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Economics of Well-being and Mental Health: A cost-of-illness analysis on Mental Health in Denmark

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D e c l a r a t i o n o f A u t h e n t i c i t y

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Prague, August 24, 2019

Signature

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Title of the Master's Thesis:

Economics of Well-being and Mental Health: A cost-of-illness analysis on Mental Health in Denmark.

Abstract:

The purpose of this thesis was to conduct a cross-sectional cost-of-suboptimal mental well-being analysis which estimates additional healthcare and non-healthcare costs of low and moderate compared to high mental well-being for the Danish society in 2017. Methods from conventional cost-of-illness studies were applied as well as an OLS regression. Necessary data came from a Danish survey on Mental Health and Well-being which was linked to Danish registries. Total healthcare and non-healthcare costs for low and moderate compared to high mental well-being were estimated to be € 1,552.6 million in 2017. Estimated additional costs suggest that it is not enough to merely measure the economic costs of classified mental disorders. Implications for the field of promotion in mental health and well-being were described. Another study has to be carried out to include more cost components.

Key words:

Economics of Well-being and Mental Health, cost-of-illness studies, mental well-being.

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List of Acronyms

BOD Burden of disease

COI Cost-of-illness

CI 95 % Compatibility interval

CUA Cost utility analysis

CPR Civil Registration System

DALY Disability-adjusted life year

DRG Diagnostic-related groups

DMHWBS 2016 Danish Mental Health and Well-Being Survey 2016

DKK Danske Kroner

DSM Diagnostic and Statistical Manual of Mental Disorders

FCA Friction cost approach

GP General Practitioner

GDP Gross Domestic Product

HCA Human capital approach

ICD International Classification Of Diseases

LPR Landspatientregisteret

MH Mental health

MWB Mental well-being

PMH Positive mental health

NHSR Danish National Health Service Register

OC Opportunity costs

OLS Ordinary Least Square

PHS Public health service

SWB Subjective well-being

WEMWBS Warwick-Edinburgh Mental Well-being Scale

WTP Willingness to pay

WHO World Health Organization

QUALY Quality-adjusted life years

1

Introduction

'Economics is the mother tongue of public policy, the language of public life, and the mindset that shapes society' (Raworth, 2017, p. 6).

In recent years, the interest among academics and policy makers in the economics of well-being and mental health has risen substantially. A shift from output-prone indicators such as Gross Domestic Product (GDP) to indexes accounting for collective happiness and well-being of the population enhanced the interest in understanding what determines well-being. Throughout, mental health scores highest when asking people which factors to well-being are most important (Andreasson, 2018). Particularly, as cost-of-illness studies revealed an increasing economic burden of mental ill-health to societies - mental health is on every agenda. Moreover, mental health is no longer considered as the mere absence of mental ill-health. Rather is mental health a positive concept, an umbrella term which incorporates well-being (Stewart-Brown et al., 2015; World Bank, 2015).

The focus of this thesis is to study the economic impact of different levels of sub-optimal mental health (mental well-being). Analyzing the economic impact of sub-optimal mental health is of relevance to researchers in the field of politics and economics as well as psychology. The results of this thesis hold implications for many policy issues related to mental health and well-being. First, extra healthcare and non-healthcare costs arise from individuals not having optimal mental well-being. Therefore, optimal mental well-being might state a cost saving potential to be exploited through e.g. mental health and well-being promotion. Second, cost-of-illness studies merely refer to diagnosed mental disorders when estimating the economic impact of mental health. This does not provide an entire picture of the economic consequences of mental health. Those who do not quite meet the clinical threshold of a diagnose may still be suffering and generate negative economic impact (Huppert & So, 2013). Therefore, adopting a new approach to conventional cost-of-illness studies by conducting a 'cost-of-suboptimal mental well-being' analysis might shed

new light on the 'true' economic impact of mental health. Additionally, referring to mental health as a positive concept in an economic study might establish a new mindset in public policy in which mental well-being is considered a valuable resource to society. One could extend the study by incorporating more cost components such as productivity costs (indirect costs) which arise due to suboptimal levels of mental health. Furthermore, one could investigate the odds of individuals with different levels of mental well-being to seek treatment. Researchers have linked healthcare seeking behaviour and sociodemographic characteristics of mentally-disordered. In this case, the determinants of different levels of mental well-being are of interest in behavioural and health economics.

Having suffered from a burnout and depressive symptoms myself, I decided to dedicate brain power and energy to research the relevance of mental health. Burnout is not classified as a mental disorder in common classification guidelines such as the Diagnostic and Statistical Manual of Mental Disorders, or DSM-5 (American Psychiatric Association, 2017). Therefore, in conventional cost-of-illness studies, individuals with this condition would not be taken into account. In my initial investigations, I realized that considering diagnosed mental disorders in such appraisals is insufficient: Not only does it lead to underestimations but it enhances a perspective on mental health as set of negative symptoms. Therefore, viewing mental health beyond the threshold of diagnosis and investigating how it affects individuals, organizations and societies might help to reshape the general view on mental health as a positive concept.

This thesis addresses a gap in research by conducting a prospective analysis estimating healthcare and non-healthcare costs of different levels of mental health (mental well-being) for the Danish society. The hypothesis formulates as follows: Individuals with low or moderate mental well-being generate additional healthcare and non-healthcare costs compared to those with high mental well-being.

Necessary data comes from a Danish survey on Mental Health and Well-being from 2016 (DMHWBS 2016). The survey could be linked to anonymized cost data from Danish national registries through citizens' Personal Identification number (Danish: Personnummer). This allows for a bottom-up costing approach. An internationally recognized scale for mental well-being, the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) was applied to compare costs of different levels of mental well-being. A set of OLS regression was performed to estimate the following costs: (1) Costs for General Practitioner and specialist, (2) Costs for hospitalization, (3) Costs for outpatient treatment and (4) Sickness benefit transfers. All costs were extrapolated to the entire Danish populating using information from Statistics Denmark (2017) and converted into Euro. The findings (see 4.3.1) show that individuals with

low or moderate compared to high mental well-being induce extra healthcare and non-healthcare costs. Given the regression model, I find that the hypothesis can only be confirmed for (1) Costs for General Practitioner and specialist. The effect of other predictors associated with healthcare expenditure is taken into account by controlling for sociodemographic factors (gender, age, education, marital status, income, employment status and ethnicity).

The thesis is structured as follows: Section 2 outlines the emergence of economics of well-being and mental health. This section depicts how mental health is defined as a positive concept (mental well-being) in which well-being is folded into. The section further describes the main research problem addressed in this thesis: The need to assess the economic impact of mental health applying a more comprehensive and comparable measure that goes beyond clinical diagnoses. Additionally, the roots and concepts of mental health in health economics are depicted and used in the following sections. Also, the Danish healthcare system is explained in section 2. Section 3 provides an overview of methodologies and previous literature focusing on traditional cost-of-illness studies. The following section 4 analyses the economic costs of suboptimal mental well-being for the Danish society. Section 5 presents an alternative approach to enhance mental well-being, and section 6 offers a creative solution that might help to mitigate the economic effects of mental health on the healthcare system. Finally, section 7 concludes the thesis with a summary of the findings, and discusses potential shortcomings and suggestions for future research.

2

Economics of Well-being and Mental Health

For decades, monetary value served as the ultimate yardstick to measure a nation's success. GDP was the prevailing gauge of a country's economic development and well-being (Fox, 2012). Already Robert F. Kennedy noted during a campaign trail in 1968 that '...Yet the gross national product does not allow for the health of our children, the quality of their education, or the joy of their play'. For instance, merely considering output prone measures, a global decline in health could be displayed as positive for the economy: In 2016, health expenditure made up of 10 % of global GDP (US \$ 7.5 trillion). Another example: Sales from antipsychotic drugs mushroomed and are expected to reach US \$ 18.5 billion globally by the end of 2022 with a CAGR of 4,3 % (COMTEX, 2018). Is that not good for the economy? It depends: What we measure is what we value as a society.

Recently, it has doomed politicians and economists that GDP and other output prone indices have certain shortcomings to depict well-being and growth. As basic needs in societies are fulfilled, individuals shift their attention to the 'good life'. Evidence suggests that with societies becoming wealthier, people rank happiness or well-being higher than money (Fox, 2012). However, the World Health Organization has pointed out that a decline in mental well-being or mental health is something that has grown explosively (World Health Organization, 2018b).

Hence, economists started to take interest in how people feel, what is going on in their heads, and how it impacts economy.

Correlations between well-being and situational factors such as employment, social capital or income have been studied rigorously (e.g. The Easterlin Paradox, (Easterlin, 1974)). Mental health research itself was dominated by a psychiatric and psychological perspective in the last two centuries. Socioeconomic determinants

and correlations were obscured (Macintyre et al., 2018). As the increasing impact of mental health on healthcare systems and economies started to be recognized as a challenge to the future of society, new economic branches emerged (Anderson & Jané-Llopis, 2011). Economics of well-being and mental health describes a marriage between economics and psychology. It states a research branch to provide insights into impacts of mental health on the economy.

In order to understand the economic impact of mental health and well-being, the terms have to be defined. This section provides a definition on mental health and describes the evolution of a positive concept of mental health in which well-being is folded into. Furthermore, the main research problem addressed in this thesis is outlined.

2.1 Definitions and concepts: Mental Health

For long, the term mental health was thought of as an equivalent to mental illness such as depression, anxiety or any other disorder. On the contrary, (good) mental health was defined as the absence of a disease. Thus, an individual was considered to be either mentally healthy or unhealthy (Keyes, 2005). Consequently, mental health appears to have two sides on a single continuum: A positive side and a negative side. However, the notion that the mere presence of a mental disorder is enough to classify an individual as mentally healthy or not, has been challenged in recent years (Lukat et al., 2016).

2.1.1 Mental Ill-health

Mental health was for long associated with mental ill-health. What mental ill-health really is, is far from straightforward. Not too long ago, some authors have even rejected the mere existence of mental illness (Boorse, 1976).

Mental ill-health can be considered a medical phenomenon. This is assessed through taxonomic and diagnostic tools such as the Diagnostic and Statistical Manual of Mental Disorders. Another commonly used tool to ascertain health and report on diseases is the International Statistical Classification of Diseases and Related Health Problems maintained by the World Health Organization. However, these classifications are subject to change: What is recognized as mentally unhealthy changes with culture and time (World Health Organization, 2001). The latest version of the Diagnostic and Statistical Manual of Mental Disorders (DSM) for example includes Oppositional Defiant Disorder which stands for young adults who reject authority or loose temper easily, whereas burnout remains unrecorded (American Psy-

chiatric Association, 2017). The new version of the International Classification Of Diseases (ICD), version 11, has received attention as transgender was removed as a classified mental disorder. Again this shows that what is considered mentally (un)healthy is subject to change (World Health Organization, 2018a).

Often, mental ill-health is considered aberrant - differing from the usual or norm in the field of psychiatry (Boorse, 1976). In a statistical sense, normality refers to a distribution of made observations indicating that most of the observations fall within one standard deviation from the mean. Thus, normality of behaviour would mean that it occurs frequently in a population. A reference to normality in a statistical sense has to be done with precaution: Considering that one in six men, and one in every four women will fall ill with a depression during their life time, depression could be classified as a 'normal' symptom (Kessler et al., 1994).

In summary, no clear definition for the apparent negative side on a single continuum - mental ill-health - exists. Further, one should pay close attention to the changing nature of conceptions on mental ill-health.

2.1.2 From Mental Health to positive Mental Health

In the literature, no definite consensus on the term mental health exists. Rather is the field of mental health characterized by alterations of terminologies describing problems, illnesses, disorders or positive health attributes (Faculty of Public Health & Mental Health Foundation, 2016). However, the psychiatric conception that a person is either mentally healthy or mentally ill has been challenged by several authors (Keyes, 2005, 2002; Ryff, 1989).

Several authors allege that mental health and mental ill-health are non-dichotomous and propose diverse terms and frameworks to conceptualize mental health:

Dual Continuum of Mental Health

Keyes (2002) challenges the notion that mental health can be measured on a single continuum with each side representing either mental health or mental ill-health. The concept by C. L. Keyes operationalizes mental health as a syndrome of symptoms of positive feelings and positive functioning in life. According to him, mental health is more than the mere absence of illness symptoms. The founding father of the dual continuum refers to the presence of mental health as *Flourishing*. *Flourishing* refers to positive functioning in a psychological and social sense. Once a person is *flourishing*, he or she obtains complete mental health. On the other side of *flourishing* is *languishing* which represents the absence of mental health. *Languishing* accounts for

low levels of well-being and therefore states incomplete mental health Keyes (2002). Consequently, mental health represents a complete state in which mental ill-health is absent and high levels of subjective well-being are present.

Herein, subjective well-being refers to "two clusters of symptoms: emotional and functional well-being" (Keyes, 2002, p. 210). Mental health is seen a syndrome with certain length and function such as of cognitive and social nature. Furthermore, the concept portrays that neither psychiatric diagnosis is contradictory to mental health nor the absence of diagnosis a discriminating factor to the lack of mental health. Thus, a person suffering from a depression is not languishing all the time but might still report high levels of well-being from time to time. This means that positive elements of mental health and mental health problems can be present simultaneously. The author finds that mental health can be enhanced notwithstanding a diagnosis of mental ill-health. Especially, the last notion lays the foundation for successive concepts which depict mental health as non-static. In summary, the concept by Keyes goes beyond the single continuum on mental health. It depicts that mental health is much more than the absence of illness. Rather is mental health a complete state which is made up as a set of symptoms. These symptoms cover aspects of subjective well-being. Therefore, mental health is conceptually on a super-ordinate level in view of well-being.

An all encompassing concept: Mental Well-being

This relationship between well-being and mental health can be found in another slightly different concept: The concept of mental well-being. It has received increasing recognition in research, public health, and from policymakers (Wykes et al., 2015). Initially, the concept evolved around two distinct philosophies: Hedonism and Eudaimonism.

Hedonism considers well-being to draw from pleasure or happiness (Kahneman et al., 1999). Hedonic well-being therefore comprises emotional aspects of well-being such as enjoyment, satisfaction and curiosity with life (Seow et al., 2016). Dimensions encompass: *life satisfaction*, *positive mood* and the *absence of negative mood* which is assessed by the level of subjective well-being (Ryan & Deci, 2001). Subjective well-being (SWB) became a "primary index for well-being in the past decade" despite considerable debate (Ryan & Deci, 2001, p. 145).

Eudaimonic perspective goes further as it refers to the realization of human potential (one's *daimon*)(Waterman, 1993). Waterman (1993) expresses that eudamonia is reached once an individual acts or lives congruent with internal values. Carol Ryff (1989) advanced this notion to psychological well-being which covers six dimensions:

Self acceptance, Positive relations with others, Autonomy, Environmental mastery, Purpose in life. Thus, psychological well-being contrasts SWB as a more multidimensional approach defining on a theoretical and operational level what promotes emotional and physical health (Ryff & Singer, 1998).

Mental well-being can be depicted on a scale ranging from low to high mental well-being. High mental well-being equates positive mental health. Positive mental health encompasses emotional, psychological and social well-being. Therefore, the different concepts on well-being (hedonic and eudaimonic) are folded into a composite model of mental health (Ryan & Deci, 2001). Low mental well-being does not equate a diagnosed mental illness. Someone who falls into the low end of mental well-being may not meet the diagnostic criteria for a diagnosis but still suffer. Nonetheless, low mental well-being does not exclude those with a mental disorder. Individuals who suffer from a diagnosed mental disorder would be covered by the low end of the mental well-being continuum - yet, the low end is not constrained to diagnostic tools.

This concept implies a holistic view on mental health which incorporates different dimensions of well-being. Additionally, the concept understands mental health in a positive sense. Positive mental health represents positive self-perception entailing positive mood, coping and social skills. This view is in alignment with the WHO understanding of mental health: "Mental Health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (World Health Organization, 2001, p. 4).

Mental Health in policy reports

The notion that mental health is a positive concept and furthermore a resource to society is highlighted in recent policy reports and projects.

The "Foresight Project on Mental Capital and Wellbeing" from 2008 considers mental health as capital - hence, as the economic input for competitiveness and richness of a society. According to the author's definition, mental capital "refers to the totality of an individual's cognitive and emotional resources, including their cognitive capability, flexibility and efficiency of learning, emotional intelligence (e.g. empathy and social cognition), and resilience in the face of stress. The extent of an individual's resources reflects his/her basic endowment (genes and early biological programming), and their experiences and education, which takes place throughout the lifecourse" (The Government Office for Science, 2008, p.45). Thus, mental health is seen a resource valuable to society.

The Green Paper from the European Commission "Improving the mental health of the population. Towards a strategy on mental health for the European Union" from 2005 aligns with the definition from the WHO and further considers mental health as a condition subject to multiple factors such biological (genetics), individual, family, social economic and environmental ones (Commission of the European Communities, 2005).

This positive dimension of mental health is further adopted in the recent report "Health at a Glance: Europe 2018 State of Health in the EU Cycle" from the Organisation for Economic Co-operation and Development (OECD) and European Union which indicates the significance to promote mental health and prevent mental ill-health. The paper points to "good mental health" as a "critical part of individual well-being, and the foundation for happy, fulfilled, productive lives." (OECD/EU, 2018, p. 20).

Having mentioned the concepts and policy reports, it becomes evident that the notion on what mental health is, is changing. The absence of mental ill-health is not equivalent to the prevalence of (positive) mental health. The perception of mental health changed from a focus on ill-health to a more holistic concept. Mental health (MH) is considered an umbrella term which comprises aspects such as subjective well-being or mental capital. Mental health is far from being a static mental state but can change in the course of a lifetime. A multitude of factors determine one's mental health. The determinants of mental health include not only factors related to actions by individuals, such as behaviours and lifestyles, coping skills, and good interpersonal relationships, but also social and environmental factors like income, social status, education, employment, housing and working conditions, access to appropriate health services, and good physical health (Herman et al., 2011). Most significant, mental health is seen as the very fabric (resource) of a functioning economy which was highlighted in the Foresight project (2008).

This thesis views mental health as a positive concept in alignment with the concept of mental well-being. Mental health is understood as all encompassing, a feeling of purpose and satisfaction with life, relationships and oneself while having something to stand up to in the morning and contributing to something that goes beyond one's self (Nielsen et al., 2017). The terms mental health, mental well-being or positive mental health will be used interchangeably. Mental ill-health or low mental well-being will refer to the negative end on a mental well-being continuum notwithstanding diagnosis. Mental disorder will refer to diagnosed illnesses in a psychiatric sense.

2.2 Problem description

The main problem addressed in this thesis states the need to assess the economic impact of mental health applying a more comprehensive and comparable measure that goes beyond clinical diagnoses.

2.2.1 Looking inside: Measuring Mental Health

Many scales have been developed to measure positive mental health or well-being rendering comparability, transparency and consistency of results to be difficult (OECD, 2013b). As this thesis views positive mental health as a concept that incorporates well-being, measures for well-being and mental health will be discussed.

Economics did not care for well-being in itself. Rather did economists study individuals preferences. Still, well-being or happiness was thought to serve as a measurement for the gained utility an individual might derive from an action. Economic agents were assumed to be rational agents which pursue an action based on the maximum utility obtainable. Hence, economists' study actual choices rather than "stated intentions or subjective reports of likes and dislikes" (Kahneman & Krueger, 2006, p.3). Yet, Kahneman and Krueger (2006) pointed out that individuals "display bounded rationality" (Kahneman & Krueger, 2006, p.3). Inevitably, actual choices by individuals do not always mirror actual preferences. They highlight that well-being evaluate might serve as useful tools to measure social welfare.

Economics had to borrow from psychology in the endeavour to measure well-being empirically. Psychology used surveys and methods such as the Experience Sampling Method to gather respondents experiences on life satisfaction or emotional aspects (Frey, 2018). Several shortcomings arise with these indicators. One shortcoming is that confusion arises as different concepts such as happiness, positive functioning or life satisfaction are used to measure well-being (Diener, 2004). Diener and Seligmann (2004) find that "a haphazard mix of different measures of varying quality, usually taken from nonrepresentative samples of respondents" predominate the field. Some studies have a narrow scope and only consider subjective well-being in certain life domains (e.g. work). Others started to include eudaimonic and hedonistic aspects (MacKerron, 2012). To continue, well-being surveys often rely on responses to a single item question. Single-item measures are easily influenced by the testing situation and are narrow in scope. The World Values Survey, Eurobarometer and the first European Quality of Life Survey still use single-item measures (Huppert et al., 2009).

Another shortcoming is the dimension of time. Surveys often refer to a vague present

(‘these days’, ‘nowadays’). But even if questions are more precise in providing a time window, recollection bias is an issue (Kahneman et al., 1999; MacKerron, 2012).

Concerning mental health, various measurements exist. As explained in the previous section, much focus in research was put on the negative end of a mental health continuum. Here, a variety of diagnostic tools and scales exists. Recently, some authors state that both dimensions (positive mental health and mental ill-health) have to be measured in order to obtain a complete assessment on mental health (Lukat et al., 2016). However, in economics, the relationships between mental health and economic indicators have been assessed viewing positive mental health and ill-health as dichotomous. For example, Easterlin (1974) investigated the impact of income on well-being (happiness). Other correlations with economic indicators such as unemployment, crime or economic costs on healthcare sectors are confined to diagnosed mental disorders (Knapp et al., 2004; Knapp, 2003; Davies & Drummond, 1994). Consequently, economic studies measuring mental health as a holistic concept are lacking.

In summary, to measure well-being or mental health poses various problems. Comprehensiveness, comparability, reliability and repressiveness are common challenges in existing surveys. Further, measurement tools that go beyond diagnosed mental disorders are barely consulted when investigating the economic impact of mental health. In the end, the very limits of human rationality pose a problem in the attempts to measure well-being.

2.2.2 The increasing Burden of Disease

On a global level, the total number of individuals with a common mental disorder is increasing due to increasing life expectancy and growing population according to the WHO (2017). Data from the OECD suggests further, that one in two individuals will come in contact with mental disorders in their life course (OECD, 2014). Already, depression states the single largest factor of global disabilities. Globally, nearly 300 million people suffer from this disease which equates 4.4 % of the world’s population (World & Oct, 2017).

In Europe, every sixth citizen suffers from mental disorders which is depicted by figure 1 (2016). That accounts to 84 million individuals across Europe – a number equivalent to the size of German society (OECD/EU, 2018).

Despite immense individual suffering, mental disorders slump economic output.

From 2011 to 2030, global expenses on mental health conditions will reach US \$ 16 trillion through foregone labour and capital output according to estimates from the

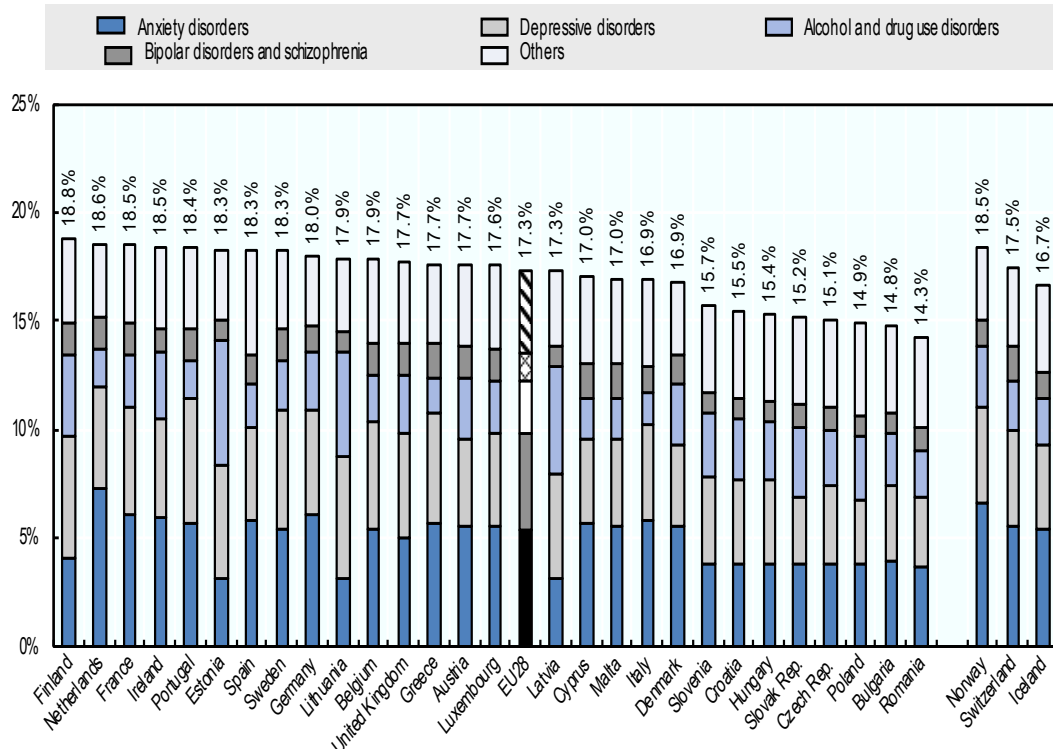


Figure 1: More than one in six people in EU countries have a mental health problem , reprinted from(OECD/EU, 2018, p.22)

World Economic Forum (Bloom et al., 2011). This is more than half of what will be spent on other non-communicable diseases combined (cardiovascular, respiratory, cancer and diabetes account for US \$ 30 trillion).

In Europe, more than 4 % of GDP is lost due to expenditure on treating mental problems (2016). Moreover, individuals with mental disorders depict higher rates of unemployment, poverty and reduced productivity at work which additionally decreases economic output (OECD/EU, 2018; Hewlett & Moran, 2014). The impact of mental disorders have profound impact on different sectors of an economy: Increased homelessness, crime and dependency on healthcare state just a few examples (Macintyre et al., 2018). The early onset of mental disorders which are in turn correlated with well-being, cognition, educational attainment and employment in later life pose a challenge to health, education and related systems (Koushede et al., 2019).

For any society, underlying changes such as population ageing and the tumbling of birth rates already state a challenge in terms of shortage of labour, funding of healthcare, and welfare systems. In the case of Denmark, despite the fact that well-being scores are reported as highest among all nations (Helliweel et al., 2018), the burden of disease seems to be particular high. In comparison with other European countries, health expenditure due to mental disorders is one the highest level (OECD/EU, 2018; OECD, 2013a).

In short, the burden of mental disorders poses a threat to the sustainability and viability of health and financial systems. However, the burden of mental ill-health is likely to be even higher. Again, it depends on what is measured. Clinical diagnoses might serve as an arbitrary cut-point for the severity of symptoms which impede individuals to engage in everyday life. Yet, those who do not quite meet the clinical threshold may still be suffering (Huppert & So, 2013). Studies that merely focus on diagnosed mental disorder might therefore underestimate the 'true' burden of mental ill-health. Under-recognition, mental health illiteracy, and stigma are likely pejorative factors to hamper the very diagnosis of a disorders (Layard, 2013).

Regarding the impact of different levels of mental health on a society through the lenses of an economist in well-being and mental health might be useful in order to estimate the 'true' economic burden. The necessary tools and concepts to conduct such a study will be discussed in the following section.

To conclude, this section revealed that (positive) mental health is a valuable resource to a functioning society (see section 2.1.2). Despite this fact, the resource seems to be scarce considering the prevalence of mental disorders. Furthermore, the likely burden of mental ill-health is likely to be even higher than depicted in conventional studies. Therefore, Richard Layard, a known scholar in economics of mental health describes mental health as the biggest of all social problems (Layard et al., 2012).

2.3 Roots and principles of Health Economics

Economics of well-being and mental health has its roots in health economics. One might be skeptical if someone would introduce himself as a "Mental Health Economist". Someone who attributes a monetary value on the status of the human mind? What good can that be ? Economics has often been criticized as being unrealistic. Models and methods used in economic theory are said to be short on considering historic and empirical aspects of markets (G. Hodgson, 2004).

