	MEAN	N	MEAN	N	MEAN	N	MEAN
1	No housing defect	852	6.82	767	7.00	740	7.53	915	6.92	3 274	7.05
2	1 housing defect	111	6.62	127	6.32	154	7.18	64	6.45	456	6.70
3	2+ housing defects	47	5.91	145	5.89	99	6.13	37	5.35	328	5.91
	All groups	**1 010**	**6.76**	**1 039**	**6.76**	**993**	**7.34**	**1 016**	**6.83**	**4 058**	**6.92**
	Welch F	5.1449		17.2798		15.1263		7.7241		38.9616	
	DF	97		222		196		65		590	
	P	0.01		0.00		0.00		0.00		0.00	

Table 44: Life satisfaction with respect to housing defects – statistics and ANOVA.

#	Narrative	CZ		HU		PL		SK		All	
		N	MEAN	N	MEAN	N	MEAN	N	MEAN	N	MEAN
1	No housing defect	852	6.59	767	6.67	740	7.28	915	6.32	3 274	6.69
2	1 housing defect	111	6.13	127	5.70	154	6.71	64	5.62	456	6.13
3	2+ housing defects	47	5.62	145	5.44	99	5.91	37	5.08	328	5.57
	All groups	**1 010**	**6.49**	**1 039**	**6.38**	**993**	**7.05**	**1 016**	**6.23**	**4 058**	**6.53**
	Welch F	5.8144		23.7247		16.5347		5.9865		40.7291	
	DF	95		221		196		65		591	
	P	0.00		0.00		0.00		0.00		0.00	

Table 45: SWB with respect to housing defects – results of multiple comparison.

	Group1		Group2	Happiness					Life satisfaction				
				CZ	HU	PL	SK	ALL	CZ	HU	PL	SK	ALL
1	No housing defect	2	1 housing defect	**N**	Y	**N**	**N**	Y	Y	Y	Y	Y	Y
1	No housing defect	3	2+ housing defects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	1 housing defect	3	2+ housing defects	Y	**N**	Y	Y	Y	**N**	**N**	Y	**N**	Y

People having major housing problems were found less happy and less satisfied that those having minor problems, who are, in turn, less happy and less satisfied than the respondents having no problems in housing in all countries. Still, the multiple comparison tests show that some of the differences are statistically insignificant.

Namely, the difference in mean happiness between "no problems" and "minor problems" groups is insignificant in the Czech Republic, Poland and Slovakia. It may indicate that facing few and unimportant housing defects may not be harmful to the happiness in some cases.

Although hypothesis 7a was accepted based on the statistical testing differences between those having no problems and the others, the association between SWB and housing defects seems to be rather weak. When more detailed approach is adopted, a different picture may appear. Further research is hence needed in this case too. It may include the analysis of particular defects to uncover the ones important from the point of view of SWB.

4 Probabilistic modelling

The pairwise relations between SWB and particular measures of the material situation were tested in Chapter 3. When testing the relation between SWB and the given variable, the influences of the other variables were not controlled. For example, it was proved that the income is associated with SWB, but it does not necessarily mean that there is a direct link between the two variables. The association may be intermediated by one or more other factors.

In this chapter, we aim to analyze the relations among SWB and all seven previously defined variables of the material situation in a more advanced way using the probabilistic modelling techniques, namely Bayesian networks. The goal is to show the relations of conditional independence among the given variables.

4.1 Data

Similarly to the statistical analysis made in Chapter 3 the data from the European Quality of Life Study were used for the probabilistic modeling. Whereas the statistical analysis was based on the most recent EQLS survey conducted in 2016 (Eurofound, 2018a), the probabilistic modelling made in this chapter was based on the third survey of the EQLS (Eurofound, 2014) conducted in 2011. The reason for not using the most recent data is that the question on relative income compared to the most people in the country missing in the last survey made in 2016. We consider this variable too important to be omitted from this analysis, thus the data from the third survey were used.

Technical details how the study was conducted are available in EQLS Sampling report (Eurofound, 2012a) and EQLS Technical report (Eurofound, 2012b). The survey was carried out in all 27 EU member states and 7 non-EU countries by a network of the national institutes led by GfK EU3C settled in Belgium. It covers all people aged 18 and over whose usual place of residence (address where the respondent usually resides, it means, where the respondent normally sleeps) is in the territory of the surveyed countries. Only one interview per household was held whereas only an adult household member was allowed to be taken as an eligible respondent.

The probability models were learnt using only the data of four post-communist central European countries (the Czech Republic, Hungary, Poland and Slovakia) consistently with the statistical analysis made in Chapter 3. This approach promises to have a sufficient sample from the very similar countries in terms of culture, geography, politics, economics and modern history. Total sample size for the four countries

is 5,298 (1,012 in the Czech Republic; 1,024 in Hungary; 2,262 in Poland; and 1,000 in Slovakia) respondents out of whom 3,259 (613 in the Czech Republic; 586 in Hungary; 1,428 in Poland; and 632 in Slovakia) complete data vectors are extracted by removing respondents, who answered the relevant questions incompletely[60].

The data were collected from September to December 2011 in the four countries of central Europe. The individuals for survey were selected strictly randomly, so that all members of the survey population had a non-zero probability of being included in the sample.

As the sufficient quality sampling frames (registers) covering at least 95% of persons were available in the Czech Republic, Hungary and Poland, random probability sampling based on the registers were made. Enumerated random route was used for the selection in Slovakia as the sampling frame with the sufficient coverage of the population was not identified. People living in institutions (prisons, hospitals etc.) were not included in the survey. The sample was stratified based on the regions according to NUTS2 and the degree of urbanization (metropolitan, urban and rural), and allocated proportionately to the population of the strata in all countries. There are 33 geographical strata in the Czech Republic, 21 strata in Hungary and 87 strata in Poland based on NUTS2 regions and urbanization. There are 39 strata based on the statutory districts in Slovakia.

The stratified three stage probability sample design was adopted in the Czech Republic, Poland and Slovakia. The three stages comprise random selection of Primary Sampling Units (PSUs) in each stratum, random selection of addresses (households) from the available registers (or by the random route in case of Slovakia) and random selection of the respondents living in the households. The two stages sample design was adopted in Hungary, because the local register is name-based and not household based. The other two stages are the same as described.

Given the sample size and the sampling procedures the third wave EQLS samples can be considered representative of the total statistical population to be covered in each surveyed country.

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[60] This selection of countries is represented by the node "country" in the model.

4.2 Measurement

The set of subjective and objective variables used in this chapter is based on the set of variables analyzed in Chapter 3. The way how the data were transformed for the purpose of the probabilistic modelling is described in this section.

4.2.1 Subjective well-being

The two questions on the two dimensions of SWB[61] are available in the third wave of EQLS. The design is the same in third and fourth wave of EQLS. The brief overview of the common approaches for SWB measurement as well as the description of questions and scales used have already been provided in Section 3.2.1.

The sample of 5,262 respondents having stated both happiness and life-satisfaction is divided into quartiles based on the average score computed from the two scales. (36 respondents refused to state either happiness or life satisfaction.) Because SWB is a two-item measure, the internal consistency of the two components was checked using Cronbach's alpha (Cronbach, 1951). The value of alpha is 0.774. It is generally considered acceptable in the social research (Nunnally, 1978, Schmitt, 1996). The two scales of happiness and life satisfaction can hence be considered internally consistent.

Thus, the variable of SWB has four ordinal states based on quartiles and the node is abbreviated as "SWB" in the Bayesian networks.

4.2.2 Household income

The income was surveyed the same way in both the third and the fourth waves and it was described in Section 3.2.2. There were only 3,965 respondents out of the 5,298 having declared their income in the third wave in the surveyed countries (non-response rate of 25.2%). The sample of 3,965 respondents having stated their household income is divided into the income quartiles the same way as in statistical analysis made in Chapter 3.

The income could be treated as a continuous variable. For the purpose of the Bayesian networks construction the variable was transformed to have four ordinal states based on quartiles. They are coded as follows in the Bayesian networks:

- 1 – 1st quartile.
- 2 – 2nd quartile.

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[61] Question 41 on happiness and question 30 on life satisfaction in the third EQLS wave conducted in 2011.

- 3 – 3rd quartile.
- 4 – 4th quartile.

The node is abbreviated as "INC" in the Bayesian networks.

4.2.3 Relative income

The questions and scales were described in Section 3.2.3[62].

The data for the relative income compared to own past were not transformed in any way. There are three ordinal states coded as follows in the Bayesian networks:
- 1 – Better.
- 2 – The same.
- 3 – Worse.

The node is abbreviated as "PAST" in the Bayesian networks.

In case of the relative income compared to others the 5-point scale was transformed into the 3-point scale in the same way[63] as in the discussion in Section 3.4.2 where the insufficient sample sizes in some of the groups were identified. The variable has three ordinal states coded as follows in the Bayesian networks.
- 1 – Worse.
- 2 – The same.
- 3 – Better.

The node is abbreviated as "OTHR" in the Bayesian networks.

There is an important reason for the reduction of states in the Bayesian networks. If the numbers of states are lower, it is more likely to have a sufficient number of data vectors for learning conditional probabilities for all configurations of nodes in a network. This is particularly important if there are more complex configurations of parents of a node. It is more likely the respondents are not available (or just few respondents are available) for the learning all the parameters given the parents configuration in case the more states are defined. The more data vectors for a particular configuration is available in the dataset the more reliable estimation of the parameters is. The reduction of the states is hence a way to increase the reliability of

....

[62] Questions 57 and 65 in the third edition of EQLS.

[63] The groups of "much worse" and "somewhat worse" were merged into the single group "worse" and the groups "much better" and "somewhat better" were merged into the single group "better". The central option of "neither worse nor better" was taken as it was.

parameters estimation. Furthermore, a distribution having 5 and more states is unnecessarily detailed for the purpose of modelling with the Bayesian networks. This line of reasoning applies also to other data transformations made in this chapter.

4.2.4 Perceived economic strain

The EQLS questions on the perceived economic strain are the same in third[64] and fourth surveys and the relevant description can be found in Section 3.2.4. Again, the data transformation was made in case of this variable. The approach adopted in the discussion made in Section 3.4.4 was applied in this case too[65].

The variable of the perceived economic strain has therefore four ordinal states. They are coded as follows in the Bayesian networks:
- 1 – Able to make ends meet easily.
- 2 – Able to make ends meet fairly easily.
- 3 – Able to make ends meet with some difficulty,
- 4 – Able to make ends meet with difficulty.

The node is abbreviated as "STRS" in the Bayesian networks.

4.2.5 Material deprivation

The remaining three variables are constructed based on the EQLS questions having several binary sub-questions. The question on the material deprivation, that is ability to afford six listed items if a respondent wants them, is the same in third and fourth waves. The question[66] including the list of the items is described in Section 3.2.5.

The six binary sub-questions were transformed into a single ternary ordinal variable. This was done in a way consistent with the approach adopted within the discussion made in Section 3.4.5. The states are coded as follows in the Bayesian networks:
- 1 – Respondents, who cannot afford 0-1 items wanted (the group of those not deprived).

....

[64] Question 58 in the third edition of EQLS.

[65] As there is no central option, the 6-point scale was transformed to 4-point scale by merging the categories of those able to make ends meet very easily and easily into the single group "easily" and those able to make ends meet with difficulty and with great difficulty into the single group "with difficulty". The two inner groups of those able to make ends meet "fairly easily" and "with some difficulty" remained as they were.

[66] Question 59 in the third edition of EQLS.

- 2 – Respondents, who cannot afford 2-4 items wanted (weakly deprived)
- 3 – Respondents, who cannot afford 5-6 items wanted (strongly deprived).

Consistently with the approach adopted in the previous chapter the respondents who refused to answer any single sub-question were excluded from the analysis. The node is abbreviated as "DEPR" in the Bayesian networks.

4.2.6 Financial problems

The financial problems are measured by the ability to pay four typical households bills as scheduled in the past 12 months. The EQLS question itself is the same in third and fourth survey[67]. There are only four items on the list in the third wave whereas and item[68] was added for the fourth wave. The question is described in Section 3.2.6.

The four binary sub-questions must have been transformed into the single ternary ordinal variable. The transformation was consistent with the approach adopted in the discussion made in Section 3.4.6. The states are coded as follows in the Bayesian networks:

- 1 – Respondents, who are able to pay all four items as scheduled (group of no financial problems).
- 2 – Respondents, who are unable to pay timely only a single item out of the four listed ones (group of minor financial problems).
- 3 – Respondents, who are unable to pay timely two or more items out of the four listed ones (group of major financial problems).

The respondents who refused to answer any single sub-question were excluded from the analysis. The node is abbreviated as "FPRO" in the Bayesian networks.

4.2.7 Housing defects

There are six sub-questions[69] on the housing defects whereas one of them differs from the third to the fourth wave[70]. The remaining questions are the same in the two waves. They are described in Section 3.2.7.

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[67] Question 60 in the third edition of EQLS.

[68] Payments related to informal loans from friends or relatives not living in your household.

[69] Question 19 in the third edition of EQLS.

[70] There is "Lack of place to sit outside" as one of the item in the third wave question instead of "Lack of facilities (heating or cooling) to keep a comfortable temperature at home" in the fourth wave.

The six binary variables were transformed into a single ordinal ternary variable. The transformation was consistent with the approach adopted in the discussion made in Section 3.4.7. The states are coded as follows in the Bayesian networks:

- 1 – No defect in housing.
- 2 – Only a single defect in housing.
- 3 – Two and more defects in housing.

The respondents who refused to answer any single sub-question were excluded from the analysis. The node is abbreviated as "HOUS" in the Bayesian networks.

4.2.8 Country

Respondent's country is represented by a separate node in the model. By its nature, this variable is not ordinal. It has four states according to the examined countries:

- 1 - Czech Republic;
- 2 – Hungary;
- 3 – Poland; and
- 4 - Slovakia.

The node is abbreviated as "CRY" in the Bayesian networks.

4.3 Method

Whereas the research in Chapter 3 was based on the quantitative analysis and deduction, the research presented in this chapter includes both qualitative and quantitative analysis and is rather inductive. The qualitative part is expressed by the structure of the Bayesian networks and the quantitative part by the learnt parameters of the Bayesian networks.

Statistical testing helped us to confirm (or not confirm is some cases) our hypotheses over the associations between SWB and particular variables describing some aspects of the material situation. The statistical tests such as one-way ANOVA and t-tests (more precisely their adaptations for comparing the samples with unequal variances) were used. The sociologists commonly use more sophisticated statistical methods for the analyses in order to control more variables. Namely, ANOVA for the multiple factors and various types of the regression analyses according to the nature of the variables. The regression analysis enables to estimate the dependent variable based on the one or more independent variables. It could be SWB as the dependent variable and the variables of the material situation as the predictors in our case. The

regression models may then be used for the forecasting. The ordinal logistic regression model is constructed as a part of the analysis in Section 4.4.4. It is compared with the Bayesian networks thereafter.

4.3.1 Brief introduction to Bayesian networks

Bayesian networks are briefly introduced, their advantages and disadvantages are outlined and the reasoning for their use is provided in this section.

Bayesian networks were first introduced by Judea Pearl in early eighties (Pearl, 1982). A Bayesian network is a compact graphical representation a joint probability distribution over the variables of interest. It is defined by a set of variables where each of the variable has a finite set of mutually exclusive states. The variables are connected by a set of directed edges. The variables together with the directed edges form a directed acyclic graph, often abbreviated as "DAG". The graphs are acyclic as they must not have any feedback loops and are directed as the edges between the nodes are oriented. For each variable in the graph a conditional probability distribution given the states of the parents of that variable is defined. A Bayesian network is defined as follows by Jensen (2001, p. 19).

Definition 13: A Bayesian network consists of the following:
- A set of variables and a set of directed edges between variables.
- Each variable has a finite set of mutually exclusive states.
- The variables together with the directed edges form a directed acyclic graph.
- A directed graph is acyclic if there is no directed path $A_1 ->...->A_n$ so that $A_1 = A_n$.
- To each variable A with parents $B_1,...,B_n$ there is attached the potential table $P(A|B_1,...,B_n)$.

Although the Bayesian networks are sometimes referred as causal networks, it is important to stress that, generally, the directed edges between the variables need not represent the "cause-to-effect" relationships. They define the relations of the conditional dependencies and independencies among the variables. In other words, the structure induces d-separation properties of the network (Jensen, 2001). It is worth of briefly introducing the concept of d-separation as it is used as the criteria during the model construction.

If there are two distinct variables A and B and an intermediate variable V, which is distinct from A and B in a Bayesian network, we can draw the three possible connections between the nodes A and B through V in the following way.

Figure 5: Types of connections in a directed graph – serial connection.
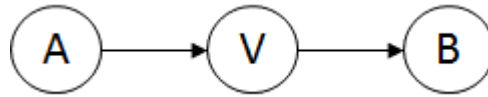
Figure 6: Types of connections in a directed graph - diverging connection.
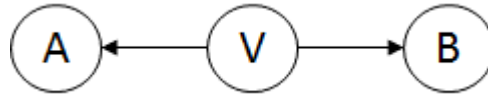
Figure 7: Types of connections in a directed graph - converging connection.
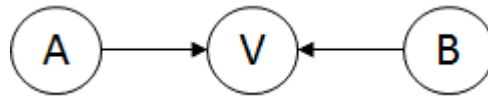
Definition 14: Two distinct variables A and B in the Bayesian network are d-separated given the intermediate variable V distinct from A and B if either the connection between A and B is serial or diverging and V is instantiated[71], or the connection between A and B is converging[72] and neither V nor any of V's descendants are instantiated.

Basically, if the state of the variable V is known, it blocks the transmission of the evidence[73] between A and B in case of serial and diverging connections. The situation of converging connection is the only different one. In this situation, the communication is blocked in case the state of V (or one of its descendants) is unknown. A and B are d-separated if *"changes in the certainty of A have no impact on the certainty of B."* (Jensen, 2001, p.11). The above definition could be generalized for more than one variable V.

The application the Bayesian networks in the contemporary sociology seems not to be frequent[74]. As the Bayesian networks have advantages (and some disadvantages, obviously) there are reasons why to use the Bayesian networks. From our perspective, the main advantages are the following.

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[71] If the state of a variable is known, we say that it is instantiated (Jensen, 2001).

[72] The converging connection is often referred also as "head-to-head" connection or V-structure. The diverging connection is also referred as "tail-to-tail" connection and the serial connection can also be referred as "head-to-tail" connection.

[73] Information that a given variable takes specific values.

[74] The author is not aware of any sociological study where Bayesian networks are used.

1. A Bayesian network represents graphically conditional independence relations. Uncertain relations between variables are modeled using the conditional probability distributions. Hence, Bayesian networks enable an efficient encoding of a domain knowledge and improve understanding of complex problems.

2. Bayesian networks provide a compact representation of the joint probability distribution[75].

3. Bayesian networks enable exact probabilistic inference assuming the structure and parameters are estimated correctly. Under these assumptions the posterior probability distribution of any variable can be calculated[76].

4. Bayesian networks help answering queries under the uncertainty. It is a method for decision making applicable also in situations when either insufficient amount of the information is available or the information is vague.

5. As the software for learning the structure and parameters of Bayesian networks is available, complex situations can be modelled with the help of Bayesian networks.

The disadvantages of the Bayesian networks are the following.

1. A large amount of data is needed to learn parameters reliably in some cases.

2. The tendency for a cause-to-effect misinterpretation of the oriented edges in graph.

Considering the advantages outlined above and being aware of the disadvantages the application of the Bayesian network seems to be suitable and innovative for the further analysis of the material aspects of SWB.