By providing a definition of (mental) health economics, diving into its history and depicting applicable concepts in the market of (mental) healthcare, this section will shed light on the significant role of economics in the field of mental health.

2.3.1 Definition of Mental Health Economics

Mental health economics has its roots in health economics which emerged as early as in the 1950's in the United States. Generally, health economics was thought to deal with any inquiry that involves both money and health from an administrative

perspective (MUSHKIN, 1958). However, this proves to be only part of the picture. Health economics itself is part of economics which is a social science that investigates choices. No unanimous definition exists that would define the subject. The textbook from Mankiw states that "Economics is the study of how society manages its scarce resources" (Mankiw, 2008, p. 4) whereas Colander states that "Economics is the study of how human beings coordinate their wants and desires, given the decision-making mechanisms, social customs, and political realities of the society" (Colander, 2006, p. 4). Hence, economics deals with coordinating and studying the science of choice and human behaviour as well as distribution of limited resources.

In 1958, Selma Mushkin stated that "health economists are concerned with the organization of the market for health services and the net yield of investment in people for health. The "optimum" use of resources for the care of the sick and the promotion of health defines the special field of inquiry." (MUSHKIN, 1958).

The increased attention to health economics is a result of genuine therapeutic methods and medicine. These provided a counterbalance to many disease which before had death as a inevitable consequence. Furthermore, an augmentation in demand for healthcare arose as life expectancy and size of population increased. Thus, questions concerning capacity of hospitals, the nature of the health care market and utilization were posed as costs for medical care boosted (Razzouk, 2017; MUSHKIN, 1958). The two issues, organizational and functional alteration of healthcare due to advances in medicine together with greater life expectancy, revealed a crucial contributing factor for health economists: How to allocate resources in an increased and aging population? (MUSHKIN, 1958). Evidence for the urgency and topicality of the allocation matter is still crystal clear: in only 65 years, from 1950 - 2015, the world population more than tripled according to the United Nations Population Division and mental issues increased with it (United Nations Department of Economic and Social Affairs, 2017).

Overall, mental health economics provides a useful tool to oversee incidence and impact of mental ill-health as well as benefits to society from mental well-being. Understanding economic correlations with mental health might become indispensable for the future of society.

2.3.2 History of Mental Health Economics

Immense attention to the field of health economics was brought about by Kenneth Arrow in 1963 who published "Uncertainty and the welfare economics of medical care" in the American Economics Review (Arrow, 1963). Still, this journal article represents one of the most cited papers in health economics and is said to record

the birth of a new discipline. Reputation stems from its implications for non-market institutions to compensate for market failure in the health sector (Savodoff, 2004). This will be discussed in more detail in the section concerning concepts for mental health economics (see section 2.3.3).

In the following years, health economists became increasingly interested in questions like how to deliver cost-effective treatment or whether free medical care and insurance should be offered.

Here, one can grasp the significance of distinguishing between positive and normative economics, with the former relying on facts (*what is?*) and being objective in nature, and the latter focusing on *what should be*. This difference was perhaps fuel for discussion in the literature: The role of economics in the health sector was and remains controversial (Feldstein, 2012). A leading scholar in the health economics field, Victor R. Fuchs, found that consensus on normative economic statements (policy-value questions) was very low compared to a high agreement on positive statements when asking a group of health economists, economic theorists and physicians (Fuchs, 1996). Fuchs explained this disperse by differences in values held by health economists as health policy decisions encounter connotations for "[...] freedom, efficiency, justice, and security." (Fuchs, 1996). Hence, a great deal of criticism faced by health economists refer to normative economics.

Some have attacked the development of health economics as a discipline due to ethical concerns. In particular, Loewy (1980) suggested that "A physician who changes her or his way of practising medicine because of cost rather than purely medical considerations has indeed embarked on the slippery slope [...]" (Loewy, 1980, p. 697). In 1992, Williams responded to the criticism by highlighting that ignoring the costs of a treatment decision is unethical (Williams, 1992).

Already Fuchs noted that economics state a supplementary point of view to a often monotechnic one from physicians or engineers (Fuchs, 1996). Fuchs stated that health professionals often hold a romantic view. They do not take into consideration limited availability of resources nor do they consider heterogeneity of preferences or substitutability of goods and services. Thus, Fuchs (1996) considers a synergistic relationship between economics and the health sector in which the former expresses what is crucial for the latter. For example, heterogeneity of preferences tends to be overlooked by medial experts. Here, an economic perspective can be useful to provide insights into attitudes or preferences concerning time, risk and tolerance from patients in treatment decisions (Fuchs, 1996).

In the second half of the 20th century, health policy development, allocation of resources, and ensuring equity in health care stated fields in which health economics

contributed.

However, mental health did not play a role until the 1990. Then, community care models were considered significant. These were put in place supplementing hospital care for the mentally ill (Razzouk, 2017). Mentioned community models comprise a much wider set of treatment: Accommodation, employment and special service teams are offered to people with mental disorders (Shepherd, 1998). Of course, due to the extension of care, costs of services boosted (Knapp, Beecham, et al., 2011). However, the shift from a centralized approach with treatment in hospitals to a more deinstitutionalised community care model is not the only reason for the long neglect of economic interference in the mental health sector. Before the 1990s, few treatment was available. After, new medication flooded the market with the introduction of psychiatric medication to tackle symptoms of disease such as depression, schizophrenia and anxiety disorders (Ban, 2001). Furthermore, little information was available about mental disorders. Also, research was limited due to the lack of instruments and systems for diagnosis (Razzouk, 2017).

The World Health Organization first shed light on the prevalence of mental disorders in a report on 'The burden of disease' from the 1990s. As measures on health status were fragmented and differed from country to country, this report stated a landmark study. A genuine approach enabled the contributing researchers to quantify the health status of a population. They used numbers on "premature death and disability" to indicate the "burden of disease" (Murray & Lopez, 1996). They also deployed a single measure to account for the the "burden of disease" - the Disability Adjusted Life Year (DALY). DALY indicates a single year lost of healthy life. In order to appraise a given disease in a population, the "years of life lost (YLLs) and years lived with disability (YLDs) of known severity and duration for that condition much each be estimated, and then the total summed." (Murray & Lopez, 1996). This method showed that depression ranked second in terms of "burden of disease" in comparison to other diseases in 1996. Further, depression was predicted to become the leading disease by 2020 according to the follow-up report from 2001. This reports elucidated that 30.8 % of Years Lived with Disabilities come from mental disorders (World Health Organization, 2001). Of total Disability Adjusted Life Years, the percentage share of mental disorders were 10 % in 1990, 12 % in 2000 and predicted to reach 15 % by 2020. Furthermore, the WHO Report stresses that it is the responsibility of governments to care for the "mental health as for the physical health of their citizen" (World Health Organization, 2001).

The report induced rising interest in the costs for treatment and related costs of mental disorders. Economists realized that mental disorders represent a behemoth

to any economy impacting employment, productivity and caregivers as well as the level of crime, public safety, morbidity, and mortality (Layard, 2013). Particularly, as healthcare systems face budget constraints, mental health economics were increasingly asked to conduct studies assessing the burden of mental disorders (Razzouk, 2017).

2.3.3 Concepts of Mental Health Economics

Mental health economics can be embedded into welfare economics which aim to maximize social welfare allocating resources through efficient strategies. Welfare economics provide theoretical foundations for instruments of public economics, the study of government interventions to improve social welfare. For example, cost-of-illness studies state a particular instrument in public economics (Razzouk, 2017; Mankiw, 2008). Certain economic principles need to be mentioned when talking about welfare economics:

Scarcity of resources

As not all goods and services wanted or wished for can be offered, a society possesses resource in a limited fashion (scarcity). Thus, society faces decisions concerning the use of resources to yield the maximum benefit (Mankiw, 2008). In healthcare for example, the number of those providing treatment (suppliers of health) is limited.

Although, it is intuitive to think of money as a scarce resource, economists do the same for time. For example, the time of a family member spent caring for a relative suffering from ill-health can be ascertained. The same time could be spent working or enjoying leisure activities. Thus, the individual faces trade-offs on how to use resources (Razzouk, 2017).

As resources are scarce and individuals face trade-offs, costs and benefits of alternatives should be considered (Mankiw, 2008).

Opportunity costs

Opportunity costs reflect the value of what has to be given up in order to obtain some good or service (Mankiw, 2008). Services or goods are ascertained by the alternative usage of resources given up to produce that item. This becomes evident if one considers the first mentioned concept, 'scarcity of resources': As resources are scarce, decisions about their usage have to be made. If a resource is spent on one activity, society foregoes the benefit of the alternative use. Hence, opportunity costs help in deciding where to allocate scarce resources. As economists think at the margin, they are generally concerned with marginal opportunity costs. That is,

the opportunity costs for the production of an extra unit of a good or service. For instance, a mental health economists would be concerned with the incremental cost of admitting one more client to a mental health service.

Efficiency, equity and equality

Scarcity of resources is linked to the notion of efficiency. As resources in (mental) healthcare are scarce, decision makers have to make choices in order to appease the demand for care with the scarce resources available. Hence, economists in the field of (mental) health advise to aim for economic efficiency. In general, this means that no intervention should be put in place unless the benefits surmount its costs. Additionally, that if several programmes would use the same resources, the one with the highest net benefit (benefit minus costs) should be given priority (Blades et al., 1987).

Considering efficiency helps to ascertain how resources should be deployed in order to obtain best value for an investment.

In contrast to efficiency, equity concerns the non existence of health differences among different social, economic or demographic groups. The WHO considers (mental) health a fundamental human right and insists that lowering inequities is of concern to welfare economics (The World Health Organization, 2011).

Members of a society will face trade-offs between efficiency and equality. The first implies to achieve the maximum from scarce resources available, whereas the later to achieve an uniform distribution of prosperity (Mankiw, 2008). This is relevant to welfare economics. For instance, policies designed to level the distribution of mental health might reduce efficiency in healthcare.

Utility

In mental health economics, utility theory enables the assessment of health outcomes. As any "action is the result of choice among alternatives, and choice reflect values, that it, individuals preferences among alternatives" (Rothbard, 1997, p. 1), utility theory provides an analysis of laws on values and choices taken by any economic actor.

One can refer back to the origins of mental health and well-being concepts (see section 2.1.2). They are closely linked to this economic principle. The notion that well-being is a striving for pleasure and avoidance of pain derives from hedonism. This Greek philosophy translated into utilitarianism. The recent alternative approach, eudaimonic well-being, originated from Aristotle. He opposes the notion

of striving for mere pleasure maximization and considers it unrighteous. Aristotle stresses that happiness is pursued through prudence and civic virtue (Ryan & Deci, 2001). Consequently, utility has its roots in philosophy. The differences between eudaimonic and hedonic principles have to be kept in mind when referring to utility in health economics.

In economics, utility is a concept which goes back to Jeremy Bentham to measure the pleasure or pain an individual can derive from a chosen experience (Bentham, 1780). The pain or pleasure acquired is referred to as 'experienced utility' which contemplates the forces behind a decision. The "sovereign masters" to use Bentham's words. They designate what ought and shall be done (Bentham, 1780). According to this utilitarianism theory, choices made by individuals declare their preferences.

Maximization of welfare

Welfare economics examines the relationship between decisions on how to allocate scarce resources and the aggregated well-being of individuals in a society. The branch is occupied with finding the link between the sum of values from individuals and the options to scientifically draw a result on the "social desirability of various alternatives" (Rothbard, 1997, p. 1). Welfare theory therefore takes on a societal perspective which means that the focus is rather on society than on the individual himself (Byford & Barrett, 2010; Arrow, 1963). To say in other words "Economics is concerned with the effect of an action on the well-being of the whole society, not just on the individual directly involved" (Byford & Barrett, 2010, p. 470).

In old welfare economics, utilities are measured on a cardinal scale. Hence, individual utilities can be added. Here, maximization of welfare implicates that only the utility (happiness) for the majority ("greatest happiness for the greatest number", (Bentham, 1780)) should be maximized.

Daniel Bernoulli introduced the notion of diminishing marginal utility. Marginal utility explains why preferences attribute more value to those resources that are scarce. Each incremental gain in utility comes at a cost - the marginal cost corresponding to that additional unit of benefit (Razzouk, 2017). Thus, marginal utility relies on the concept of scarcity of resources. Diminishing marginal utility states that the net benefit (utility) diminishes as an individual gains more units of that benefit (Nicholson & Snyder, 2009).

In application to mental health economics, this would mean that providing additional mental health benefits for an already mentally healthy person would not increase his utility (health gain) as much as providing the same unit of health benefit to an individual suffering from mental ill-health. Even though this seems somewhat

obvious, it is useful to explain another phenomena in mental health economics: The adaption to a certain condition. The more an individual adapts to his or her condition, the less priority he or she will receive in the competition for resources. For example, if a person suffering from a mild depression has fully adapted to this health state, no increase in utility can be gained from a mental health intervention (treatment or promotion). Kahneman and Dolan (2008) state that adaption states a normative problem in resource allocation. Adaption and diminishing marginal utility provide an idea why utilities of individuals might be incomparable and hence, the notion of cardinal utility not applicable in healthcare.

Perfect vs imperfect competition

The question is what kind of competition can be found in the market for (mental) healthcare as this is important to understand how prices (costs) are determined.

Even though the market for mental healthcare has consumers (patients) and suppliers (hospitals, general practitioners, etc.), the competitive model cannot explain how the market for healthcare functions. How the market for mental healthcare differs from that of a competitive model can best be depicted by looking at the following conditions: The prevalence of a good or service, full information, profit maximization, free entry and exit into the market and absence of market power.

The first question is whether mental health is an economic good. In general, a production process underlies the offering of a good or service (Mankiw, 2017). Goods present quantifiable material or non material means with which an individual intends to satisfy his needs (Gabler, 2019). From consuming an economic good or service, individuals usually gain a benefit (utility). Goods are scarce and therefore come at an opportunity cost.

When talking about an economic good, other parties not involved in the production process are generally indifferent to the purchase decision of a single economic actor. For example, if I decide to buy a scoop of ice cream, my purchase decision has no immediate influence on bystanders.

This is different for mental health. If a person suffering from a mental disorder decides not to undergo treatment ('purchase better mental health'), this has devastating effects on the surrounding. For example, the chance to fall into unemployment is much higher. This may lead to a loss of output and foregone wage impacting the employer, an existing family and social welfare system (OECD, 2012). The effect on well-being of bystanders is called externality. If the effect is adverse, it is a negative externality.

Furthermore, it is difficult to acquire or build a set quantity of (mental) health. Some authors argue that in certain areas, such as technology (e.g. online cognitive based therapy) a patient (customer) is aware what utility (satisfaction) he or she will derive from the consumption of a particular service. However, it is rather the service per se for which the consumption is quantifiable than mental health itself. To continue, offering (mental) health services requires human and capital inputs (doctors, nurses, buildings etc.) (Razzouk, 2017; Mankiw, 2017). Therefore, a production process exists. In consequence, certain mental health services have similar characteristics to an economic good or service.

A good is said to be marketable if it can be traded. A trade usually involves the transfer of ownership rights. Despite a non-property-principle for the human body, an increasing commodification of body parts such as tissues, organs or blood can be observed in the medical literature. However, mental health is not subject to ownership rights (Lenk, 2011).

Kenneth Arrow (1963) stated that non-marketability occurs as soon as "risk bearing" occurs. The economic notion on risk bearing is that an individual faces uncertainty. Uncertainty occurs if a consumer's decision may lead to several possible outcomes. The probability of an outcome to happen or not depends on the relative frequency with which an event occurs. As people are risk averse, they dislike uncertainty (Nicholson & Snyder, 2009). For instance, whether one will come down with a mental disorder such as depression or anxiety is highly uncertain. Hence, risk bearing exists. A way to reduce risk is insurance. In (mental) healthcare, people tend to pay a premium to insurance companies in order to be compensated for the risk of e.g. foregone (expected) value of a loss (income). The insurance market itself is characteristic for *moral hazard* and *adverse selection*. The former refers to the "tendency of a person who is perfectly monitored to engage in dishonest or otherwise undesirable behaviour" (Mankiw, 2017, p. 5). For instance, a person with healthcare insurance might care less about maintaining his psychological health. The latter refers to an agent (consumer) obtaining private information about innate characteristics. Particularly, individuals with bad mental health would be attracted to insurances with extensive coverage because it is the firm who bears the costs in case of onset of disease. In brief, mental health is not marketable.

Second, for the notion of a competitive market to achieve (allocative) efficiency, it is generally assumed, that economic actors possess full information on equilibrium market prices and quality of goods or services. Kenneth Arrow (1963) pointed out that a consumer (patient) lacks information on the quality of healthcare. More precisely, a patient cannot test services or medication in advance. Therefore, information is incomplete in the market for healthcare.

Third, Kenneth Arrow (1963) stated in his paper that no self interest of physicians or institutions for treatment exists. In contrast to the notion of profit maximization, a non-profit orientation occurs in the market for (mental) healthcare.

Fourth, in a competitive market no barriers of entry exist. Suppliers can entry and exit the market. However, barriers of entry occur in mental healthcare as professionals are subject to licensing. Therefore, the fourth condition is not satisfied.

Considering the final assumption, imperfect competition occurs as soon as the supply or demand side is able to exert market power. That is the possibility to influence prices or allocation of resources. R. Kessel provided an example of market power in the paper "Price Discrimination in Medicine" published in 1958. Doctors in the USA demanded prepayments which indicates a control over prices (market power) (Kessel, 1958).

In summary, certain aspects of mental healthcare are similar to an economic good. Because of the uncertainty of onset of illness, expenditure in healthcare is unpredictable. Uncertainty itself and patients' response to it explains why insurances can be found in the market for healthcare. As externalities render unregulated markets inefficient, governments intervene in the market of mental healthcare.

2.4 The Danish Healthcare System

The welfare system in Denmark, which is also called the Scandinavian welfare model, provides a number of services such as health care that are free of charge for its users. With free and equal access to healthcare as a basic principle of public policy, the system is majorly financed by general taxes (Ministry of Health, 2017).

In Denmark, life expectancy is one of the highest in the world with 81 years in 2017. In comparison: Worldwide the average life expectancy is almost 9 years less (72.2 years) (The World Bank, n.d.). But: Age is expensive. In Denmark, the increasing life expectancy along with the increasing burden of disease puts pressure on the public financial budget. Expenditure on health across providers has increased from €25 million in 2010 to almost €30 million in 2017. An increase in expenditure goes along with enhanced pressure on public finances. In relation to other European countries, health expenditure in Denmark is high both for per capita and % share of GDP, as figure 2 displays: Denmark spent 10.2 % of its GDP on health in 2016, a higher share than most other EU countries. Per capita, Denmark spent €3,581.7 on health (adjusted for differences in purchasing power), quite more than the EU average of €2,623 (2016).

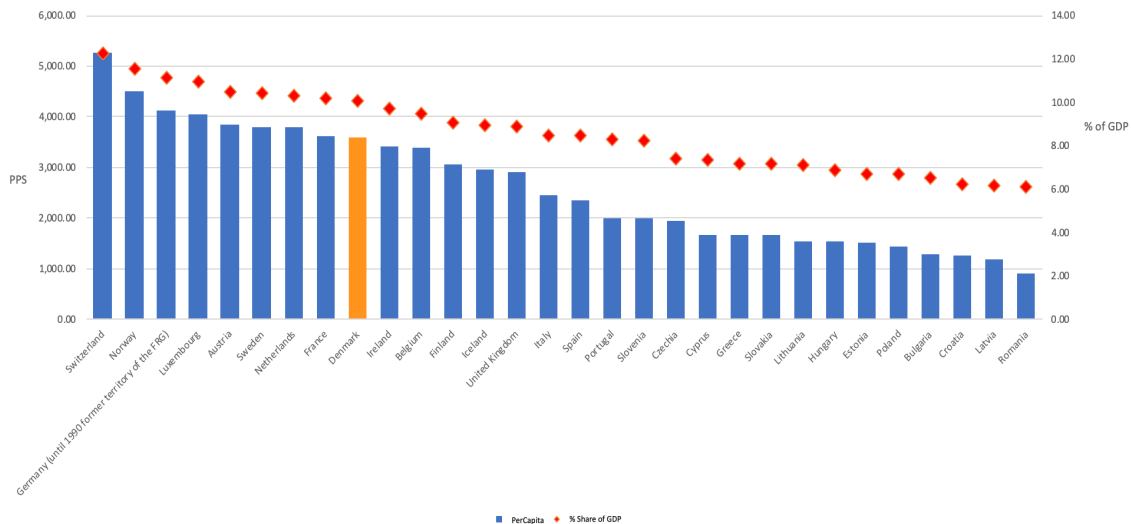


Figure 2: Expenditure on healthcare in Denmark is high in per capita and % share of GDP, Source: Author's design based on Eurostat, ICHA11HP (2016)

The public sector uses general taxes as the major financing source for health services. This financing system is complemented by a system of central government block grants, balancing schemes and reimbursements. In 2017, 16.4% from government spending was allocated towards health care (Statistics Denmark, 2017). Most of the spending on health care is public. In fact, the share of public expenditure (84%) in relation of total health expenditure is among the highest in the EU. Out-of-pocket payments made up for 14% with the remaining 2% paid by voluntary health insurance (Busse et al., 2016).

Danish hospitals fall under the administration of the regions even though financing comes from the state and municipalities. Care provided by hospitals is provided free of charge to the entire danish population. Only 2% of hospital activities are provided by private hospitals with the rest being performed by public providers (Olejaz et al., 2012). Currently, 16 new hospital projects receive investment (€6.4 billion). From 2007 to 2020, modernizing the hospital infrastructure is said to foster the expansion of outpatient treatment by 50 %. Additionally, the total number of bed days should be shrunken by 20 % (Ministry of Health, 2017).

The Danish System: Organization

In general, healthcare is provided across three political levels: The state, the regions, and municipalities. On state level, regulatory and supervisory aspects of healthcare are being addressed. The five regions maintain responsibility for hospitals, general practitioners (General Practitioner (GP)), and psychiatry. In total, 98 municipalities hold the responsibility for the provision of primary healthcare services as well as care for the elderly. Figure 3 depicts the organization of the public sector in Denmark.

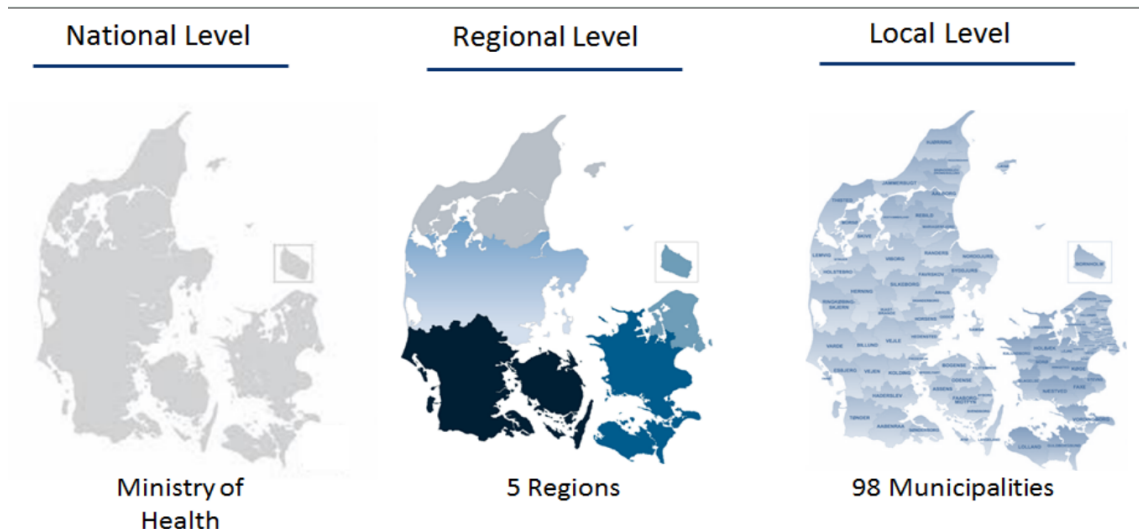


Figure 3: Organization of the public sector in Denmark, reprinted from (Ministry of Health, 2017, p. 5)

Primary healthcare covers General Practitioners (GP) and other professionals such as dentists and psychologists. In Denmark, there are 3.7 doctors per 1 000 people. Even though the number per capita is above the EU average (3.6 per 1 000 population), this still presents a limited resource in the market for health care (OECD/European Observatory on Health Systems and Policies, 2017).

Within the primary sector, Danish citizen have the choice between two insurance groups: Group 1 or Group 2. The first group makes of more than 99% of all this patients in Denmark (Ministry of Health, 2017). Persons in group are registered with a GP who maintains a gatekeeper function to the rest of the healthcare sector: The GP is the primary point of referral to a patient. She or he is the one to refer patients to hospitals, emergency wards or specialists. Patients belonging to group 2 however have a free choice of GP and do not need a referral to see a specialist. Belonging to group 2 is more cost-intensive. Co-payments have to be made. Again, for the patient in group 1, the consultation of general practitioners and specialists is free of charge (Kruse & Christiansen, 2011).

About 3,500 GPs obtain a collective contract with the public healthcare system. On average, 1,600 patients are covered by each GP whom they consult seven times a year (Ministry of Health, 2017). Within the primary health sector, the ratio of nurses per capita in Denmark is 16.7 per 1000 population. This is about twice as much as in the rest of the EU: 8.4 per 1000 population. Most nurses work in practices of GPs or in municipal health services. The primary sector is characteristic for a strong focus on information communication technology : A shared electronic medical record system ensures interoperability among health care providers across sectors. They can access, treat and prescribe according to patient data.

The Danish System: Challenges of Mental Health Care

In Denmark, the number of patients with a psychiatric disorder has grown in recent years. Patients in contact with psychiatric hospitals have increased by 28% between 2009 and 2014 (Ministry of Health, 2017). Moreover, mental ill-health states a major contributing source of Disability-adjusted life year (DALY). Depressive and anxiety disorders represent of the top ten causes of disability in 2017.

As to every healthcare system, one of the major challenges to the Danish one is maintaining an efficient allocation of resources in the face of increasing life expectancy. The increasing burden of disease as well as the enhanced demand for mental health services only adds heft to budget constraints. Despite the fact that Denmark is consistently placed on the top scale for life satisfaction and well-being, mental ill-health states a major challenge to the country's health performance. As depicted within the section Mental Health Economics (2.3.2), treatment methods have changed. Also in Denmark, community-based care supplements hospital care. Further, an increase in outpatient consultations goes along with reduction in hospital beds. Patients suspect to a potential mental disorder consult a GP before seeing a specialist - a strategy very likely to enhance pressure on the primary sector. Therefore, it is relevant to investigate the economic impact of mental health on the Danish society.

3

Economic evaluations in Mental Health Economics

As explained in section 2.3.3 resources in health care are scarce. Therefore, decision makers require relevant information on the prevalence, impact and costliness of diseases and their respective treatment or prevention. For instance, likely opportunity costs and benefits of interventions to ensure economic efficiency are of interest. This means, that interventions should be evaluated based on their benefit to cost ratio in order to allocate resources to those with greatest net benefits (benefit minus cost) (Shiell et al., 1987). As a consequence, a multitude of studies in the field of health and policy literature evaluates healthcare from an economical perspective (Razzouk, 2017; Drummond et al., 2005).

One has to differentiate between economic evaluations and cost-of-illness studies in health economics. The former compares outcomes and costs whereas the latter merely focuses on used resources (Razzouk, 2017). This thesis focuses on the methods and theories underlying cost-of-illness studies. Hence, this section provides an overview on traditional cost-of-illness studies and its relevance for Economics of Well-being and Mental Health. Economic evaluations are only explained briefly to draw a demarcation.

Economic evaluations are used to compare required resources for an intervention with its outcomes. The outcomes have to be ascertained in order to appraise welfare maximization from gains in health. How a gain (benefit) in health is defined and how it is measured is controversial.