4.3.2 Methods of network construction

The Bayesian networks construction includes two main consequent phases:

1. Determining the structure.

2. Learning the parameters[77].

Determining the structure includes definition of model variables and establishing of directed links among the variables in a network. The structure can be determined

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[75] The structure defines the parents for every variable. A standard representation of the joint probability distribution has 2^n parameters whereas the joint probability distribution represented by a Bayesian network has at most $n2^k$ parameters (n = number of variables and k = maximum number of parents, the random variables binary).

[76] The inference can be „bottom-up"(a diagnostic inference, we look for the cause with the maximum posterior probability) and top-down (a causal inference – we look for the probability of an effect given the causes).

[77] The parameters of a Bayesian network are the conditional probabilities that define the joint probability distribution of the network as their product.

based on the expert knowledge or learnt from the available data using a structure learning algorithm. There are two main types of the learning algorithms:

1. Search and score algorithms.
2. Constraint-based algorithms.

Search and score methods search for the structure maximizing a score function. The likelihood function, Akaike Information Criterion (AIC) (Akaike, 1974) and Bayesian Information Criterion (BIC) (Schwarz, 1978) can stand as examples of the scoring functions most often used. The typical example of this type of methods is a greedy search algorithm (Chickering, 2002). Based on the conditional independence tests constraint-based methods establish the independence relations as constrains that should satisfy the d-separation criteria in a final graph. Most common constraint-based method is probably the PC algorithm (Spirtes et al., 2000).

Learning the parameters means the estimation of the conditional probability distributions based on the training data. Again, the parameters can either be set by engineering considerations or estimated from the data. Expectation maximization algorithm (EM algorithm) (Dempster et al., 1977) is probably the most widely used method for learning the parameters in Bayesian networks.

We learnt five Bayesian networks using different structure learning algorithms and parameters learning algorithms and the ordinal logistic regression model. Table 46 summarizes the way how the models are constructed.

Table 46: Models construction.

	Model	Structure learning algorithm	Scoring criteria	Parameters learning algorithm
1	Expert/EM	expert	-	EM
2	Expert/OLR	expert	-	Ordinary logistic regression
3	Greedy/EM	Greedy search and score	BIC	EM
4	Gobnilp/EM	Gobnilp algorithm	BIC	EM
5	TAN/EM	Tree augmented Naive Bayes	-	EM
6	OLR	-	LL	gradient

1. **"Expert/EM" model** – the structure of this model is established using the expert knowledge in Section 4.4.1 and all the parameters are learnt using the EM algorithm[78].

2. **"Expert/OLR" model** – the model has the same structure as Expert/EM model, whereas the parameters are learnt based on the ordinal logistic regression model with SWB as the dependent variable. (Only the parameters of the income were learnt using the EM algorithm, because the country is not the ordinal variable and it is the only parent of the income in the expert model.)

3. **"Greedy/EM" model** – the structure of this model is established using the greedy search-and-score learning algorithm with BIC as a scoring criterion. The structure learning is made using the analytical software Hugin (Hugin, 2014). All the parameters are learnt using the EM algorithm.

4. **"Gobnilp/EM" model** – the structure of this model is established with the Gobnilp learning algorithm embedded in the Gobnilp software (Cussens and Bartlett, 2015) with BIC as a scoring criteria. Gobnilp software promises to learn the structure optimal in terms of BIC. All the parameters are learnt using the EM algorithm.

5. **"TAN/EM" model** – the structure of this model is established with the Tree-augmented Naïve Bayes learning algorithm. The structure learning is made using the analytical software Hugin (Hugin, 2014). All the parameters are learnt using the EM algorithm.

6. **"OLR" model** – the ordinal logistic regression model with SWB as the dependent variable and all other variables included as explanatory variables. The calculation was made using R software[79] (R Core team, 2014).

The machine learning of the structure was done using the EQLS data described in Section 4.1. The definition of the variables is described in Section 4.2. No hidden variables are considered, all variables are observed. When the EM algorithm is used, the learning of the parameters was made using the analytical software Hugin (Hugin, 2014) based on the same dataset. Unless stated otherwise the parameters are learnt based on the whole dataset of 3,259 complete vectors.

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[78] As the our dataset is complete (there are not missing values) EM algorithm simply calculates relative frequencies.

[79] The command „polr" from the MASS package was used for the calculation. An explanation and a working example are provided in https://stats.idre.ucla.edu/r/dae/ordinal-logistic-regression/.

4.3.3 Methods of testing the networks

A decision, which model to select as the most proper one, must be taken in situations when more than one model is constructed. First of all, the d-separation as a *"property of human reasoning"* (Jensen, 2001, p. 11) is used to discuss important relations of conditional independence implied by the structures of the models. The concept of d-separation was described in Section 4.3.1.

The outlined models are tested using the following criteria.

- Bayesian Information Criterion (BIC).
- The prediction accuracy of SWB.

BIC is one of the most commonly used scoring criteria to search over possible networks. It was developed by Schwarz (1978) and is sometimes called Schwarz information criterion after the inventor. The following formal definition is adapted from Jaakkola (2006).

Definition 15: BIC of an acyclic graph G over d discrete variables $x_1,...,x_d$, where $x_i \in 1,...,r_i$, and n complete observations $D = \{(x^t_1,...,x^t_d), t=1,...,n\}$ and parameter estimates $\hat{\theta}$ are defined as follows:

$$BIC(G) = l\big(D; \hat{\theta}; G\big) - \frac{\dim(G)}{2} \log(n)$$

BIC is based on the log-likelihood function $l(D; \hat{\theta}; G)$ as a score function from which a penalization is deducted in order to prefer the models with fewer parameters. The log-likelihood function of the graph G given the complete data D and parameter estimates $\hat{\theta}$ is defined the following way:

$$l(D; \theta; G) = \log P(D|\theta) = \sum_{t=1}^{n} \sum_{i=1}^{d} log\theta_{x_i^t | x_{pa_i}^t}$$

Function dim(G) stands for the number of independent parameters in the model. It is defined as:

$$\dim(G) = \sum_{i=1}^{d} (r_i - 1) \prod_{j \in pa_i} r_j$$

The penalty is hence proportional to the number of independent parameters of the model. A model with the highest BIC is selected from a finite set of models. BIC for all models is calculated in the Hugin software (Hugin, 2014) based on the whole EQLS dataset.

The accuracy of the prediction is the second criterion to be used for our model evaluation.

Definition 16: Prediction accuracy is the sum of correct predictions divided by the total number of predictions.

It is important to stress here that the classification of any variable in the model is not our primary goal. It means we do not look for the quality of prediction itself. It is just one of the several ways how to recognize which model could be good. The main goal is to establish the best possible structure that explains the relations of conditional independences among SWB and the variables of the material situation. The prediction of SWB is tested only because we assume that a good model should provide good predictions. The prediction of SWB was selected as the criteria, still, the states of any other model variable could be predicted in the same way.

The 10-fold cross-validation method was used for assessing the prediction accuracy. This method of cross-validation randomly split the data into 10 equal sized subsets. The nine subsets are used as a training data to learn the parameters of the models whereas the obtained predictions of SWB are compared with the remaining single subset. This process is repeated ten times and each subset is used exactly once for the validation[80]. The prediction accuracy of SWB is tested using the R software (R Core team, 2014).

4.3.4 PC algorithm

The PC algorithm (Spirtes et al., 2000) is used[81] for establishing the expert model structure. Prior to the determining the structure itself, the PC algorithm is introduced briefly to enhance the understanding of the process.

The PC algorithm is a constraint-based learning method as already mentioned. The methods of this type are based on tests of conditional independencies. As many as possible constraints represented by the conditional independencies must be satisfied by the resulting structure[82]. The algorithm normally search for the relations of conditional independences based on the empirical data. Here, the expert knowledge instead of the empirical data is used for determining the skeleton and v-structures.

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[80] The "leave *p*-out" approach could alternatively be used for the cross-validation. Under this approach *p* observations are randomly excluded from a training dataset and used as a validation set. The special case is the „leave-one-out" method where only a single observation is excluded and used for the validation.

[81] PC is the abbreviation of the first names of the two inventors – Peter Spirtes and Clark Glymour.

[82] Constraint-based learning algorithms assume the d-separation encoded in the DAG is equivalent to the conditional independencies in the distribution. This is called faithfulness assumption.

The algorithm works in three in three basic stages:

1) Determining the skeleton.

2) Determining the v-structures.

3) Directing the remaining edges as far as possible.

The first step starts with the initial complete graph where all variables are pairwise linked by the undirected edges. In this first step tests of triples (X,Y,S) are carried, where X and Y are variables and S is a subset of variables separating X and Y, to decide on conditional independence of X and Y given S - $(X \perp Y|S)$. The tests for every pair of (X,Y) starts with k = 0, where k is the size of the separating set S. In case the conditional independence of X and Y given S is identified, the edge linking the variables (X,Y) is removed in the graph. The testing will be terminated when the maximum adjacencies for all (X, Y) is less than k+1. The output of the first step is the skeleton of a DAG[83].

The direction of edges is derived in the second and third step. In case there are the edges between variables (X,Z) and variables (Y,Z) in the skeleton, there is no edge between the variables (X,Y) in the skeleton and $Z \notin S(X, Y)$, the edges are to be oriented X -> Z and Y -> Z. V-structure appear in the graph in this way. The edges directed in this way may imply the direction of some other edges to prevent other v-structures to be established. The result of this second and third steps is a graph with directed and undirected edges called "essential graph" or Completed Partially Directed Acyclic Graph (hereinafter abbreviated as "CPDAG"). In general, the PC algorithm is unable to determine the direction of the edges uniquely. It only produces a unique CPDAG. The remaining edges can be directed randomly so that no other V-structure is defined.

4.4 Models

4.4.1 Expert models construction

The expert knowledge is used for the construction of the model structure. What we mean by the "expert knowledge"? Two sources can be considered:

1. The knowledge gained from the review of the relevant literature made in Chapter 2. Unfortunately, the literature usually examines correlates and predictors of

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[83] The skeleton of a DAG is the undirected graph where all directed edges are replaced by undirected edges.

SWB and other factors, but scarcely provides with the detailed analysis of conditional independences. This knowledge is not strictly limited to the central European context because the provenance of the reviewed literature is mostly western European and Anglo-Saxon.

2. The knowledge based on the empirical individual real-life experience. The use of this type of knowledge means that the hypotheses are formulated based on the common sense of an informed subject rather than on the exact scientific evidence. This second type of the knowledge is used when the sufficient research-based evidence is not available.

Following the approach outlined in Section 4.3.4, the construction of the model starts with the complete undirected graph. This graph is presented by Figure 8.

Step 1:

First, the pairs of variables (X, Y) are tested for the conditional independence given the empty separating set of variables S (the size of the separating set is zero)[84]. In Chapter 3 we found that the relations between SWB and the seven variables of the material situation exist (no conditionality has been examined throughout the analysis so far). Also, the variables of the material situation are considered interdependent. We hence remove no edges in the first step. The graph after the first step remains the same.

Figure 8: Complete undirected graph.

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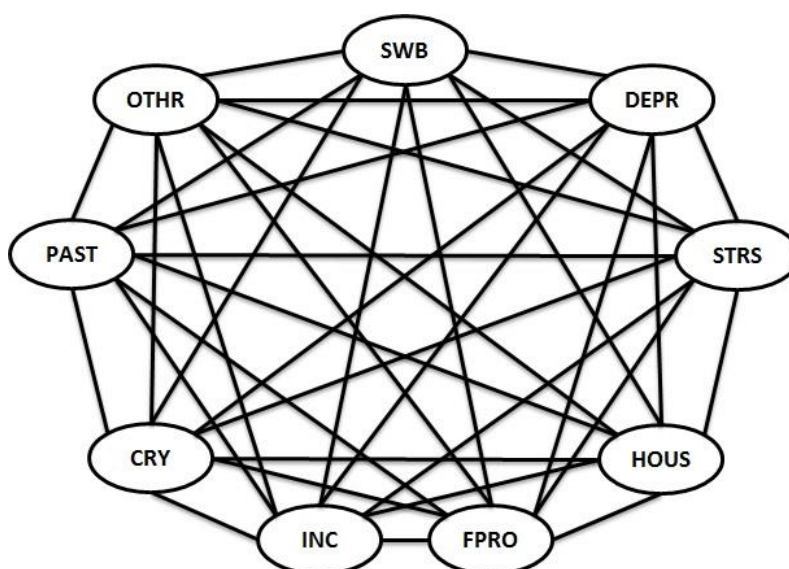
[84] As the separation set is empty, the relations between the pairs are actually unconditional in this case.

Step 2:

For k=1 (which means there is only one variable in the separating subset) there is a set of 252 triples to be tested for the conditional independences. There seems to be two important separating variables: income (INC) and financial problems (FPRO).

As we saw in Chapter 2 the scientific discussion over the relation among income, country and SWB continues. The independence of SWB and economic growth can be supported, for example, by the conclusions made by famous Richard Easterlin (1974; 1995; 2001; 2005; 2015). Easterlin proposes that the association between the income and happiness is positive within a given country, but the level of happiness on average is not associated with national income per head. At least in countries, where the income per head is sufficient to cover basic needs. The other authors collected the evidence not supporting Easterlin's conclusions and promoted the positive link between national income and the average level of SWB in a given country (Veenhoven, 1991; Hagerty and Veenhoven, 2003; Veenhoven and Hagerty, 2006; Stevenson and Wolfers, 2008; Diener and Biswas-Diener, 2002).

It can be easily argued that the level of household's income in absolute terms mostly varies from country to country[85], whereas the material situation characteristics mostly depend on the household's income[86]. Hence, when the income is known it is not necessary to know the household's country to conclude on SWB and material situation. It is easy to imagine the household living in poorer country, still having a good material standard of life and high SWB as well has the household with low SWB and material standards in a rich country. Thus, the income seems to be the variable separating country from other variables in the model. These conditional independencies may be coded in the following way.

- CRY ⊥ FPRO | INC (country is conditionally independent to financial problems given income).
- CRY ⊥ DEPR | INC (country is conditionally independent to material deprivation given income).
- CRY ⊥ HOUS | INC (country is conditionally independent to housing defects given income).
- CRY ⊥ STRS | INC (country is conditionally independent to financial stress given income).

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[85] The levels of the disposable income are not too different in the four examined Central European countries, but the difference may be very obvious when comparing rich and poor countries in a wider geographical context.

[86] The material situation may depend on material conditions in wider sense including amount of savings, assets ownership, overall wealth etc. Such variables are not embedded into the model.

- CRY ⊥ OTHR | INC (country is conditionally independent to relative income compared to others given income).
- CRY ⊥ PAST | INC (country is conditionally independent to relative income compared to past given income).
- CRY ⊥ SWB | INC (country is conditionally independent to SWB given income).

    Or, alternatively

- CRY ⊥ HOUS, FPRO, DEPR, STRS, OTHR, PAST, SWB | INC (country is conditionally independent to housing defects; financial problems; material deprivation; economic stress; relative income compared to others; and compared to past and SWB given income).

More precisely, the node of the income seems to be the only node in Markov blanket[87] of the country. The income d-separates the country from all the other variables in the model. As a result of this considerations, the income will remain the only node directly linked with the country in the expert model.

Apparently, the income is also important in terms of the relative income represented by the two nodes (PAST – the relative income as compared to own past 12 months ago and OTHR – the relative income as compared to most people in the country). It is not contra intuitive that the measures of the relative income are linked to the absolute income unconditionally by the other measures in the model. Higher income will certainly increase the probability of better relative income[88]. Similarly, when the income is low, the financial problems; housing problems; economic stress; and material deprivation may be more probable. The direct links between these variables and income can be expected. On the other hand, it might be uneasy to directly conclude from the relative income to material deprivation, financial and housing problems and economic stress. It could be coded this way.

- OTHR ⊥ HOUS | INC (relative income compared to others is conditionally independent to housing problems given the income).
- OTHR ⊥ DEPR | INC (relative income compared to others is conditionally independent to material deprivation given the income).
- OTHR ⊥ FPRO | INC (relative income compared to others is conditionally independent to financial problems given the income).

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[87] The Markov blanket of a variable A is the set consisting of the parents of A, the children of A, and the variables sharing a child with A. If all variables in the Markov blanket for A are instantiated, then A is d-separated from the rest of the network (Jensen, 2001, p. 11).

[88] There are variables of the absolute income of neither others nor own past in the model. The own income in absolute terms is hence the only influencer.

- OTHR $\perp$ STRS | INC (relative income compared to others is conditionally independent to economic stress given the income).
- PAST $\perp$ HOUS | INC (relative income compared to past is conditionally independent to housing problems given the income).
- PAST $\perp$ DEPR | INC (relative income compared to past is conditionally independent to material deprivation given the income).
- PAST $\perp$ FPRO | INC (relative income compared to past is conditionally independent to financial problems given the income).
- PAST $\perp$ STRS | INC (relative income compared to past is conditionally independent to economic stress given the income).

Or, alternatively
- OTHR, PAST $\perp$ HOUS, DEPR, FPRO, STRS | INC (relative income is conditionally independent to housing problems; material deprivation; financial problems; and economic stress given the income).

The financial problems seems to be an important variable separating the housing problems from the other seven variables in the model. The housing problems are mostly caused by the financial problems (caused, for example, by the low income). The conclusion on housing problems can be drawn directly from the household's income, but when the evidence of financial problems is known, income will become conditionally independent. Given the financial problems, other variables seems also be conditionally independent from the housing problems. It could be coded as follows (the aggregated notation will be used hereinafter).
- INC, DEPR, CRY, OTHR, PAST, STRS, SWB $\perp$ HOUS | FPRO (housing defects are conditionally independent from income; material deprivation; country; relative income; economic stress; and SWB given the financial problems).

To conclude, 22 conditional independencies out of the 242 were derived in this step. Based on these identified conditional independencies 19 edges were removed and the graph after this phase is shown in Figure 9.

Step 3:

In the third step the separating sets of the size k=2 (which means there are two separating variables) are considered. It seems that the only conditional independence can be identified.
- STRS $\perp$ INC | FPRO, DEPR (economic stress is conditionally independent to income given financial problems and material deprivation).

Figure 9: Graph after testing conditional independencies with k=1.
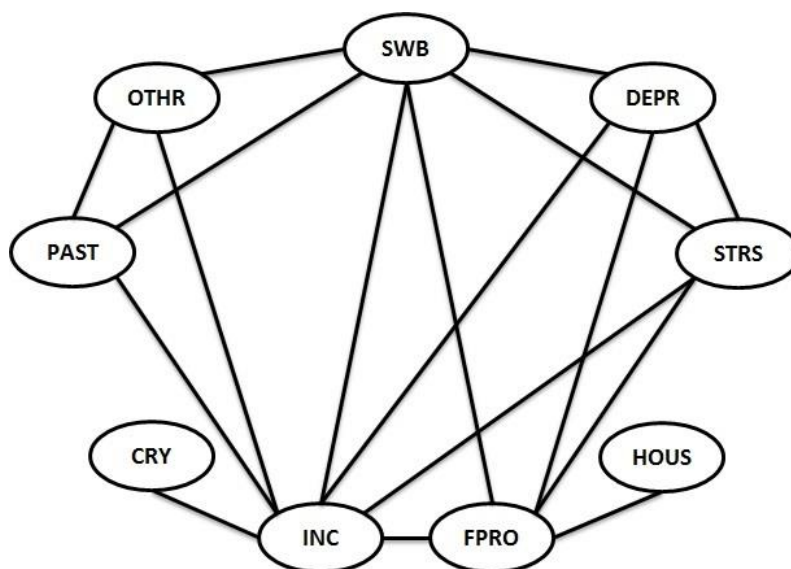
It means that the conclusions on the perceived economic strain can be drawn directly from the household's income, but they are conditionally independent providing we know both the material deprivation and the financial problems. People feel strained because of their objective financial problems and material deprivation (than may be influenced by the level of the income) rather than by the insufficient level of the income itself.