The notion of a health gain links back to welfare theory. As stated in the section 2.3.3, benefits are linked to preferences and values of individuals. Hence, a benefit represents the value of an output to an economic actor ('utility').

A gain can be expressed in mortality and morbidity rates. For instance, a gain reflects the decrease of morbidity due to some intervention (Razzouk, 2017). However,

a health status of an individual might be assessed by different scales encompassing clinical symptoms, quality of life or physical functioning. Therefore, to assess gains in mental health poses an open and complex question in mental health economics.

3.1 Cost-of-illness studies

Cost-of-illness (COI) studies state economic studies prevalent in the medical literature with the objective to assess particular costs of an illness: Burden of disease (BOD) to society (Byford et al., 2000). The terms cost-of-illness or burden of disease are used interchangeably to explain the impact of a disease on a state, regional, community or individual level (Changik, 2014). The studies aim to provide information so that health policies can be formulated and prioritized within resource constraints. In contrast to economic evaluations, COI ignore outcomes (health gains) and are therefore limited in scope. Still, COI analyses can be considered as a crucial pre-stage to calculate costs for economic evaluations. Results itself are merely an indicator for the burden of a disease shouldered by society and can make no statement on efficient allocation of resources. Consequently, the studies can only state *what is* and not *what should be*. Thus, COI fall into the positive branch of economic analysis.

Traditional COI serve as an economic tool for analytical and policy issues. However, their relevance has been questioned by scholars in health economics (Larg & Moss, 2011; Rice, 2000). Particularly, the usage as a public policy tool is highly controversial (Shiell et al., 1987; Rice, 2000).

The following section provides a definition on costs calculated in cost-of-illness studies. Additionally, methods and major examples of COI examining mental health are presented. This is followed by a discussion on the usefulness of depicting the economic burden of a disease. Last, approaches that go beyond calculating the economic impact of diagnosed mental disorders are considered.

3.1.1 Definition of costs

In general, the costs of an illness are calculated by imputing a monetary value of those components that generate costs due a disease (Razzouk, 2017).

Economic costs have to be delineated to accounting costs. Economic costs are conceptualized differently as they refer to Opportunity costs (OC). As stated in section 2.3.3, resources in mental care are scarce. Thus, the costs of a good or service are evaluated by the foregone alternative invested into that good or service. Economic

costs express the value of a resource in its best alternative use whereas accounting costs are directly linked to the monetary units of inputs deployed in order to produce a good or service (Mogyorosz & Smith, 2005). Hence, opportunity costs reflect the monetary value attributed to cost generating components.

Economic cost are further categorized into explicit and implicit costs. The former are costs that involve direct monetary payments such as wages to employees. In distinction to explicit costs, implicit costs state the opportunity costs of input factors (capital) owned by a provider of health services. Economists value the cost of capital (e.g. cost of a machine) by referring to the value someone else would be willing to pay for its use. For instance, the implicit costs of a psychiatric hospital would be the potential market price the hospital provider could receive if it sold (or leased) the hospital instead of using it to provide mental health care. In contrast, an account would look at the historic price of the building plus depreciation. Further, costs can be fixed or variable. The former depend on the level of output (treatment or other health services) whereas the later is independent. Total costs comprise both fixed and variable costs.

Health economists think at the margin, that is, they are interested in marginal costs - that is, the additional cost of producing one more unit of output (Mankiw, 2008). Instead of being interested in the average costs (total costs divided by quantity) of e.g. an intervention, health economists are interested in how much it costs to provide that intervention to one additional unit (one more person). Marginal costs depend on variable costs only whereas average costs depend on fixed and variable costs (Drummond et al., 2005).

The selected time horizon is significant in order to make statements on variations and effects of economic costs: Costs can occur in the long ($>$ one year) or short run ($<$ one year). Only in the short run, fixed costs such as capital (land, leases or utility contracts) are fixed. A long run perspective is preferable if the development of costs is to be tracked. For instance, Hallam and Trieman (2001) conducted a long term study on "difficult-to-place" patients who stayed in rehabilitation facility after leaving psychiatric hospital. They found that even though no alteration in psychiatric state could be detected, total costs of care had decreased (Hallam & Trieman, 2001).

In traditional COI, a classification into direct, indirect or productivity as well as intangible costs has been widely accepted. These comprise the cost generating components in COI (Razzouk, 2017; Tarricone, 2006; Koopmanschap & van Ineveld, 1992).

Direct costs

Direct costs relate to resources used to to treat, prevent or discover a disease. Hence, they represent resources allocated to healthcare services such as "doctor hours, medication, hospital beds, overhead costs of running facilities, capital costs of buildings or equipment etc." (Luyten et al., 2016). Medical costs to treat an illness are generally considered direct costs. A major challenge when calculating direct costs, particularly hospital costs, is that often only fixed charges are available as a source. These do not necessarily reflect true costs but represent a fixed rate for a service or given item (Segel, 2006).

Direct costs cover outside healthcare costs which are related to the sector. Related costs are those for "research, training, construction, and administrative functions that are carried out by both public and private agencies to support prevention and treatment activities, including the administrative costs of providing health insurance" (T. A. Hodgson & Meiners, 1982, p. 432). For instance, travel costs or relocation expenses might be included. Also, the time spent caring for a sick family member might be relevant. Researchers have to be careful not to double count costs. For instance, training staff for healthcare might already be included in fixed charges for care. Including them again separately would lead to double-counting. The further, it is difficult to allocate other healthcare related costs to a particular disease. The time horizon to which costs are attributed is relevant. Healthcare expenditure in a period might not directly be related to a disease in that period (T. A. Hodgson & Meiners, 1982).

Whether government benefits can be considered direct costs is controversial. Government benefits or taxes are transfer payments such as sick leave from work or other welfare and disability payments (Frisman & Rosenheck, 1996). Some health economists oppose their inclusion as direct costs. From an economics perspective, transfer payments constitute a mere shift of resources. Especially from a microeconomics perspective, no cost or benefit to society arises: The costs to those who pay for the transfer (e.g. tax money) and the benefits to recipients cancel each other out (Razzouk, 2017; Larg & Moss, 2011). Nevertheless, some authors such as Frisman and Rosenheck (1996) claim that the in- or exclusion of transfer payments depends on the selected perspective of study. Conventional cost-of-illness studies take on a societal perspective. Here, the total value of societal resources consumed state the cost of an illness. As transfer payments describe a mere redistribution of wealth, no consumption underlays the process. However, an illness might cause additional administrative resources to conduct the transfers. These additional activity needed to transfer funds from one person to another relate to societal costs (Rice et al., 1991). For instance, Rice et al. (1991) included social welfare administration

in a study on 'Estimates of economic costs of alcohol and drug abuse and mental illness, 1985 and 1988'. Larg and Moss (2011) claim that transfer payments should be included if the effect of redistribution is relevant for the research question. The authors also stress the significance of considering the perspective of study and highlight that from a governmental perspective, transfer payments are relevant. The different perspectives in COI will be discussed in section ??, 3.1.2.

Indirect costs

Indirect costs arise outside the health sector (Oostenbrink et al., 2002). They are labeled indirect costs because they are not directly linked to the health sector but relate to negative externalities caused by a disease. Indirect costs refer to lost resources in other sectors such as employment, social care, housing or criminal justice systems. As the impact of a disorder in these sectors is not always obvious, some scholars in the field of mental health, such as Martin Knapp, labeled them *hidden costs* (Knapp, 2003). Indirect costs generally measure two types of costs:

1. Morbidity costs, which state the lost value of productivity due to illness.
2. Mortality costs, which state the lost value of productivity as a consequence of premature death followed by a disorder.

In general, morbidity costs equal the lost value of goods or services not produced due to a disease. In return, mortality costs represent the present value of foregone earnings due to ill-health. The product of number of deaths and expected future earnings discounted to translate aggregated earnings into present value results in mortality costs. This method takes into account gender and age for life expectancy as well as labour force participation (Rice & Miller, 1998).

Overall, indirect costs target to value the economic loss to society due to disease. This can occur on different levels: On a national level, greater charge on the public finances might occur due to enhanced need for social security benefits. Additionally, mental and human capital may be lost due to suicide or withdrawal from the labour market (unemployment) (Razzouk, 2017). For instance, a person suffering from depression may be less productive, absent from work ('absenteeism') or be present at work but not contribute at all ('presenteeism'). Furthermore, premature mortality due to disease causes production loss (Koopmanschap & van Ineveld, 1992).

On a workplace level, the costs of replacing a depressed worker might be relevant as a firm has to spend resources searching for a new employee. These costs are therefore called 'productivity costs' (OECD/EU, 2018; Razzouk, 2017). Notably, indirect costs are felt by the affected individual himself. The person falling into

unemployment does not only lose income or entitlements to pensions but further lacks a social network and source of self-esteem (Knapp, 2003). Also, on an individual level, indirect costs can mirror opportunity costs of patients or those providing care in terms of time foregone being sick, being treated or providing unpaid care (Razzouk, 2017).

As many studies on mental disorders found, the largest share of total cost, the sum of direct and indirect costs, stems from indirect costs. For instance, Sobocki et al (2007) found that cost of depression in Sweden (2005) account for €3.5 billion of which 83% are due to lost productivity (SOBOCKI et al., 2007). An earlier study in the United Kingdom by Tomas and Morris (2000) highlighted that absenteeism induced indirect costs 23 times greater than direct costs. Within indirect costs, an American study assessing the economic costs for anxiety disorders found that 88% of workplace costs stem from diminished productivity while at work in contrast to absenteeism (P. E. Greenberg et al., 1999). That workplace costs state the highest share in the total economic burden was further displayed by a study on depression highlighting that 62% of total costs were *productivity* costs in the United States (P. E. Greenberg et al., 2003). Most recent, the report "Health at a Glance: Europe 2018 State of Health in the EU Cycle" (2018) found that 1.64% of GDP was lost due to *productivity* costs predominating the share of total costs (4.10% of GDP) of mental health problems in EU countries. Consequently, notwithstanding differences between mental disorders or country specific forces influencing the workplace, indirect costs caused by mental disorders state the highest share of total economic costs.

Intangible costs Traditionally, intangible costs reflect the psychological pain of an individual suffering from mental ill-health (Tarricone, 2006). Intangible costs cover human costs: For example, the pain that may arise due to a disease. Hence, they attribute a value to being healthy. Obviously, this value is difficult to monetize. Seldom are intangible costs incorporated in COI analysis as they amount of pain suffered is difficult to measure. The intangible costs can be calculated as a supplement to the COI analysis and appear as lost, good years of life due to illness.

In this thesis, 'costs' will refer to 'economic costs'. To continue, a classification of costs into direct, indirect and intangible costs follows the approach mostly found in the literature.

3.1.2 Study perspective, approaches and methods of costing

Perspective of study as well as approaches to estimate economic costs and methods underlying a cost-of-illness study have to be clarified in order to interpret results.

As mentioned in the previous section, the perspective of a study is crucial to determine which cost components should be included in the study (Luce et al., 1996). The following table provides an overview of perspectives and suggested cost components (table 1).

Perspective	Medical costs	Morbidity	Mortality	Nonmedical	Transfer payments
Societal	All costs	All costs	All costs	All costs	-
Health care system	All costs	-	-	-	-
Third-party payer	Covered costs	-	Covered costs	-	-
Business	Self insured costs	Productivity costs	Productivity costs	-	-
Government	Covered costs	-	-	Criminal justice costs	Attributable to illness
Paritipants and families	Out-of-pocket costs	Wage losses/- Household production	Wage losses/- Household production	Out-of-pocket costs	amount received

Table 1: Cost components by study perspective, adopted from Luce (1996)

For instance, all costs incurred by families, e.g. out-of-pocket costs and time lost caring for families, would be included if the study has a societal perspective. If the study perspective is narrow, e.g. governmental, transfer payments would be included. Thus, depending on the chosen perspective, COI will differ in their comprehensiveness (Razzouk, 2017).

To continue, different approaches exist to estimate economic costs of diseases. The classification into direct, indirect costs and intangible costs explained in the previous chapter is most commonly used in the human capital approach.

Human capital approach (HCA) is interested in healthcare and non-healthcare (production and income losses) costs. The level of analysis is the firm or individual (Trautmann et al., 2016). Hence, conceptually the analysis belongs to the field of microeconomics in which welfare economical concepts have to be kept in mind due to specifics in the healthcare market (see section 2.3.3).

The theory underlying human capital formation can be traced back to Professor Theordore W. Schultz and his work on "Investment in Human Capital" (1970). Human capital is defined as the sum of knowledge, skills, habits, social and personal

attributes which an individual gains over life. Similar to other capital, this capital input enables the production of goods and services (Schultz, 1970). Schultz pushed forward economic investigations on investment in humans through education. However, the notion that humans state a resource that require investment dates back to the 1960s (Denison, 1962). In the field of health care, the article from Selma Mushkin "Health as an Investment" clearly marks the most formidable work. She highlights that human capital from an economic point of view deals with the question "What is the contribution of changes in the quality of people to economic growth?" (Mushkin, 1962, p.129) The author appraises that a return on investment through health interventions occurs. Using a HCA to assess the burden of mental ill-health, total economic costs for mental disorders were calculated to be US \$2.5 trillion with US \$1.7 trillion indirect costs for 2010 globally. For the same year, direct and indirect costs accounted for €798 billion in the EU (Gustavsson et al., 2011). By 2030, economic costs for mental ill-health forecast to double (Trautmann et al., 2016).

An economic growth approach in return takes interest in the impact of a disease on a macroeconomic level. For instance, lost economic output can be quantified by the impact of a disease such as depression on Gross Domestic Product. Mostly, the approach rests on the notion that a disease negatively influences labour and capital - the inputs for economic growth. Thus, capital and labour depletion are calculated. For mental ill-health, the impact on economic growth is enormous: US \$ 16.3 trillion will be lost between 2011 and 2030 according to a study by Bloom et al. (2011). The output lost is higher than that of e.g. cancer, diabetes or other physical diseases (Trautmann et al., 2016; Bloom et al., 2011).

Another approach, the so called value of a statistical life describes perceived costs of an illness. The underlying assumption is that the risk of suffering from an illness is quantifiable. Thus, that trade-offs between risk and money can be used to ascertain risk of death or disability by mental ill-health. As individuals are risk averse (see section 2.3.3) they are asked how much they would be willing to pay to avoid a particular risk. This approach rests on a willingness-to-pay method. A willingness-to-pay method in economics values the amount an individual is willing to pay to obtain an item. In health economics this converts into the willingness to reduce the risk of falling ill with a disorder. According to this approach, the global economic burden of mental ill-health was calculated at US \$8.5 trillion in 2010. This burden is again higher than calculated for cancer or other physical diseases (Bloom et al., 2011).

In brief, economic costs of mental ill-health are immense notwithstanding the approach used to measure the burden.

How to measure economic costs has several other implications: First of all, the methods used in COI depend on the epidemiological data. A *prevalence* and *incidence* approach exist. Second, to estimate economic costs, one has to distinguish between a *top-down* vs *bottom up* approach. Third, whether the study is *retrospective* or *prospective* shows the "temporal relationship between the study itself and data collection (Tarricone, 2006; Byford et al., 2000).

In reference to the first point, a prevalence method cover the total cost of an illness in a given period (a year). The method follows the notion that economic costs should directly be attributed to the period in which they are borne - the onset of disease (Tarricone, 2006). For instance, foregone future income (earnings) due to premature death are said to occur in the year of death.

In contrast, incidence studies require richer data as the lifetime costs of a disease are involved. Here, lifetime cost are calculated based on the diagnosed cases in a particular year establishing a baseline to which new interventions can be assessed (Byford et al., 2000). The rationale behind this method is that economic costs of an illness cause a stream of costs which should be accredited to the year of onset of costs (Tarricone, 2006). Hence, direct and indirect costs in this approach are discounted in order to obtain the present value relevant to the year of onset of illness.

To sum up the first point, one has to keep in mind that the incidence approach generally provides smaller result ins terms of economic costs for long-term ill-health as costs are not discounted like in the prevalence approach.

To come to the second point, the top-down approach aims to estimate unit costs (per patient costs) of a service (e.g. hospital) relevant to a disease. With this method, researchers gather data from national statistics on total costs of a group of disorders (e.g. national health care expenditure) to extract costs of a specific disorder. The method takes total health care expenditure and divides it by a measure of output (e.g. hospital beds) to determine costs per unit. Consequently, the method reveals 'average' per unit costs. This approach has shown to be useful when ascertaining fixed costs. Yet, it remains problematic to estimate the precise per unit costs as little information on consumption of a resource is readily available (Razzouk, 2017). To provide an example for mental ill-health: How high the average costs of a patient with depression are for a general hospital treating various diseases would be difficult to calculate. The exact consumption of hospital's resources are difficult to attribute. An alternative is represented by the micro-costing (bottom up) approach. Similar to the top-down method, micro-costing aims to identify per unit costs. However, the method is different: Researchers identify each resource consumed by individual patients and assign all used resources to one case. In consequence, 'actual' per unit costs can be derived. Of course the method requires richer data. This implicates

several problems: Firstl, despite the fact that mental health service provider collect and process sensitive personal data, information about patients health status is protected in EU countries (Art. § 1 GDPR). Hence, relevant data is often not accessible. Second, information from medical records lacks comprehensiveness and completeness. The major disadvantage of deploying a bottom-up approach is the risk to double count economic costs as individuals often suffer from multiple diseases (Gustavsson et al., 2011). For example, an individual with depression might also suffer from anxiety. Some studies address this issue by contemplating supplementary costs caused by an individual with a specific mental ill-health (Gustavsson et al., 2011).

In comparison, the bottom-up method is found to be both more transparent and comparable than the top-down one.

Some authors even label the bottom-up approach as the 'gold standard' (Tarricone, 2006, p. 56).

The third point indicates that COI can be performed in retroperspective or prospective. Basically, the time between gathering the data and initiation of study defines whether the study is retroperspective or prospective. Both temporal relationships can be found in incidence and prevalence approaches. If all data has already been recorded in the past, the study is retroperspective. Conversely, if relevant events occur after the initiation of study, the temporal relationship is prospective. The more data hungry retrospective COI is suitable for diseases with a long duration. Prospective studies often benefit from tailored questionnaires to patients on the utilization of health care services. Most COI studies are retroserspective (Tarricone, 2006).

3.2 Cost-of-illness studies: Absurd or useful?

As already pointed in the introductory part of this section, the use of COI analysis is controversial. Hence, this section explores the major skepticism faced by COI as well as the question whether COI has a role in Economics of Well-being and Mental Health.

Skepticism concerning cost-of-illness analysis addresses two issues: Theoretical and methodological (Tarricone, 2006; Razzouk, 2017).

3.2.1 Theoretical issues

First, on a theoretical level, COI contradicts to the very principles of welfare economics: Maximization of social welfare. COI studies merely focus on the burden

of disease to society but say nothing about the worthiness of interventions. Simply evaluating the costs of a mental health problem does not reveal any information about effectiveness of alternative interventions (Hutubessy et al., 1999). Thus, some welfare economists completely reject COI as a tool for resource allocation or decision-making (Razzouk, 2017). This debate was especially initiated by Shiell et al. in the 1980s in their paper "Cost of illness studies: An aid to decision making?". Their criticism targets at the basic concept of opportunity costs in health appraisals, the use of cost-of-illness studies in the policy context and the use of human capital theory. Referring to opportunity costs, the authors proclaim that diseases are neither an economic activity nor a "result of a conscious decision" (Shiell et al., 1987, p.320). Consequently, costs are not generated by a disease but result "from decisions to commit resources to the treatment of disease" (Shiell et al., 1987, p.320). Economic costs can therefore not be seen as a mirror of the benefits of alternative interventions. Here, the authors refer to the incapability of an intervention to eradicate a disease: The cost-of-illness could only mirror the benefits of treatment options if a treatment or program were to eradicate or throughout prevent the disease. However, this is highly utopian. As S. Byford et al. (2000) put it: "The cost savings of either fully or partially preventing a given disease are, to a large extent, illusory" (Byford et al., 2000, p. 1335). This point is fostered by other authors who highlight that high expenditure on an illness does not directly mirror economic inefficiency or waste (Feldstein, 2012; Byford et al., 2000). In reference to section 2.3.3, an inefficient allocation of resource in healthcare would occur if those resources would yield a greater benefit in an alternative intervention. Despite, COI analysis provides no information on this. Knapp et al. (2004) also refers to the inability of COI analysis to indicate a cost saving potential. The authors tackle the assumption that cost-of-illness estimates attribute all costs to a single disease. Co-morbidities often exist: For example, Harris and Barraclough (1998) found that in comparison to the general population, people with poor mental health are more likely to be subject to poor physical health (Harris & Barraclough, 1998).

The other issue was raised by Shiell et al. (1987) and concerns the use of COI analysis for policy decisions. The authors point out that most decision makers have to deal with the option of either expanding or limiting a given program. Here, from an economical perspective, a decision maker would be mostly interested in comparing the marginal change of outcome with the costs of that change. The authors conclude that COI analysis lack the notion of the margin and is therefore of no use in policy decision.

Last, Shiell et al. criticize COI for using human capital approach. According to the HCA it would be of greater priority to foster health in the working population as they

induce higher costs than the unemployed members of society. Some authors have tried to transfer the concept of opportunity costs to unemployed but active members of society such as to 'housewife's services'. This implies that the economic value of unpaid work equals the amount a person would ask for in the labour market (Murphy, 1978). Other authors such as R. Tarricone (2006) condemn HCA and COI analysis in general for not valuing the human life correctly: Productivity and earnings say nothing about the amount that should be spent to save a human life. Another theoretical pitfall is that COI analysis is insensitive to past decisions on how resources in healthcare are allocated. If the past decision was to spend a lot on curing a disease, this disease will appear as costly in a subsequent analysis. This in return may lead to a vicious spending circle: A decision maker may decide to prioritize the illness which appears more costly only based on the result of COI ignoring potential irrationality of the former spending decision (Drummond, 1981). In addition, referring to economic costs in COI as opportunity costs is incorrect: As indicated in section 2.3.3 prices do not reflect true market values as healthcare markets show imperfect competition. Nevertheless, COI studies adopt unadjusted market prices as opportunity costs. In practice, another economic analysis would have to be performed to ascertain consumed healthcare services to obtain the true market price.

Due to theoretical issues, Shiell et al. (1987) consider COI as futile and misleading than helpful for decision makers.

3.2.2 Methodological issues

Second, the lack of uniform methodology in COI states a major problem in evaluating the economic impact of a disease.

Health economists such as Dorothy Rice (1967) or Hodgson and Meiners (1982) were the first to spell out methods for costing diseases in detail. The authors first classified costs into direct and indirect costs (Rice, 1967; T. A. Hodgson & Meiners, 1982). Despite that subsequent studies have followed this classification, other methodological issues remain.

On the one hand, the chosen perspective (societal, business, or health provider) influences the result as different cost components are in- or excluded depending on the choice (Hutubessy et al., 1999). Therefore, obtained results from COI are difficult to compare across countries or over time (Tarricone, 2006).

On the other hand, the availability, valuation, quality of data and selected time horizon have to be considered. The availability of data varies across countries and determines whether a top-down or a more data hungry bottom-up approach can be

performed. In any country the valuation of service use is the most complicated part in COI. Some scholars such as P. McCrone (2011) argue that unit costs need to be identified in order to correctly value service use. Especially, in mental healthcare, individuals use services in a "face-to-face" manner. Hence, unit costs should relate to that (McCrone, 2011). However, the reporting of unit costs differs across and within countries. For example, the cost per hour from a professional service (e.g. GP or psychotherapist) can vary depending on whether working hours or number of patients are taken as a denominator. Another issue is the evaluation of informal care. The last is defined by Brouwer et al. (1999): "Informal care is a specific type of health care provided by nonprofessionals. Specifically, informal caregivers are defined here as family, friends, acquaintances, or neighbors of a patient providing care for which they do not have to be financially compensated". Even though, informal care belongs to the cost category of direct costs, the valuation methods from indirect costs are applicable. Not only do caregivers give up leisure or work time but might also suffer from spill over effects of care such as fatigue or less social contacts (Tarricone, 2006). Evaluation of informal care can either be done by taking the hypothetical costs of a professional caregiver or by valuing lost leisure time in quality of life (lost) (Brouwer et al., 1999). Moreover, data derived from national registries might not be as accurate and reliable as often thought. Even if data is available, other expenses such as patient out-of pocket expenses or loss in productivity of informal caregivers is not taken into account. This leads to underestimations of costs (D. Greenberg et al., 2014). In reference to retrospective studies, some authors have argued that potential biases and approximations due to the time gap between initiation of study and data handling distorts results (Tarricone, 2006).

3.2.3 Room of COI studies in Economics of Well-being and Mental Health

Despite the methodological and theoretical skepticism and shortcomings, several scholars in the field of health economics consider COI analysis as useful (Tarricone, 2006; McCrone, 2011; Knapp, 2003).

A counter argument to the theoretical issue of disconnectedness to the very principles of welfare economics is the fact that COI analysis does not aim to say anything about the beneficently of interventions. The mere objective of such a study is to indicate the burden of a disease.

In contrast to methodological issues, several guidelines have been published by ministries to ensure coherent methodology in recent years. For instance, the Dutch Minister of Public Health approved the "Dutch manual for Costing in Economic Evaluations" in 2003 (Oostenbrink et al., 2002).

An indicator for the relevance of COI studies in mental health is the abundance of reported papers in the health economics literature. Nevertheless, up to the 1950's, the focus of COI studies was on physical ill-health. The first cost of illness analysis on mental health was conducted by Malzberg (1950). Some other scholars became interested in the costs of mental ill-health in the following years (Mushkin, 1962; Fein, 1958). Furthermore, the World Health Organization, OECD as well as European Union started to publish several papers on the burden of mental ill-health using cost-of-illness methods (OECD/EU, 2018; OECD, 2014; World Health Organization, 2013).

The joint report published by the OECD and EU (2018) highlights that 4 % of GDP was lost in Europe due to mental disorders. Denmark shows to experience one of the highest output-losses (5.38 % of GDP), (see 4). Calculated direct costs covered healthcare expenditure on treatment as well as social security spending in form of sick leave and other social benefits (OECD/EU, 2018).

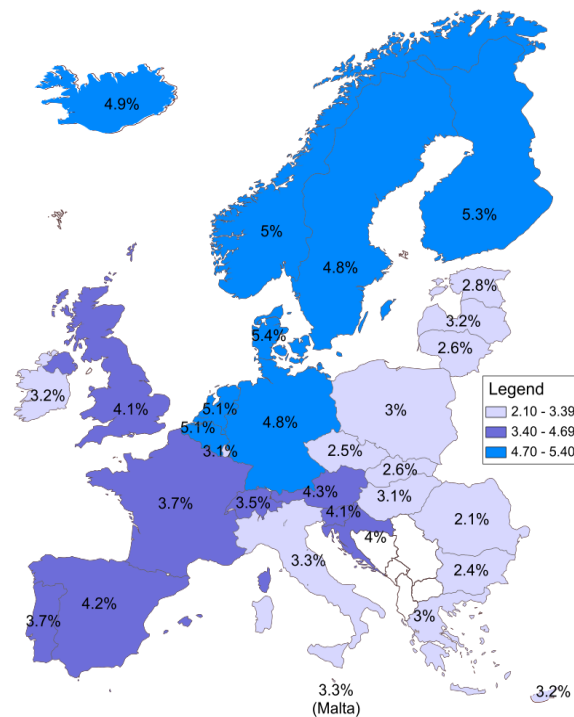


Figure 4: Estimated direct and indirect costs related to mental health problems across EU countries, as a % share of GDP, 2015, reprinted from (OECD/EU, 2018, p. 22)

Indirect costs account for productivity losses due to mental ill-health. The report uses a mixed-method approach to estimate economic costs. Partially, it draws costs on classified mental health conditions from an earlier study in combination with data on country level health spending and macroeconomic data (Gustavsson et al., 2011; OECD/EU, 2018). Total costs for all EU member states account for €600

billion of mental disorders. The report demonstrates that mental problems pose a colossal burden on EU economies. Overall, cost results from the report have to be considered with caution: Mixed-methods, using macroeconomic data and reliance on an earlier study are not in alignment with conventional cost-of-illness methodology. The report which served as a source for some cost components will be discussed next.