Hence, the single edge needs to be removed in this step of conditional independencies testing. The graph resulted from this phase is shown in Figure 10.

Figure 10: Graph after testing conditional independencies with k=2.
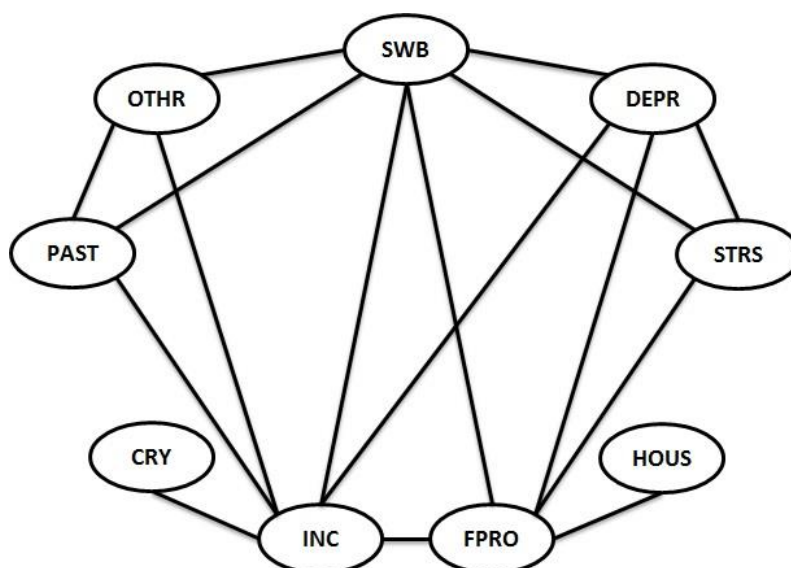
Step 4:

In this step the separating sets of the size k=3 (the set has three separating variables) are considered. It is hardly to find any exact evidence for such a complex relation of conditional independence in the literature. SWB seems to be dependent with the financial problems (as a consequence of the low income), but only when no information of material deprivation, income and stress is available (all three together). The financial problems may influence SWB and may not. If we do not have another piece of information, we can hardly conclude from one to another. But it seems to be possible to draw such a conclusion if we know the states of material deprivation, income and stress together. It could be coded as follows.

- SWB ⊥ FPRO | DEPR, INC, STRS (SWB is conditionally independent given material deprivation; income; and economic stress).

The edge linking the nodes INC and SWB needs to be removed and the graph resulted from this phase is shown in Figure 11.

Figure 11: Graph after testing conditional independencies with k=3.
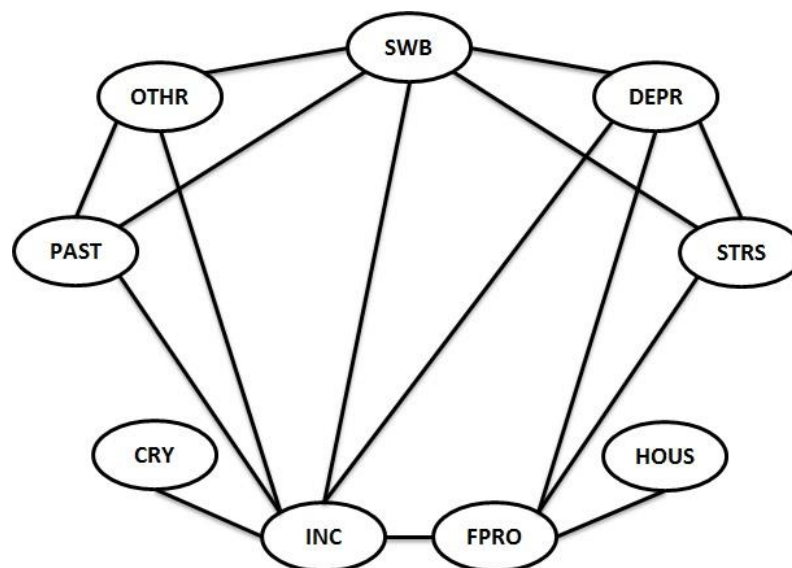
Step 5:

The separating set with four variables (k=4) is to be identified in this step. Although it is quite a complex relation of conditional independence yet, the literature review come up with some helpful evidence on the relation between the income and SWB. The newer research tend to understand the income rather as an indirect measure in terms of SWB (e.g. Christoph, 2010). As seen before, the direct link between SWB and the relative income can be traced to the literature, for example Clark and Oswald (1996), Ferrer-i-Carbonell (2005), Luttmer (2005), Clark et al. (2008),

Dittmann and Goebel (2010) and others. Simply said, people are unhappy and unsatisfied when feeling their material situation get worse comparing to either what was before or what others have. The measures of relative income hence seem to stand in between the income and SWB.

The perceived economic strain as well as the material deprivation were examined in the EU-wide context by Fahey (2007), who suggest that these measures should be employed as indicators for certain purposes rather than the income as they provide better information that pure income thresholds in situation of inequality in the income between the EU member states. The evidence for the direct link between SWB and the perceived economic strain can be found, for example, in Mills et al. (1992) and Ervasti and Venetoklis (2010). Common sense reasoning is that SWB is reduced in case a household is unable to make ends meet. The link between SWB and the material deprivation can be supported by, for example, Bellani and D'Ambrosio (2011). Basically, SWB drops down if one hunger after something that cannot be afforded. In his study on poverty Ringen (1988) discusses the measurement of poverty directly in terms of consumption (poverty as a low standard of consumption) and indirectly in terms of income (poverty as a low income). The consumption could be one of the variables standing in between income as indirect measure and SWB.

In other words, the evidence is available for the four variables of material deprivation, economic stress and two measures of the relative income intermediating the variables of SWB and income. When encoded we obtain the following.

- SWB $\perp$ INC | DEPR, OTHER, PAST, STRS (SWB is conditionally independent to income given material deprivation; relative income compared to others as well as to own past; and economic stress).

As a consequence the edge between the nodes INC and SWB is removed and the graph resulting from this phase is shown in Figure 12.

The testing can be stopped with the set of four separating variables (k=4) as the maximum adjacencies for all pairs (X, Y) is less than k+1 (which is five). The obtained undirected graph is the skeleton of a DAG. Planar version[89] of the skeleton is shown in Figure 13.

Step 6:

When the skeleton is prepared, the orientation of the edges is the next task. V-structures need to be identified in the next step of the PC algorithm. The following

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[89] Planar graph is the graph which can be plotted so that there are no edges crossing each other.

conditional independencies found in the first step of the PC algorithm indicate the v-structures.

- PAST ⊥ DEPR | INC
- PAST ⊥ STRS | INC
- OTHR ⊥ DEPR | INC
- OTHR ⊥ STRS | INC

Figure 12: Graph after testing conditional independencies with k=4.
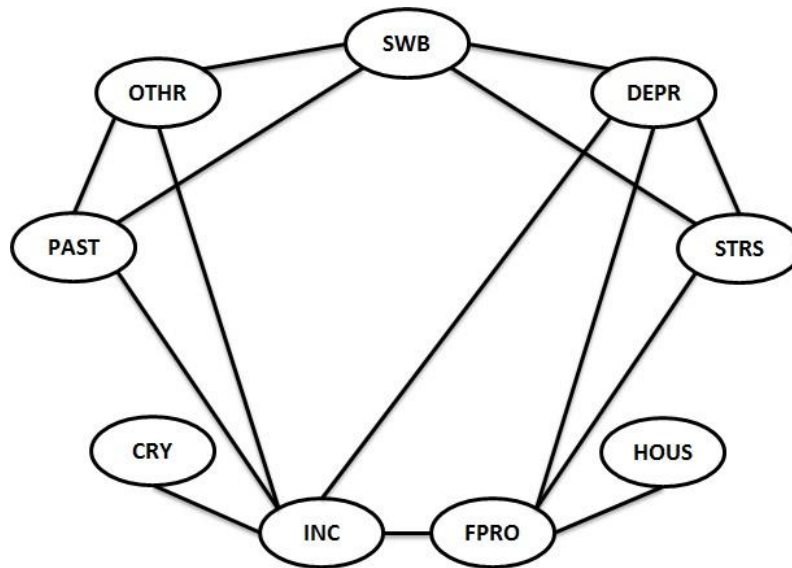
Figure 13: Skeleton - planar version.
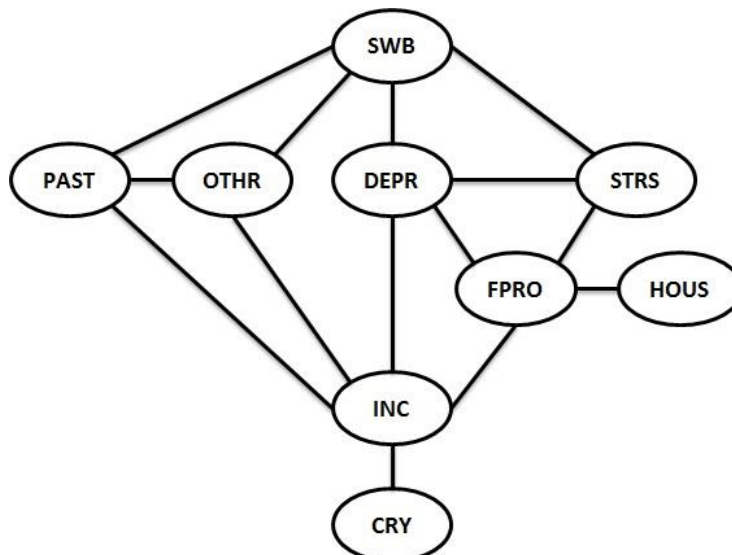
In the first case, material deprivation (DEPR) and relative income as compared to own past (PAST) are conditionally independent given income (INC). Still, there is one

more way between DEPR and PAST through SWB, whereas SWB ∉ S(DEPR, PAST). DEPR and PAST are independent if we know income, but we must not know the state of SWB at the same time. The node of SWB is hence a collider on the way between DEPR and PAST. V-structure hence must appear here. The explanations of the other three cases are analogous. CPDAG is obtained when the relevant edges are oriented according to the v-structures identified. It is shown in Figure 14 and the directed edges are drawn red.

Figure 14: CPDAG (expert version).
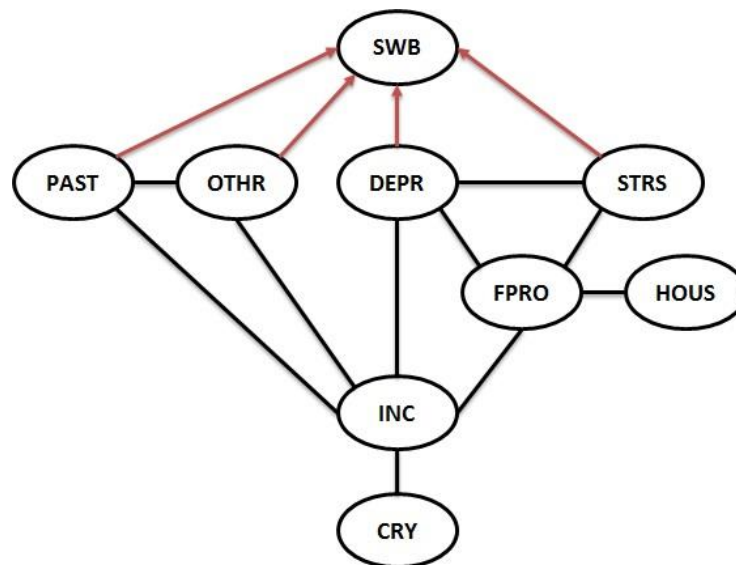
Step 7:

No further computation is made in the PC algorithm (in its basic version) in order to orientate the remaining edges. The edges may be directed randomly and care must only be taken not to draw another v-structure. The remaining edges were oriented from the bottom node of country towards the node of SWB[90]. This last model is shown in Figure 15 (all the edges are directed and are drawn red).

Both expert models have the same structure, the one shown in Figure 15, constructed the way described in this chapter. The only difference among the expert models resides in the parameters.

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[90] Various orientations are possible unless other v-structures are defined.

Figure 15: Bayesian network structure (expert version).
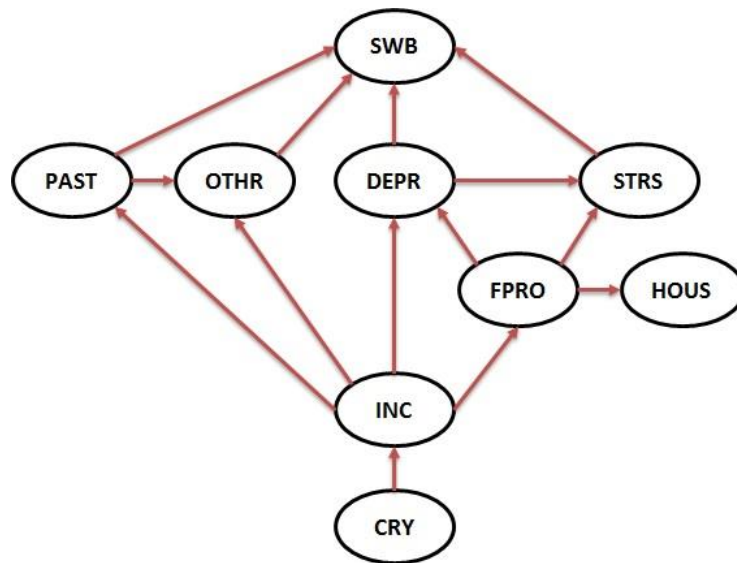
The relations of conditional independence given the separating sets having the minimum cardinality[91] implied by the DAG are shown in Appendix 3. The appendix shows the pairs of variables in rows and columns conditionally independent given the separating sets shown in the matrix. In the table, the symbol „∧„ is used when there is more than one variable in the separating set having the minimum cardinality. The symbol "∨"means that that there are more than one possible separating sets of the same sizes[92]. The conditional probability distributions for Expert/OLR model are provided in Appendix 4.

The structure established using the expert knowledge in this section is confronted with the structures established using the three different machine learning algorithms in the following sections.

4.4.2 Greedy/EM and Gobnilp/EM models

The structure of the Greedy/EM model is constructed with the greedy search-and-score algorithm and parameters are learnt with the EM algorithm, both learning steps are performed in the Hugin software (Hugin, 2014). The scoring function is BIC. The model is shown in Figure 16.

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[91] The separating set of a minimum size.

[92] Obviously, the list of the relations of the conditional independence would be much larger when the separating sets with no cardinality restrictions were considered.

Figure 16: Bayesian network structure (greedy/EM version).
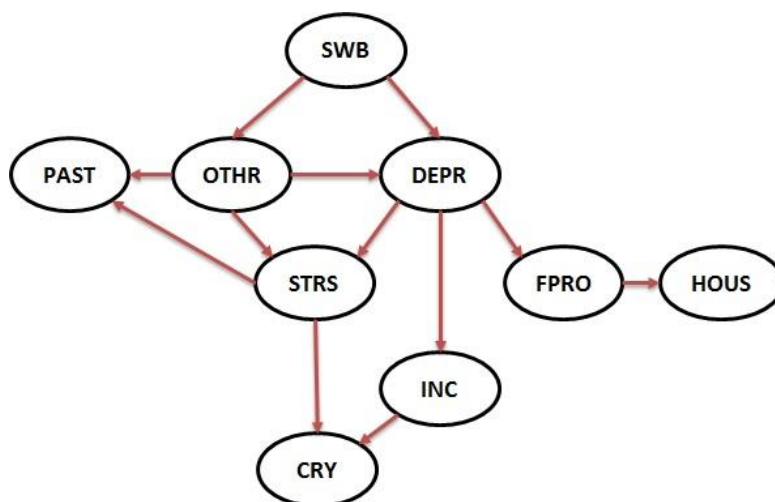
The conditional independence statements given the separating sets having the minimum cardinality implied by the DAG is provided in Appendix 3 again.

Gobnilp learning algorithm (Cussens and Bartlett, 2015) was used to establish the structure of the Gobnilp/EM model. Again, BIC was used as a scoring function. Unlike the other available search and score algorithms, Gobnilp guarantees the optimal structure with respect to BIC.

The Greedy/EM model and the Gobnilp/EM model appeared to be in the same class of Markov equivalence, because they have the same essential graphs (CPDAGs). The two models are said to be Markov equivalent. The essential graph is shown in Figure 17.

The undirected edges in CPDAG can be orientated randomly. Compared to the Greedy/EM model only a single edge was unequally oriented (the one between the nodes of SWB and OTHR) by the Gobnilp software in the Gobnilp/EM model.

The equivalent graphs imply the same set of conditional independence relations via d-separation (they have the same d-separation properties). The Gobnilp/EM model reache*d the optimum of BIC and so does the Greedy/EM model. The Greedy/EM model is hence also BIC optimal and these two models together are also referred as "BIC optimal" hereinafter.

Figure 17: CPDAG (Greedy/EM and Gobnilp/EM models)
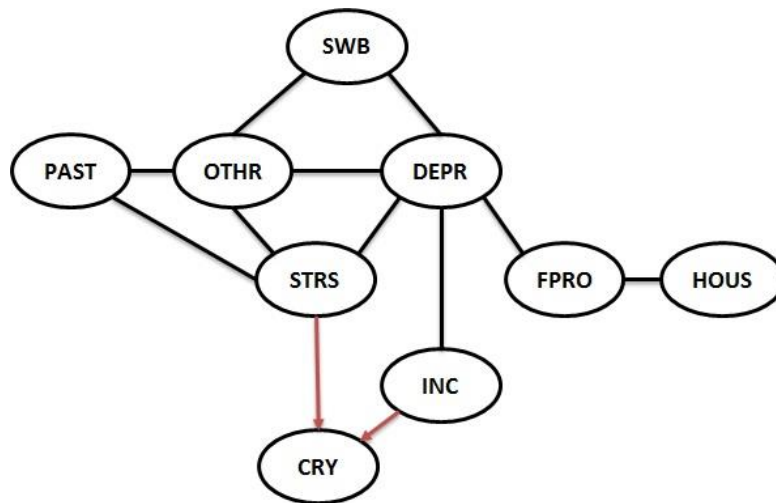
4.4.3 TAN/EM model

Unlike the previously discussed structure learning algorithms Tree Augmented Naïve Bayes (Friedman et al., 1997) is a method often used for classification problems[93]. Although the classification of any variable is not the primary objective of our model, we decided to use this method to have a greater variety of the benchmark models. The algorithm is an extension of the Naïve Bayes classifier[94]. Tree Augmented Naïve Bayes relaxes the assumptions of independence of attributes given the class variable (Friedman et al., 1997). Hence, each of the variable has the class variable and at most one other attribute variable as its parents. The attribute variables form the tree to augment the Naïve Bayes. This property should be clear from Figure 18, where the TAN/EM model is presented.

The variable of SWB is the class variable and, as such, it is the parent of all other variables – attributes in this model. The attributes are linked in the tree structure from CRY to PAST with the two tree branches[95].

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[93] Learns a Bayesian network optimized with the intention to predict one of the variables.

[94] The Naive Bayes classifier assumes that the observed feature variables (attributes) are conditionally independent given the class variable (a variable to be classified based on the feature variables). If represented as a Bayesian network, the class variable has no parents and attributes have the class variable as the only parent.

[95] The Hugin software enables to define the root variable – the variable where the tree is starting. Following the expert model, country was defined as a starting point in this model. When the income is set as the starter, the Markov equivalent model is obtained – only the edge between CRY and INC is directed the other way.

**Figure 18: Bayesian network structure (TAN/EM version).**
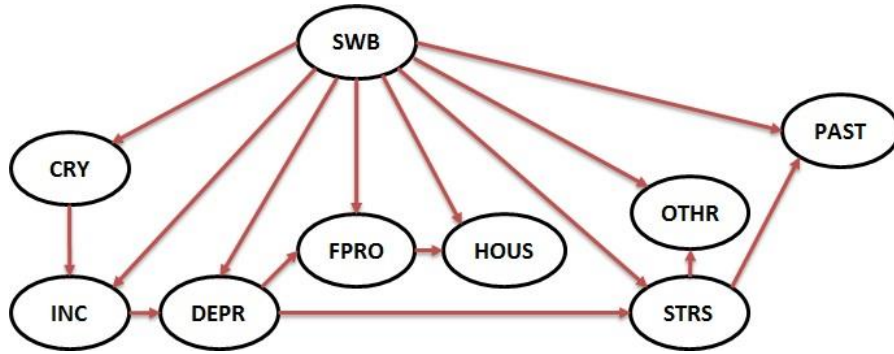
The conditional independence statements given the separating sets having the minimum cardinality implied by the DAG is provided in Appendix 3 again.

4.4.4 Ordinal logistic regression

In previous sections structures were established using four different structure learning methods. As two of them are in the same equivalence class, only three different models were obtained. As we select the prediction accuracy of SWB as one of the criteria for testing the Bayesian networks, the ordinal logistic regression (hereinafter referred also as "OLR") is employed in order to have another benchmark model. OLR (also called ordered logit model) is a type of statistical regression models used for the classification if the dependent variable is discrete and ordinal (McCullagh, 1980).

Formally, an ordered logit model establishes a relationship between an ordinal response variable Y_i (SWB in our case) with C categories for the *i-th* subject and the set of independent variables X_i. It is based on the ordered logit function:

$$logit(g_{ci}) = \log\left(\frac{g_{ci}}{1 - g_{ci}}\right) = \alpha_c - \beta' x_i, \quad c = 1, 2, \dots, C - 1.$$

where

$$g_{ci} = P(Y_i \leq y_c | x_i), \quad c = 1, 2, \dots, C.$$

is cumulative probabilities related to a linear predictor

$$\beta' x_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots$$

and the threshold parameters α_c define the changes among categories C.

The overall constant β_0 is usually omitted from the model. The above definition is taken from Grilli and Rampichini (2014).

SWB is the dependent variable and the other eight variables are independent variables in our regression model. The independent variables are ordinal except the country. Country as a multi-nominal variable was transformed into the following three dichotomous variables in the following way:

- CRY2 (if CRY = Hungary then CRY2 = 1)
- CRY3 (if CRY = Poland then CRY3 = 1)
- CRY4 (if CRY = Slovakia then CRY4 = 1)
- CRY = the Czech Republic if all three variables are zero.

The OLR model is presented in Table 47 and Table 48. The calculations are made in R software (R Core team, 2014). Thanks to the way how the ordered states of the model variables are coded (described in Section 4.2) some coefficients appeared negative.

Table 47: Ordinal logistic regression – coefficients.

Variable	Value	Std. Error	t value	p value
CRY2	0.38340221	0.11237612	3.411777	0.001
CRY3	0.78396892	0.09466560	8.281455	0.000
CRY4	0.13670987	0.10812207	1.264403	0.206
INC	0.08697156	0.03607650	2.410754	0.016
OTHR	0.46596625	0.06174160	7.547039	0.000
PAST	-0.27090906	0.05832283	-4.644991	0.000
STRS	-0.27411935	0.04513885	-6.072803	0.000
DEPR	-0.49603267	0.06095403	-8.137816	0.000
FPRO	-0.10474871	0.04964784	-2.109834	0.035
HOUS	-0.20441594	0.04658649	-4.387881	0.000

Table 48: Ordinal logistic regression – thresholds.

	Value	Std. Error	t value	p value
1|2	-2.32518538	0.29770178	-7.810452	0.000
2|3	-0.86866908	0.29486580	-2.945981	0.003
3|4	0.40559976	0.29490313	1.375366	0.169

Variable CRY4 is statistically insignificant on 5% significance level. It means that the difference between the Czech Republic and Slovakia is not statistically significant

in terms of SWB prediction. Otherwise the country is an important variable for SWB. Also, income (INC) and financial problems (FPRO) are both insignificant predictors on 1% significance level (but are significant on 5% level). Both variables are separated by the other variables in the expert version of the Bayesian network. The ordered regression suggests the housing defects (HOUS) is the significant variable for SWB prediction whereas there are variables separating housing defects from SWB in the expert model (financial problems, economic stress and material deprivation). There may be significant influence of one variable to another in the network even of it is mediated by other variables. Again, we remain that the classification is not the primary goal of the expert model.

The model is unable to statistically distinguish the state 3 and 4 of SWB on 5% significance level. It is in line with the results of the multiple comparison tests reported in Section 3.4.2.

4.5 Testing the models

Before the models are evaluated based on the criteria of BIC and the prediction accuracy, the conditional independence statements implied by the models are compared and commented. The matrices showing the relations of conditional independencies given the separating sets having the minimum cardinality is provided for every models in Appendix 3. The purpose of this appendix is to illustrate the relations implied by the DAGs. It is just a sample and the list would be much longer in case the restriction of the minimum cardinality is removed. Instead of exploring all the conditional independence statements implied by the graph, only the sets separating a variable from the rest of the model may be reviewed. These sets are shown as Markov blankets of every node in the model[96]. The Markov blankets for the three models are provided in Table 49.

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[96] As already explained, if the evidence is available for all the variables in the Markov blanket of a node, then the state of the remaining variables become irrelevant in terms of the variable represented by that node.

Table 49: Markov blankets.

	Expert	BIC optimal	TAN
CRY	INC	INC;STRS	INC;SWB
DEPR	FPRO;INC;OTHR;PAST;STRS;SWB	FPRO;INC;OTHR;STRS;SWB	FPRO;INC;STRS;SWB
FPRO	DEPR;HOUS;INC;STRS	DEPR;HOUS	DEPR;HOUS;SWB
HOUS	FPRO	FPRO	FPRO;SWB
INC	CRY;DEPR;FPRO;OTHR;PAST	CRY;DEPR;STRS	CRY;DEPR;SWB
OTHR	DEPR;INC;PAST;STRS;SWB	DEPR;PAST;STRS;SWB	STRS;SWB
PAST	DEPR;INC;OTHR;STRS;SWB	OTHR;STRS	STRS;SWB
STRS	DEPR;FPRO;OTHR;PAST;SWB	CRY;DEPR;INC;OTHR;PAST	DEPR;OTHR;PAST;SWB
SWB	DEPR;OTHR;PAST;STRS	DEPR;OTHR	CRY;DEPR;FPRO;HOUS;INC;OTHR;PAST;STRS

Some remarks arise when comparing the conditional independence statements and Markov blankets of the three Bayesian networks.

- Markov blankets of the BIC optimal model are subsets of Markov blankets of the expert model with only few exceptions (STRS in Markov blankets of CRY and INC and CRY and INC in Markov blanket of STRS). The BIC optimal model is simpler, it has less edges than the expert model.

- It seems not worth comparing rigidly TAN/EM model with the other two models. It is because the Tree Augmented Naïve Bayes algorithm is designed to learn the structure for the selected variable classification of SWB. As we selected SWB to be classified it is not separated from any other variable and, in turn, it appears in every identified separating sets. The existence of the direct links between SWB and other variables is not contradictory to the literature, still, we aspire to describe the relations more in depth.

- The four variables of relative income (both variables), material deprivation and financial stress constitute the Markov blanket of SWB in the expert model. They d-separate the other nodes from SWB and, hence, the evidence for these four variables is the only relevant for the prediction SWB based on the expert model. Except the material deprivation the variables are subjective[97].

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[97] The material deprivation is the objective variable in nature as the respondent is asked for defined items whether they can be afforded if wanted. Still, it has the subjective aspect as people want the different things whereas the list of items is fixed. The material deprivation can also be understood as a subjective feeling.

- The BIC optimal model is in nature similar – SWB is d-separated by the relative income (only as compared to others) and material deprivation. The financial problems are d-separated by the material deprivation from SWB in the BIC optimal model.
- Income and financial problems seem to be the most important factors in terms of the relations of the conditional independence in the expert network. They are positioned in the heart of the network and seem to separate an important portion of other variables. Material deprivation and the economic strain seem to have this core position in the BIC optimal model.
- Housing defects and country seem to have the similar positions in all the models. Their positions are rather marginal. The housing defects are conditionally independent of the rest of the models given the financial problems in both expert and BIC optimal models.
- The two variables of the relative income stand close to each other in all the models.

To conclude this short revision, it seems that the expert and BIC optimal models are in many aspects similar, whereas the TAN/EM model, thanks to its different primary purpose, differs in some way. No clash with the literature was identified in the BIC optimal model.

4.5.1 Likelihood

The Bayesian networks are compared using the likelihood measures in this section. The likelihood of the models measured by Log-likelihood (LL) and Bayesian Information Criteria (BIC) is presented in Table 50. The measures are calculated in the Hugin software (Hugin, 2014) based on the whole dataset of 3.259 data vectors.

Table 50: Models likelihoods.

	Model	LL	BIC
1	Expert/EM	-29 579	-31 342
2	Expert/OLR	-29 938	-30 112
3-4	BIC optimal	-29 195	-29 822
5	TAN/EM	-29 285	-30 268

It is not any surprise that the BIC optimal model outperforms the other models in terms of BIC as the optimality of BIC is ensured by the Gobnilp algorithm. Also, the

log likelihood is the highest for the BIC optimal model[98]. Other models are worse in terms of both reported measures. Expert/OLR model is better in terms of BIC than the TAN/EM and Expert/EM, but is worst of all in terms of the log-likelihood. Expert/OLR model is penalized much less by BIC as the number of free parameters is only 43 when the conditional probability tables are restricted to have parameters of the ordered regression. Compared to that Expert/EM model has 436 free parameters. Hence the penalty is reduced and BIC increases from -31,702 to -30,112.

4.5.2 SWB prediction accuracy

The Bayesian network models are intended to describe the relations among the various aspects of the individual material situation and SWB the way the conditional independencies may appear. The model is not designed primarily for SWB prediction.

The prediction of SWB is used as a testing criteria because of the special position of SWB in the models. This position follows from the fact that it is the only measure of happiness/life satisfaction, whereas the other measures (except country) relates to the material situation. Also, it is often supposed that the level of SWB is influenced by the material situation (and not vice versa), although the literature is not always comfortable with this view. (The review of this type of the research is provided by Lyubomirsky et al. (2005).)

The results of the 10-fold cross-validation described in Section 4.3.3 is summarized for the Bayesian networks as well as for the ordinal logistic regression model in Table 51.

Table 51: SWB prediction accuracy.

	Model	Accuracy	95% confidence interval		P-Value
1	Expert/EM	41.58%	39.88%	43.29%	0.00
2	Expert/OLR	41.06%	39.36%	42.77%	0.00
3-4	BIC optimal	39.55%	37.87%	41.25%	0.00
5	TAN/EM	41.82%	40.12%	43.54%	0.00
-	OLR	42.13%	40.43%	43.85%	0.00

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[98] The optimality of log-likelihood is not guaranteed by the algorithm.

The visualization of results in a variable classification is often provided by a confusion matrix[99]. The confusion matrices are available for all seven models in Appendix 5. The calculation of various indicators can be made based on the matrices. Several observations can be summarized as a result of the testing the prediction accuracy of SWB.

- The five Bayesian networks and the ordinal logistic regression provide quite similar results in terms of SWB prediction. The 95% confidence intervals are largely overlapping.

- However, the ordinal logistic model yields the best prediction of all. Thus, we cannot confirm the suggested Bayesian networks provide better accuracy in terms of the prediction than widely used statistical methods based on the regression.

- Still, the parameters suggested by the ordinal logistic regression led to the lower prediction accuracy than the parameters learnt by the EM algorithm in the expert models[100].

- The TAN/EM model is slightly better that the expert models as the algorithm is designed for the prediction of a selected variable, which is SWB in our case.

- On the other hand, the expert models are better than the BIC optimal model, although this model provides the best likelihood of all models given the data we have.

- It can be reasonably expected that the prediction accuracy would be improved if other than economic factors were introduced to the models.

- The prediction accuracy around 40% seems to be low at the first sight[101]. Still, it is statistically significantly more than No Information Rate. No Information Rate is 27.80 % for all our models.

Definition 17: No Information Rate is the largest class percentage in the data. If the most common class is always predicted this resulting accuracy of such prediction will be equal to this rate[102].

Although the expert versions of the Bayesian networks have neither the best accuracy of the prediction nor the best likelihood, they are still worth considering them, because they represent relations and conditional independencies of SWB and factors

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[99] The matrix compares the actual and predicted states. In our layout the rows represent the instances in a predicted four classes and the columns the instances in an actual four classes of SWB.

[100] The classification based on OLR parameters is monotonic whereas the classification based on EM parameters is not.

[101] Four states of SWB are predicted. The accuracy of the Expert/EM model would be almost 66% if only two states of SWB were considered (1 and 2 summed up and 3 and 4 summed up). The quick calculation can be made based on the confusion matrix.

[102] The most frequent class is SWB = 1 (906 times) in our case. When it is divided by the total number of data vectors (3.259), No Information Rate is obtained.

related to material conditions known from the social research probably better than the other considered Bayesian networks. Because the machine learnt models fit the training data they are often better than the expert model given the data. Still, the data may reflect the conditions under which they were collected. The survey was conducted in 2011/2012 when the economies of most countries have barely started recovering from the economic dropdown. We can reasonably expect that the expert model has more general applicability than the other models, because it rather reflects the state of the art in the social research and depends less on the conditions under which the data were collected.

The models are able to predict SWB based on material living conditions and deprivation considering that these factors constitute only a small part of the whole picture. As it is apparent from the literature review, batches of studies are available on SWB and how it is associated with the factors related to demography; aspirations; expectations; personality; social relations; and wider environment, where personality traits seems to matter in long term, while life events play the role rather in short term. Most of the factors we examined falls into the latter category, whereas the subjective opinion of material living standards and deprivation are certainly impacted by the personality too. Therefore the results must be interpreted taking into consideration that the material situation is only a piece in the large puzzle.

5 Discussion

Seven subjective and objective factors approximating various aspects of the individual material situation were employed in order to explore how the material aspects of living are associated with the individually perceived overall well-being.

The material conditions of many people are sourced from their monthly income primarily. Therefore, many people consider their income important. Contrary to that, findings made in this dissertation suggest that the association between SWB and income in absolute terms does not seem to be very strong on average. Both happiness and satisfaction rise from the first to third quartiles in every four examined countries, but the pattern is mixed between third and fourth quartiles and moreover, the change in both measures is insignificant between these two upper-end quartiles in every surveyed countries. This was concluded based on the 2016 EQLS data and the same conclusion was reached by the ordinal regression model using 2011 EQLS data. This might indicate that the association with both happiness and life satisfaction seems to be weakening as the income increases. Such a conclusion is in accordance with the reviews provided by Dolan et al. (2008), and Diener and Ryan (2009). It is in line with the theory of diminishing marginal utility of wealth as proposed by Hermann Heinrich Gossen; William Jevons; Carl Menger; and Léon Walras in 19th century.

Although the hypotheses that the high-income people are happier and more satisfied than the low-income people were supported in most cases (but not in every cases), the absolute differences in both happiness and life satisfaction seem to be rather minor. The relaxed relations are apparent from the two box-plots showing the patterns for happiness and satisfaction. The concave patterns can be observed whereas the differences between the third and fourth quartiles are hardly observable.

The income is one of the central variables in the expert Bayesian network. It d-separates the variables of the relative income (OTHR, PAST) from the rest of the model except SWB. It d-separates country from all the other variables[103]. The influence of the income over SWB is important, but it is not direct. The income is conditionally independent of SWB given the set of four variables: relative income

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[103] The model suggests that SWB can be inferred from country, but when the household's income is known, knowledge of the residential country becomes irrelevant. The microeconomic characteristics of the household seem to be more important than the microeconomic ones.

measured by the two variables (OTHR, PAST), material deprivation (DEPR) and economic stress (STRS). Income has hence no impact on SWB if the evidence for these four variables is available.

Based on this model, the income as the objective variable influences directly relative income and material deprivation. The economic stress is influenced indirectly through another objective variable of financial problems. The model suggest, that the income only affects the intermediating variables. For example, a low income typically causes unsatisfactory relative income, high material deprivation and high financial problems. The high financial problems cause the economic stress thereafter. The four variables of relative income, material deprivation and economic stress affect directly SWB yet.

As another example, a low income does not necessarily mean either a low relative income (in case it is not perceived as lower compared to others and to past), a high material deprivation (in case a respondent is low in materialism), or high financial problems (if the expenses are low) or low economic stress (if there are enough savings). Only if these factors become burdensome, SWB will be negatively affected. The low income itself is not necessarily the problem.

Figure 19: Happiness and household income in central Europe – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
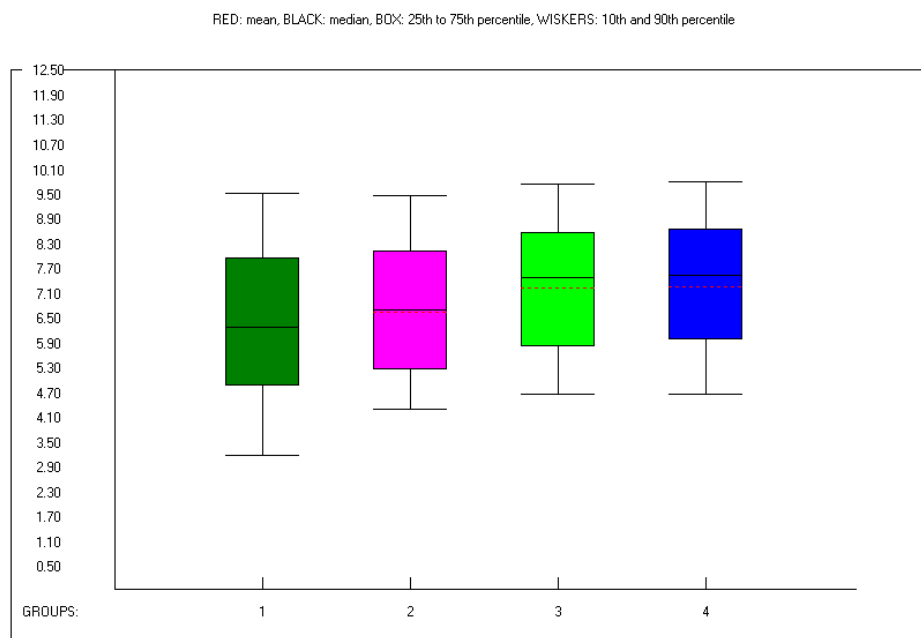
Figure 20: Life satisfaction and household income in central Europe – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
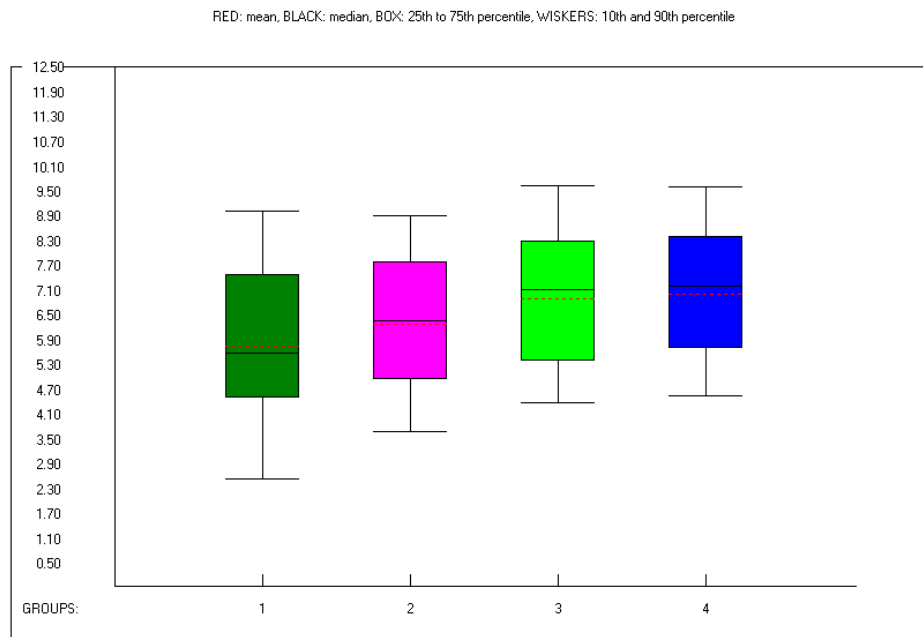
The weak association of income and SWB proved by the statistical analysis corresponds with the position of income in the expert model. The influence exists, but may not necessarily be direct. The income as an indirect measure is discussed, for example, by Christoph (2010). The box plots shown in Figures 19 and 20 (the values on the horizontal axes denote to the income quartiles, the values on the vertical axes denotes to SWB) demonstrate that both happiness and satisfaction do not differ too much based on the quartiles.