A major example and influential study is the "Cost of disorders of the brain in Europe 2010". The study was encouraged by the European Brain Council (EBC2010) and published in 2011 drawing on a previous study on costs of brain disorder published in 2005 (EBC2005) (Gustavsson et al., 2011). In terms of methodology, a literature review was performed for estimates on ubiquity and cost per person for 19 groups of brain disorders. Health economic panels were consulted to calculate costs. Furthermore, the authors elaborated a cost model to coincide total cost per disorder for 30 European countries. This composes a landmark study for a threshold of reasons: First, an estimation of the number of individuals with a specified brain disorder could be indicated covering a population of 514 million people. Thus, this study is one of the few that researches mental ill-health on a large scale. Second, total cost per individual in relation to each disorder including direct and indirect costs was calculated. Hence, covered cost components are comprehensive. Last, total costs per disease and country was provided enabling cross-country comparison. The study indicated annual total costs of €798 billion for brain disorders in Europe for 2010. In opposition to other national COI studies, direct costs make up the largest share of costs (60 %). Total costs are more than twice the amount than in the 2005 study (€386 billion).

Having mentioned sample studies on economic costs such as the one by the OECD and EU, it is evident that mental disorders have an enormous hidden impact on health systems and employment. Here, cost-of-illness methodology and theory helps to ascertain the economic impact. Despite that cost estimates are likely to be an underestimate, the focus of the studies is on diagnosed mental disorders only. Cost-of-illness studies therefore have a room in economics of mental health - yet, only to the extend as that they refer to the negative end of the mental health continuum.

This states a problem: Many mental disorders go undiagnosed (and untreated). A mere focus on diagnosed mental disorders is likely to lead to an even bigger underestimation of economic costs (see section 2.2.2). Furthermore, mental health is understood to be a holistic concept which comprises mental well-being ranging from a negative to a positive end on a mental health continuum (Stewart-Brown et al., 2015). Consequently, economic cost analysis that focus on the negative end only

are incomplete. Yet, measures for a holistic view on mental health and well-being are inconsistent and no single yardstick exists: Does this close the door for COI in Economics of Well-being and Mental Health?

Only one study from the United States presents an alternative to scrutinize economic costs of poor mental health notwithstanding diagnosis (Goetzal et al., 2004). The authors introduce a measure for poor emotional well-being called poor mental health day. A poor mental health day refers to perceived low emotional well-being. In opposition to a diagnosed mental illness, the measure relies on self-reported mental health. The researchers found that an additional poor mental health day per month correlates with 1.84 % decrease in per capita real income growth rate which again equates US \$53 billion less total income. Using an economic growth model, the researches add that economic costs of mental illness is to surpass US \$16 trillion over the next 20 years. The analysis used economic and demographic data from 2008 and 2014 as well as county-level data from public sources. Data for the mental health day was drawn from County Health Rankings. The study uses a self-reported measure for emotional well-being. Self-reported measures are subject to endogeneity and might mask the impact of more objective economic indicators on economic growth. Furthermore, self-reported measures are likely to exaggerate the significance of questioned health status on the dependent variable (Bound, 1991). Partially, the authors account for this problem by adding control variables. Yet, the effect of poor mental health in comparison to high mental health on economic costs is not accounted for. Further, a more objective scale on mental health and well-being might help to show the effect on economic costs with more certainty.

Despite being criticized for methodological inconsistencies and theoretical flaws, COI maintain a role in health economics to indicate the burden of a disease. Due to their complexity, results from COI have to be considered with care in a public policy context. Studies serve as an input for decision making rather than a distinct tool.

Most cost-of-illness studies focus on the negative end of a mental health continuum. Here, the use of COI fosters to depict the immense burden of mental health problems shouldered by economies. Still, these estimates are likely to be an underestimation as only diagnosed mental illness are taken into account. As Economics of Well-being and Mental Health's understanding of mental health is more holistic, new methods to measure economic costs of mental health are needed. Particularly, comparisons of economic costs generated by different mental health status might present worthwhile incentives to invest into positive mental health.

The next section intends to provide an alternative method for measuring the economic costs of mental health for the Danish population.

4

A prospective analysis estimating the costs of suboptimal Mental Well-being in Denmark

The objective of the analysis is to compare the costs of low and moderate to high mental well-being on a national level. Total healthcare and non-healthcare costs attributable to low and moderate mental well-being compared to high mental well-being in Denmark were estimated using data from national registries from 2017. The hypothesis formulates as follows:

Hypothesis: Individuals with low or moderate mental well-being generate additional healthcare and non-healthcare costs compared to those with high mental well-being.

Mental well-being (MWB) refers to mental health in a positive sense and covers a continuum ranging from low to high (see section 2.1.2).

At first, the following section provides an overview of data used for the analysis. Herein, consulted Danish national registries are presented. This is followed by an illustration of the study population drawn from the DMHWBS 2016. Afterwards, the method section provides an overview of healthcare and non-healthcare related costs (outcome measures), an explanation on how mental well-being is measured as a predictor measure as well as derivation of applicable regression model to evaluate the additional costs of low and moderate mental well-being. Last, total costs of low and moderate relative to high mental well-being are compared in the result section. Finally, outcomes and study limitations are discussed as are implications for future research.

Conventional health economic evaluations with regard to mental health are cost-of-illness analysis which investigate the economic impact of diagnosed disorders.

Whilst it is crucial to estimate costs associated with different illness information, costs related to less than optimal mental health are not covered in these types of analysis. Therefore, conducting a 'costs-of-suboptimal mental well-being' analysis which ascertains healthcare and non-healthcare costs associated with different states of mental well-being may provide a broader picture.

From a public policy perspective it is relevant to examine whether different levels of mental well-being generate intensified pressure on healthcare budgets. Further to investigate whether optimal positive mental well-being implies a cost saving potential and whether promoting mental health among the entire population provides a tool to exploit a likely cost saving potential.

4.1 Data

This analysis uses anonymized (micro)data from Danish national registers. Health economic analysis and especially cost-of-illness analysis can profit from the use of register-based data as comprehensive data material is available. Healthcare costs are well described in the registers. Denmark has had a pioneer position in research using register data for decades. Especially, studies in the field of health economics inquiring costs of diseases have benefited from Danish registers (Jørgensen et al., 2017). As the registers comprise data on the entire population, nationwide population-based studies are feasible (Munk-Jørgensen & Dinesen Østergaard, 2011). Moreover, data from national registers is linked to each citizens personal identification number (Danish: Personnummer). This national identification number is part of the personal information stored in the Civil Registration System (CPR) (Danish: Det Centrale Personregister) which allows for linkages with surveys and between various registers (Kruse & Christiansen, 2011).

Moreover, this cost analysis used data from a national survey on mental health and well-being called the DMHWBS 2016 (see section 4.1.5 for information on the survey). By linking data from the DMHWBS 2016 via each participants personal identification number with national registries, a comprehensive data set was used.

4.1.1 The Danish Civil Registration System

Any resident who is born in or relocated to Denmark is assigned a ten digit registration number. The state requires to obtain such a number. The CPR number is related to information on an individual level covering name, address, birth registration, citizenship, church membership, parentage, marital status as well as information on the status of the individual registration. The covered information period goes back

to 1968 with residents from Greenland included since 1972 (Økonomi- og Indenrigsministeriet, 2017). The information stored via the CPR number is collected in a national database: The Danish Civil Registration System (Danish: Det Centrale Personregister). In short, the CPR lists persons who:

1. Are born in Denmark and whose mother is already registered
2. Registered their birth or baptism in the Danish church book (Danish: Dansk Elektronisk Kirkebog)
3. Legally reside in Denmark for more than 3 months

Only thanks to this number is it possible to track for example the utilization of healthcare over time and across institutions.

4.1.2 The Danish National Health Service Register

The Danish National Health Service Register (Danish National Health Service Register (NHSR)) contains information on doctor and patient centered data. The purpose of this register is to foster research in public health by documenting activities in the primary health care sector. Activities of general practitioners, medical specialists, physiotherapists, dentists as well as psychologists and other health professionals who maintain a contract with the public health care system are recorded. From 1990 and onwards, the register covers data on citizens who consult providers of health care. The NHSR encloses minimal information on citizens reason to consult a doctor and their health problem. Data for the register is collected via an invoice system which reports to the Regional Health Administration. As all GPs are linked to an uniform computer system, an electronic fee request which comprises data on patients, provider and type of service is reported on a weekly basis (Sahl Andersen et al., 2011).

4.1.3 The Danish National Patient Register

The Danish National Patient Register (Landspatientregisteret (LPR)) was established in 1977 and is a national register of patients treated and examined in Danish hospitals. The register aims to provide information on hospital statistics for decision-making and allow monitoring of frequency of different diseases and treatments. Initially, the register served as a monitoring instrument for activities in hospitals. However, since 2000 its function was expanded to be a payment tool implementing the Diagnostic-related groups (DRG) system. In international comparison, the LPR is one of a kind.

The LPR includes both administrative and clinical data. The administrative data is patient centered. As soon as a person has been examined or hospitalized, the hospital records a series of information about the patient: The persons CPR number, background information on causes leading to hospital contact, etc. Clinical data relates to diagnosis and treatment procedures. Here, the LPR adapts the International Classification on Diseases, version (ICD-10) . Originally, only inpatients with a somatic disease were registered. Yet, since 1995 both somatic and psychiatric in-and outpatient activities are covered. Since 2003, it is compulsory for private hospitals to report to the LPR (Lyng et al., 2011).

4.1.4 The Sickness Benefits Statistics Register

The Sickness Benefits Statistics Register is maintained by Statistics Denmark. The objective of the register is to monitor the correlation between sickness benefits and social conditions. The register covers information on recipients of sickness benefits in case of illness or birth within one calendar year. The register provides information on length of period for which individuals receive benefits but also on why someone qualifies for sickness benefits. For each person the first and last day of absence is reported. Further variables cover amount paid to the individual or employer as well as occupation, socioeconomic status and case type. Data for this register is provided by the Danish municipalities (Baadsgaard & Quitzau, 2011).

4.1.5 The Danish Mental Health and Well-Being Survey 2016

Data on individuals mental well-being stems from a national survey on mental health and well-being called the DMHWBS 2016. In danish, the study is called *Danskernes Trivsel 2016*. The DMHWBS 2016 includes questions on mental well-being.

Background to DMHWBS 2016

Mental health is not merely the absence of a mental disorder but encompasses positive dimensions such as hedonic and eudemonic well-being (see section 2.1.2). In Denmark, the focus was primarily on measuring mental ill-health when it comes to mental health (Due et al. 2014). Hence, data points about the level of mental health in the Danish population were lacking.

Researchers at the National Institute of Public Health (Statens Institut for Folkesundhed) have therefore taken the initiative to conduct a survey. The questionnaire was designed to assess mental health in the Danish context applying numerous instruments for measuring mental health and well-being (Nielsen et al., 2017). The

DMHWBS 2016 was initiated as part of the institute’s Act-Belong-Commit campaign on positive mental health. The study has been registered with Data Inspectorate via the Legal Office at the University of Southern Denmark (journal number 16/44641). For the sake of the study, a random collection of data via the Danish Civil Registration System was conducted by Statistics Denmark.

4.1.6 Study population

A sample of men and women aged 16 years and above was randomly drawn from the Danish Civil Registration System. The sample population was contacted via electronic letters in October 2016. The electrical letter contained information about the study as well as an invitation to participate (Koushede et al., 2019).

The total sample contacted was 10,250 of which 5,050 were men and 5,200 women. A total of 5,854 did not respond to the electronic invitation to participate in the survey. An additional 463 people did not complete the survey and 183 rejected participation. Due to privacy issues another 213 were not able to take part and 26 individuals were not able due to medical issues or disability. Another three individuals could not participate due to language barriers (Koushede et al., 2019).

Valid responses were available for 3,508 individuals for the DMHWBS 2016 which is going to be defined as the ‘study population’ for this analysis. Thus, the response rate in relation to the invited survey sample was 34 % (N^*). The total ‘study population’ was therefore $n = 3,508$ which is defined as 100 % of observations.

4.1.7 Ethics

The survey DMHWBS 2016 adheres to the Helsinki 2 declaration on ethics (The World Medical Association, n.d.). Further, the study complies with confidentiality and privacy requirements and is registered with the Danish Data Protection Authority. Consent by participants was implied by their voluntary completion of the survey (Koushede et al., 2019). Concerning the use of data from registries, an approval from an ethics committee was not required if studies base their results merely on national registries in Denmark (Dahl & Kongstad, 2017).

4.2 Methods

The following section enumerates applied methods in this study .

First and foremost, it was significant to delimit the analysis and consider which perspective was desired. Traditional cost-of-illness study adopted a socio-economic

perspective. This societal perspective implied that all costs of a disease throughout society are considered: Notwithstanding on which level - state, region, municipality or individual - they occur. Low and moderate mental well-being do not necessarily reflect a disease. Therefore, this analysis adopted the term 'cost-of-suboptimal mental well-being'. Still, methodologies and underlying theories were adopted from conventional cost-of-illness studies (see section 3.1).

This cost-of-suboptimal mental well-being analysis adopted a societal viewpoint on costs. This study cannot account for all economic costs as available cost data is limited, i.e. only costs for which data is available is considered in this thesis. In order to include non-healthcare costs in form of transfers, the study perspective was enlarged to a governmental perspective.

Second, costs are referred to from an economic perspective. As stated in section 2.3.3, resources in the healthcare sector are scarce. Costs therefore reflect opportunity costs - the foregone value of the alternative use of the resources at stake. A human capital approach was used to estimate economic costs. A human capital approach distinguishes between direct and indirect costs. Direct costs are related to healthcare consumption, where there is an actual production behind. They state the costs for treatment in the primary sector in Denmark. Indirect costs are costs which arise outside of healthcare production. As explained in section 3.1.1, indirect costs are referred to as productivity losses. No information on production costs was readily available. This study included money transfers in form of social transfers for sick leave. Transfer payments do not state a resource as there is no production behind. Rather are they considered as a income redistribution since tax money changes hand from the tax payer to a beneficiary (Razzouk, 2017; Drummond et al., 2005). However, in line with other cost-of-illness studies, transfer payments can be included if the perspective is governmental (Larg & Moss, 2011; Rice et al., 1991). Intangible costs were excluded due to the difficulty of attributing a monetary value. In summary, costs in this study comprised direct costs and received benefits from transfer payments. They are (1) Costs for General Practitioner and specialist, (2) Costs for hospitalization, (3) Costs for outpatient treatment. Including a governmental perspective, (4) Sickness benefit transfers were calculated as well. It is crucial to note that these costs do not arise for the affected person but to society as healthcare is funded through taxes in Denmark (section 2.4).

Third, as the information from the DMHWBS 2016 could be linked via the CPR number with register-based data on healthcare and non-healthcare costs, a bottom-up costing approach was possible. Through the linking of Danish registers with the information from the survey, distinct resource consumption for each individual was ascertained. The so called 'gold standard' in COI analysis was therefore applied (see

section 3.1.2).

Fourth, this study is prevalence-based. The economic burden of low and moderate mental well-being compared to high mental well-being is constraint to a specific time period. Costs were derived for the period of 12 month starting in January 2017. Even though the DMHWBS 2016 was carried out in late 2016, the data for cost components stemmed from 2017. This is due to the fact that the study was carried out late in the year of 2016. It was assumed that the level of mental well-being did not alter during the period for which cost data was extracted. The study is of prospective nature.

Fifth, this study proposed and evaluated a classification technique to compare costs of low and moderate well-being to high well-being. Here, a internationally recognized scale for mental well-being - the WEMWBS was applied to the study population. According to the distribution of scores, the study population was grouped into: Low, moderate and high mental well-being. This scale has been validated for the Danish population before (Koushede et al., 2019).

Sixth, a set of regression analysis was performed to calculate the costs of low and moderate compared to high mental well-being for (1) Costs of General Practitioner and specialist, (2) Costs of hospitalization, (3) Costs of outpatient treatment and (4) Sickness benefit transfers. Expenditure on medicine and productivity loss could not be included as data was not available for the time of this thesis. In the regression model, costs and transfers stated the dependent and mental well-being the independent variable.

Finally, all costs are in 2017 prices and were converted to euros (€) using an average yearly exchange rate for 2017 (eurostat, 2019). Both direct costs and transfer payments were extrapolated to the entire Danish populating using information from Statistics Denmark (2017).

4.2.1 Measures for costs of healthcare utilization and transfers

The outcome variable states the costs of each DMHWBS 2016 participants healthcare consumption ((1), (2),(3)) and reception of social transfers (4)). How the costs for the outcome variable were classified and measured is going to be explained briefly.

Costs for General Practitioner and Specialists

The NHSR was used to extract costs on (1) Costs of General Practitioner and specialist for the study population using the respondents CPR. Data on services for GPs

and specialists comprises more than 200 individually priced services. The prices are agreed upon between the Organization of General Practitioners and the Danish regions. Data from the register is accurate and complete as information on each resident in Denmark covered by health insurance is included. Every patient's consultations of a GP or specialist is recorded via their issued card which indicates the CPR (Sahl Andersen et al., 2011). The unit costs for GPs and specialists are based on the current national health insurance rate (Kronborg et al., 2009).

Costs for Hospitalization and Outpatient treatment

The National Patient Register for 2017 (LPR) was used to obtain the costs for (2) Hospitalization and (3) Outpatient treatment. The National Patient Register includes all full-time admissions, emergency room contacts, and outpatient contacts for each CPR number respectively. Each treatment for a similar condition is linked to a rate that represents the average cost of a treatment course. This rate is called DRG (Kronborg et al., 2009). Hence, for each diagnostic group, the consumed resources can be estimated. Admissions related to normal births, sterilization or healthy companions are not included.

The (2) Costs for hospitalization are ascertained by the Danish Ministry of Health. This Ministry collects cost data on all public hospitals in Denmark on a yearly basis. Information on length of stay and as well as quantity and type of services consumed by each patient is also gathered. This information is then combined to calculate a per day average treatment cost for each department within the hospital and for the hospital itself. To estimate the total costs for hospitalization of an individual patient, the number of days admitted to a hospital ward is multiplied by the per day average costs of that department. Additionally, the sum of costs from consumed services is added whereas other costs such as capital or research are excluded (Dahl & Kongstad, 2017). In short, DRG charges were used as unit costs for both (2) Costs of hospitalization (3) Costs of outpatient treatment.

Sickness benefit transfers

The LPR was used to extract relevant information for (4) Sickness benefit transfers. This register only takes those which have employment into account. Hence, the transfers only applied to those in the study sample who fall in the age range of 16 to 64 years and obtain employment. In order to extrapolate the amount of transfers to the entire Danish population, the employment rate for 2017 (73.6) was taken from Statistics Denmark.

4.2.2 Measuring Mental Well-being

These questions in the DMHWBS 2016 were evaluated by the Warwick-Edinburgh Mental Well-being Scale. The WEMWBS is used to measure and monitor mental well-being with a focus on positive aspects of mental health (Tennant et al., 2007). It states the psychometric measure to represent mental well-being and was developed in the United Kingdom. The scale was first put in place to measure the Scottish Executive’s National Program for Improving Mental Health and Well-being in Scotland. The scale covers both eudaimonic and hedonic well-being as well as psychological functioning and subjective well-being. As explained in section 2.1.2 this refers to positive aspects of mental health (Stewart-Brown, 2015). Technically, WEMWBS does not measure mental illness at all. It measures mental health on a continuum ranging from low mental wellbeing to high mental wellbeing. Still, the low end of the scale has strong associations with e.g. depression (Koushede et al., 2019). Hence, someone with low mental wellbeing might also be suffering from a diagnosed mental disorder. The positive end of the scale parallels positive mental health. Therefore, the terms positive mental health and high mental well-being are regarded as synonyms (Stewart-Brown et al., 2015). With 200 publications annually (Koushede et al., 2019; McKay & Andretta, 2017; Smith et al., 2017) - WEMWBS has been translated into more than 25 languages (Taggart, n.d.).

The scale consists of 14-items. The items are framed as positive statements (see Annex A). Participants are required to check a box which describes their experience of that statement over the past two weeks. A 5-point Likert scale ('none of the time', 'rarely', 'some of the time', 'often', 'all of the time') attributes a score 1 one to 5 respectively. The total score is obtained by totalling the score for each item with equal weights. It ranges from 14-70 for the 14-item version WEMWBS (Stewart-Brown et al., 2015; Tennant et al., 2007). The measure has been validated for the Danish population examining face validity, content and construct validity in an earlier study (Koushede et al., 2019).

The distribution of scores in the DMHWBS 2016 corresponds to a standard deviation. The standard deviation (s^2) of a statistical population equals the square root of its variance. In empirical research, a crucial dispersion parameter is the variance. It is calculated by squaring both positive and negative deviations from the mean ($(y_i - \bar{y})^2$). The squared values are then added as well as divided by the total number of observations (n). Equation (4.1) shows the standard deviation.

$$s^2 = \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}. \quad (4.1)$$

For the study population, the mean score for WEMWBS was 52.8 and the standard deviation 8.38. As the WEMWBS scores depict a normal distribution, most of the individuals well-being scores from the DMHWBS 2016 data set are close to the mean. The histogram (see figure 5) displays that the study population was divided into three groups according to the distribution of WEMWBS scores: Individuals with low mental well-being were defined as persons who have a WEMWBS score between 14-43 which represents the bottom 15th percentile according to the standard deviation ($n = 456$). The reference group, people with high mental well-being have a score of 61-70 ($n = 514$) which reflects the top 15th percentile of scores. Persons with moderate positive mental health are said to have a WEMWBS of 44-60 which states the remainder percentile ($n = 2,364$).

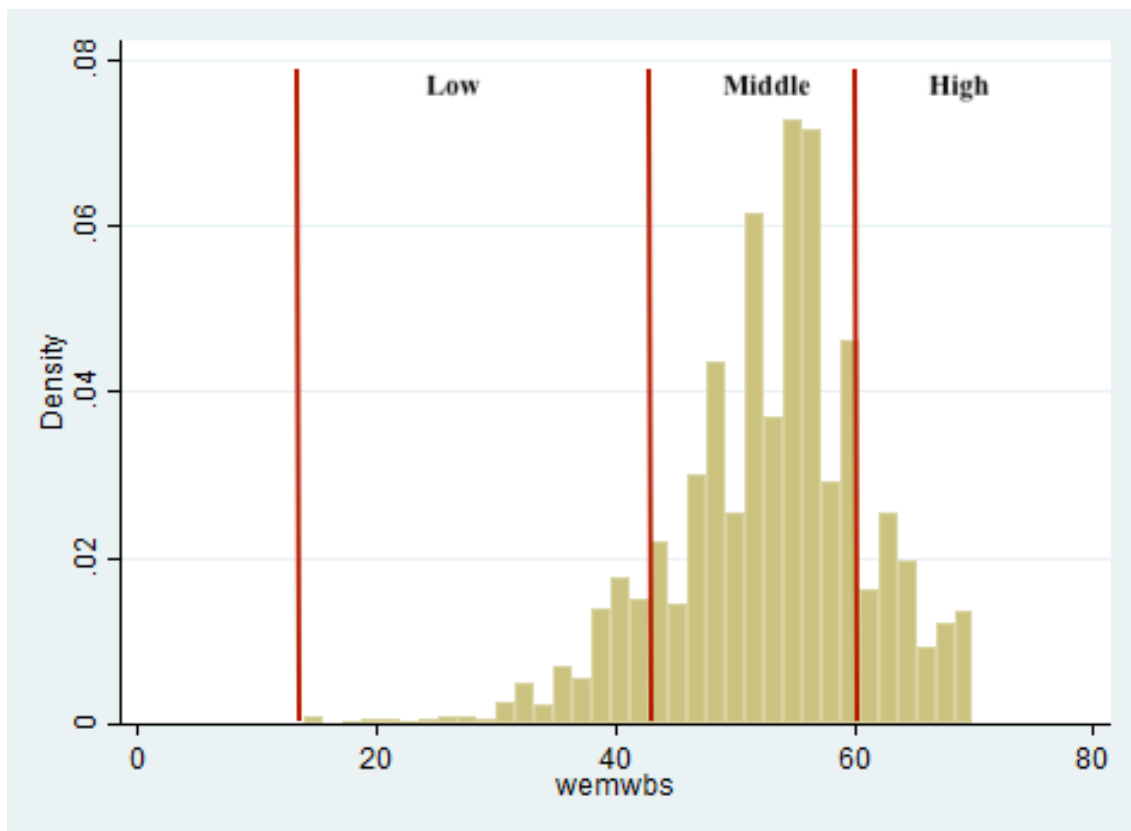


Figure 5: Histogram of WEMWBS scores for DMHWBS 2016.

4.2.3 Statistical Analysis

For the statistical analysis, STATA version 14 was used. For the overall sample, descriptive statistics was tabulated (see table 2).

A statistical sample weight was provided by Statistics Denmark to attenuate selection bias due to non-response. In all analyses, the sample weighting was taken into account to obtain nationally-representative estimates (Nielsen et al., 2017). This means that the answer from each person was assigned a weight corresponding to the

probability of getting a response from a person of the same gender, age, education, marital status, income, employment status and ethnicity (Fangel et al., 2007)

In general, a regression analysis depicts the relationship between a set of independent variables and depended variable. Here, the objective was to minimize the variance between the collected observations in the given data set (DMHWBS 2016) and the responses (costs) predicted by a linear approximation of the data. As there are numerous regression models, the choice of model should be in accordance with the character of the data (Cleff, 2013). Costs can be influenced by many other variables. Hence, the analysis attempted to adjust for certain individual characteristics: Gender, age, education, marital status, income, employment status and ethnicity. These variables are associated with (mental) well-being (Stutzer & Frey, 2012; Stewart-Brown et al., 2015). Also, these covariates are not uncommon as they serve as proxies for a persons need for healthcare service (Diehr et al., 1999). The overall result, that is the total cost (i.e. the total additional costs of moderate and low mental well-being relative to high) was based on having adjusted for these covariates.

OLS Regression

For a continuous dependent variable, the ordinary least square regression model (called OLS or linear regression) helps to depict the mean change in the response variable for one unit of change in the predictor variable while holding other predictors in the model constant. In this analysis, the dependent variable (outcome variable) was continuous and represents the costs in terms of health care utilization (direct costs) and transfers. The predictor variable (mental well-being) was categorical. In order to have categories of mental well-being that can be compared, the independent variable was transformed into dummy variables. The first dummy represented a WEMWBS of > 60 (high mental well-being), the second dummy depicted a WEMWBS between ≤ 60 and > 43 (moderate mental well-being) and the last dummy showed a WEMWBS of ≤ 43 (low mental well-being). The first dummy was called the 'reference category'.

The Regression Model has the following form:

$$Y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} * \dots + \beta_k x_{ki} + u_i$$

with the individual cost probabilities Y_i as the dependent variable and x_{1i}, \dots, x_{ki} as the individual characteristics (mental well-being, age, gender etc..). Each person from the study sample has different characteristics and induces different costs. A regression line can identify the association of the scatter-plot of the data points

(Cleff, 2013). A simplified scatter plot is shown for a OLS regression model omitting covariates in Annex E, F and ?? for the costs of (1) Visits to the general practitioner and specialist, (2) Hospitalization and (3) Outpatient treatment (in Danske Kroner (DKK)).