This study may join the research stream accentuating the importance of the relative income (for example Clark and Oswald, 1996; McBride, 2001; Luttmer, 2005; Ferrer-i-Carbonell, 2005; D'ambrosio and Frick, 2006; Johnson and Krueger, 2006; Caporale et al., 2009 etc.). The difference between those who evaluate their financial situation as much worse compared to others and those who evaluate it as much better is 2.86 (happiness in all examined countries) and 3.44 (satisfaction in all examined countries) on the 10-point scale, which is considerably more than in the case of household income. Some research on the relative income suggests that an individual with an above-average income is not happier than the reference group, while SWB of a poorer individual is negatively influenced by the fact of his income being lower than that of the reference group (Ferrer-i-Carbonell, 2005). Taking a look at the box plots shown in Figures 21 and 22 (the values on the horizontal axes denote to the income quartiles, the values on the vertical axes denotes to SWB) we can observe that both happiness and satisfaction rise steadily throughout the scale

from "much worse" to "much better" in central Europe (the Slovak exception from this pattern was discussed). On the other hand, the rise tend to slow down with improved relative income compared to others. The pattern of the relative income compared to the past is very similar.

Figure 21: Happiness and relative income compared to others in central Europe – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
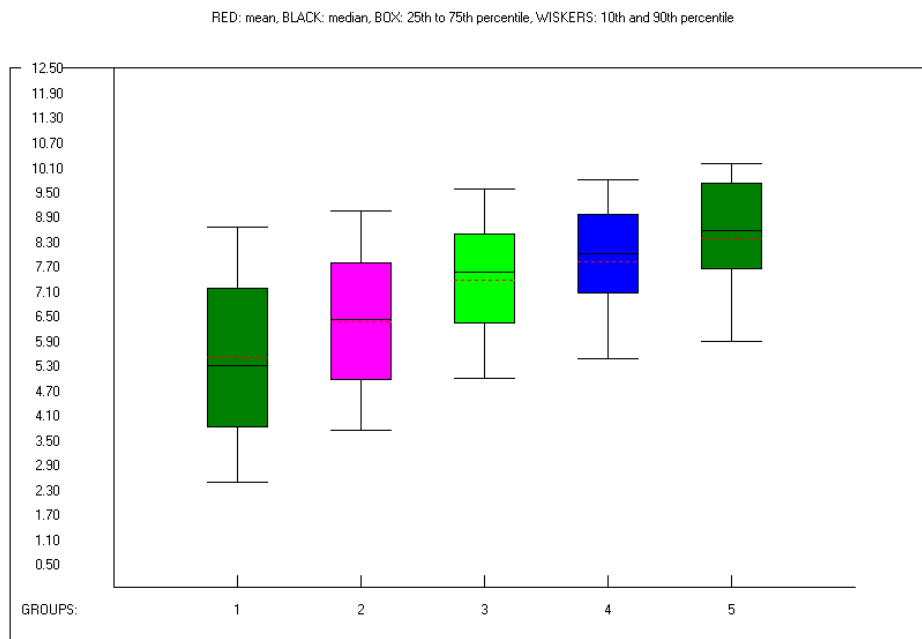
Figure 22: Life satisfaction and relative income compared to others in central Europe – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
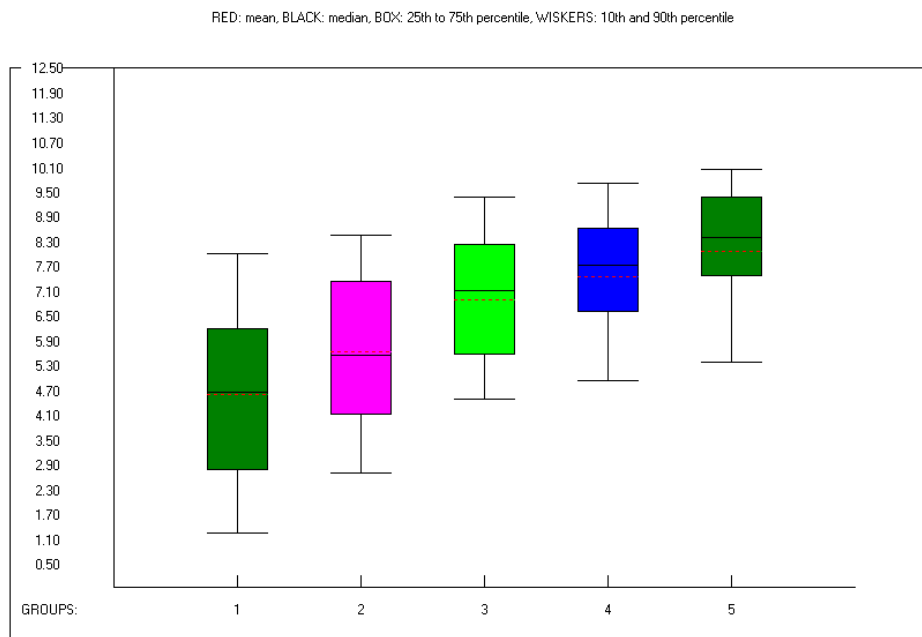
There is a research suggesting that SWB may behave differently with respect to the relative income in Eastern Europe comparing to Western Europe. Based on the data from the European Social Survey for 19 countries, Caporale et al. (2009) discovered a different pattern in the Eastern Europe countries, where the reference income impacted SWB positively. It means the lower-than-reference income of an individual positively affected his SWB. The authors concluded that, in a stable environment, the reference income serves as a measure for comparison, while in a less stable environment (e.g., during rapid development) the reference income is a promise for one's future situation. This tunnel effect was not confirmed by our study.

As the association between SWB and the relative income was found stronger in comparison with the income measured absolutely, the two variables of the relative income (OTHR and PAST)[104] are directly connected with SWB in the expert model. The relative income is one of the factors d-separating SWB from the income. Based on the model the subjective perception of the income given the two comparison standards is more important than the amount of the income as it objectively is. For example, when the income is in fact low, but its level is still perceived satisfactory comparing to others at the same time, then SWB is not affected negatively by the low actual income itself.

The perceived economic strain, it means the ability to make ends meet (denoted STRS), is another variable associated with SWB strongly. The difference between those who are able to make ends meet very easily and those who are able to make it with great difficulty is 3.18 (happiness in all examined countries) and 3.81 (satisfaction in all examined countries) on the 10-point scale. Again, it is considerably more than in case of the household income and it is also a bit more than in case of the relative income. With some exceptions discussed in Section 3.4.4 SWB rises in line with the economic strain being improved, but the rise tends to flatten. The pattern is visible from the box plots in Figures 23 and 24 again (the values on the horizontal axes denote to the income quartiles, the values on the vertical axes denotes to SWB). The graphs are decreasing just because the coding is reversed. It might be interpreted that SWB of the roughly strained people is increased with the enhanced ability to make ends meet more than SWB of the people having no problems making ends meet.

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[104] The variables of the relative income are obviously connected one to the other in the model and the orientation of the edge is unimportant. The two models having this edge oriented reversely are Markov equivalent.

Figure 23: Happiness and perceived economic strain in central Europe – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
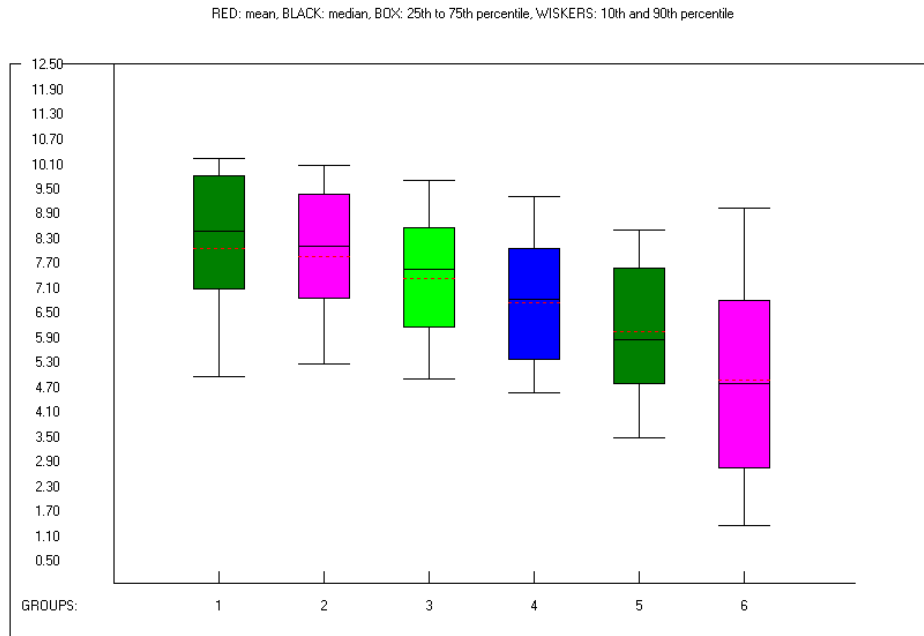
Figure 24: Life satisfaction and perceived economic strain in central Europe – box plot.

RED: mean, BLACK: median, BOX: 25th to 75th percentile, WISKERS: 10th and 90th percentile
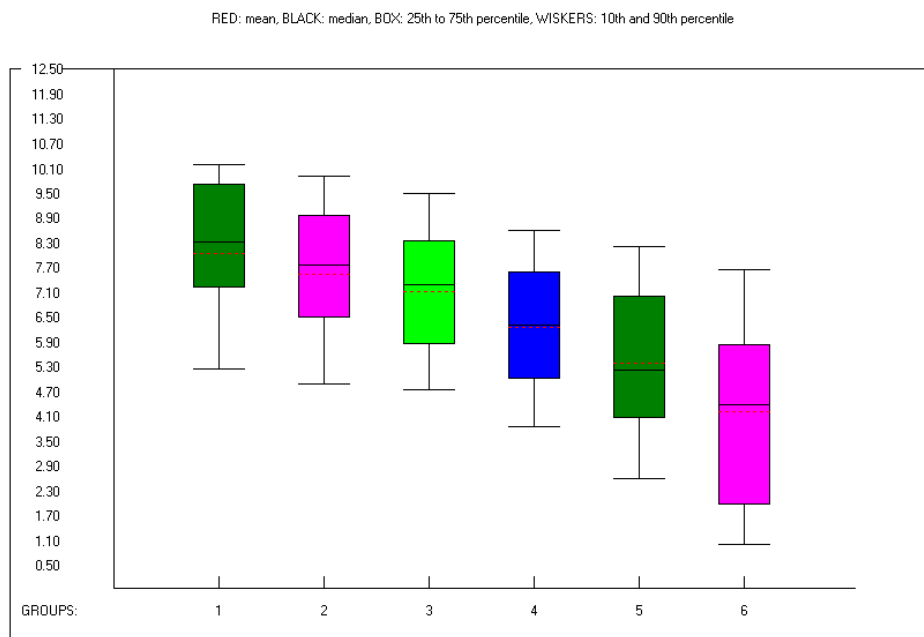
The economic stress together with the material deprivation[105] become the topic of various studies (Mills et al., 1992; Whelan, 1992; Whelan et al., 2001; Johnson and

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[105] Some authors, for example Berthoud and Bryan (2011), consider the financial strain as one of the measures of the material deprivation.

Krueger, 2006; Whelan and Maitre, 2007; Ervasti and Venetoklis (2010)). For example, Johnson and Krueger (2006) demonstrated that the perceived financial situation together with the control over life mediate the association between the wealth and life satisfaction. Consistently with this view the perceived economic strain is one of the variables mediating the objective individual material situation and SWB in the suggested expert model. The actual income, inter alia, has the influence to the number of financial problems and the financial problems, as the objective measure, cause the perceived economic stress in turn. Yet, the economic stress (the subjective measure) is directly linked with SWB as one of the four variables in Markov blanket of SWB.

In their recent analysis on economic characteristics and SWB (Želinský et al., 2018) suggested that SWB of people living in indebted households (who can be expected to be unable to make ends meet) is lower than those living in households free of debts in Slovakia. The capacity to face unexpected financial expenses is another important indicator used in the study. It predicts the financial stability of a household. The authors conclude that SWB of people living in financially unstable households is significantly lower (3.4 points on average) in comparison to people living in households with sufficient capacity to face financial problems. The differences in both happiness and satisfaction between groups of people who are able to make ends meet very easily and those making it with great difficulty were also found considerable in this paper.

Inability to make ends meet in essence corresponds directly with the impossibility to afford things desired (denoted DEPR), the main measure used for the approximation of the material deprivation in contemporary studies (for example Whelan et al. (2001) and Whelan and B. Maître (2007)). Both variables are also directly linked in the expert model. Our findings suggest that the association between SWB and the material deprivation measured by the ability to afford things wanted is not too close. The mean happiness of those able to afford all six items and those unable to afford all six items differs only 1.12 points on the 10-point scale in central Europe (the mean satisfaction differs 1.20 points.). Similarly, those unable to afford 0-1 desired things (not deprived) are only 2.04 points happier than those unable to afford 5-6 desired things (strongly deprived) in central Europe as a whole. (The difference is 2.01 for the life satisfaction). As the studies on measuring poverty mentioned above place the great importance on the measures based on the material deprivation, I did expect the greater influence of the material deprivation on SWB. However, these studies are focused on the income and deprivation rather than on SWB. Similarly, although the differences in SWB based on the factors of financial and housing problems appeared

to be statistically significant, they are not that remarkable compared to income relative to others and economic strain.

Following to the analysis we conclude that the objective material conditions themselves influence SWB rather indirectly through the subjective situational assessment of various aspects related to the individual material conditions. These subjective variables are crucial in terms of SWB.

Recently, Bayesian networks were used as an instrument for the analysis of the multidimensional well-being in a study published by Ceriani and Gigliarano (2016). It is probably the first study in the area of the happiness research where the Bayesian networks are used. The study is based on the data from the second wave of the Life in Transition Survey conducted in 2010. (LITS II). The data for Western European countries and for five new European member states are used and the WestEU and EastEU[106] groups of countries are compared using the Bayesian networks. Ten dimensions of well-being are defined in the study (material living standards; health; education; personal activities and work; political voice and governance; participation to social activities and civil society; social connections and relationships; security of physical nature; security of economic nature; and personal satisfaction). There are sixteen variables within these dimensions and two more variables (age and household size) are added as control variables. Out of this set of variables only four ones (material deprivation, economic security today and in past and satisfaction with life) are somehow similar to variables used in our Bayesian network (material deprivation; relative income compared to others and to past; and SWB). Hill-climbing structure learning algorithm with K2, AIC and BIC scores is used, whereas a set of edges was excluded and another set was forced to be included in the structure based on the expert knowledge. The accuracy of the networks was tested using BIC and the prediction accuracy of four selected variables resulted from a cross-validation procedure.

The authors confirmed that *"subjective variables are strongly interlinked, as well as that objectives dimensions influence subjective variables"* (Ceriani and Gigliarano, 2016, p. 13). Although the scope of the study was broader than ours and different datasets as well as different structure learning methods were used, the conclusion is not far from the one we reached in this Chapter.

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[106] EastEU group includes Bulgaria, Hungary, Romania, Croatia and Slovakia. The Czech Republic and Poland are not included.

5.1 Links strength in Bayesian networks

So far the strength of the edges were not displayed in the Bayesian network. A Bayesian network shows that the particular edge exist, but the edges may be unequally strong. We talk about the link strength in this section only. Based on Boerlage (1992 in Ebert-Uphoff, 2007), who first formally introduced the concept, the link strength and connection strength must be distinguished. According to the author the link strength is the strength of connection between the two nodes in the network along a single edge, whereas the connection strength is the strength between any two nodes in the network. The strengths are used to enhance the visualization in a DAG, but the joint probability distribution remains unaffected.

The mutual information (MI) is one of the ways to estimate the link strengths in the Bayesian networks (Ebert-Uphoff, 2007). The mutual information was introduced by Shannon (1948) together with his widely influential communication theory. It is the measure that quantifies the information one random variable contains about another random variable. It is the reduction of uncertainty of one variable thanks to the knowledge of the other variable. If the two random variables are independent, the random variable contains no information about the other random variable, then MI = 0. The more dependent the variables are the greater the mutual information is.

Definition 18: Mutual information is

$$MI(X,Y) = U(Y) - U(Y|X)$$

where *U(Y)* is the entropy of a discrete random variable *Y* and *U(Y|X)* is conditional entropy of the variable *Y* given the variable *X*. The arithmetic transformations gives

$$MI(X,Y) = \sum_{x,y} P(x,y) \, \log_2\left(\frac{P(x,y)}{P(x)P(y)}\right)$$

The above definition is taken from Ebert-Uphoff, 2007.

The mutual information is used as a measure of how strongly the information on a state of a variable affects an adjacent variable in our expert model. The mutual information for the adjacent variables in the expert model was calculated and a classification of link strengths was made. It is shown in Table 52.

Table 52: Mutual information and link strengths in the expert model.

Edge	MI	Strength
CRY -> INC	0,079011	1
INC -> PAST	0,067764	1
INC -> OTHR	0,118245	2
INC -> DEPR	0,224232	3
INC -> FPRO	0,05792	1
FPRO -> DEPR	0,083494	1
FPRO -> HOUS	0,045838	1
FPRO -> STRS	0,074217	1
DEPR -> STRS	0,323067	4
STRS -> SWB	0,138674	2
PAST -> SWB	0,065536	1
DEPR -> SWB	0,122994	2
OTHR -> SWB	0,118941	2
PAST -> OTHR	0,133116	2

Based on the mutual information the link strengths were sorted out into the four arbitrary intervals for the purpose of the visual representation. The definition of the intervals is in Table 53.

Table 53: Strength definition.

Strength	MI interval
1	[0, 0.1)
2	[0.1, 0.2)
3	[0.2, 0.3)
4	[0.3, 0.4)

The expert DAG having the link strengths visualized is in Figure 25. We can observe that only two edges are extraordinarily relevant from the point of view of the mutual information. Material deprivation (ability to afford desired things) and economic stress (ability to make ends meet) are linked most strongly. As already discussed these two measures are used together to measure the same phenomenon, usually labeled as material deprivation or life-style deprivation by some authors (for example Whelan, 1992; Whelan et al., 2001; Layte et al., 2001 etc.). The strong link is hence not that surprising given that the two variables probably describe the very similar

phenomena. Another very strong edge is the one connecting the income with the material deprivation. It seems that this connection between the income and SWB is much more important than the other connections of the two nodes suggested by the model.

Figure 25: Bayesian network structure (expert version) – visualization of the link strengths.
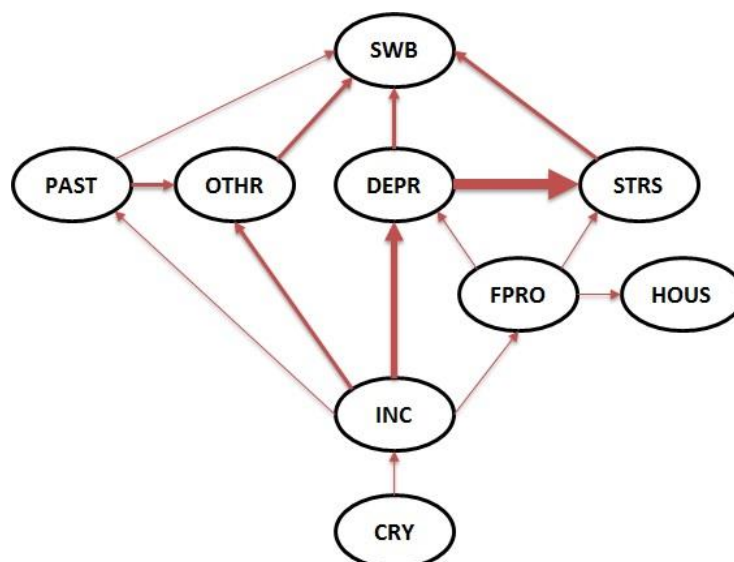
On the other hand, the edges linking the relative income compared to past (PAST) with SWB and with income are very thin. It indicates that only the single measure of the relative income (compared to other people – OTHR) may be sufficient in the model.

Similarly, objective measures of financial and housing problems seem to be only marginally important in terms of the mutual information. It may support the previously discussed hypothesis that the subjective feelings are more important in terms of SWB that the objective material conditions.

5.2 Inference in the Bayesian networks

It is the ambition of this section to answer the question certainly occurred to most of the readers unfamiliar with the topic: "What can the Bayesians networks serve for?" We attempt to give a hint by demonstrating the inference in the expert version of the Bayesian network. For that purpose the version with the parameters learnt based on the ordinal logistic regression (the "Expert/OLR" model) was used, because it guarantees a monotonic classification.

Intuitively, the two ordered sets are monotonic (monotone) if their given order is preserved or reversed. Ben David et al. (2009, p. 6,627) illustrated this property with

the following example: "A model that guarantees monotonic classifications will never classify a young and healthy applicant in a higher life insurance premium category than an old, unhealthy one". Based on the analysis we can reasonably expect the monotonic patterns of all parameters in our model except country (it is not ordinal). On the other hand we can hardly assume our underlying dataset is monotonic, because the data are largely based on human judgement. Therefore, the EM parameters cannot be monotonic, because the algorithm is not designed to satisfy the monotonicity conditions unless the dataset is monotonically consistent[107].

5.2.1 Top-down inference

The example of the top-down (causal) inference is provided in this section. Top-down inference is the process of reasoning where the posterior probability distribution of the query node is computed based on the evidence of the causes. All the computations were made in the Hugin software (Hugin, 2014). First, the overview of the marginal probability distributions is provided in Figure 26 for all nodes in the expert DAGs.

In the next step, we can compare the joint probability distributions for the low (1st quartile) and high (4th quartile) income people. When the evidence of the income is entered, the marginal probabilities change to conditional probabilities conditioned by the observed values. This is shown for low income in Figure 27 and for high income in Figure 28. When the income of a person is low, it is highly probable that this person will evaluate his income worse compared to own past (approx. 60%) and compared to other people (approx. 53%). And about 35% of low-incomers evaluate their situation as the same compared to own past and approx. 42% evaluate their situation as the same compared to other people in the country. On the other hand people having high-end incomes mostly believe that their income is the same compared to their own past (approx. 60%) and compared to other people in the country (57%). Only the minority (12%) are conscious their income is above average in their country.

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[107] When the training data are reduced, the monotonicity seems to become even more important condition to be satisfied. This hypothesis is to be tested in a future research study the author of this dissertation participates on.

Figure 26: Causal inference – starting point.
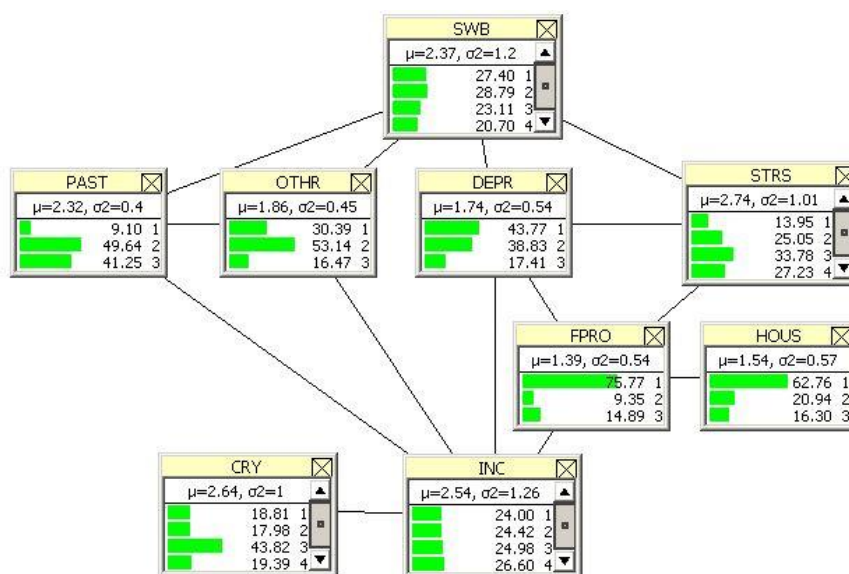
Figure 27: Causal inference – the income is low.
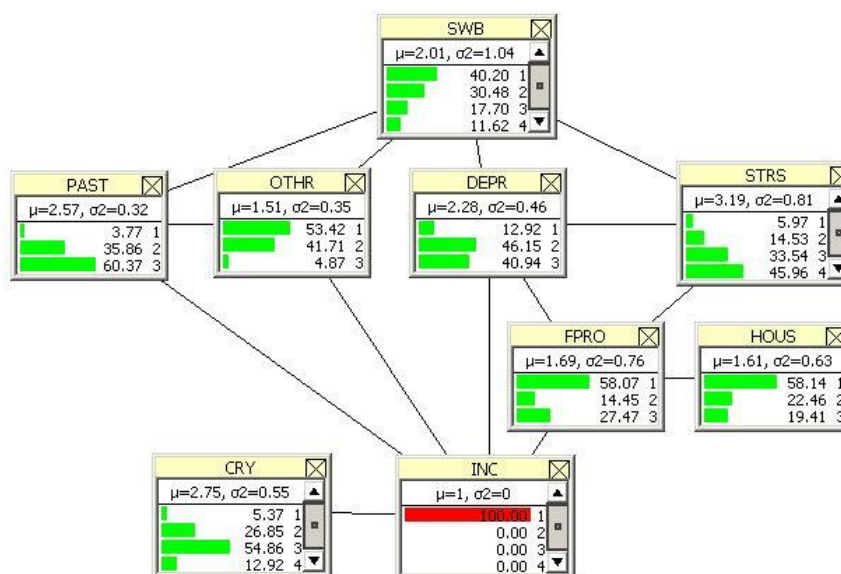
Surprisingly, 58% of low income people have no financial problems and the same percentage apply for those having no housing problems (not necessarily they are the same people), but almost 46% is expected to be able to make ends meet with difficulty and further approx. 34% with some difficulty. On the contrary, almost 90% of the high-end people are able to pay bills as scheduled and their ability to make ends meet is quite equally distributed. The rich people seems not to be materially deprived (only 3% are strongly deprived) whereas approx. 87% of poor people is deprived to some extent. Other similar findings can be inferred this way from the model.

Figure 28: Causal inference – the income is high.
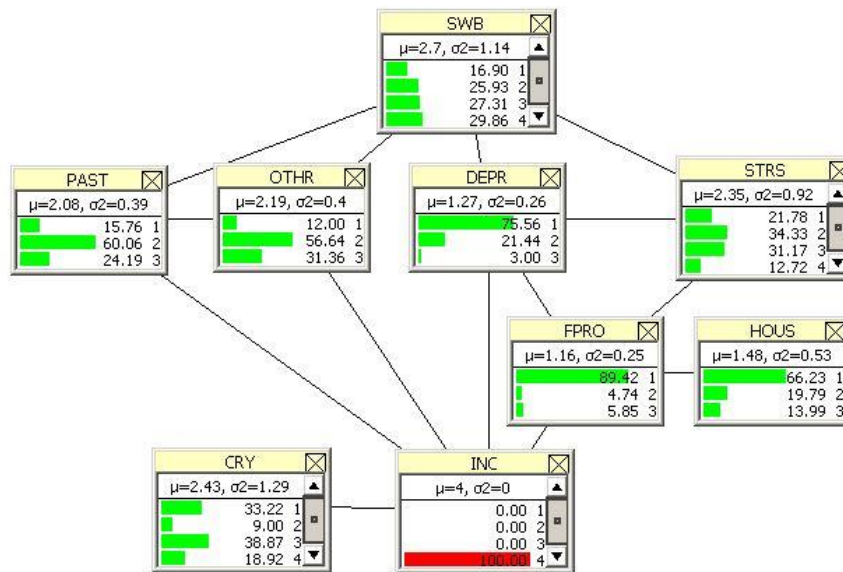
Let us compare two persons now. First person has a low income (the lowest quartile), but has little desires and low expenses at the same time. This person has probably low material deprivation and low financial stress. Although it is not accurate this person can be called "the poor". Assume another person, who have the high income (the highest quartile), but is also high in material desires. Despite a high income this person is deprived because of his undue wants. He may also have troubles making ends meet due to a high level of expenses. This second person can be called "the rich". Figures 29 and 30 demonstrate these two situations.

Figure 29: Causal inference - deprivation and economic stress are low.
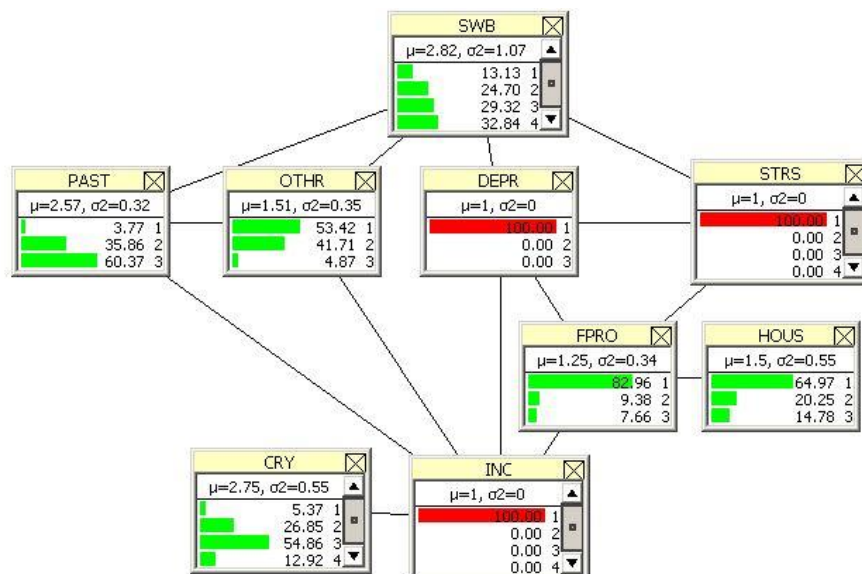
Figure 30: Causal inference - deprivation and economic stress are high.

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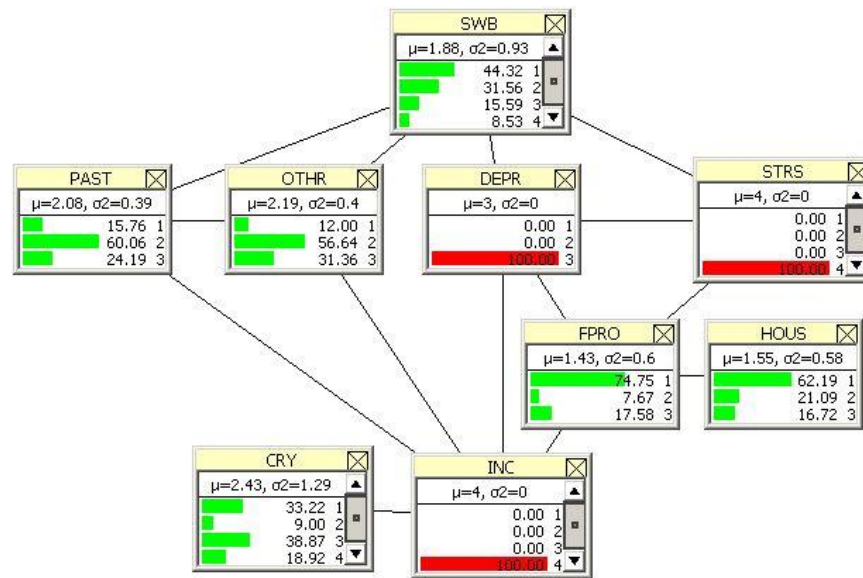
We can observe that "the poor" has approx. 62% chance of enjoying an above median SWB despite the income below the lower quartile. On the contrary, "the rich" has as much as 76% probability of experiencing a below median SWB even though his income is above the upper quartile. The Bayesian network suggests that SWB is more determined by the subjective perceptions of the own material situation than the income itself.

By having these two situations it should be noted that the variables of financial problems and housing defects are conditionally independent of the rest of the model given the evidence of the income; material deprivation and economic strain. When these three variables are instantiated (it means the evidence is available), the financial and/or housing defects are irrelevant. Also, country is conditionally independent of the other variables providing we know the income.

Now, let us suppose we have no evidence of the actual income, but we know how this income is evaluated based on the own past and based on the income of other people in the country. In other words, the relative income is known. Figure 31 shows the situation where "the poor" from the previous example considers his income relatively the same compared to other people and to own past (even if his actual current income is objectively low). The remaining evidence is the same. Now, the evidence of the income becomes irrelevant for the prediction of SWB, because SWB is conditionally independent of the income given relative income, material deprivation and economic stress. We know the composed effects of the income reflected in the four intermediating variables and the knowledge of the income itself is no longer needed.

Figure 31: Causal inference – deprivation and economic stress are low and relative income is the same.
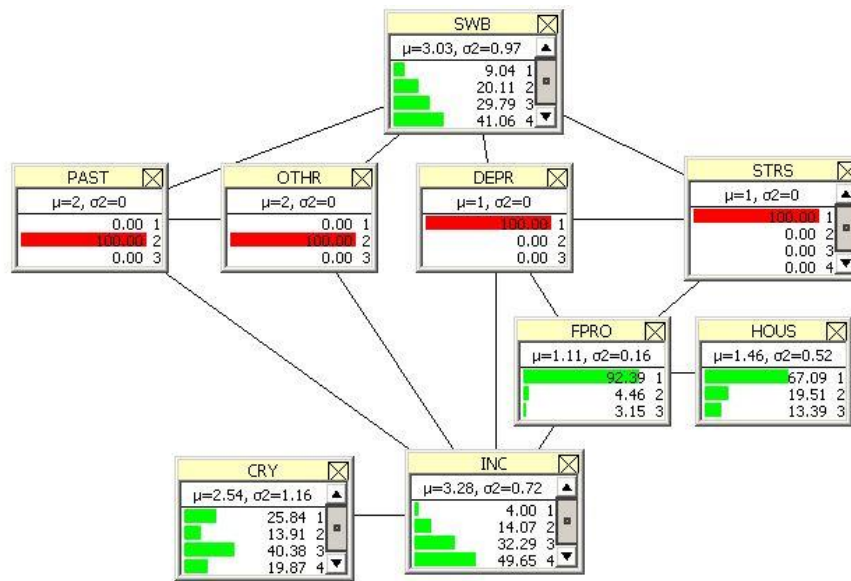
Given the evidence of a low material deprivation and a low economic stress together with the relative income considered the same as income of others and income in past, there is approx. 70% probability that the person is above median in terms of SWB regardless of the actual income (the probability of the low income in this situation is only 4%).

Similarly, Figure 32 shows the situation of the second person, who has high both material deprivation and economic stress. It can be supposed that this person is aware of his high relative income in this case. This person has approx. 63% probability of having below median SWB. Again, the actual income is irrelevant for SWB prediction as the two variables are conditionally independent given the four variables.

5.2.2 Bottom-up inference

A short example of the bottom-up (diagnostic) inference is provided in this section. In this type of the reasoning we look for the probability of causes as results of the known symptom, which is SWB in our model.

Figure 32: Causal inference – deprivation, economic stress and relative income are high.
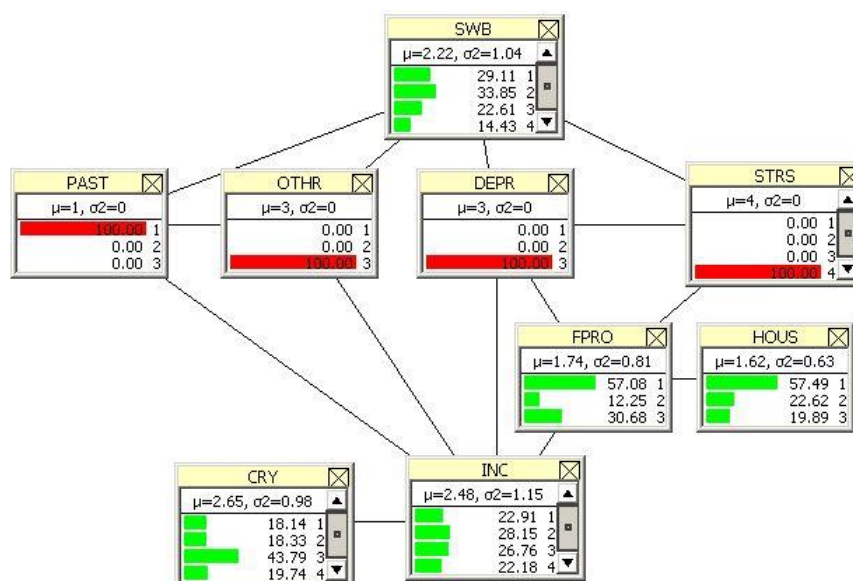
Based on the data of European Values Study, Rabušic and Chromková Manea (2018) reported that 1% of people in the Czech Republic would say they are not at all happy, 10% they are not very happy, 72% they are quite happy and 18% are very happy[108] in 2017. Based on this survey the majority of the people in the Czech Republic is quite happy. The conditional probabilities of the material situation of these people can be inferred based on the model[109]. They are provided in Figure 33.

We can read out that the income of the people reporting they are quite happy (state 3) taking all things together is highly probably (30.7% + 51%) above the median[110]. They have little financial and housing problems, they can mostly afford what they want (approx. 65%), or they are just weakly deprived (further approx. 30%). On the other hand about half of them feels economically strained (approx. 47% of the people make the ends meet with some level of difficulty). These people mostly assess their income is the same compared to others in the country (58%) and compared to past (57%).

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[108] The EVS question was: „Taking all things together would you say you are: very happy, quite happy, not very happy, not at all happy (Q2 in the EVS 2017 master questionnaire).

[109] The inference is not distorted because of the model parameters based only on EQLS 2011 data. The EVS report was used just to determine the modal group.

[110] This assertion is a bit biased by the fact that the income quartiles are calculated for all four countries together. In the other three countries are the inferred probabilities considerably different.