The linear regression line displays two components: First, where the line crosses the y -axis is called β_0 . β_0 depicts the distance to the origin along the y -axis. u_i states the error term. The slope of the regression line is indicated by β_k which determined to what extent the independent variable impacts the outcome variable. For this purpose, the regression coefficients β_k can be calculated.

$$E(y|x) = x'y = \beta_1x_1 + \beta_2x_2 + \dots + \beta_kx_k$$

The goal is to estimate the "linear conditional mean" $E(y|x)$ of this equation by estimating the values for the β_k coefficients. The regression model is specified with the following equation:

$$y_i = x_i'\beta + u_i, i = 1, \dots, N$$

N states the number of observations. The β coefficients are estimated by minimizing the sum of the squared errors:

$$\sum_{i=1}^N (y_i - x_i'\beta)^2$$

and thus the estimated coefficients $\hat{\beta}$ can be calculated with the following equation (Verbeek, 2012):

$$\hat{\beta} = \left(\sum_{i=1}^N x_i x_i' \right)^{-1} \sum_{i=1}^N (x_i - y_i \beta)^2$$

In the OLS regression model the Beta β coefficient depicts average additional costs per person (in DKK) of moderate and low mental well-being with high mental well-being being the reference. That is true as for each incremental change in the independent variable mental well-being, the β represents an average change in mean scores in the dependent variable (costs). To ascertain individual effects of each characteristic on the independent variable (costs), the beta coefficient of the OLS Model β_k are estimated.

Regression outputs

The set of three regression outputs replicate the influence of each single category on the characteristic's x_k on the direct costs and social transfer benefits respectively. Mainly, this analysis is interested in moderate and low groups of mental well-being with high mental well-being being the reference group. Here, the tables depict the extra costs per person on average (in DKK) for the two groups that have less than high mental well-being compared to optimal mental well-being.

Before going into detail of each regression output, it is explained briefly, why unlike other studies this this thesis reports not only on coefficients and standard errors but also on p values and 95 % Compatibility interval (CI).

In empirical cost studies in the healthcare sector, p values are often consulted as an indicator for statistical significance (Rowell & Jackson, 2011). For each estimated regression coefficient, the p value provides an estimate of the probability that the true coefficient is zero given the value of the estimate. Low p-values (< 0.05) suggest that the true coefficient is very unlikely to be zero, which means that the predictor is likely to have a relationship with the dependent variable - this is referred to as statistical significance (Verbeek, 2012). In reverse, a high p value (> 0.05) is supposed to show statistical non-significance.

In opposition to this dichotomous classification, recent scholars have "risen up against statistical significance" (Amrhein et al., 2019, p. 1). In fact, scientists should be aware that statistically non-significant results are not synonymous with a zero hypothesis (that there is no association or effect) (FISHER, 1935; Gelman & Loken, 2014). By only referring to p values as an dichotomous indicator for statistical significance - several problems arise: First, merely evaluating point estimates or whole studies based on statistical significance leads to biases. Secondly, false conclusions about the non-/prevalence of associations between variables is not only a hazard to research but bears the risk to mislead decision makers who in the end base their decision upon research. In order to circumvent this problem, the documentation on regression outputs goes beyond reporting point estimates. This will foster a more holistic approach to prove or reject the **hypothesis**.

Hence, to test the **hypothesis**, a test hypothesis is formulated guarding assumptions underlying the regression model. Here, a zero hypothesis tests that individuals with low and moderate MWB generate zero additional healthcare and non-healthcare costs compared to those with high mental well-being. Whenever the the test on the effect size produces $p > 0.05$, a range of sizes compatible with the data is defined corresponding to a $1 - 0.05 = 95\%$ confidence interval (hereafter called 'compatibility

interval'). The true effect size (the true point estimate) lies in the CI (Greenland et al., 2016).

4.3 Results

This section depicts the characteristics found in the study sample and the results of the Ordinary Least Square (OLS) regression. The results are displayed in the following table 3 for the costs of (1) General Practitioner and Specialist (in DKK). The costs of (2) Hospitalization and (3) Outpatient treatment as well as (4) Sickness benefit transfers can be found in Annex B, C and D (in DKK). Last, total direct costs as well as social transfers for low and moderate mental well-being compared to high mental well-being for the Danish population of 16 years or more in 2017 are shown.

Study sample

The study sample (see table 2) consisted of 53 % men ($n = 1,852$) and 47 % ($n = 1,656$) women. The majority of respondents were between 45-64 years (41 %), with 29 % aged 65 years and above, 26-44 years accounting for 21 % and 16-25 years for 9 %. Of all respondents, 1,457 (42 %) obtained a degree from a higher school (Gymnasium or similar) and 1,220 (35 %) have undergone higher education (Bachelor, Master and doctoral studies). Among participants 1,992 (57 %) were either married or living with a partner. All four income groups were represented evenly in the study sample (lowest quartile to highest quartile). Additionally, more than half of the study population was employed ($n = 1,906$, 54 %) and 27 % received social pensions or early retirement ($n = 948$). Concerning ethnicity, 93 % of the respondents were Danish.

(1) Costs for GPs and specialist

Table 3 depicts that the extra costs per person on average for low mental well-being relative to high mental well-being are more than double the amount than for someone with moderate mental well-being. A person with low mental well-being incurred additional 1123.92 DKK on average compared to high mental well-being. Despite employment status, low mental well-being seems to score highest as an influencing factor for (1) Costs for GP and Specialists. Only, the category 'Social Pension/Early retirement' and 'Early retirement' depict higher point estimates. Some coefficients show negative values. These are to be understood as less costs compared to some reference category. But one has to be careful about preciseness and explanatory power of point estimates (Amrhein et al., 2019).

Characteristic	Category	<i>n</i>	%
Total number of respondents (<i>N</i>)*		3,508	100
Sex	Female	1,852	52.8
	Male	1,656	47.2
Age (years)	16-25	319	9.1
	26-44	735	21.0
	45-64	1,437	41.0
	65+	1,017	29.0
Education	Primary or unknown	831	23.7
	Gymnasium/Youth education	1,457	41.5
	Higher education	1,220	34.8
Marital Status	Married/Registered partnership	1,992	57.0
	Divorced, separated partners, widow	589	16.8
	Unmarried	917	26.2
Income	Highest quartile	817	25
	Second-highest quartile	818	25
	Third-highest quartile	818	25
	Lowest quartile	817	25
Employment status	Employed	1,906	54.4
	Unemployed	147	4.2
	In education	312	8.9
	Social Pension/Early retirement	948	27.1
	Early retirement	120	3.4
	Other	68	1.9
Ethnicity	Danish	3,272	93.3
	Immigrant/Descendent	236	6.7

Table 2: Study characteristics of study population

(1) Costs for GPs and specialist					
	Coefficient	Std. Error	p value	95% CI	
Mental wellbeing					
High	0	(.)			
Moderate	423.3327	155.4711	0.007	118.4962	728.1692
Low	1,123.92	253.2974	0.000	627.2726	1,620.567
Gender					
Men	0	(.)			
Women	747.0692	124.8587	0.000	502.2552	991.8831
Age	32.63526	7.124991	0.000	18.66509	46.60543
Education					
Primary of unknown	0	(.)			
Gymnasium/Youth education	28.81253	170.5554	0.866	-305.6003	363.2253
Higher education	85.17607	160.2229	0.595	-228.9775	399.3297
Marital status					
Married/Registered partnership	0	(.)			
Divorced, sep. partners, widow	-228.8614	199.98	0.253	-620.9677	163.245
Unmarried	206.6121	158.3719	0.192	-103.9121	517.1362
Income					
Highest quartile	0	(.)			
Second highest quartile	107.6407	148.2071	0.468	-182.953	398.2344
Third-highest quartile	-0.3088051	162.7172	0.939	-334.8855	362.2363
Lowest quartile	13.6754	177.7712	0.08	-334.885	362.2363
Employment status					
Employed	0	(.)			
Unemployed	835.4502	343.3408	0.015	162.2523	1,508.648
In work education	-162.3857	257.9641	0.529	-668.183	343.4116
Social Pension/Early retirement	1,166.539	237.3475	0.000	701.1652	1,631.913
Early retirement	2,951.671	778.5757	0.000	1,425.096	4,478.246
Other	-414.2912	318.5529	0.194	-1,038.887	210.3043
Ethnicity					
Danish	0	(.)			
Immigrant/Descendent	43.31425	244.5141	0.859	-436.1113	522.7398
Constant	-321.648				
Observations	3,334				
R^2	0.1242				

Table 3: Regression output for (1) Costs for GPs and specialists

The standard error displayed in the third row of table 3 is a crucial indicator of how precise the coefficient for the sample statistic is. It measures the dispersion in point estimates. It depicts the average distance that the observed values fall from the regression line. Hence, the smaller the standard error, the more precise the estimate (Verbeek, 2012).

Those covariates with a negative coefficient (in Marital status: Divorced, separated partners or widows; in Income: Third-highest quartile; in Employment status: In work education or other) display a high standard error which shows that the coefficients are imprecise. In fact, the true value for β_1 is covered by the 95% confidence interval. This interval is depicted in the fifth and sixth column and is called compatibility interval (Amrhein et al., 2019). With a probability of 95% the true value of β_1 lays within that range. For those point estimates depicting a negative value (less costs), the CI range covers negative, zero and positive values. This can be seen in e.g. the category 'Divorced, separated partners, widow'. Hence, it might be more likely that this factor is associated with a negative value given the larger orientation towards the negative end.

Concerning well-being, the standard error for low mental well-being (253.2974) is relatively smaller than the one for moderate mental well-being (155.4711). Hence, the coefficient for low mental well-being is more precise than the one for moderate mental well-being. For low mental well-being the true point estimate's value lays somewhere between 627.2726 and 1620.567 DKK. For moderate well-being the CI ranges from 118.4962 to 728.1692 DKK. In both cases, the range has a positive value for the lower limit which affirms a positive point estimate using a OLS regression model.

The predictors low and moderate mental well-being show a low p value (low: 0.000 and moderate: 0.007). Furthermore, the covariates for gender, age and employment status seem to state meaningful influencing factors for (1) Costs of GPs and specialists.

The R^2 tells us how much percentage of the cost variation can be explained by the regression model (Cleff, 2013). The value for R-squared is low (12%) which reflects that the model is not very well specified.

(2) Costs for hospitalization

Table 10 depicts extra average hospitalization costs per person for both low and moderate mental well-being compared to high mental well-being. Low mental well-being accounts for more than six times the amount of extra costs on average than moderate mental well-being (with high mental well-being as a reference). However, the high values in standard errors for both categories depict that the coefficients

are imprecise. Besides that, both p values are high (Low mental well-being: 0.327, moderate mental well-being: 0.777). Finally, both CI show a range from -3609.173 to 10815.75 for low, and -3456.768 to 4624.356 for moderate mental well-being. Despite age, all other covariates show a negative lower limit on CI. Here, the extra average costs for hospitalization per person are 228.8488 DKK for every additional year of age.

(3) Costs for outpatient treatment

A similar pattern can be found in regression output for (3) Costs for outpatient treatment (C). Both moderate and low mental well-being display a high standard error and p value. Despite age, all lower limits of the CI are negative - also for the other covariates.

(4) Sickness benefit transfers

The analysis on (4) Sickness benefit transfers is slightly different from the other analyses. Only participants that are on the labor market and fall into the age range of 16 years up to less than 65 years are part of the analysis. The total of 3,321 observations mirror the restricted sample size. Table 12 in Appendix D displays that low mental well-being induces additional costs of 8207.799 DKK per person on average in comparison to high mental well-being. The standard error here is less than half the value of coefficient (2940.69). Additionally, the lower end of the CI displays a positive value (2442.037) with 1,3973.56 as an upper limit. Not only is low mental well-being the only variable for which the lower CI is positive but also is the p-value the smallest of all variables using OLS regression.

Robustness check

Several assumptions of the OLS are worth mentioning to ensure that results from the analysis are not misinterpreted (Verbeek, 2012).

First, OLS regression lays on the assumption that the relationship between the predictor and outcome variable as well as error term is **linear**. The main interest states the effect size of the independent categorical variable mental well-being on costs. Other independent variables - the individual characteristics (gender, income etc..) are also categorical while age states a continuous covariate. Categorical variables are transformed into dummy variables. Here, the assumption would be that for every unit of change in mental well-being, the outcome (costs) increase or decrease in a linear fashion. For this type of variables there is no need to control for the linearity condition. This condition is automatically valid in a regression with dummy variables (Verbeek, 2012).

The second assumption reflects the **homoscedasticity of error terms** for the dependent variable which can be expressed by the following equation: $E(u_i)=\sigma^2$. This requires that all error terms have the same variance (Verbeek, 2012). As the figure in Appendix (H) displays, this assumption is not fulfilled. Contrarily to the assumption, the residuals of error terms depict heteroscedasticity: Over the range of measured values a systematic change in the spread of the residuals is apparent. For the coefficient estimates with OLS, heteroscedasticity does not cause a bias but renders them less precise. OLS can actually be used with heteroscedasticity but one should be cautious when interpreting results (Verbeek, 2012).

The third assumption states strict exogeneity. The errors in the regression should have conditional mean zero: This implies that errors have a mean zero and that the independent variables are uncorrelated with the errors.

4.3.1 Extrapolation of results

Extrapolating the results from the DMHWBS 2016 shows that approximately 460,052 Danes (15 % of the entire population) have low mental well-being and 2,146,911 (70 % of the entire population) have moderate mental well-being (see Appendix I).

Total direct costs

Table 4 shows the average additional cost per person as well as total costs for the Danish population for low mental well-being in 2017. The costs cover admissions in the primary healthcare sector ((1) GPs and specialists and (2) Hospitalization, (3) Outpatient treatment).

Socio-economic perspective				
Low mental well-being				
	Additional cost p.p.	Total costs	Additional cost p.p.	Total costs
	-kr.-	-bn. kr.-	-€-	-ml. €-
(1) GPs and specialists	1,123.92	0.7	151.1	93.1
(2) Hospitalization	3,603.289	2.2	484.4	298.4
(3) Outpatient treatment	2,846.69	1.8	382.7	235.8
Total health cost	7,573.90	4.7	1,018.18	627.2

Table 4: Additional and total costs for low mental well-being in Denmark, 2017

Overall, the calculation displays that individuals with low mental well-being have extra healthcare costs of €627.2 million in 2017. The largest cost category states (2) Costs for Hospitalization with half of total expenses. (3) Outpatient treatment

accounts for one third and visits to the GPs and specialists for one-sixth of total costs. Compared to high mental well-being, individuals with low mental well-being consumed additional healthcare resources worth €1,018 per person on average.

For moderate mental well-being, table 5 shows total healthcare costs of €925.4 million to the Danish society in 2017. The largest share of costs comes from (3) Outpatient treatment while (1) GPs and specialists and (2) Hospitalization account for little less than one-fourth of total costs. Additional per person healthcare consumption accounts for €321.89 for moderate mental well-being in comparison to the reference group.

Socio-economic perspective				
Moderate mental well-being				
	Additional cost p.p.	Total costs	Additional cost p.p.	Total costs
	–kr.–	–bn. kr.–	–€–	–ml. €–
(1) GPs and specialists	423.3327	1.2	56.9	163.6
(2) Hospitalization	583.7937	1.7	78.5	225.6
(3) Outpatient treatment	1,387.274	4.0	186.5	536.2
Total health cost	2,394.40	6.9	321.89	925.4

Table 5: Additional and total costs for moderate mental well-being in Denmark, 2017

Total sickness benefit transfers

From a governmental perspective, transfers to those on sick leave are part of the expenses and are therefore included. In the applicable cash-flow analysis, only those expenditures associated with sickness absence as sickness benefits paid to companies or citizens are included.

Governmental perspective				
Low mental well-being				
	Additional cost p.p.	Total costs	Additional cost p.p.	Total costs
	–kr.–	–bn. kr.–	–€–	–ml. €–
Sickness benefits	8,207.80	2.8	1,103.4	373.6
Total social transfers		2.8		373.6

Table 6: Additional and total social transfers for low mental well-being in Denmark, 2017

Table 6 displays that low mental well-being causes extra social transfers in form of sickness benefits of €373.6 million in 2017. For each individual with low mental well-being this implies €1,103.4 in extra transfers.

For moderate mental well-being, table 7 shows that €169.6 million of additional social transfers were made in 2017. Per person, the government allocated an extra €101.6 in sickness benefits to those with moderate mental well-being compared to the reference group of high mental well-being.

Governmental perspective				
Moderate mental well-being				
	Additional cost p.p.	Total costs	Additional cost p.p.	Total costs
	–kr.–	–bn. kr.–	–€–	–ml. €–
Sickness benefits	756.11	1.2	101.6	160.6
Total social transfers		1.2		160.6

Table 7: Additional and total social transfers for moderate mental well-being in Denmark, 2017

Total healthcare and non-healthcare costs

Adding all healthcare and non-healthcare costs, the economic impact of low and moderate compared to high mental well-being accounts for €1,552.6 million in 2017 (see table 8).

Socio-economic and governmental perspective	
Low and Moderate mental well-being	
	Total costs
	—ml. €—
Primary sector (GP visits and specialist)	256.7
Hospitalization	524.0
Outpatient treatment (incl. Emergency room)	771.9
Sickness benefits	534.2
Total economic costs	1,552.64

Table 8: Total healthcare and non-healthcare costs for low and moderate mental well-being in Denmark, 2017

4.4 Discussion

The study on economic costs of mental well-being shows that suboptimal mental health generates additional healthcare and non-healthcare costs to the Danish society.

Low mental well-being costs the Danish society €627.2 million extra for healthcare utilization compared to high mental well-being in 2017. In respect to the reference

group, the total costs for moderate mental well-being state €925.4 million in 2017. The higher amount for moderate mental well-being has to be viewed in respect to the higher share (70 %) in that group. In particular, calculated healthcare expenses cover (1) GPs and specialists, (2) Hospitalization and (3) Outpatient treatment. Extra social transfers for sickness benefits incurred by the Danish government estimate to a total of €373.6 million for low, and €160.6 million for moderate mental well-being in 2017. In total, €1,552.64 million of healthcare and non-healthcare costs were generated for low and moderate mental well-being in comparison to the reference group.

This 'cost-of-suboptimal mental well-being analysis' uses an internationally recognized and validated scale to measure for positive mental health. Using a well-being measure which incorporates multi-item questions and accounts for hedonic and eudaimonic dimensions counters the problem presented in section 2.2.1. In particular, the call for a national well-being index which assesses well-being for representative samples is accounted for. As opposed to conventional cost-of-illness analysis that restrict their illness variable to those suffering from diagnosed mental illness, this analysis provides a more holistic view on the economic consequences of different levels of well-being. From a methodological perspective, this addresses the problem of underestimation in conventional COI studies (see section 2.2.2. Moreover, the use of register data and bottom-up costing approach imply a sound, transparent and comprehensive analysis.

With respect to the used regression model to calculate economic costs of suboptimal mental well-being, **Hypothesis** can be confirmed partially: Only for (1) Costs for GPs and specialist do individuals with either low or moderate mental well-being generate higher healthcare costs compared to high mental well-being. Hereby, results suggest that individuals with low mental well-being induce higher additional costs than those with moderate mental well-being considering the reference group. For non-healthcare costs, it can merely be stated that individuals with low mental well-being would receive extra social benefits given the regression model.

However, ascertained healthcare and non-healthcare costs have to be considered under certain considerations. One has to note that calculated healthcare costs of low and moderate mental well-being state a considerable underestimation and that certain theoretical and methodological issues arise.

From a theoretical standpoint, if the study perspective is societal - not only healthcare costs but morbidity, mortality and transportation as well as productivity costs are included. The non-inclusion of those cost components leads to an underestimation. Unfortunately, information on prescription medicine could not be included in

the study due to time constraints. As access to anonymised micro data from national registries has to be authorized by Statistics Denmark, the request for prescription medicine data was not granted. Furthermore, morbidity and mortality costs are not included as no information on this was available. The DMHWBS 2016 itself did not include questions on time absent from work or related productivity losses and costs were omitted in the calculation. Especially, the absence of productivity costs is likely to result in an enormous underestimation on costs. As pointed out in section 3.1.1, the largest share of total costs in cost-of-illness studies stem from workplace costs. In brief, cost components in the analysis are not comprehensively covered due to unavailability of data or time constraints. In consequence, total healthcare costs of €1,552.6 million for low and moderate mental well-being in reference to high mental well-being state an extremely conservative estimate. In opposition, using a prevalence based method might result in larger estimates than if one would have used a incidence based method. This is due to a difference of calculation: Direct and indirect costs in an incidence based method are present-valued whereas disease costs are attributed to the year of their onset in the prevalence method (section 3.1.2).

In reference to transfer payments - the societal perspective of the study was enlarged to include a governmental perspective. From a theoretical standpoint, a societal perspective implies an omission of transfer payments. Most scholars argue that transfer payments constitute merely a reallocation of resources. The total cost to society is zero as (tax) money changes hand from the donor to a beneficiary. Therefore, no additional value or benefit is created for society (Rice & Miller, 1998; Changik, 2014; Razzouk, 2017). Simply extending the perspective of study to fit the data available might not be the most legit method. However, a researcher much work with what's available. This study decided to include transfer payments as data was readily available. Furthermore, because the alternative use of the tax money goes unnoticed. The very principle of economics - the concept of trade-offs helps to explain this notion. With tax money, society faces the decision of what to do with that money to attain maximum benefit. Despite the fact that several factors might influence the onset of sickleave for which the Danish government compensates either the firm or individual, the transferred money could be used for alternatives such as education. Hence, the transfer payments should be considered in COI studies even though there is no immediate production behind. The risk of double counting is often mentioned by scholars if one includes transfer payments (Razzouk, 2017; Rice & Miller, 1998). This would occur if, for example, both productivity costs of a person with low mental well-being absent from work and sickness benefits for that same period would be counted. In this analysis however, productivity costs are

not included. Therefore, the risk of double counting is not a concern. Last, despite claiming a societal perspective, other cost-of-illness studies have incorporated money transfers (Jørgensen et al., 2017).

Another issue concerning the preciseness of economic costs stems from their source: Danish registers only provide proxies for costs, such as tariffs, expenditures and prices. Using diagnosis-related groups (DRG) for unit costs might not reveal real costs as DRG ignore opportunity costs. The calculation of national tariffs is based on accounting costs. Further deviance stems from the methodological problem that costs are pulled together from different diagnostic groups. The mean of accounting costs for patients with the same diagnosis is taken as a basis for the calculation (Raz-zouk, 2017). Further variation in costs within DRG is caused by other factors such as heterogeneity of hospitals, the geographical location and procedural complexity as well as patient characteristics (Dormont & Milcent, 2004). Several authors have shown that treatment costs vary within DRGs in Danish hospitals (Dahl & Kongstad, 2017; Ω).

Whether the economic costs of suboptimal well-being are representative states another concern. The response rate is 34 % which is not uncommon in web based surveys (Nulty, 2008). As imprecision and bias are behemoth to sound conclusions, a researcher is interested in avoiding bias and seeks for representation of the population of interest. Generally speaking, it is preferable to receive a high response rate (80% or higher) from a small sample than a low response rate from a large sample. Indeed, non-response can offset the advantages from a random survey (Evans, 1991). Here, the weighting and representation from various social groups aims to reduce problems related to selection bias.

From a methodological point of view, using a simple OLS regression model for healthcare utilization inclines several shortcomings.

First and foremost, the underlying data pattern for the dependent variable depicts two things: A constraint at zero and a observations cluster at this point. This type of distribution is common in healthcare data and is referred to be as being censored (Humphreys, 2013; Diehr et al., 1999). The zeros are referred to as "genuine zeros" as they stem from non-users of healthcare in contrast to zeros from non-observation (Humphreys, 2013). As the underlying data pattern depicts skewness with heavy right tails, several statistical attempts have been made to account for non-normality (Mihaylova et al., 2011). The problem is that normal distribution-based methods are sensitive to extreme values. Concerning the underlying structure of data, the OLS might not replicate the most accurate coefficients. For the (1) Costs of GPs and specialists, there are only a few observations that generate zero healthcare costs

(see Appendix J). Here, a OLS can still be used. For the other regression outputs (2), 3), 4) there is a high fractions of individuals for whom the observed outcome is zero (e.g. almost 90% for 2), not shown). Though, to test and compare different regression models for healthcare expenditure is not within the scope of this thesis.

A second point has to be mentioned in reference to p values and CI for the regression outputs.

For the case of (1) Costs of GPs and specialists, p values are below 0.005 for low and moderate mental wellbeing. For (4) Sickness benefit transfers, only low mental wellbeing depicts a p value < 0.005 . It is tempting to conclude that the results are statistical significant for these coefficients. However, as Altman (1991) claims "forcing a choice between significant and non-significant obscures the uncertainty present whenever we draw inferences from a sample". The p value below < 0.05 merely shows that the difference from the tests hypothesis prediction would be larger than 5% if merely chance created that difference. Therefore, the low p value states that the data and used OLS model to compute the p value is nearly incompatible.

Additionally, low and moderate mental well-being depict a positive lower and upper bound on the CI for (1) Costs of GPs and specialists (see table 3). The same is the case for low mental well-being for (4) Sickness benefit transfers. Given the assumptions underlying the OLS regression model, any value between the two end points is possible with the point estimate being the most compatible (Amrhein et al., 2019). The point estimate for low mental well-being in (1) is more than twice the value of moderate mental well-being. Considering the low p values and positive limits on the CI for low mental well-being in the two cases, it seems unlikely that no effect between low mental well-being and costs exists. For moderate mental well-being, the same can be said only for (1). Therefore, the zero hypothesis, i.e. individuals with low and moderate MWB generate zero additional healthcare and non-healthcare costs compared to those with high MWB can be rejected entirely for (1) Costs of GPs and specialists and partially for low mental well-being for (4) Sickness benefit transfers.

For the remaining outputs of regression, observed p values state > 0.05 . Nonetheless, a zero hypothesis, the absence of an effect cannot be confirmed merely from the finding of $p > 0.05$ (Greenland et al., 2016). As the p value are less than 1, some correlation must be prevalent in the data. Point estimates and CI should be consulted. For all the other regression outputs on healthcare costs ((2) and (3)) the lower limits of the CI replicate a negative value. For (4) Sickness benefit transfers, all but low mental well-being depicts a negative value (2,442.01 DKK). For these cases, a zero hypothesis cannot be rejected with certainty.

In consequence, the results suggest that low and moderate mental well-being generate additional costs merely for (1) Costs of GPs and specialists with certainty. Furthermore, the difference in point estimates suggest that the size effect of low mental well-being is larger than that for moderate mental well-being. For (4) Sickness benefit transfers, only low mental well-being compared to high mental well-being suggests a positive association. For the other outcomes, a negative association between low or moderate mental well-being and costs cannot be ruled out.

This result is not surprising if one considers the structure of the Danish healthcare system. As explained in section 2.4, the GP has a gatekeeper function. This means that a patient will always (despite an emergency) consult a GP before being sent to hospital or prescribed special treatment. Hence, for the first contact with the healthcare system (the GP), low mental well-being appears to be a cost driver. As explained before, low mental well-being might go hand in hand with mental ill-health and is characteristic for co-morbidities (Demyttenaere et al., 2007; Stewart-Brown, 2015). Therefore, low mental well-being still appears to have some effect on (2) Cost for hospitalization and (3) Costs for outpatient treatment as p values are below 1 and smaller for low mental well-being than for moderate mental well-being. However, a GP will refer a patient for further treatment based on a classified disease and not based upon the status of mental well-being. Therefore, it is difficult to see a positive effect of low or moderate mental well-being on (2) Cost for hospitalization and (3) Costs for outpatient treatment with certainty. Furthermore, one has to consider the cost variability: In this analysis comparing costs of low and moderate mental well-being relative to high, hospitalization and outpatient treatment appear to incur higher costs. This is probably due to higher cost intensity of special service and equipment for hospitals and outpatient treatment. Considering the set up of the Danish healthcare system, the major costs derive from services which occur sequentially after visits to the GP. As the GP is the one transferring individuals to those services, his or her decision is likely to have an enormous impact on subsequent costs.