Figure 33: Diagnostic inference.
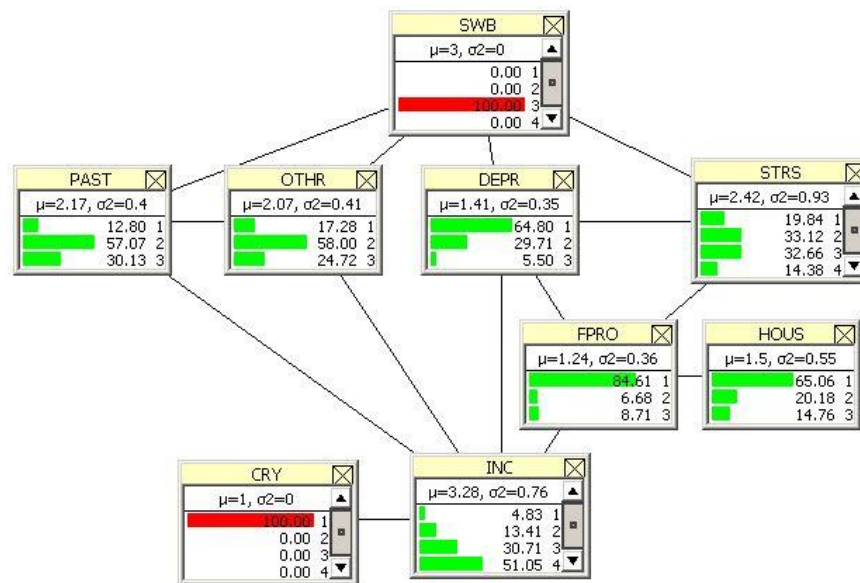
A quite a comprehensive picture of the most likely material situation of the mainstream population in the Czech Republic (in terms of happiness) can be inferred from the Bayesian network in this way.

These two examples provides a reader with an illustration how causal and diagnostic inference can be used in Bayesian networks. It means, if a marginal probability is fixed based on the available evidence the effects on the conditional probability distributions of other variables can be modelled.

6 Conclusion

With no doubt the great majority of people worldwide is interested in their good material living conditions. The commonly assumed association between the good material situation and the high subjectively perceived well-being; happiness; satisfaction; quality of life; health; no matter how we call it, might be one of the reasons people want to have high material standards. This association is explored using several methods of statistical analysis and machine learning in this dissertation.

We studied associations of SWB with various factors of the individual material living conditions based on empirical data of the four central European countries using the methods of statistical analysis. While the statistical analysis helped to analyze the relations between SWB and a particular variable of material situation, an attempt of a more complex representation of the relations was made using the Bayesian network.

The summary from the statistical hypotheses testing is provided in Tables 54 and 55 separately for the two components of SWB: happiness and life satisfaction.

Table 54: Happiness - summary from hypotheses testing

Hyp.#	Variable	CZ	HU	PL	SK	ALL
1a	Income	Confirmed	Rejected	Confirmed	Confirmed	Confirmed
2a	Relative to others	Confirmed	Confirmed	Confirmed	Rejected	Confirmed
3a	Relative to past	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
4a	Economic strain	Confirmed	Rejected	Confirmed	Confirmed	Confirmed
5a	Material deprivation	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
6a	Financial problems	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
7a	Housing defects	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed

Table 55: Life satisfaction - summary from hypotheses testing

Hyp.#	Variable	CZ	HU	PL	SK	ALL
1b	Income	Confirmed	Rejected	Confirmed	Rejected	Confirmed
2b	Relative to others	Confirmed	Confirmed	Confirmed	Rejected	Confirmed
3b	Relative to past	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
4b	Economic strain	Confirmed	Rejected	Confirmed	Confirmed	Confirmed
5b	Material deprivation	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
6b	Financial problems	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
7b	Housing defects	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed

Apparently, all hypotheses can be confirmed in case of the Czech Republic and Poland as well as in all four central European countries together. The income as well as the perceived economic strain seem to play too little role in Hungary to be statistically significant. No particular explanation for such a different pattern in Hungary was identified and further research must be undertaken on this topic. It also seems that in Slovakia the relative income comparing to others is unimportant in terms of SWB. In this case, the related hypotheses were rejected based on the tests made on sample of only 10 respondents who evaluated their current financial situation as much better compared to others in the country. The test is likely to be affected by a small sample size in this case.

The tables summarize the results with regards to the outlined research hypotheses. As the statistical tests are designed to test the null hypothesis of the means equality, the confirmation of our research hypothesis is, in fact, only rejecting the null hypothesis and accepting the alternative hypothesis. Similarly, rejecting the research hypothesis is, in fact, only the acceptance of the null hypothesis of equal means.

Pure comparisons of the mean SWB measured by happiness and life satisfaction among the groups show that the differences, although statistically mostly significant, are not too sharp, namely in cases of objective measures of living conditions such as the households income; housing defects; and financial problems. While the association between SWB and objective conditions seem to be rather weak, especially income as perceived relative to others as well as perceived economic strain seems to be much more important factors. It may suggest the subjective perception of one's own material situation might be more important that the living conditions as they objectively exist.

The statistical analysis investigates only the pairs of SWB and a variable of the material situation. The relation between the SWB and the particular variable may be significant, but not necessarily direct. The basic statistical analysis does not take into consideration factors lying possibly in between SWB and the examined variables. The Bayesian networks enable a deeper insight into the situation. It helps to make clear that SWB is directly influenced by the set of variables whereas, in turn, these variables are influenced by other variables. The direct and the mediating factors are well visible in the Bayesian network. This is one of the main contributions of this dissertation for the research of SWB.

Five different versions of Bayesian networks were constructed. Two expert versions having their parameters learnt in different ways were supplemented by three other models constructed using various machine learning algorithms. All Bayesian networks were tested for the likelihood and accuracy of SWB prediction. The classification of SWB was compared with the ordinal logistic regression model. Although the expert models did not perform best given the testing criteria, they are highly competitive compared with the benchmark models. In fact, all the models scored very closely. The expert model suggest that objective conditions such as income and financial problems influence SWB indirectly through the subjective perception of relative income, material deprivation and economic stress.

6.1 Implications for management science

Although the research presented in this dissertation is in essence a basic research, the findings can be applied in the management science and practice.

The overall satisfaction with life as explored above is associated with the satisfaction with various life domains, whereas the job-satisfaction is undoubtedly the most important one for a manager. The research suggest that life satisfaction and job satisfaction are associated one to the other (Rice et al., 1980, Tait et al., 1989; Rain et al., 1991). For example, Rice et al. (1980) reviewed 23 studies and showed that the relationship between job and life satisfaction was positive in 90% of examined cases and the negative relationships were not statistically significant in any single case. Tait et al. (1989) reported the significant relationship between job satisfaction and life satisfaction based on their meta-study of 34 studies. Judge and Watanabe (1993) suggest that this relationship is positive and reciprocal. The relationship is relatively strong based on the cross-sectional analysis, but the longitudinal results suggest a weaker relationship in terms of the effect of job satisfaction on life satisfaction. In the Czech context the relationship between job and life satisfaction was researched by Mysíková and Večerník (2016). As the job and life satisfaction are associated, the

manager might be aware of this piece of the research in order to understand better the factors influencing the satisfaction and hence the job performance of the work-force in the company[111].

Apart from SWB itself, there are other variables relevant to the manager in the model. Namely income and relative income are important ones, because they both together with the job satisfaction are related closely to job motivation. Lots of models of the job motivation are available and some of them have been widely influential (Maslow (1943); Herzberg (1966); Porter a Lawler (1968) etc.) for the long time. For example, the variable of perceived equitable rewards is employed in the Porter-Lawler model of the job motivation. This variable corresponds with the relative income compared to others in our Bayesian network. As the source of monthly income of a large portion of the population is their day-to-day job, the management has the parameters of this variable for most people in their hands. It was demonstrated how the inference can be done. In a further research the Bayesian network could be tailored to correspond better to managerial needs in terms of modelling the job motivation of the workforce. It could be done by adding other variables suggested by the job motivation frameworks into the model.

6.2 Limitations of the research

The general applicability of our research results may be limited due to the research design and data. Only the data for four central European countries were used with the argument of the similar background; culture; politics; economy; and so on. It was the purpose of this work to study SWB only in central European context, but the results must hence be applied in the different context carefully.

Also, the analysis brought some knowledge about the "mainstream" income groups, but we know little about happiness and satisfaction of the very wealthy people. Also, very poor people having problems to satisfy their basic needs were not specifically addressed in the study. We can hardly conclude on SWB of any of these two groups. Furthermore, we know nothing about SWB of the people under the age of 18 as they were not included in the sample.

It must be repeated that neither associations between SWB and factors of material living conditions nor the edges in Bayesian network should be understood as causal links. No causality was ascertained by the statistical methods and the orientation of

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[111] The relation between job satisfaction and job performance is quite a complex topic that is out of the scope of this dissertation.

edges in the Bayesian network does not imply the causality as it is commonly understood. The structure of the DAG imply the relations of conditional independence only. The variables are related, but no proof was made in terms of the causality. For example, happiness and income are often assumed to be a one-way relation where a higher income causes a higher happiness. But, there are also studies suggesting the causation may be the opposite, for example, Diener et al. (2002b) and Lyubomirsky et al. (2005).

The accuracy of the prediction of SWB is used as one of the metrics for the Bayesian networks assessment. Obviously, the models can be used for the prediction of any variable, but the prediction is not the main purpose of the network. The main purpose is to model the complex relations between the variables of material living conditions and SWB. In case the model was designed with the intention to maximize the prediction accuracy of a particular variable, for example SWB, also different learning methods and approaches can be considered and adopted[112].

6.3 Further research

Bayesian networks have just been discovered the area of the happiness research. So far, they are used very scarcely. As such, this research should be understood as one of the very early steps on a longer journey. Several issues should be addressed in further research.

As some of the variables in the Bayesian networks are ordinal, the monotonicity of the parameters may be an issue. Standard Bayesian network parameter learning algorithms do not guarantee learning parameters satisfying monotonicity conditions. These conditions may be satisfied by introducing restrictions on conditional probabilities. The monotonicity conditions can likely be expected in the presented Bayesian networks. Recently, a gradient based method for learning parameters of Bayesian networks under the monotonicity conditions was presented by Plajner and Vomlel (2018). It would be worth applying this new algorithm to the research of SWB.

Last, but not least, we should stress that the scope of our analysis was solely the material conditions and how they are associated with SWB. The literature review

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[112] Chow-Liu tree, Rebane-Pearl polytree and Tree Augmented Naïve Bayes are the examples of structure learning methods available in software package Hugin (Hugin, 2014) that might be used.

demonstrated that a large number of other factors related to SWB is being researched. The suggested Bayesian networks could hence be extended and personality, situational and other factors can be added.

Generally, Bayesian networks as the analysis instrument are still waiting for the social scientists to be used in a greater extent. It is the modest wish of the author of this dissertation to help it a little along.

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Appendices

Appendix 1: Testing equalities of variances

Factor	Country	Happiness			Life satisfaction		
		Chi sq.	DF	p	Chi sq.	DF	p
Level of income (INCOME)	Czech Republic	4.79	3	0.187	10.75	3	0.013
	Hungary	5.35	3	0.148	17.54	3	0.001
	Poland	7.12	3	0.068	4.11	3	0.250
	Slovakia	22.80	3	0.000	6.91	3	0.075
	All	21.98	3	0.000	25.84	3	0.000
Fin. situation compared to others (FINSITEVAL)	Czech Republic	10.69	4	0.030	16.01	4	0.003
	Hungary	30.74	4	0.000	9.21	4	0.056
	Poland	69.39	4	0.000	90.27	4	0.000
	Slovakia	23.59	4	0.000	15.36	4	0.004
	All	116.52	4	0.000	75.46	4	0.000
Fin. situation compared to past (PASTFIN)	Czech Republic	3.23	2	0.199	2.72	2	0.257
	Hungary	10.32	2	0.006	14.92	2	0.001
	Poland	6.47	2	0.039	1.09	2	0.580
	Slovakia	12.59	2	0.002	15.94	2	0.000
	All	16.10	2	0.000	12.74	2	0.002
Subjective economic strain (MEETENDS)	Czech Republic	9.00	5	0.109	8.56	5	0.128
	Hungary	16.95	5	0.005	21.57	5	0.001
	Poland	36.81	5	0.000	19.29	5	0.002
	Slovakia	31.56	5	0.000	23.99	5	0.000
	All	74.70	5	0.000	59.49	5	0.000
Material deprivation (WANTED)	Czech Republic	0.02	1	0.895	0.90	1	0.342
	Hungary	8.87	1	0.003	30.50	1	0.000
	Poland	18.16	1	0.000	14.44	1	0.000
	Slovakia	7.41	1	0.006	8.16	1	0.004
	All	30.92	1	0.000	39.47	1	0.000

Factor	Country	Happiness			Life satisfaction		
		Chi sq.	DF	p	Chi sq.	DF	p
Financial problems (UNABLEPAY)	Czech Republic	0.20	1	0.656	0.92	1	0.338
	Hungary	1.51	1	0.219	1.55	1	0.213
	Poland	7.24	1	0.007	1.97	1	0.161
	Slovakia	7.98	1	0.005	9.52	1	0.002
	All	9.55	1	0.002	3.38	1	0.066
Housing defects (ACCOMP)	Czech Republic	2.83	1	0.092	8.04	1	0.005
	Hungary	10.28	1	0.001	12.11	1	0.001
	Poland	6.47	1	0.011	4.88	1	0.027
	Slovakia	12.21	1	0.000	6.72	1	0.010
	All	34.49	1	0.000	28.55	1	0.000

Appendix 2: Details for multiple comparison testing

Happiness and income

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	-0.506	137.56	0.614	-3.397	434.97	0.001	-0.436	350.29	0.663	-3.004	362.50	0.003	-3.259	1 446.49	0.001
1	3	-3.097	134.43	0.002	-5.026	357.33	0.000	-4.408	349.19	0.000	-5.877	325.71	0.000	-8.593	1 423.11	0.000
1	4	-3.224	126.25	0.002	-4.239	350.23	0.000	-4.819	404.39	0.000	-5.282	340.76	0.000	-8.645	1 437.73	0.000
2	3	-3.587	370.39	0.000	-1.667	335.58	0.096	-3.683	316.40	0.000	-3.033	398.39	0.003	-5.534	1 458.32	0.000
2	4	-3.815	352.28	0.000	-1.041	334.93	0.299	-3.981	321.01	0.000	-2.779	332.46	0.006	-5.655	1 456.76	0.000
3	4	-0.103	438.75	0.918	0.546	306.03	0.586	-0.023	319.77	0.981	-0.300	294.62	0.765	-0.271	1 455.78	0.787

Life satisfaction and income

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	-1.935	132.69	0.055	-3.948	447.44	0.000	-0.693	347.54	0.489	-3.574	365.84	0.000	-4.537	1 434.27	0.000
1	3	-4.556	126.67	0.000	-5.834	372.83	0.000	-6.115	353.20	0.000	-5.177	354.25	0.000	-10.011	1 427.35	0.000
1	4	-5.061	115.00	0.000	-5.083	383.35	0.000	-5.853	403.67	0.000	-5.802	340.43	0.000	-10.844	1 425.00	0.000
2	3	-3.740	365.81	0.000	-2.174	326.89	0.030	-4.957	314.74	0.000	-1.689	409.13	0.092	-5.848	1 464.98	0.000
2	4	-4.532	335.69	0.000	-1.395	336.57	0.164	-4.682	334.21	0.000	-2.740	334.77	0.006	-6.760	1 456.82	0.000
3	4	-0.594	434.60	0.553	0.738	306.87	0.461	0.404	336.11	0.687	-1.286	322.52	0.199	-0.949	1 460.67	0.343

Happiness and relative income compared to others

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	-2.759	67.66	0.007	-1.453	96.89	0.150	-4.484	265.44	0.000	-4.017	189.18	0.000	-6.464	610.76	0.000
1	3	-6.722	54.70	0.000	-4.502	76.39	0.000	-9.804	186.15	0.000	-9.162	142.18	0.000	-15.284	456.58	0.000
1	4	-7.114	67.86	0.000	-6.156	96.06	0.000	-11.432	247.52	0.000	-9.781	202.15	0.000	-17.650	605.64	0.000
1	5	-6.151	67.69	0.000	-5.590	32.74	0.000	-12.761	235.16	0.000	-1.738	10.23	0.112	-15.562	326.41	0.000
2	3	-7.723	409.83	0.000	-5.954	353.50	0.000	-8.289	604.46	0.000	-7.495	423.26	0.000	-14.825	1 783.50	0.000
2	4	-7.660	389.07	0.000	-8.127	323.65	0.000	-10.349	710.73	0.000	-8.042	261.10	0.000	-17.393	1 734.27	0.000
2	5	-5.175	38.44	0.000	-5.466	18.30	0.000	-11.599	160.03	0.000	-0.592	9.40	0.568	-13.078	184.03	0.000
3	4	-1.623	289.38	0.106	-4.131	213.16	0.000	-4.689	488.13	0.000	-2.827	177.78	0.005	-6.816	1 174.89	0.000
3	5	-1.991	32.21	0.055	-3.494	15.95	0.003	-7.365	94.62	0.000	0.713	9.16	0.493	-6.887	147.41	0.000
4	5	-1.209	38.59	0.234	-1.926	18.29	0.070	-3.730	145.01	0.000	1.273	9.61	0.233	-3.472	184.29	0.001

Life satisfaction and relative income compared to others

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	-1.831	68.24	0.071	-2.201	105.43	0.030	-4.986	262.42	0.000	-6.125	216.12	0.000	-7.432	649.24	0.000
1	3	-5.844	54.62	0.000	-6.609	81.01	0.000	-11.175	185.35	0.000	-11.627	152.11	0.000	-17.950	469.25	0.000
1	4	-7.013	67.64	0.000	-8.442	113.13	0.000	-12.137	247.18	0.000	-13.177	210.74	0.000	-20.516	642.73	0.000
1	5	-4.372	57.69	0.000	-7.675	35.50	0.000	-15.604	238.98	0.000	-1.753	10.03	0.110	-16.884	288.78	0.000
2	3	-7.850	403.28	0.000	-7.502	380.03	0.000	-9.842	603.50	0.000	-6.553	416.09	0.000	-16.299	1 797.15	0.000
2	4	-9.054	391.70	0.000	-9.493	301.89	0.000	-10.752	709.59	0.000	-9.017	278.70	0.000	-19.118	1 731.79	0.000
2	5	-3.758	35.23	0.001	-7.254	19.95	0.000	-15.379	205.36	0.000	-0.053	9.46	0.959	-13.630	180.35	0.000
3	4	-3.185	289.19	0.002	-4.353	208.34	0.000	-3.611	482.45	0.000	-4.632	185.60	0.000	-7.454	1 181.10	0.000
3	5	-1.015	31.06	0.318	-4.247	16.70	0.001	-10.120	103.97	0.000	1.165	9.17	0.273	-6.961	146.67	0.000
4	5	0.136	35.10	0.893	-2.001	21.31	0.058	-6.078	183.63	0.000	2.089	9.60	0.064	-3.366	180.95	0.001

Happiness and relative income compared to past

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	1.066	167.78	0.288	2.984	123.40	0.003	2.269	177.31	0.024	4.277	118.72	0.000	5.110	581.81	0.000
1	3	3.161	262.80	0.002	5.968	224.69	0.000	6.960	282.49	0.000	6.960	231.30	0.000	11.345	1 016.78	0.000
2	3	3.259	222.81	0.001	5.123	247.41	0.000	6.570	250.03	0.000	4.901	213.34	0.000	9.937	932.96	0.000