A similar pattern can be seen in (4) Sickness benefit transfers. A firm or person will only be granted a transfer in case of a diagnosed disease or condition. As low mental well-being is associated with other illnesses, a positive effect of considerable size was evaluated through the OLS regression model.

5

Treatment or Prevention? The example of the Act-Belong-Commit Mental Health Promotion Program in a Danish context

5.1 Treatment or prevention? What an economist would recommend

Considering the high costs of low and moderate compared to high mental well-being in Denmark, a decision maker in public policy might ask himself '*What to invest in?*' Allocate more resources to treatment of mental ill-health or consider an alternative use of limited available resources?

As explained in section 2.1.2, mental well-being is not static but changes during the life course. Despite that biological and social environment impact ones mental capital, mental health changes during the life course. It has been recognized that promotion and prevention is key in enabling individuals to protect their mental health and prevent slipping into low levels of well-being (McHenry & Donovan, 2013; World Health Organization, 2005, 2001).

Whether an investment in the promotion of mental health states good value for money, is a question scholars in the field of mental health economics just started to investigate. Some researcher have launched programs to investigate likely returns on mental health promotion on a collective level (McDaid & Park, 2011; Knapp, McDaid, & Parsonage, 2011).

In opposition to treatment, which takes place *ex eadem* the onset of a mental disorder, promotion is relevant *ante* and *post*. The objective of promotion of mental health is to maximize the benefits from high mental well-being by various measures such as increasing awareness or coping mechanisms (World Health Organization, 2005). To which extent promotion can substitute or accompany treatment and whether promotion is more cost-effective states a very difficult question to answer empirically.

A systematic review on economic evaluations in mental health promotion and mental disorder prevention undertaken by Zechmeister et al. (2008) found that evidence for cost-effectiveness is limited. Most studies examine interventions with limited scope. Transferability and generalisability of results is therefore hardly feasible. Still, the authors find that "interventions have a high potential to be of economic benefit to society." (Zechmeister et al., 2008).

In their paper 'Mental health promotion and mental illness prevention: The economic case', M. Knapp et al. (2011) present several economic analyses on the costs and economic pay-offs of interventions for mental health promotion. Their approach is unique as they break down pay-offs and costs by year, sector and budget type. This enables to estimate a return on investment, show the benefit to society as a whole and evaluate financial impacts on the health system. The authors model different interventions such as mental health promotion and well-being of children, workplace mental health promotion or protecting mental health of the unemployed. Then, the potential return on investment across different sectors (healthcare system, other public expenditure, non-public expenditure) was calculated. Particularly, workplace mental health promotion was calculated to have a net return on investment five times greater than costs (McDaid & Park, 2011). Further evidence suggests a likely return of €9 for every Euro invested in general well-being programmes (McDaid & Park, 2011; McDaid, 2005).

In summary, the underlying economic rationale for promoting positive mental health is not well established. More cost-effectiveness studies with a broader scope need to be carried out in order to prove the worthiness of promotion activity. Also, comparisons with effects from treatment are lacking. To conduct a study of this kind would burst the scope of this thesis. Instead, this thesis presents an example of a national promotion program on mental health which could serve as a source for future cost-effectiveness analysis.

5.2 As simple as ABC: A holistic framework for Well-being and Mental Health

The Act-Belong-Commit ('ABC') is a population-wide mental health promotion program originated in Australia (Donovan & Anwar-McHenry, 2014). Individuals are encouraged to participate in mentally healthy activities while organizations are asked to offer these activities and promote and establish mental health. A social franchising approach is used to alter behaviour on an individual level and foster the establishment of supportive environments (Donovan & Anwar-McHenry, 2014; Koushede et al., 2015). Therefore, the campaign intends to utilize resources from multiple layers: The individual, the group and society itself.

The rationale behind this campaign is that promotion for mental health has to take place on both the societal and the individual level (McHenry & Donovan, 2013). In contrast to other campaigns which focus on the individual, ABC targets the entire population. The notion is to shift the distribution of well-being levels towards the higher end, as depicted in figure 6.

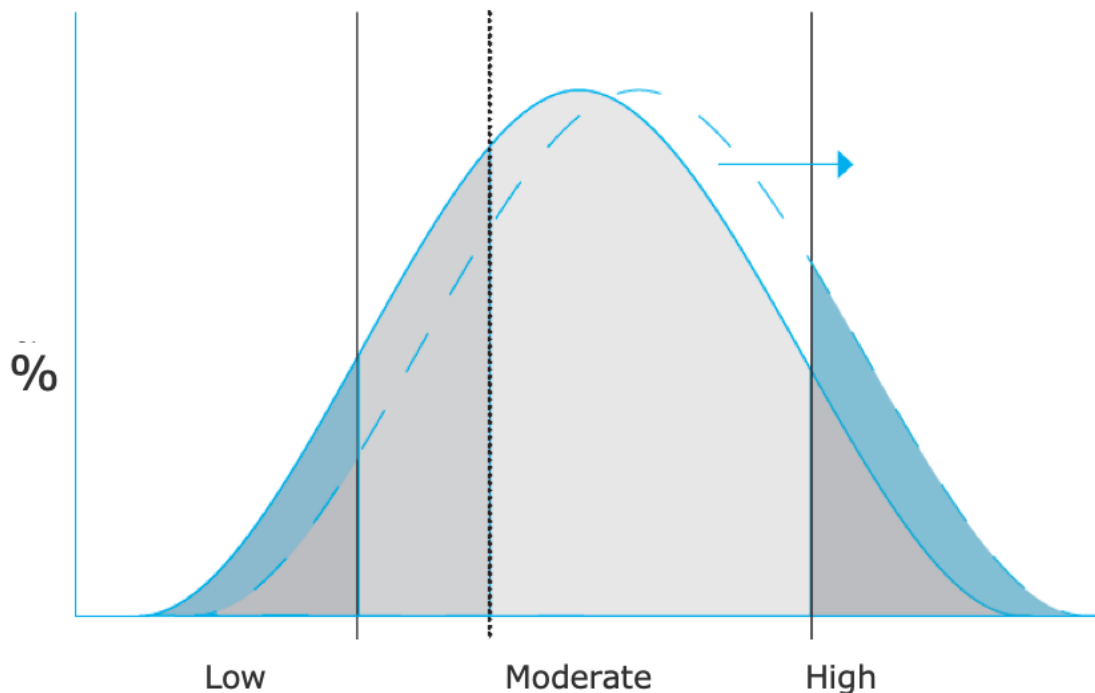


Figure 6: Shifting the mental health spectrum
, adapted from from (Huppert, 2009, p. 109)

In 2014, the Danish National Institute for Public Health was the first to adapt and implement the framework in the Danish context. The institute serves a organiza-

tional, administrative and research hub for the program. An internal research group led by Vibeke Koushede tracks and provides scientific evidence on the program's implementation. The framework comprises three domains (Act-Belong-Commit) which relate to behavioural aspects likely to boost mental health.

- Act: Physical, mental, social and spiritual engagements show higher degree of mental well-being.
- Belong: Encouraging individuals to maintain contact with social networks, engage in associations and promote integration is fundamental for mental health.
- Commit: Having a purpose in life and engaging in meaningful activities foster self esteem and well-being (Koushede et al., 2015; Donovan & Anwar-McHenry, 2014).

The principles of Act-Belong-Commit have their roots in research. For instance, social networks play a major role in the etiology of depression. Hence, diverse, integral, and supportive social networks are indispensable for better mental health (Z. I. Santini et al., 2015; Rosenquist et al., 2011). Encouraging individuals to reach out and keep contact with family and friends and to engage in clubs and community activity ('Belong') helps to elevate mental health.

A study conducted by the ABC mental health research group among 14,000 Scandinavians found that the hours spent volunteering represent a worthwhile investment in terms of well-being. Individuals who work voluntarily, for example as a scout leader, football coach or visitor friend, have twice the likelihood of having good mental health (Koushede et al., 2015).

Another study published in 2017 found the Act-Belong-Commit indicators to serve as protective factors against the onset of mental disorders. The researchers used data on a sample of 6098 adults aged ≥ 50 years in Ireland together with validated scales on depression, anxiety and cognitive impairment. Inter alia, it was discovered that a marginal increase of social or recreational activities ('Act') is inversely correlated with the commencement depression or anxiety (I. Z. Santini et al., 2017).

The implementation of the ABC framework takes place via collaboration with partners from different societal levels and backgrounds (municipalities, schools, business, healthcare etc). So far, the ABC campaign has initiated a multitude of activities through their partners for which a description can be found on the website <http://abcmamentalsundhed.dk/abc-aktiviteter/>.

In summary, the campaign's comprehensive scope, its community-based approach and linkage with research as well as its focus on positive aspects of mental health

render this program one of its kind. Particularly, the linkage with the Danish Institute for Public Health as a hub for research enables future studies to investigate the cost-effectiveness and benefits of positive mental health for society. Hopefully, this will enable decision makers to allocate resources efficiently to the maximum benefit of the Danish society.

6

Can technology help? ‘Mental Mentors Application’

High mental health seems to state a scarce resource even in universities. Enhancing and indicating students well-being might allow universities to obtain additional bargaining power in recruiting students and staff. This section identifies the need for an innovative solution to boost mental health of students and describes benefits, advantages and features of such a solution.

6.1 The need for an innovative solution

As depicted in the first section (section 2.2.2) global costs of mental disorders will outstrip costs of other non-communicable diseases. On the one hand, the burden of mental disorder was found to be detrimental to society as not only health utilization skyrockets but indirect costs such as loss of productivity pose a threat to health and financial systems (section 3.1). Moreover, results from section 4 suggest that the burden of mental ill-health is much higher if one does not constrain cost-of-illness studies to diagnosed disorders. Extra economic costs arise for society if individuals obtain suboptimal mental well-being. On the other hand, it was explained that good mental health bolsters against physical diseases, is associated with greater productivity, higher employment, and life satisfaction (see section 2.1.2). Consequently, it is imperative to identify and develop protective factors and systems that enable individuals to have and guard high mental well-being to secure sustainability for health and financial systems, such ensuring societal well-being in general.

Face-to-face therapy state the gold standard in psychological interventions. In view of the increasing burden of suboptimal mental well-being, however, they are too labour and cost intensive to keep pace with the increasing demand for mental health services. Enhanced self care and improved efficiency for better mental health are

therefore inevitable.

6.2 Target group

I decided to focus on the need for better mental well-being in CEMS universities. CEMS is an international Master's in Management program with 32 CEMS member schools with presence on every continent. Two main reasons explain the underlying cause of this focus: First, mental health in students is on the decline. A US study from 2010 found that self-rated emotional health in students is at the lowest point since 1985 (Hurtado et al., 2011). Another study from the UK pointed out that one in four students suffers from problems with mental health (Scott & Smith, 2016). Drop out of programs or worse, suicide, are known effects from poor mental health in university students. Second, stigma and taboo around mental health seem particularly high in CEMS Business Schools. A study done by students from NOVA SBE uncovered that more than 60 % of CEMS students consider depression and burnout as a taboo (Corazza et al., 2017). Considering that more than 30 % of questioned students responded to having dealt with a depression or burnout themselves, there is a need for action. As explained before, output prone indicators say nothing about the prevalence of well-being. In summary, the target group consists of 32 CEMS member schools with 1 269 CEMS students in the academic year 2018-2019.

6.3 The solution

In order to come up with a solution to the societal challenge - the increasing burden of suboptimal mental well-being - I intend to tap into mobile technologies as a source of innovation to improve mental well-being through self care and mentorship. My aim is to implement a solution that helps CEMS universities and students to become aware and monitor levels of mental well-being as well as provide skills, techniques and mentor-ship to students in times of low mental well-being. More specific, the solution will consist of a mobile phone application which incorporates the 'Act-Belong-Commit' indicators comprising a mentorship function. The application will be named 'Mental Mentors'. This application, however, is not a substitute for treatment. Yet, it might avert the necessity of treatment and render individuals more conscious about the benefits of treatment in case of the onset of a mental disorder.

6.4 Benefits, advantages, features

Generally, implementing the 'Mental Mentors' Application in an educational setting will benefit the following dimensions:

- Beliefs: Altering beliefs about mental health and mental illness;
- Consciousness: Increasing awareness that mental health is valuable, worthy of protection and trainable just as physical health;
- Openness: Encouraging openness to talk about mental health issues and thereby reduce of stigma attached to mental ill-health;
- Behaviour: Promoting and engaging in activities to enhance mental health;
- Sustainability: Establishing supportive networks and partnerships is likely to introduce systemic change within health systems;

Investing in rendering CEMS students competent and conscious about mental health might show further positive returns on an individual level. During their studies, students acquire skills, knowledge and awareness on their own mental health. As high mental well-being is associated with better coping mechanisms in face of stress and adversity, fewer drop outs, enhanced well-being and success in studies are likely benefits to students themselves.

A "mental health skills gap" is perceived by members of all MBA programmes . 80 % of members from MBA programmes indicated that the ability to manage ones mental health is looked for by employers (Macintyre et al., 2018). Once CEMS students hit the labour market, the skills achieved in Mental Mentors might give them a competitive advantage in view of the high number of graduates from other top performing business and MBA programs.

On an organizational level, enhanced well-being of CEMS students incorporates benefits to educational providers. To universities, fewer drop outs and resilient students will lead to less administrative resources needed to support students. Measuring and monitoring students well-being enables universities to keep a live record of how different students are experiencing university, and whether and where actions are needed to enhance well-being. Furthermore, a well-being index presents an alternative indicator to evaluate and compare business school in rankings such as drawn by the Financial Times.

Students capable of monitoring, protecting and being open about their mental well-being would be less likely to cause costs on the health system in their life course. As graduates from the CEMS program are likely to obtain influential positions in

their professional career, they might inspire others to follow their example enabling change at a societal level.

Concerning the functioning of application, students can register with their student number and create an account. The account will create a random number for each user to ensure anonymity. Before having access to the different functions of the app, the students are asked to fill out a well-being survey based on the Warwick-Edinburgh Mental Well-being Scale. The account section in the app will provide the student with an overview of his or her level of mental well-being and track and compare activities with other users. Here, an overview on one's 'Mental Coins' budget is provided. These coins are part of a reward scheme based on the engagement with the app. Obtained Mental Coins could be used as a payment method for university cafeterias, bookshops and related educational expenses.

The features of the app comprise the following functions: The dimension 'Act' will consist of a calendar with daily (free and fee-based) activities for each location of CEMS university. Both, events from each CEMS clubs as well as external events taking place in and near the schools location will be displayed. The interface will display a description of the event, its location, cost, and provide a booking and paying feature. Besides local events and activities, the section will comprise videos and online material on the topic of mental health. Here, students can choose to become a certified 'Mental Mentor' by going through an online training course based on the principles of cognitive-based-therapy, and accomplishing a final test and interview with an already certified 'Mental Mentor'. A certified 'Mental Mentor' has either experienced and overcome mental ill-health or is a student willing to listen and offer support to peers. Each activity or accomplishing the 'Mental Mentor' certificate will be rewarded with 'Mental Coins'. This section targets individuals who simply want to train their mental health, and those who intend to become a 'Mental Mentor'.

The 'Belong' section will comprise a 'Mentorship' function. It will consist of an anonymous support platform through which a matching of a student with low mental well-being or mental disorder ('Mental Mentee') is automatically matched with a certified 'Mental Mentor'. The mentorship itself will be conducted in accordance with a guideline. A help function will enable the mentor and mentee to be put in contact with the school's psychologists in case of need for advanced professional help. Also, this section will host different virtual groups in which students can share and gather knowledge on how to overcome mental health difficulties.

The 'Commit' section will host offers from local associations or non-profit organizations who seek volunteers. A description of tasks and expected time commitment

are displayed.

The advantages of the 'Mental Mentors Application' are manifold and arise to different stakeholders. A new index to compare and evaluate business schools provides a valuable tool to measure students well-being. The market demand for alternative indices to measure the success of societies, business and related sectors as well as higher mental health is high (see section ?? and 2.2.2). For students, the app is likely to enhance well-being which in turn enhances the likelihood of academic success, new coping skills and their marketability. Barriers to replicability of technological solutions to enhance well-being in students are however low: No physical uniqueness nor path dependency occur. However, social complexity and causal ambiguity of positive mental health might impede imitability.

6.5 Strategic steps

Further strategics steps are necessary to test and implement the 'Mental Mentors' application.

1. Refining and adjusting features of app: Conduct a questionnaire to gather insights, verify and specify needs from CEMS business schools and students;
2. Investment plan: Estimate of initial costs and revenues;
3. Strategic partners: Discuss partnership and collaboration options with universities, CEMS Alliance, local event platforms and other associations ;
4. Mapping of customer experience;
5. Finding a co-founder with coding skills.

Overall, tapping into technologies to create innovative solutions to challenge an increased burden of suboptimal mental well-being might present a valuable business idea. I intend to launch a business in order to test and establish such a solution.

7

Conclusion

Section 7 concludes this thesis by presenting the key research results and suggestions by the author for future research.

This study presents a new method for measuring the economic costs of suboptimal mental health for the Danish population.

For suboptimal mental health, the study applied the WEMWBS as a well-being measure. The WEMWBS incorporates multi-item questions and accounts for hedonic and eudaimonic dimensions. In opposition to many other measures (see section 2.2.1), the WEMWBS is comparable and comprehensive in nature.

This analysis estimated that additional economic costs for individuals with low and moderate mental well-being compared to high mental well-being accrue. This work demonstrates the feasibility of estimating the prospective association between mental well-being and economic costs in conjunction with other explanatory factors on state level.

The cost components for the study were extracted from national registries for (1) Visits to the General Practitioner and specialist, (2) Hospitalization, (3) Outpatient treatment and (4) Sickness benefit transfers.

As a main result, the study finds that total healthcare and non-healthcare costs for low and moderate compared to high mental well-being account for €1,552.6 million. Annual costs of extra healthcare utilization account for €627.2 million for low and €925.4 million for moderate mental well-being in Denmark in 2017. Moreover, an additional €373.6 million for low and €160.6 million for moderate mental well-being was spent on sickness benefit transfers. These results suggest that it is very costly for the Danish society to not have a high level of mental well-being for its citizen. Still, these estimates are very conservative. Actual costs are likely to be much higher (see section 4.4).

Therefore, from a public policy perspective, it is relevant to examine the extra costs of different levels of mental well-being as suboptimal levels of mental well-being generate intensified pressure on healthcare budgets. Optimal positive mental well-being might imply a cost saving potential. Promoting mental health on a population level might state a tool to exploit a likely cost saving potential. However, an additional cost-effectiveness study would be necessary to investigate the worthiness of promotion (see section 5).

In order to mitigate the negative impact of suboptimal mental health on economy, an application which monitors and enhances mental well-being might state an innovative solution (section 6).

In the end, this analysis addresses a research gap on economic costs of suboptimal mental well-being on a national level. Further research is necessary to refine the used regression model and specify actual economic costs. However, estimated additional costs suggest that it is not enough to merely measure the economic costs of classified mental disorders. Rather should more nuanced measures be used in order to grasp the full economic impact of different levels of mental health.

Limitations occur as data on cost components such as productivity costs (indirect costs) are lacking. Further complications arise from the underlying structure of healthcare cost data. Since the data on healthcare expenditure is constituted of a high fraction of zero costs, models that are robust to censored data need to be employed. This is referred to in more detail in the subsequent section.

7.1 Future approach

As pointed out in the previous section, additional data on healthcare (prescriptive medicine, transportation etc.) and productivity costs are necessary to provide a comprehensive estimate on total 'costs of suboptimal mental well-being' on a national level.

Furthermore, several limitations from the OLS regression highlighted in section 4 encourage future research to conduct a similar analysis on 'costs of suboptimal mental well-being' comparing different regression models. Other statistical methods such as a two-stage model or transformation of data should be applied (e.g. log transformation (Manning & Mullahy, 2001) or two-stage model (Mihaylova et al., 2011)).

Concerning the calculation of healthcare utilization, a uniform method is needed to ascertain resource consumption across services. As the market for healthcare is

not perfectly competitive (see section 2.3.3), prices do not reflect marginal costs. One cannot speak of opportunity costs in the sense of welfare economics without committing a theoretical faux pas. Consequently, a separate analysis which assesses the economic value of services in the primary healthcare sector is needed.

In the end, cross-national data would be needed to draw a full picture of the economic impact of suboptimal mental well-being. The major challenge here will be to maintain a common approach and methodology to estimate the burden of suboptimal mental well-being. Therefore, guidelines on an European level would be preferable to ensure the comparability of studies.

References

- American Psychiatric Association. (2017). *DSM-5® Update October 2017* (Tech. Rep.). Arlington: American Psychiatric Association. Retrieved from <https://www.psychiatry.org/psychiatrists/practice/dsm>
- Amrhein, V., Greenland, S., & McShane, B. (2019, 3). Scientists rise up against statistical significance. *Nature*, 567(7748), 305–307. Retrieved from <http://www.nature.com/articles/d41586-019-00857-9> doi: 10.1038/d41586-019-00857-9
- Anderson, P., & Jané-Llopis, E. (2011). Mental health and global well-being. *Health Promotion International*, 26(SUPPL. 1), 147–155. doi: 10.1093/heapro/dar060
- Andreasson, U. (2018). *IN THE SHADOW OF HAPPINESS* (Tech. Rep. No. 01). Nordic Council of Ministers. doi: 10.2307/j.ctt183p28m.7
- Arrow, K. (1963). Uncertainty ant the welfare economics of medical care. *The American Economic Review*, 53(5), 941–973. Retrieved from <http://web.pdx.edu/~nwallace/EHP/ArrowUWE.pdf>
- Baadsgaard, M., & Quitzau, J. (2011). Danish registers on personal income and transfer payments. *Scandinavian Journal of Public Health*, 39(7), 103–105. doi: 10.1177/1403494811405098
- Ban, T. A. (2001, 5). Pharmacotherapy of mental illness-a historical analysis. *Progress in neuro-psychopharmacology & biological psychiatry*, 25(4), 709–27. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11383974>
- Bentham, J. (1780). *An Introduction to the Principles of Morals and Legislation* (Vol. 45) (No. n/a). Dover Publications.
- Blades, C. A., Culyer, A. J., & Walker, A. (1987, 1). Health service efficiency: Appraising the appraisers—A critical review of economic appraisal in practice. *Social Science & Medicine*, 25(5), 461–472. Retrieved from <https://www-sciencedirect-com.proxy1-bib.sdu.dk/science/article/pii/0277953687901699> doi: 10.1016/0277-9536(87)90169-9

- Bloom, D., Cafiero, E., Jané-Llopis, E., Abrahams-Gessel, S., Bloom, F. S., L.R., A.B., F., ... Weinstein, C. (2011). *The Global Economic Burden of Non-communicable Diseases* (Tech. Rep.). Geneva: The World Economic Forum. Retrieved from www.weforum.org/EconomicsOfNCD
- Boorse, C. (1976, 4). What a Theory of Mental Health should be. *Journal for the Theory of Social Behaviour*, 6(1), 61–84. Retrieved from <http://doi.wiley.com/10.1111/j.1468-5914.1976.tb00359.x> doi: 10.1111/j.1468-5914.1976.tb00359.x
- Bound, J. (1991, 24). Self-Reported Versus Objective Measures of Health in Retirement Models. *The Journal of Human Resources*, 26(1), 106. Retrieved from <https://www.jstor.org/stable/145718?origin=crossref> doi: 10.2307/145718
- Brouwer, W. B. F., Van Exel, N., Koopmanschap, M. A., & Rutten, F. F. H. (1999). THE VALUATION OF INFORMAL CARE IN ECONOMIC APPRAISAL A Consideration of Individual Choice and Societal Costs of Time. *International Journal of Technology Assessment in Health Care*, 15, 147–160. Retrieved from <https://doi.org/10.1017/S0266462399152346> doi: 10.1017/S0266462399152346
- Busse, R., Blümel, M., Scheller-Kreinsen, D., & Zentner, A. (2016). State of Health in the EU: Denmark, Country Health profile 2017. *Quarterly of the European Observatory on Health Systems and Policies*, 22(2), 64. Retrieved from <http://dx.doi.org/10.1787/888933593475%0Ahttp://www.euro.who.int/en/about-us/partners/observatory/publications/studies/tackling-chronic-disease-in-europe-strategies,-interventions-and-challenges> doi: 10.1016/j.cll.2004.07.001
- Byford, S., & Barrett, B. (2010). Ethics and economics: the case for mental healthcare †. *Advances in psychiatric treatment*, 16, 468–473. Retrieved from https://www.cambridge.org/core/services/aop-cambridge-core/content/view/15F982743AB4F4C6B70B4F379604DBA6/S1355514600007148a.pdf/ethics_and_economics_the_case_for_mental_healthcare.pdf doi: 10.1192/apt.bp.107.005355
- Byford, S., Torgerson, D. J., & Raftery, J. (2000, 5). Economic note: cost of illness studies. *BMJ (Clinical research ed.)*, 320(7245), 1335. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/10807635http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC1127320> doi: 10.1136/bmj.320.7245.1335

- Changik, J. (2014, 12). Cost-of-illness studies: concepts, scopes, and methods. *Clinical and molecular hepatology*, 20(4), 327–37. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25548737><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC4278062> doi: 10.3350/cmh.2014.20.4.327
- Cleff, T. (2013). *Exploratory Data Analysis in Business and Economics*. doi: 10.1007/978-3-319-01517-0
- Colander, D. C. (2006). *Economics*. McGraw-Hill/Irwin.
- Commission of the european communities. (2005). *GREEN PAPER Improving the mental health of the population. Towards a strategy on mental health for the European Union*. Brussels. Retrieved from <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52005DC0484>
- COMTEX. (2018). *Antipsychotic Drugs Market Synopsis and Highlights 2018 — Key Findings and Major Companies Analysis with Growth of 4 . 3 % of CAGR — Forecast to 2022*. Retrieved from <https://www.marketwatch.com/press-release/antipsychotic-drugs-market-synopsis-and-highlights-2018-key-findings-and-major-companies-analysis-with-growth-of-43-of-cagr-forecast-to-2022-2018-06-26>
- Corazza, B., Schlicht, D., Rattez, D., & Brave den, P. (2017). *Enerwise*. Lisbon.
- Dahl, C. M., & Kongstad, L. P. (2017). The costs of acute readmissions to a different hospital – Does the effect vary across provider types? *Social Science and Medicine*, 183, 116–125. Retrieved from <http://dx.doi.org/10.1016/j.socscimed.2017.04.036> doi: 10.1016/j.socscimed.2017.04.036
- Davies, L. M., & Drummond, M. F. (1994). Economics and schizophrenia: The real cost. *British Journal of Psychiatry*, 165(NOV. SUPPL. 25), 18–21.
- Demyttenaere, K., Bruffaerts, R., Lee, S., Posada-Villa, J., Kovess, V., Angermeyer, M. C., ... Von Korff, M. (2007, 6). Mental disorders among persons with chronic back or neck pain: Results from the world mental health surveys. *PAIN*, 129(3), 332–342. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0304395907000462> doi: 10.1016/J.PAIN.2007.01.022
- Denison, E. F. (1962). *The sources of economic growth in the United States and the alternatives before us*. New York: Committee for Economic Development.
- Diehr, P., Yanez, D., Ash, A., Hornbrook, M., & Lin, D. Y. (1999). *Methods for analyzing health care utilization and costs* (Vol. 20; Tech.

- Rep.). Retrieved from <https://search.proquest.com/docview/235229246/fulltextPDF/A59A1AA3E6FD49F7PQ/1?accountid=14211>
- Diener, M. E., Ed; Seligmann. (2004). Toward an Economy of Well-Being. *Psychological Science in Public Interest*, 5(1), 1–31. doi: 10.1126/science.1191273
- Donovan, R. J., & Anwar-McHenry, J. (2014). Act-Belong-Commit: Lifestyle Medicine for Keeping Mentally Healthy. *American Journal of Lifestyle Medicine*, 10(3), 193–199. doi: 10.1177/1559827614536846
- Dormont, B., & Milcent, C. (2004, 10). The sources of hospital cost variability. *Health Economics*, 13(10), 927–939. Retrieved from <http://doi.wiley.com/10.1002/hec.935> doi: 10.1002/hec.935
- Drummond, M. (1981). *Studies in economic appraisal in health care*. Oxford University Press. Retrieved from https://alvis-bib.sdu.dk/uhtbin/cgisirsi/x/SDUB-0/0/57/5?user_id=WEBSEVER&searchdata1=8028+{ckey}
- Drummond, M., Sculpher, M. J., Torrance, G. W., O'Brien, B. J., & Stoddart, G. L. (2005). *Methods for the economic evaluation of health care programmes*. Oxford University Press.
- Easterlin, R. A. (1974). Does Rapid Economic Growth Improve the Human Lot ? Some Empirical Evidence. In P. A. David & M. W. Reder (Eds.), *Nations and households in economic growth* (pp. 89–125). New York: Academic Press. doi: 10.1007/BF00286477
- eurostat. (2019). *Euro/ECU exchange rates - annual data - Eurostat*. Retrieved from https://ec.europa.eu/eurostat/web/products-datasets/-/ert_bil_eur_a
- Evans, S. J. (1991, 2). Good surveys guide. *British Medical Journal*, 302(6772), 302–303. Retrieved from <https://www.bmj.com/content/302/6772/302> doi: 10.1136/BMJ.302.6772.302
- Faculty of Public Health, & Mental Health Foundation. (2016). Better Mental Health For All: Public Health Approach to Mental Health Improvement. , 65.
- Fangel, S., Linde, P., & Thorsted, B. (2007). Nye problemer med repræsentativitet i surveys, som opregning med registre kan reducere. *Metode & Data*, 93, 14–26.
- Fein, R. (1958). *Economics of mental illness*. New York: Basic Books. Retrieved from <http://content.apa.org/books/11257-000> doi: 10.1037/11257-000
- Feldstein, P. J. (2012). *Health Care Economics* (seventh ed.). New York: DELMAR Cengage Learning.

- FISHER, K. A. (1935). Statistical Tests. *Nature*, 136(3438), 474. Retrieved from <https://doi.org/10.1038/136474b0> doi: 10.1038/136474b0
- Fox, J. (2012). *The Economics of Well-Being*.
- Frey, B. S. (2018). Economics and Well-Being. In V. Zeigler-Hill & T. K. Shackelford (Eds.), *The sage handbook of personality and individual differences* (Vol. 3, pp. 552–567). London: SAGE Publication Ltd.
- Frisman, L., & Rosenheck, R. (1996). How transfer payments are treated in cost-effectiveness and cost-benefit analyses. *Administration and Policy in Mental Health*, 23(6), 533–546. doi: 10.1007/bf02108689
- Fuchs, V. (1996). Economics, Values and Health Care Reform. *The American Economic Review*, 86(1), 1–24.
- Gabler. (2019). *Gut Definition*. Retrieved from <https://wirtschaftslexikon.gabler.de/definition/gut-36114>
- Gelman, A., & Loken, E. (2014). The Statistical Crisis in Science. *American Scientist*, 102(6), 460. Retrieved from <https://www.americanscientist.org/article/the-statistical-crisis-in-science> doi: 10.1511/2014.111.460
- Goetzel, R. Z., Long, S. R., Ozminkowski, R. J., Hawkins, K., Wang, S., & Lynch, W. (2004). Health, Absence, Disability, and Presenteeism Cost Estimates of Certain Physical and Mental Health Conditions Affecting U.S. Employers. *Journal of Occupational and Environmental Medicine*, 46(4), 398 - 412. Retrieved from www.wbgh.org doi: 10.1097/01.jom.0000121151.40413.bd
- Greenberg, D., Mohamed Ibrahim, M. I. B., & Boncz, I. (2014, 9). What Are the Challenges in Conducting Cost-of-Illness Studies? *Value in Health Regional Issues*, 4, 115–116. Retrieved from <https://linkinghub.elsevier.com/retrieve/pii/S2212109914000661> doi: 10.1016/j.vhri.2014.08.003
- Greenberg, P. E., Kessler, R. C., Birnbaum, H. G., Leong, S. A., Lowe, S. W., Berglund, P. A., & Corey-Lisle, P. K. (2003, 12). The economic burden of depression in the United States: how did it change between 1990 and 2000? *The Journal of clinical psychiatry*, 64(12), 1465–75. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/14728109>
- Greenberg, P. E., Sisitsky, T., Kessler, R. C., Finkelstein, S. N., Berndt, E. R., Davidson, J. R., ... Fyer, A. J. (1999). The economic burden of anxiety disorders in the 1990s. *Journal of Clinical Psychiatry*, 60(7), 427–435. doi: 10.4088/JCP.v60n0702

- Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. *European Journal of Epidemiology*, 31(4), 337–350. doi: 10.1007/s10654-016-0149-3
- Gustavsson, A., Svensson, M., Jacobi, F., Allgulander, C., Alonso, J., Beghi, E., ... Olesen, J. (2011, 10). Cost of disorders of the brain in Europe 2010. *European Neuropsychopharmacology*, 21(10), 718–779. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0924977X1100215X> doi: 10.1016/J.EURONEURO.2011.08.008
- Hallam, A., & Trieman, N. (2001, 11). The cost effectiveness of specialised facilities for service users with persistent challenging behaviours. *Health & social care in the community*, 9(6), 429–35. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11846822>
- Harris, C., & Barraclough, B. (1998, 7). Excess mortality of mental disorder. *British Journal of Psychiatry*, 173(1), 11–53. Retrieved from https://www.cambridge.org/core/product/identifier/S0007125000150512/type/journal_article doi: 10.1192/bjp.173.1.11
- Helliweel, J. F., Layard, R., & Sachs, J. D. (2018). International Migration and World Happiness. *World Happiness Report 2018*, 172. Retrieved from https://s3.amazonaws.com/happiness-report/2018/WHR_web.pdf
- Herman, S., Archambeau, O. G., Deliramich, A. N., Kim, B. S. K., Chiu, P. H., & Frueh, B. C. (2011, 11). Depressive Symptoms and Mental Health Treatment in an Ethnoracially Diverse College Student Sample. *Journal of American College Health*, 59(8), 715–720. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/21950252><http://www.ncbi.nlm.nih.gov/pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC3210726><http://www.tandfonline.com/doi/abs/10.1080/07448481.2010.529625> doi: 10.1080/07448481.2010.529625
- Hewlett, E., & Moran, V. (2014). *Making Mental Health Count: The Social and Economic Costs of Neglecting Mental Health Care* (No. July). Paris: OECD Publishing. Retrieved from <https://www.oecd.org/els/health-systems/Focus-on-Health-Making-Mental-Health-Count.pdf> doi: 10.1787/9789264124523-en
- Hodgson, G. (2004). Reviewed Work: How Economics Forgot History: The Problem of Historical Specificity in Social Science. *Challenge*, 47(2), 109–114. Retrieved from https://www.jstor.org/stable/40722247?seq=1#metadata.info_tab_contents

- Hodgson, T. A., & Meiners, M. R. (1982). *Cost-of-Illness Methodology: A Guide to Current Practices and Procedures* (Vol. 60; Tech. Rep. No. 3). Retrieved from <https://www.jstor.org/stable/3349801>
- Humphreys, B. R. (2013). Dealing With Zeros in Economic Data. Retrieved from <https://pdfs.semanticscholar.org/35c3/8229c8f7393acffc93b4a83120661df1f02c.pdf>
- Huppert, F. A. (2009). Perspectives on Psychological Science A New Approach to Reducing Disorder and Improving. , 4(1), 108–111. doi: 10.1111/j.1745-6924.2009.01100.x
- Huppert, F. A., Marks, N., Clark, A., Siegrist, J., Stutzer, A., Vittersø, J., & Wahrendorf, M. (2009). Measuring Well-being across Europe: Description of the ESS Well-being Module and preliminary findings. *Social Indicators Research*, 91(3), 301–315. doi: 10.1007/s11205-008-9346-0
- Huppert, F. A., & So, T. T. (2013). Flourishing Across Europe: Application of a New Conceptual Framework for Defining Well-Being. *Social Indicators Research*, 110(3), 837–861. doi: 10.1007/s11205-011-9966-7
- Hurtado, S., Pryor, J. H., Tran, S., DeAngelo, L., & Blake, L. P. (2011). *The American Freshman National Norms* (Tech. Rep. No. January). Higher Education Research Institute UCLA.
- Hutubessy, R. C., van Tulder, M. W., Vondeling, H., & Bouter, L. M. (1999, 3). Indirect costs of back pain in the Netherlands: a comparison of the human capital method with the friction cost method. *Pain*, 80(1-2), 201–207. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0304395998002048> doi: 10.1016/S0304-3959(98)00204-8
- Jørgensen, M. B., Davidsen, M., & Tolstrup, J. S. (2017). *De samfundsmæssige omkostninger ved muskel- og skeletlidelser i Danmark* (Tech. Rep.). Copenhagen: Statens Institut for Folkesundhed. Retrieved from <https://portal.findresearcher.sdu.dk/en/publications/de-samfundsm\0T1\saessige-omkostninger-ved-muskel-og-skeletlidelser-i-da>
- Kahneman, D., Diener, E., & Schwarz, N. (1999). *Well-being: The foundations of hedonic psychology*. (D. Kahneman, E. Diener, & N. Schwarz, Eds.). New York, NY, US: Russell Sage Foundation.
- Kahneman, D., & Krueger, A. B. (2006). Development in the Measurement of Subjective Well-Being. *The Journal of Economic Perspectives*, 20(1), 3–24.

- Kessel, R. A. (1958, 10). Price Discrimination in Medicine. *The Journal of Law and Economics*, 1, 20–53. Retrieved from <https://www.journals.uchicago.edu/doi/10.1086/466540> doi: 10.1086/466540
- Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S., ... Kendler, K. S. (1994, 1). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. Results from the National Comorbidity Survey. *Archives of general psychiatry*, 51(1), 8–19. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/8279933>
- Keyes, C. L. M. (2002). The Mental Health Continuum : From Languishing to Flourishing in Life. *Journal of Health and Social Behavior*, 43(2), 207–222. Retrieved from <http://www.jstor.org.ucd.idm.oclc.org/stable/3090197>
- Keyes, C. L. M. (2005). Mental Illness and/or Mental Health? Investigating Axioms of the Complete State Model of Health. *Journal of Consulting and Clinical Psychology*, 73(3), 539–548. Retrieved from <http://www.midus.wisc.edu/findings/pdfs/191.pdf> doi: 10.1037/0022-006X.73.3.539
- Knapp, M. (2003). Hidden costs of mental illness. *British Journal of Psychiatry*(183), 477–478. doi: 10.7748/ns.17.38.4.s3
- Knapp, M., Beecham, J., Mcdaid Msc, D., Matosevic, T., & Smith Msc, M. (2011). The economic consequences of deinstitutionalisation of mental health services: lessons from a systematic review of European experience. *Health and Social Care in the Community*, 19(2), 113–125. Retrieved from https://s3.amazonaws.com/academia.edu.documents/45858116/The_economic_consequences_of_deinstituti20160522-20193-10xvyve.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1554973338&Signature=W5hfBYRr2N2Cu5JTlaX0cOTJQrw%3D&response-content-disposition=inline doi: 10.1111/j.1365-2524.2010.00969.x
- Knapp, M., Mangalore, R., & Simon, J. (2004). The Global Cost of Schizophrenia. *Schizophrenia Bulletin*, 30(279-293). Retrieved from <https://ovidsp-dc1-ovid-com.proxy1-bib.sdu.dk/sp-3.33.0b/ovidweb.cgi?WebLinkFrameset=1&S=AOGHFPJIIIOACAAMIKPDKKEGJPBLAAA00&returnUrl=ovidweb.cgi%3f%26Full%2bText%3dL%257cS.sh.22.23%257c0%257c01435748-200430020-00009%26S%3dAOGHFPJIIIOACAAMIKPDKKEGJPBLAAA00&d>
- Knapp, M., McDaid, D., & Parsonage, M. (2011). *Mental health promotion and mental illness prevention: The economic case* (Tech. Rep.). London: Department of Health. Retrieved from http://eprints.lse.ac.uk/38227/1/Knapp_et_al_MHPP_The_Economic_Case.pdf

- Koopmanschap, M. A., & van Ineveld, B. M. (1992). Towards a new approach for estimating indirect costs of disease. *Social Science and Medicine*, 34(9), 1005–1010. doi: 10.1016/0277-9536(92)90131-9
- Koushede, V., Lasgaard, M., Hinrichsen, C., Meilstrup, C., Nielsen, L., Boe, S., ... Ivan, Z. (2019). Measuring mental well-being in Denmark : Validation of the original and short version of the Warwick-Edinburgh mental well-being scale (WEMWBS and SWEMWBS) and cross-cultural comparison across four European settings. *Psychiatry Research*, 271(December 2018), 502–509. Retrieved from <https://doi.org/10.1016/j.psychres.2018.12.003> doi: 10.1016/j.psychres.2018.12.003
- Koushede, V., Nielsen, L., Meilstrup, C., & Donovan, R. J. (2015). From rhetoric to action: Adapting the act-belong-commit mental health promotion programme to a Danish context. *International Journal of Mental Health Promotion*, 17(1), 22–33. doi: 10.1080/14623730.2014.995449
- Kronborg, C., Handberg, G., & Axelsen, F. (2009). Health care costs, work productivity and activity impairment in non-malignant chronic pain patients. *European Journal of Health Economics*, 10(1), 5–13. doi: 10.1007/s10198-008-0096-3
- Kruse, M., & Christiansen, T. (2011). Register-based studies of healthcare costs. *Scandinavian Journal of Public Health*, 39(7), 206–209. doi: 10.1177/1403494811404277
- Larg, A., & Moss, J. R. (2011). Cost-of-Illness Studies: A Guide to Critical Evaluation. *PharmacoEconomics*, 29(8), 653–671. Retrieved from <https://doi.org/10.2165/11588380-000000000-00000> doi: 10.2165/11588380-000000000-00000
- Layard, R. (2013). Mental health: the new frontier for labour economics. *IZA Journal of Labor Policy*, 2(1), 1. doi: 10.1186/2193-9004-2-2
- Layard, R., Banerjee, S., Bell, S., Clark, D., Fielding, S., Knapp, M., ... Strang, J. (2012). *How mental illness loses out in the NHS* (Tech. Rep. No. June). London: The Centre for Economic Performance's Mental Health Policy Group. Retrieved from <http://cep.lse.ac.uk/pubs/download/special/cepsp26.pdf>
- Lenk, C. (2011). *Mein Körper - mein Eigentum ?* Retrieved from <https://www.bpb.de/apuz/33319/mein-koerper-mein-eigentum?p=all>
- Loewy, E. H. (1980, 3). International Encyclopedia of Pharmacology and Therapeutics: Duplication or Updating? *New England Journal of Medicine*, 302(12), 697–698. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/>

6766531<http://www.nejm.org/doi/abs/10.1056/NEJM198003203021226> doi:
10.1056/NEJM198003203021226

Luce, B. R., Manning, W. G., Siegel, J. E., & Lipscomb, J. (1996). *Cost-effectiveness in health and medicine*. New York.

Lukat, J., Margraf, J., Lutz, R., van der Veld, W. M., & Becker, E. S. (2016, 2). Psychometric properties of the Positive Mental Health Scale (PMH-scale). *BMC psychology*, 4, 8. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/26865173><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC4748628> doi: 10.1186/s40359-016-0111-x

Luyten, J., Naci, H., & Knapp, M. (2016, 5). Economic evaluation of mental health interventions: an introduction to cost-utility analysis. *Evidence Based Mental Health*, 19(2), 49–53. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/27075444><http://ebmh.bmj.com/lookup/doi/10.1136/eb-2016-102354> doi: 10.1136/eb-2016-102354

Lynge, E., Sandegaard, J. L., & Rebolj, M. (2011). The Danish National Patient Register. *Scandinavian Journal of Public Health*, 39(7), 30–33. doi: 10.1016/j.soard.2015.11.001

Macintyre, A., Ferris, D., Gonçalves, B., & Quinn, N. (2018, 12). What has economics got to do with it? The impact of socioeconomic factors on mental health and the case for collective action. *Palgrave Communications*, 4(1), 10. Retrieved from <http://www.nature.com/articles/s41599-018-0063-2> doi: 10.1057/s41599-018-0063-2

MacKerron, G. (2012). HAPPINESS ECONOMICS FROM 35 000 FEET. *Journal of Economic Surveys*, 26(4), 705–735. doi: 10.1111/j.1467-6419.2010.00672.x

Mankiw, N. G. (2008). *Principles of Microeconomics* (fifth ed.). Mason: South-Western Cengage Learning.

Mankiw, N. G. (2017). The Economics of Healthcare. In *The economics of healthcare* (pp. 1–14).

Manning, W. G., & Mullahy, J. (2001, 7). Estimating log models: to transform or not to transform? *Journal of Health Economics*, 20(4), 461–494. Retrieved from <https://www.sciencedirect-com.proxy1-bib.sdu.dk/science/article/pii/S0167629601000868> doi: 10.1016/S0167-6296(01)00086-8

- McCrone, P. (2011). Mental health economics: Current methodological issues. *Epidemiology and Psychiatric Sciences*, 20(3), 239–243. doi: 10.1017/S2045796011000485
- Mcdaid, D. (2005). Mental health I: Key issues in the development of policy and practice across Europe. *European Observatory on Health System and Policies*, 19.
- McDaid, D., & Park, A. L. (2011). Investing in mental health and well-being: Findings from the DataPrev project. *Health Promotion International*, 26(SUPPL. 1), 1–26. doi: 10.1093/heapro/dar059
- McHenry, J. A., & Donovan, R. (2013). Developing the Perth Charter for the promotion of mental health and wellbeing. *Advances in Mental Health*, 12(1), 8–10.
- McKay, M. T., & Andretta, J. R. (2017, 9). Evidence for the Psychometric Validity, Internal Consistency and Measurement Invariance of Warwick Edinburgh Mental Well-being Scale Scores in Scottish and Irish Adolescents. *Psychiatry Research*, 255, 382–386. Retrieved from <https://linkinghub.elsevier.com/retrieve/pii/S0165178117302330> doi: 10.1016/j.psychres.2017.06.071
- Mihaylova, B., Briggs, A., O’Hagan, A., & Thompson, S. G. (2011, 8). Review of statistical methods for analysing healthcare resources and costs. *Health Economics*, 20(8), 897–916. Retrieved from <http://doi.wiley.com/10.1002/hec.1653> doi: 10.1002/hec.1653
- Ministry of Health. (2017). *Healthcare in Denmark - An Overview* (Tech. Rep.). doi: 10.1108/Mrr-06-2015-0147
- Mogyorosz, Z., & Smith, P. (2005). *The main methodological issues in costing health care services: A literature review*. Retrieved from <https://ideas.repec.org/p/chy/respap/7cherp.html>
- Munk-Jørgensen, P., & Dinesen Østergaard, S. (2011). Register-based studies of mental disorders. *Scandinavian Journal of Public Health*, 39(7), 170–174. doi: 10.1177/1403494810390728
- Murphy, M. (1978, 9). THE VALUE OF NONMARKET HOUSEHOLD PRODUCTION: OPPORTUNITY COST VERSUS MARKET COST ESTIMATES. *Review of Income and Wealth*, 24(3), 243–255. Retrieved from <http://doi.wiley.com/10.1111/j.1475-4991.1978.tb00051.x> doi: 10.1111/j.1475-4991.1978.tb00051.x

- Murray, C. J., & Lopez, A. D. (1996). *The Global burden of disease A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020: summary* (Tech. Rep.). Boston: Harvard School of Public Health. doi: 10.1088/1742-6596/707/1/012025
- MUSHKIN, S. J. (1958, 9). Toward a definition of health economics. *Public health reports (Washington, D.C. : 1896)*, 73(9), 785–93. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/13579116><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC1951624>
- Mushkin, S. J. (1962). Health as an Investment. *Journal of Political Economy*, 70(5), 129–157. Retrieved from <https://about.jstor.org/terms>
- Nicholson, W., & Snyder, C. (2009). *Intermediate Microeconomics and Its Application* (Eleventh ed.). Mason: South-Western Cengage Learning.
- Nielsen, L., Sørensen, B. B., Donovan, R. J., Tjørnhøj-Thomsen, T., & Koushede, V. (2017). ‘Mental health is what makes life worth living’: an exploration of lay people’s understandings of mental health in Denmark. *International Journal of Mental Health Promotion*, 19(1), 26–37. Retrieved from <http://dx.doi.org/10.1080/14623730.2017.1290540> doi: 10.1080/14623730.2017.1290540
- Nulty, D. D. (2008). The adequacy of response rates to online and paper surveys: What can be done? *Assessment and Evaluation in Higher Education*, 33(3), 301–314. doi: 10.1080/02602930701293231
- OECD. (2012). *Sick on the job? Myths and realities about mental health and work*. Paris: OECD Publishing. Retrieved from <http://link.springer.com/10.1007/s12498-012-0114-3> doi: 10.1007/s12498-012-0114-3
- OECD. (2013a). *Mental Health and Work: Denmark*. doi: <http://dx.doi.org/10.1787/9789264188631-en>
- OECD. (2013b). *OECD Guidelines on Measuring Subjective Well-being*. Retrieved from http://www.oecd-ilibrary.org/economics/oecd-guidelines-on-measuring-subjective-well-being_9789264191655-en%0Ahttp://www.ncbi.nlm.nih.gov/pubmed/24600748 doi: 10.1787/9789264191655-en
- OECD. (2014). *FOCUS ON HEALTH Making Mental Health Count* (Tech. Rep.). Paris. Retrieved from <http://dx.doi.org/10.1787/9789264124523-en>. doi: 10.1787/9789264124523-en

- OECD/EU. (2018). *Health at a Glance: Europe 2018 State of Health in the EU Cycle* (Tech. Rep.). Paris. Retrieved from <https://doi.org/10.1787/health-glance-eur-2018-en> doi: 10.1787/fd41e65f-es
- OECD/European Observatory on Health Systems and Policies. (2017). *Denmark: Country Health Profile 2017, State of Health in the EU* (Tech. Rep.). European Observatory on Health Systems and Policies. doi: <https://doi-org.proxy1-bib.sdu.dk/10.1787/9789264283343-en>
- Økonomi- og Indenrigsministeriet. (2017). *Executive Order of the Civil Registration System Act* (No. 2017-2725). CPR administration. Retrieved from <https://www.retsinformation.dk/Forms/R0710.aspx?id=191719>
- Olejz, M., Juul Nielsen, A., Rudkjøbing, A., Okkels Birk, H., Krasnik, A., & Hernández-Quevedo, C. (2012). Denmark health system review. *Health systems in transition*, 14(2), 1–192. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22575801>
- Oostenbrink, J. B., Koopmanschap, M. A., & Rutten, F. F. (2002). Standardisation of costs: The Dutch Manual for Costing in Economic Evaluations. *PharmacoEconomics*, 20(7), 443–454. doi: 10.2165/00019053-200220070-00002
- Raworth, K. (2017). *Doughnut economics : seven ways to think like a 21st century economist*. Vermont: Chelsea Green Publishing.
- Razzouk, D. (2017). *Mental Health Economics The Costs and Benefits of Psychiatric Care* (D. Razzouk, Ed.). Sao Paulo: Springer.
- Rice, D. P. (1967, 3). Estimating the cost of illness. *American journal of public health and the nation's health*, 57(3), 424–40. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/6066903><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC1227175>
- Rice, D. P. (2000). Cost of illness studies: What is good about them? *Injury Prevention*, 6(3), 177–179. doi: 10.1136/ip.6.3.177
- Rice, D. P., Kelman, S., & Miller, L. S. (1991). Estimates of economic costs of alcohol and drug abuse and mental illness, 1985 and 1988. *Public health reports (Washington, D.C. : 1974)*, 106(3), 280–92. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/1905049><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC1580246>
- Rice, D. P., & Miller, L. S. (1998, 7). Health economics and cost implications of anxiety and other mental disorders in the United States. *British Journal*

- of Psychiatry*, 173(S34), 4–9. Retrieved from https://www.cambridge.org/core/product/identifier/S0007125000293458/type/journal_article doi: 10.1192/S0007125000293458
- Rosenquist, J. N., Fowler, J. H., & Christakis, N. A. (2011, 3). Social network determinants of depression. *Molecular Psychiatry*, 16(3), 273–281. Retrieved from <http://www.nature.com/articles/mp201013> doi: 10.1038/mp.2010.13
- Rothbard, M. N. (1997). Toward a Reconstruction of Utility and Welfare Economics. In E. Elgar (Ed.), *The logic of action one: Method, money, and the austrian school* (Reprinted ed., pp. 211–255). London: The Mises Institute.
- Rowell, D. S., & Jackson, T. J. (2011). Additional costs of inpatient malnutrition, Victoria, Australia, 2003–2004. *European Journal of Health Economics*, 12(4), 353–361. doi: 10.1007/s10198-010-0245-3
- Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annual review of psychology*, 52, 141–66. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11148302> doi: 10.1146/annurev.psych.52.1.141
- Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57(6), 1069–1081. doi: 10.1037/0022-3514.57.6.1069
- Ryff, C. D., & Singer, B. (1998). The Contours of Positive Human Health. *Psychological Inquiry*, 9(1), 1–28.
- Sahl Andersen, J., De Fine Olivarius, N., & Krasnik, A. (2011). The Danish national health service register. *Scandinavian Journal of Public Health*, 39(7), 34–37. doi: 10.1177/1403494810394718
- Santini, I. Z., Koyanagi, A., Tyrovolas, S., Maria, J., Donovan, R. J., Nielsen, L., & Koushede, V. (2017). The protective properties of Act-Belong-Commit indicators against incident depression , anxiety , and cognitive impairment among older Irish adults : Findings from a prospective community-based study. *Experimental Gerontology*, 91, 79–87. Retrieved from <http://dx.doi.org/10.1016/j.exger.2017.02.074> doi: 10.1016/j.exger.2017.02.074
- Santini, Z. I., Koyanagi, A., Tyrovolas, S., Mason, C., & Haro, J. M. (2015, 4). The association between social relationships and depression: A systematic review. *Journal of Affective Disorders*, 175, 53–65. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25594512><https://>

linkinghub.elsevier.com/retrieve/pii/S0165032714008350 doi: 10.1016/j.jad.2014.12.049

Savedoff, W. D. (2004). Kenneth Arrow and the birth of health economics. *Bulleting of the World Health Organization*, 82(2), 139–40. doi: 0.1590/S0042-96862004000200012

Schultz, T. W. (1970). *Investment in Human Capital: The Role of Education and of Research*. New York: Free Press. Retrieved from <https://nla.gov.au/nla.cat-vn2661595>

Scott, A., & Smith, M. (2016). *One in four students suffer from mental health problems — YouGov*. Retrieved from <https://yougov.co.uk/topics/lifestyle/articles-reports/2016/08/09/quarter-britains-students-are-afflicted-mental-hea>

Segel, J. E. (2006). *Cost-of-Illness Studies — A Primer* (Tech. Rep.). RTI-UNC Center of Excellence in Health Promotion Economics,.