Life satisfaction and relative income compared to past

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	0.551	168.68	0.582	2.931	141.25	0.004	0.999	168.30	0.319	3.852	113.41	0.000	4.158	590.81	0.000
1	3	3.694	262.24	0.000	7.777	262.38	0.000	6.867	262.52	0.000	6.552	224.53	0.000	12.268	1 021.64	0.000
2	3	4.623	225.07	0.000	7.083	252.25	0.000	8.170	265.82	0.000	4.891	208.38	0.000	12.124	944.41	0.000

Happiness and perceived economic strain

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	-0.892	62.20	0.376	-0.545	16.60	0.593	0.927	57.01	0.358	3.056	49.05	0.004	0.960	179.52	0.338
1	3	0.508	47.95	0.614	-0.187	14.85	0.855	3.162	48.82	0.003	4.975	40.12	0.000	3.744	148.96	0.000
1	4	2.038	49.84	0.047	0.773	14.48	0.452	5.528	57.16	0.000	6.583	35.07	0.000	6.861	147.23	0.000
1	5	3.834	67.29	0.000	1.763	16.20	0.097	6.317	88.94	0.000	8.315	47.66	0.000	9.648	196.34	0.000
1	6	4.520	60.94	0.000	3.697	22.09	0.001	6.411	84.18	0.000	8.744	87.13	0.000	11.912	312.31	0.000
2	3	2.788	238.37	0.006	1.099	165.50	0.273	4.180	328.16	0.000	2.797	231.57	0.006	5.566	953.63	0.000
2	4	5.542	263.59	0.000	4.132	136.71	0.000	7.976	392.70	0.000	5.508	182.47	0.000	12.015	927.05	0.000
2	5	7.437	208.54	0.000	5.896	211.49	0.000	7.818	168.57	0.000	7.859	262.02	0.000	14.843	964.87	0.000
2	6	6.241	37.35	0.000	7.921	93.65	0.000	6.843	58.61	0.000	7.749	88.50	0.000	14.477	270.20	0.000
3	4	4.022	648.99	0.000	4.471	531.19	0.000	4.945	505.11	0.000	3.043	402.59	0.002	8.477	2 610.24	0.000
3	5	6.393	137.40	0.000	6.203	221.91	0.000	5.564	139.00	0.000	6.136	315.33	0.000	12.188	787.52	0.000
3	6	5.325	30.75	0.000	7.982	69.01	0.000	5.362	53.54	0.000	6.551	76.06	0.000	12.474	225.71	0.000
4	5	3.612	151.84	0.000	3.438	182.30	0.001	2.154	172.89	0.033	4.258	262.67	0.000	6.564	765.25	0.000
4	6	3.989	31.62	0.000	6.341	63.37	0.000	3.342	58.64	0.001	5.473	68.66	0.000	9.430	223.15	0.000
5	6	2.053	39.99	0.047	3.982	89.07	0.000	1.844	79.36	0.069	3.150	86.77	0.002	5.487	294.09	0.000

Life satisfaction and perceived economic strain

Group1	Group2	Czech Republic			Hungary			Poland			Slovakia			All		
		t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p	t	D.F	p
1	2	0.535	70.85	0.594	0.282	16.38	0.781	2.166	62.28	0.034	2.020	40.01	0.050	2.521	184.82	0.013
1	3	2.271	49.49	0.028	0.602	14.77	0.556	3.940	50.36	0.000	2.906	36.53	0.006	4.829	150.48	0.000
1	4	4.431	52.21	0.000	1.866	14.51	0.820	7.496	59.45	0.000	4.573	32.85	0.000	9.303	148.44	0.000
1	5	6.474	80.37	0.000	3.506	16.81	0.003	8.049	88.85	0.000	6.042	41.41	0.000	12.582	209.89	0.000
1	6	6.313	56.91	0.000	5.427	20.94	0.000	7.450	85.31	0.000	7.947	66.84	0.000	14.739	307.78	0.000
2	3	2.759	227.89	0.006	0.956	164.70	0.340	2.828	312.96	0.005	1.716	250.57	0.087	4.234	943.68	0.000
2	4	6.176	254.05	0.000	5.016	142.74	0.000	8.445	378.00	0.000	5.528	186.48	0.000	13.078	913.70	0.000
2	5	8.207	202.49	0.000	7.990	219.67	0.000	8.383	186.02	0.000	7.553	270.68	0.000	16.414	950.84	0.000
2	6	6.857	38.91	0.000	10.233	95.96	0.000	7.007	62.96	0.000	8.970	92.29	0.000	16.591	283.79	0.000
3	4	5.149	644.37	0.000	5.986	565.07	0.000	6.991	511.78	0.000	4.181	377.53	0.000	11.787	2 606.85	0.000
3	5	7.430	128.42	0.000	8.707	194.45	0.000	7.076	145.74	0.000	6.592	314.51	0.000	15.233	756.75	0.000
3	6	5.982	30.83	0.000	10.650	69.72	0.000	5.975	55.03	0.000	8.269	82.07	0.000	15.329	230.30	0.000
4	5	4.140	141.71	0.000	5.288	171.67	0.000	2.058	182.02	0.041	3.965	248.11	0.000	7.726	733.73	0.000
4	6	4.235	31.84	0.000	8.294	65.03	0.000	2.874	61.03	0.006	6.643	70.25	0.000	10.822	227.06	0.000
5	6	1.804	43.29	0.078	4.106	104.27	0.000	1.419	81.77	0.160	3.992	97.27	0.000	5.652	321.53	0.000

Appendix 3: Matrices of conditional independencies given the minimum cardinality separating sets

Expert model

	CRY	INC	PAST	OTHR	DEPR	FPRO	STRS	HOUS	SWB
CRY	xx	-	INC	INC	INC	INC	INC	FPRO $\vee$ INC	INC
INC		xx	-	-	-	-	DEPR $\wedge$ FPRO	FPRO	DEPR $\wedge$ OTHR $\wedge$ PAST $\wedge$ STRS
PAST			xx	-	INC	INC	INC	FPRO $\vee$ INC	-
OTHR				xx	INC	INC	INC	FPRO $\vee$ INC	-
DEPR					xx	-	-	FPRO	-
FPRO						xx	-	-	DEPR $\wedge$ INC $\wedge$ STRS
STRS							xx	FPRO	-
HOUS								xx	FPRO
SWB									xx

BIC optimal model

	CRY	INC	PAST	OTHR	DEPR	FPRO	STRS	HOUS	SWB
CRY	xx	-	STRS $\wedge$ (DEPR $\vee$ INC $\vee$ OTHR)	STRS $\wedge$ (DEPR $\vee$ INC)	DEPR $\wedge$ INC	DEPR	-	DEPR $\vee$ FPRO	(STRS $\wedge$ DEPR) $\vee$ (STRS $\wedge$ INC) $\vee$ (DEPR $\wedge$ OTHR)
INC		xx	DEPR	DEPR	-	DEPR	DEPR	DEPR $\vee$ FPRO	DEPR
PAST			xx	-	OTHR $\wedge$ STRS	DEPR	-	DEPR $\vee$ FPRO	OTHR $\wedge$ (DEPR $\vee$ STRS)
OTHR				xx	-	DEPR	-	DEPR $\vee$ FPRO	-
DEPR					xx	-	-	FPRO	-
FPRO						xx	DEPR	-	DEPR
STRS							xx	DEPR $\vee$ FPRO	DEPR $\wedge$ OTHR
HOUS								xx	DEPR $\vee$ FPRO
SWB									xx

TAN model

	CRY	INC	PAST	OTHR	DEPR	FPRO	STRS	HOUS	SWB
CRY	xx	-	SWB ∧ (DEPR ∨ INC ∨ STRS)	SWB ∧ (DEPR ∨ INC ∨ STRS)	SWB ∧ INC	SWB ∧ (DEPR ∨ INC)	SWB ∧ (DEPR ∨ INC)	SWB ∧ (DEPR ∨ FPRO ∨ INC)	-
INC		xx	SWB ∧ (DEPR ∨ STRS)	SWB ∧ (DEPR ∨ STRS)	-	SWB ∧ DEPR	SWB ∧ DEPR	SWB ∧ (DEPR ∨ FPRO)	-
PAST			xx	SWB ∧ STRS	SWB ∧ STRS	SWB ∧ (DEPR ∨ STRS)	-	SWB ∧ (DEPR ∨ FPRO ∨ STRS)	-
OTHR				xx	SWB ∧ STRS	SWB ∧ (DEPR ∨ STRS)	-	SWB ∧ (DEPR ∨ FPRO ∨ STRS)	-
DEPR					xx	-	-	SWB ∧ FPRO	-
FPRO						xx	SWB ∧ DEPR	-	-
STRS							xx	SWB ∧ (DEPR ∨ FPRO)	-
HOUS								xx	-
SWB									xx

Appendix 4: Conditional probability distributions for the Expert/OLR model

Relative income compared to others (OTHR)

PAST	1				2			
INC	1	2	3	4	1	2	3	4
1	0.165768	0.099328	0.057676	0.032853	0.37791	0.252142	0.157624	0.09408
2	0.639877	0.597696	0.503115	0.381884	0.548952	0.623377	0.638439	0.590106
3	0.194355	0.302976	0.439208	0.585263	0.073138	0.124481	0.203937	0.315814
Exp.	48	51	62	138	281	338	454	548

PAST	3			
INC	1	2	3	4
1	0.650006	0.507568	0.363891	0.240981
2	0.324832	0.447992	0.558792	0.62784
3	0.025162	0.04444	0.077318	0.131179
Exp.	453	407	298	181

Relative income compared to past (PAST)

INC	1	2	3	4
1	0.037692	0.061875	0.099963	0.157558
2	0.358593	0.463142	0.550546	0.600563
3	0.603715	0.474982	0.349491	0.241879
Exp.	782	796	814	867

Country (CRY)

1	0.188095
2	0.17981
3	0.438171
4	0.193925
Exp.	3 259

Subjective well-being (SWB)

STRS	1								
DEPR	1								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.115994	0.141423	0.171346	0.073368	0.090408	0.110931	0.045598	0.056582	0.070018
2	0.236018	0.264029	0.289883	0.173507	0.201126	0.229686	0.119538	0.142332	0.167617
3	0.302564	0.29859	0.28791	0.286593	0.297864	0.30249	0.243145	0.265229	0.283286
4	0.345424	0.295958	0.250861	0.466533	0.410603	0.356892	0.591719	0.535857	0.479079

STRS	1								
DEPR	2								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.177427	0.213078	0.253682	0.115166	0.140442	0.170199	0.072819	0.089744	0.110135
2	0.294314	0.315453	0.330909	0.235001	0.263058	0.289018	0.172553	0.20012	0.228666
3	0.285252	0.267825	0.246175	0.302576	0.298851	0.288397	0.286079	0.297572	0.302446
4	0.243007	0.203645	0.169233	0.347257	0.297648	0.252386	0.468549	0.412565	0.358754

STRS	1								
DEPR	3								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.261762	0.308013	0.358468	0.176248	0.211723	0.252152	0.114343	0.139467	0.169058
2	0.333049	0.340223	0.339723	0.293475	0.314789	0.330471	0.233983	0.262085	0.288148
3	0.241812	0.217144	0.191552	0.285777	0.268527	0.247002	0.302578	0.299103	0.288876
4	0.163377	0.134619	0.110257	0.2445	0.204961	0.170375	0.349096	0.299344	0.253918

STRS	2								
DEPR	1								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.161761	0.19501	0.233192	0.1043	0.127536	0.155051	0.065652	0.081057	0.099691
2	0.282358	0.305725	0.324141	0.22098	0.249487	0.276678	0.159698	0.186441	0.21464
3	0.291819	0.276973	0.257204	0.301823	0.301549	0.294311	0.278316	0.292725	0.300928
4	0.264062	0.222291	0.185462	0.372896	0.321428	0.27396	0.496334	0.439777	0.384741

STRS	2								
DEPR	2								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.24083	0.284809	0.333294	0.160666	0.193742	0.231747	0.103546	0.126637	0.153993
2	0.326898	0.337648	0.34094	0.281454	0.304969	0.323587	0.219959	0.248485	0.27575
3	0.253106	0.229422	0.204108	0.29224	0.277595	0.257977	0.301703	0.301681	0.294683
4	0.179166	0.148121	0.121659	0.265639	0.223695	0.186689	0.374792	0.323197	0.275575

STRS	2								
DEPR	3								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.342745	0.395636	0.451088	0.239352	0.283162	0.331496	0.159577	0.19248	0.230308
2	0.340697	0.33484	0.321757	0.326386	0.337389	0.340955	0.280547	0.304206	0.323025
3	0.199342	0.173869	0.149445	0.253901	0.230302	0.205021	0.292654	0.27821	0.258745
4	0.117217	0.095655	0.077711	0.18036	0.149146	0.122527	0.267223	0.225104	0.187922

STRS	3								
DEPR	1								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.22107	0.26269	0.309036	0.146217	0.176945	0.212524	0.093661	0.11483	0.140044
2	0.319163	0.333276	0.340293	0.268654	0.293972	0.315183	0.205979	0.234586	0.262661
3	0.263644	0.241311	0.216609	0.297219	0.285467	0.268112	0.299146	0.302578	0.298955
4	0.196123	0.162723	0.134062	0.28791	0.243615	0.204181	0.401215	0.348007	0.29834

STRS	3								
DEPR	2								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.318127	0.369355	0.423705	0.219679	0.261124	0.307309	0.145209	0.175769	0.211172
2	0.340758	0.338654	0.329009	0.318542	0.33289	0.340173	0.267697	0.293131	0.314516
3	0.211881	0.186264	0.161214	0.264376	0.242156	0.217513	0.297521	0.285989	0.268812
4	0.129234	0.105727	0.086073	0.197403	0.163829	0.135005	0.289574	0.245111	0.205501

STRS	3								
DEPR	3								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.434051	0.490517	0.547225	0.316373	0.36747	0.421728	0.218294	0.259564	0.305588
2	0.326441	0.308921	0.286212	0.340689	0.338862	0.329474	0.317913	0.332495	0.340044
3	0.156701	0.133468	0.112376	0.21279	0.187174	0.162085	0.265103	0.242998	0.218415
4	0.082807	0.067094	0.054187	0.130148	0.106495	0.086712	0.19869	0.164942	0.135954

STRS	4								
DEPR	1								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.294486	0.343826	0.396783	0.201195	0.240226	0.284136	0.131931	0.160221	0.193226
2	0.338959	0.340652	0.334636	0.309273	0.32669	0.337544	0.254279	0.281084	0.304658
3	0.224271	0.1988	0.17334	0.273899	0.253431	0.229781	0.300794	0.29241	0.277847
4	0.142284	0.116721	0.095241	0.215633	0.179653	0.148539	0.312996	0.266285	0.224269

STRS	4								
DEPR	2								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.406936	0.462758	0.51953	0.292806	0.342001	0.394846	0.199896	0.238751	0.282492
2	0.332699	0.318237	0.297877	0.338756	0.340726	0.334979	0.308547	0.326176	0.337281
3	0.168702	0.144599	0.12241	0.225162	0.199715	0.174234	0.27455	0.254224	0.230661
4	0.091663	0.074406	0.060183	0.143276	0.117559	0.095942	0.217006	0.18085	0.149566

STRS	4								
DEPR	3								
OTHR	1			2			3		
PAST	1	2	3	1	2	3	1	2	3
1	0.530064	0.586085	0.639964	0.404982	0.460745	0.517508	0.291131	0.34018	0.392912
2	0.293564	0.268189	0.240405	0.33309	0.318862	0.298687	0.338544	0.340789	0.335312
3	0.118535	0.099104	0.082137	0.169588	0.145427	0.123162	0.226052	0.200629	0.175129
4	0.057837	0.046622	0.037494	0.09234	0.074966	0.060642	0.144273	0.118402	0.096646

Housing problems (HOUS)

FPRO	1	2	3
1	0.687281	0.537488	0.380608
2	0.18932	0.252263	0.284519
3	0.123399	0.210249	0.334874
Exp.	2 467	305	487

Financial problems (FPRO)

INC	1	2	3	4
1	0.580738	0.716792	0.822212	0.894184
2	0.144532	0.111498	0.075894	0.047355
3	0.27473	0.17171	0.101894	0.058461
Exp.	782	796	814	867

Material deprivation (DEPR)

INC	1			2			3		
FPRO	1	2	3	1	2	3	1	2	3
1	0.168489	0.102338	0.060276	0.342891	0.226957	0.141764	0.573343	0.430543	0.298432
2	0.517748	0.449338	0.348821	0.506332	0.533171	0.498899	0.36216	0.460294	0.522722
3	0.313763	0.448325	0.590903	0.150777	0.239872	0.359337	0.064497	0.109163	0.178846
Exp.	438	125	219	589	83	124	672	60	82

INC	4		
FPRO	1	2	3
1	0.775815	0.660675	0.522775
2	0.198111	0.293902	0.399245
3	0.026074	0.045422	0.077979
Exp.	768	37	62

Perceived economic strain (STRS)

FPRO	1			2			3		
DEPR	1	2	3	1	2	3	1	2	3
1	0.280224	0.060019	0.010363	0.209591	0.041677	0.007082	0.152978	0.028768	0.004834
2	0.402442	0.200784	0.044336	0.384767	0.152071	0.030835	0.346514	0.111884	0.021307
3	0.262012	0.47608	0.260048	0.326469	0.462313	0.200376	0.388421	0.424413	0.149508
4	0.055322	0.263117	0.685253	0.079173	0.343939	0.761707	0.112087	0.434935	0.82435
Exp.	1 279	906	282	46	153	106	99	211	177

Income (INC)

CRY	1	2	3	4
1	0.068515	0.358362	0.30042	0.15981
2	0.154976	0.267918	0.234594	0.330696
3	0.306688	0.240614	0.228992	0.25
4	0.469821	0.133106	0.235994	0.259494
Exp.	613	586	1 428	632

Appendix 5: Confusion matrices

Expert/EM

Prediction	Reference				
	Actual=1	**Actual=2**	**Actual=3**	**Actual=4**	
Predicted=1	597	301	174	128	**1 200**
Predicted=2	196	328	250	180	**954**
Predicted=3	64	142	173	145	**524**
Predicted=4	49	122	153	257	**581**
	906	**893**	**750**	**710**	**3 259**

Expert/OLR

Prediction	Reference				
	Actual=1	**Actual=2**	**Actual=3**	**Actual=4**	
Predicted=1	579	286	148	100	**1 113**
Predicted=2	226	344	261	189	**1 020**
Predicted=3	14	40	33	39	**126**
Predicted=4	87	223	308	382	**1 000**
	906	**893**	**750**	**710**	**3 259**

BIC optimal (Greedy/EM, Gobnilp/EM)

Prediction	Reference				
	Actual=1	**Actual=2**	**Actual=3**	**Actual=4**	
Predicted=1	566	289	159	114	**1 128**
Predicted=2	204	267	193	151	**815**
Predicted=3	97	241	269	258	**865**
Predicted=4	39	96	129	187	**451**
	906	**893**	**750**	**710**	**3 259**

TAN/EM

Prediction	Reference				
	Actual=1	Actual=2	Actual=3	Actual=4	
Predicted=1	573	278	136	96	**1 083**
Predicted=2	195	307	223	172	**897**
Predicted=3	71	144	189	148	**552**
Predicted=4	67	164	202	294	**727**
	906	**893**	**750**	**710**	**3 259**

Ordinary logistic regression

Prediction	Reference				
	Actual=1	Actual=2	Actual=3	Actual=4	
Predicted=1	576	264	130	82	**1 052**
Predicted=2	224	337	259	195	**1 015**
Predicted=3	33	98	101	74	**306**
Predicted=4	73	194	260	359	**886**
	906	**893**	**750**	**710**	**3 259**