Seow, L. S. E., Vaingankar, J. A., Abdin, E., Sambasivam, R., Jeyagurunathan, A., Pang, S., ... Subramaniam, M. (2016, 1). Positive mental health in outpatients with affective disorders: Associations with life satisfaction and general functioning. *Journal of Affective Disorders*, 190, 499–507. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0165032715308053> doi: 10.1016/J.JAD.2015.10.021

Shepherd, G. (1998). Models of community care. *Journal of Mental Health*, 7(2), 165–177. Retrieved from <https://www.tandfonline.com/action/journalInformation?journalCode=ijmh20> doi: 10.1080/09638239818210

Shiell, A., Gerard, K., & Donaldson, C. (1987, 12). Cost of illness studies: An aid to decision-making? *Health Policy*, 8(3), 317–323. Retrieved from <https://www.sciencedirect.com/science/article/pii/0168851087900078> doi: 10.1016/0168-8510(87)90007-8

Shiell, A., Gerard, K., & Donaldson, C. (1987). *A Second Opinion Cost of illness studies: an aid to decision-making?* (Vol. 8; Tech. Rep.). Retrieved from <https://pdf.sciencedirectassets.com/271761/1-s2.0-S0168851000X01352/1-s2.0-0168851087900078/main.pdf?x-amz-security-token=AgoJb3JpZ2luX2VjEGlhcXVzLWVhc3QtMSJIMEYCIQCCvcVhGiyq2zVvOnUnI40W86U07%2BsLKEWhEXggLOgfIwIhA0lAv%2BrZbcEqFT6GjM38Vrd%2Bu%2BfiHiazlU1xr>

- (WEMWBS): development and UK validation. *Health and Quality of Life Outcomes*, 5(1), 63. Retrieved from <http://hqlo.biomedcentral.com/articles/10.1186/1477-7525-5-63> doi: 10.1186/1477-7525-5-63
- The Government Office for Science. (2008). *Foresight Mental Capital and Wellbeing Project* (Tech. Rep.). London. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/292450/mental-capital-wellbeing-report.pdf
- The World Bank. (n.d.). *Life expectancy at birth, total (years) — Data*. Retrieved from <https://data.worldbank.org/indicator/sp.dyn.le00.in>
- The World Health Organization. (2011). *WHO — Equity*. World Health Organization. Retrieved from <https://www.who.int/healthsystems/topics/equity/en/>
- The World Medical Association. (n.d.). *Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects*. Retrieved from <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>
- Trautmann, S., Rehm, J., & Wittchen, H. (2016). The economic costs of mental disorders: Do our societies react appropriately to the burden of mental disorders? *EMBO Reports*, 17(9), 1245. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5007565/> doi: 10.15252/EMBR.201642951
- United Nations Department of Economic and Social Affairs. (2017). *World Population Prospects: The 2017 Revision* (Tech. Rep.). United Nations. Retrieved from <https://population.un.org/wpp/Download/Standard/Population/>
- Verbeek, M. (2012). *A guide to modern econometrics* (4. edition ed.). West Sussex: Wiley.
- Waterman, A. S. (1993). Two Conceptions of Happiness: Contrasts of Personal Expressiveness (Eudaimonia) and Hedonic Enjoyment. *Journal of Personality and Social Psychology*, 64(4), 678–691. Retrieved from <https://www.researchgate.net/publication/232515799> doi: 10.1037/0022-3514.64.4.678
- Williams, A. (1992). Cost-effectiveness analysis: is it ethical? *Journal of medical ethics*, 18, 7–11. Retrieved from <http://jme.bmj.com/> doi: 10.1136/jme.18.1.7
- World, G. B., & Oct, N. D. (2017). The Taboo Of Mental Health. , 2017–2019.

- World Bank. (2015). Economic and Social Development Brief. *5th Eastern European Economic and Social Development Conference on Social Responsibility*, 05(May), 21–22. Retrieved from <http://www.esd-conference.com>
- World Health Organization. (2001). *Mental Health: New Understanding, New Hope* (Tech. Rep.). Geneve. Retrieved from https://s3.amazonaws.com/academia.edu.documents/45858116/The_economic_consequences_of_deinstituti20160522-20193-10xvyve.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1554973338&Signature=W5hfBYRr2N2Cu5JTlaX0cOTJQrw%3D&response-content-disposition=inline
- World Health Organization. (2005). *Promoting mental health : concepts, emerging evidence, practice : a report of the World Health Organization, Department of Mental Health and Substance Abuse in collaboration with the Victorian Health Promotion Foundation and the University of Melbourne* (Tech. Rep.). Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2408399&tool=pmcentrez&rendertype=abstract%5Cnhttp://doi.wiley.com/10.1111/j.1466-7657.2004.00268.x>
- World Health Organization. (2013). *Mental health action plan 2013–2020*. (Tech. Rep.). Retrieved from http://apps.who.int/iris/bitstream/10665/89966/1/9789241506021_eng.pdf doi: ISBN9789241506021
- World Health Organization. (2018a). *International statistical classification of diseases and related health problems (11th Revision)*. World Health Organization. Retrieved from <https://icd.who.int/browse11/l-m/en>
- World Health Organization. (2018b). *Mental disorders*. Retrieved from <https://www.who.int/en/news-room/fact-sheets/detail/mental-disorders>
- Wykes, T., Haro, J. M., Belli, S. R., Obradors-Tarragó, C., Arango, C., Ayuso-Mateos, J. L., ... Wittchen, H.-U. (2015, 11). Mental health research priorities for Europe. *The Lancet Psychiatry*, 2(11), 1036–1042. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S2215036615003326> doi: 10.1016/S2215-0366(15)00332-6
- Zechmeister, I., Kilian, R., & Mcdaid, D. (2008). Is it worth investing in mental health promotion and prevention of mental illness ? A systematic review of the evidence from economic evaluations. *BMC Public Health*, 8(20), 1–11. doi: 10.1186/1471-2458-8-20

Appendices

Appendix A

Items in the WEMWBS questionnaire

Items included in the WEMWBS questionnaire :

-
1. I've been feeling optimistic about the future.
 2. I've been feeling useful.
 3. I've been feeling relaxed.
 4. I've been feeling interested in other people
 5. I've had energy to spare.
 6. I've been dealing with problems well.
 7. I've been thinking clearly.
 8. I've been feeling good about myself.
 9. I've been feeling close to other people.
 10. I've been feeling confident.
 11. I've been able to make up my own mind about things.
 12. I've been feeling loved.
 13. I've been interested in new things.
 14. I've been feeling cheerful.
-

Answers options were: "none of the time", "rarely", "some of the time", "often", "all of the time".

Warwick-Edinburgh Mental Well-being Scale (WEMWBS)

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Table 9: Annex A: WEMWBS

Appendix B

Regression output for (2) Costs of hospitalization

(2) Costs for hospitalization					
	Coefficient	Std. Error	p value	95% CI	
Mental wellbeing					
High	0	(.)			
Moderate	583.7937	2060.746	0.777	-3456.768	4624.356
Low	3603.289	3678.462	0.327	-3609.173	10815.75
Gender					
Men	0	(.)			
Women	-466.3015	1491.705	0.755	-3391.129	2458.526
Age	228.8488	83.13954	0.006	65.8348	391.8628
Education					
Primary of unknown	0	(.)			
Gymnasium/Youth education	104.0464	1585.195	0.070	-3004.089	3212.182
Higher education	97.65884	1926.526	0.050	-3679.734	3875.052
Marital status					
Married/Reg. partnership	0	(.)			
Divorced, sep. partners, widow	-527.9846	1739.539	0.762	-3938.747	2882.778
Unmarried	848.1225	3134.114	0.787	-5297.022	6993.267
Income					
Highest quartile	0	(.)			
Second highest quartile	-4,889.343	2,599.605	0.060	-9,986.46	207.7747
Third-highest quartile	-2,900.835	2,992.208	0.332	-8,767.739	2,966.07
Lowest quartile	-3,731.056	3,254.313	0.252	-10,111.88	2,649.767
Employment status					
Employed	0	(.)			
Unemployed	4,327.975	4,240.728	0.308	-3,986.939	12,642.89
In work education	2,057.155	1,842.725	0.264	-1,555.928	5,670.237
Social Pension/Early ret.	1,250.911	2,844.198	0.660	-4,325.788	6,827.609
Early retirement	8,135.626	6,245.142	0.193	-4,109.397	2,0380
Other	17,408.85	13,128.53	0.185	-8,332.616	43,150.32
Ethnicity					
Danish	0	(.)			
Immigrant/Descendent	-1,722.285	1,874.904	-0.92	-5,398.462	1,953.892
Constant	-3,544.193	5,272.713			
Observations	3,334				
R^2	0.0136				

Table 10: Regression output for (2) Costs for hospitalization

Appendix C

Regression output for (3) Costs of outpatient treatment

(3) Costs for outpatient treatment					
	Coefficient	Std. Error	p value	95% CI	
Mental wellbeing					
High	0	(.)			
Moderate	1,387.274	1,584.574	0.381	-1,719.645	4,494.193
Low	2,846.69	2,112.068	0.178	-1,294.499	6,987.88
Gender					
Men	0	(.)			
Women	861.3244	1,208.984	0.476	-1,509.165	3,231.813
Age	230.1543	66.6523	0.001	99.4673	360.8413
Education					
Primary or unknown	0	(.)			
Gymnasium/Youth education	-300.4773	1,655.086	0.856	-3,545.65	2,944.696
Higher education	-1,929.016	1,552.934	0.214	-4,973.897	1,115.866
Marital status					
Married/Reg. partnerships	0	(.)			
Divorced, sep. partners, widow	250.7694	2,283.02	0.913	-4,225.611	4,727.15
Unmarried	2,353.067	2,178.625	0.280	-1,918.623	6,624.757
Income					
Highest quartile	0	(.)			
Second highest quartile	165.4644	1,745.332	0.924	-3,256.657	3,587.586
Third highest quartile	536.3996	1,761.487	0.761	-2,917.397	3,990.197
Lowest quartile	-1,745.541	1,699.955	0.305	-5,078.69	1,587.608
Employment status					
Employed	0	(.)			
Unemployed	2158.384	1,831.533	0.239	-1,432.753	5,749.521
In work education	316.7599	1,250.872	0.800	-2,135.86	2,769.38
Social Pension/Early ret.	2,479.988	2,311.701	0.283	-2,052.629	7,012.605
Early retirement	2,351.254	4,395.738	0.593	-6,267.592	1,0970.1
Other	43.41733	1,944.958	0.982	-377.115	3,856.95
Ethnicity					
Immigrant/Descendent	-94.45211	1,909.973	0.961	-3,839.388	3,650.484
Constant	-6,525.046				
Observations	3,334				
R^2	0.0174				

Table 11: Regression output for (3) Costs for outpatient treatment

Appendix D

Regression output for (4) Sickness benefit transfers

(4) Sickness benefit transfers					
	Coefficient	Std. Error	p value	95% Conf.	Interv.
Mental wellbeing					
High	0	(.)			
Moderate	756.105	1,117.573	0.499	-1,435.096	2,947.306
Low	8,207.799	2,940.697	0.005	2,442.037	13,973.56
Gender					
Men	0	(.)			
Women	2,085.442	1,191.794	0.080	-251.2826	4,422.166
Age	16.09449	65.11994	0.805	-111.5848	143.7738
Education					
Primary of unknown	0	(.)			
Gymnasium/Youth education	-589.0753	1,857.561	0.751	-4,231.155	3,053.004
Higher education	-3,259.152	1,696.113	0.055	-6,584.685	66.38072
Marital status					
Married/Reg. partnership	0	(.)			
Divorced, sep. partners, widow	2,192.272	2,297.108	0.340	-2,311.619	6,696.164
Unmarried	-84.74693	1,386.859	0.951	-2,803.931	2,634.437
Income					
Highest quartile	0	(.)			
Second highest quartile	404.3256	1,167.487	0.729	-1,884.74	2,693.392
Third-highest quartile	933.2101	1,259.259	0.459	-1,535.792	3,402.212
Lowest quartile	1,805.799	2,120.842	0.395	-2,352.49	5,964.088
Employment status					
Employed	0	(.)			
Unemployed	474.8962	3,225.277	0.883	-5,848.834	6,798.627
Ethnicity					
Danish	0	(.)			
Immigrant/Descendent	-3,250.655	1,174.337	0.006	-5,553.152	-948.1587
Constant	1,445.31				
Observations	3,321				
R^2	0.030				

Table 12: Regression output for (4) Sickness benefit transfers

Appendix E

Costs for GPs and specialists by mental well-being

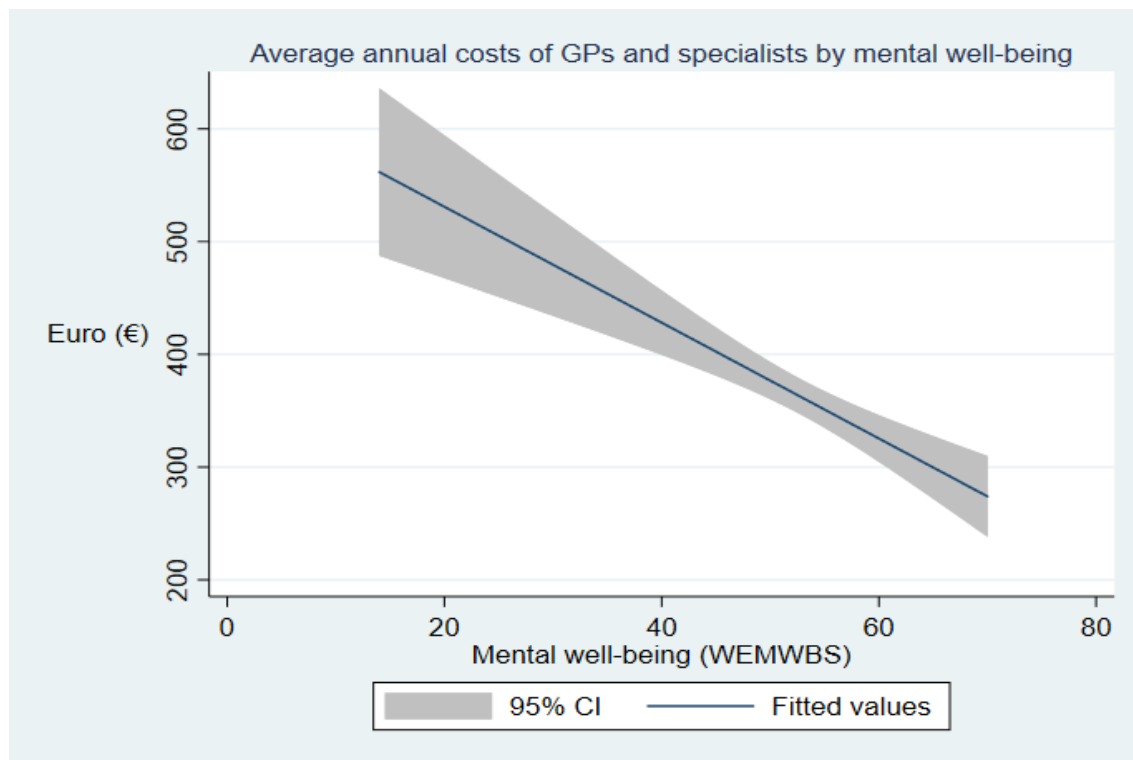


Figure 7: Costs for GPs and specialists by mental well-being

Appendix F

Costs for hospitalization by mental well-being

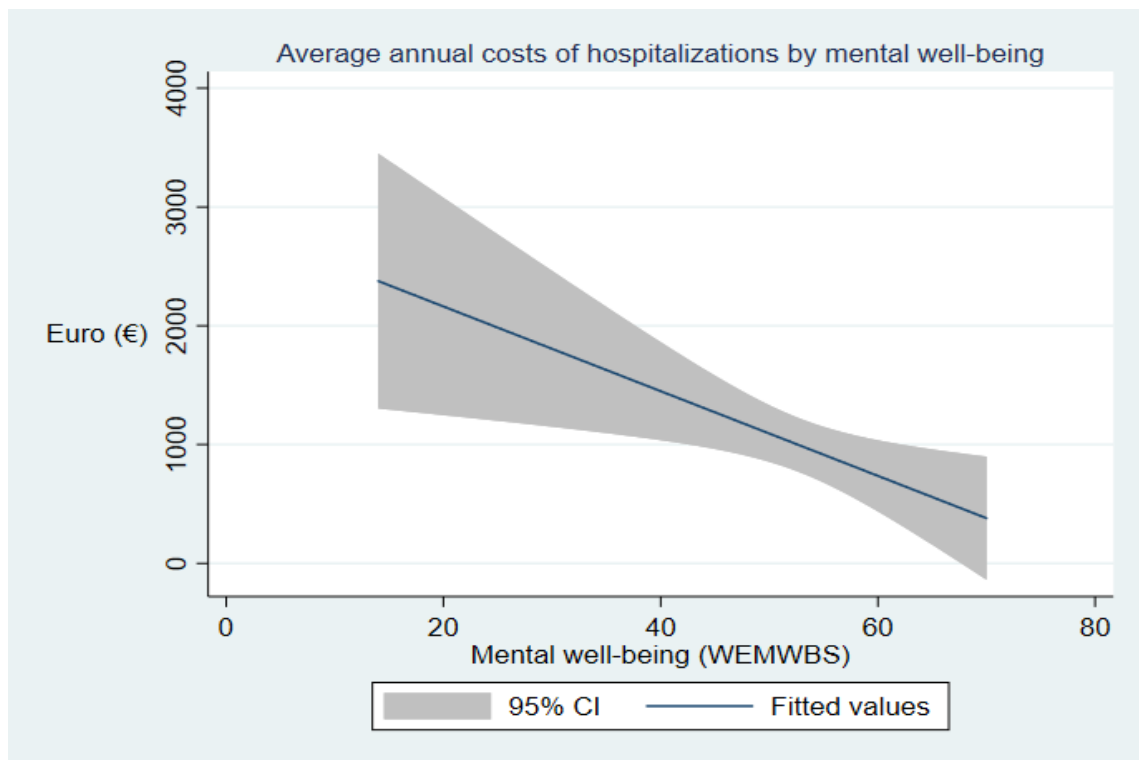


Figure 8: Costs for hospitalization by mental well-being

Appendix G

Costs for outpatient by mental well-being

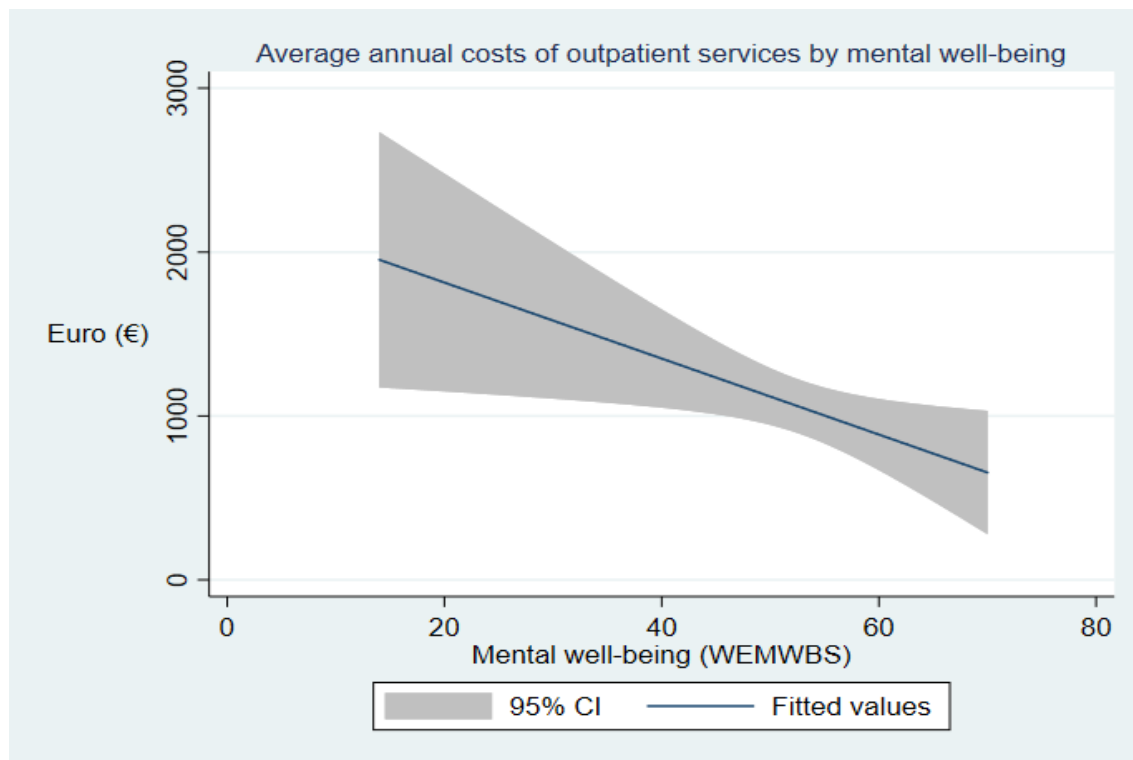


Figure 9: Costs for outpatient by mental well-being

Appendix H

OLS Model - Heteroscedasticity

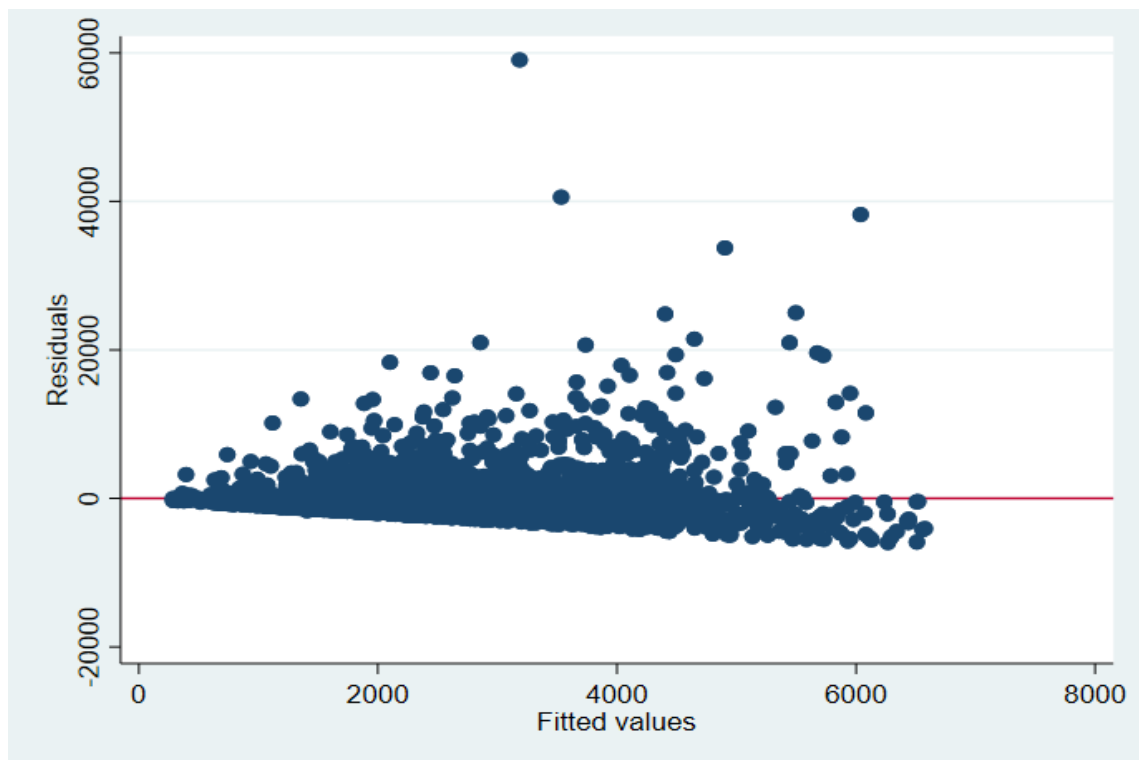


Figure 10: OLS Model - Heteroscedasticity

Appendix I

Extrapolating results to Danish population

	Persons in DMHWS 2016		% in DMHWS		Danish population*	
	non weighted	weighted	non weighted	weighted	non weighted	weighted
Persons over 16 years	3,508	3,508				4,106,988
Low MWB	456	526	13.7%	15.0%	-	616,048
Reference group	514	526	15.4%	15.0%	-	616,048
Persons > 16 years	3,508	3,508				
Moderate MWB	2,364	2,456	70.9%	70.0%	-	2,874,892
Reference group	514	526	15.4%	15.0%	-	616,048
Persons 16 - 64 years employed	1,762	1,762		54.4%	2,257,324	2,257,324
Low MWB	219	264	12.4%	15.0%		338,599
Reference group	249	264	14.1%	15.0%		338,599
Persons 16 - 64 years employed	1,904	1,904			2,257,324	2,257,324
Moderate MWB	1,294	1,333	73.4%	70.0%		1,580,127
Reference group	249.0%	286	14.1%	15.0%		338,599
*From Statistics Denmark						
Population per January 1, 2017: 4,106,988						
Female and male 16 - 64 years per January 1, 2017: 3,067,016						
Total average yearly employment rate per January 1, 2017: 73.6						

Table 13: Extrapolating results to Danish population

Appendix J

Histogram of (1) Costs for GPs and Specialists

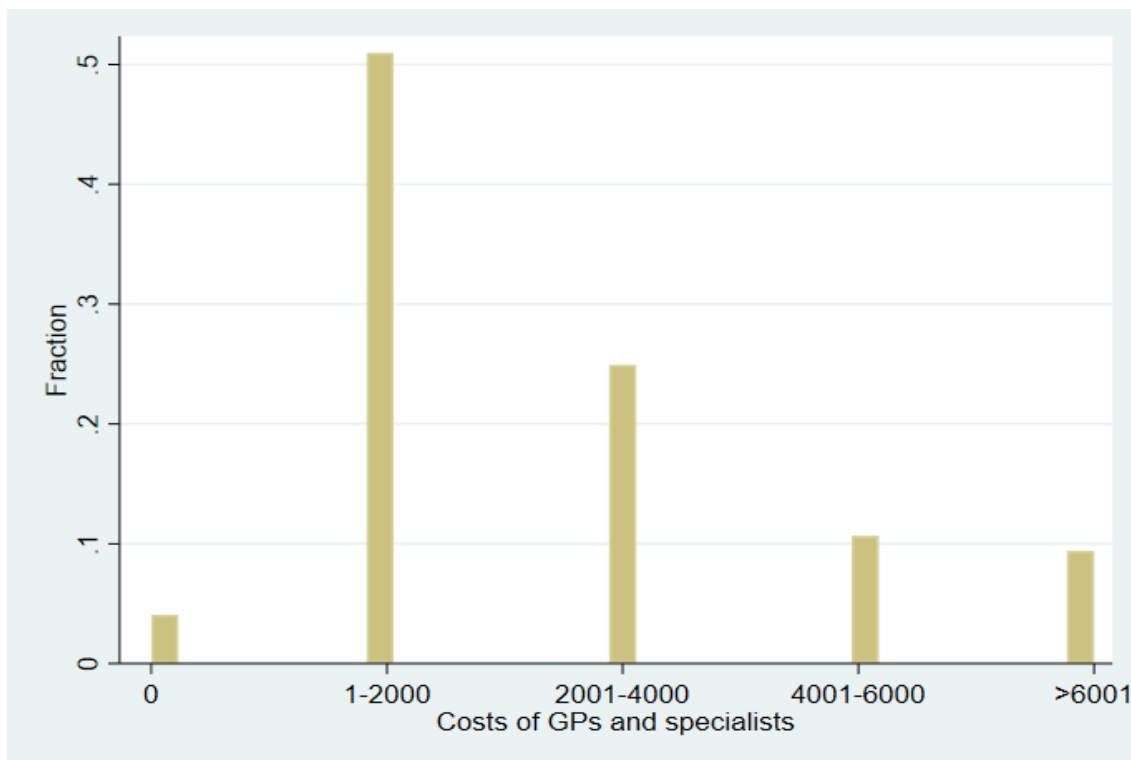


Figure 11: Histogram of (1) Costs for GPs and Specialists