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University of Southern Denmark

PhD Thesis

Reflections on fair allocation of health care resources: three empirical contributions

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- DaCHE

"People do not decide to become extraordinary. They decide to accomplish extraordinary things."

– EDMUND HILLARY

"The person who follows the crowd will usually go no further than the crowd. The person who walks alone is likely to find himself in places no one has ever seen before."

– ALBERT EINSTEIN

Preface

This thesis is based on and incorporates texts from, the following papers:

Paper 1: Simonsen, N. F, Oxholm, A. S., Kristensen, S. R. and Siciliani, L. (2020). What explains differences in waiting times for health care across socioeconomic status? *In review (third round, revised and resubmitted) at Health Economics.*

Paper 2: Simonsen, N. F and Kjær, T. (2020). New Evidence of Health State Dependent Utility of Consumption: A combined survey and register study.

Paper 3: Simonsen, N. F, Kjær, T. and Gyrd-Hansen, D. (2020). Pure altruism and misjudgement: A driver of wrongful societal willingness to pay?

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Most importantly, I want to thank my soon-to-be wife Lise for her sympathetic ear and for always supporting me.

Abbreviations

HSD	Health state dependence
SES	Socioeconomic status
SWB	Subjective well-being
WTP	Willingness To Pay

Contents

1 Introduction

The inequalities that exist within society and more specific ways of measuring and mitigating these are receiving increasing attention by policymakers and international organizations. Being one of the United Nations Sustainable Development Goals (United Nations, 2020) and a primary focus for OECD (OECD, 2020), measuring inequalities and, more importantly, understanding what drives them and what they entail are both of great interest. Inequalities with regard to health are especially of interest due to health's non-market-good characteristics. These characteristics entail that its provision and allocation are influenced by political ideology, efficiency considerations and preferences within the given society.

Efficient and equitable allocation of resources are essential requirements for social welfare. The decision makers face a trade-off between efficiency and other welfare equitable objectives in the allocation of public resources such as health care. This trade-off is also known as the "equity-efficiency tradeoff" (Wagstaff, 1991). When discussing the variations in the use and allocation of health care across different individuals, it is important to consider the differences between inequality and inequity with regard to health (Kawachi et al., 2002). The concept of inequality in health solely refers to the differences in measurable quantities that define the health of individuals. It implies that any observable or measurable difference in health between individuals is defined as an inequality in health. Health inequity, on the other hand, refers to cases of health inequality that are deemed unfair (Kawachi et al., 2002; Wagstaff and van Doorslaer, 2000). The classification of (un)fair inequality is the key to defining inequity. By definition, health inequity is a normative concept, which means, some kind of judgement needs to be applied to determine whether an observed inequality in health can be deemed unfair and, hence, represent inequity (Sen, 2002).

One of the most widely used definitions of an inequity in health is the one put forward by Whitehead (1992). She defines inequities as health inequalities that are avoidable, unnecessary and unfair. The simplicity of the definition is certainly an at-

tractive property, but it is not really linked to the theories of justice (Daniels, 2007). Norheim and Asada (2009) challenge the definition provided by Whitehead (1992) by asking whether all the avoidable differences in health that stem from infinitesimal differences in factors such as income and level of education, should be avoided at all costs. If this is in fact the case, Whitehead's definition clashes with the general agreement on reducing inequity in health and increasing the general health of a population (Wagstaff, 2002).

An example of health inequalities is the result of the study conducted by MacDorman and Mathews (2013), which showed that the infant mortality is more than twice as high for black non-Hispanics compared to white non-Hispanics. Another example is the more commonly known fact that younger individuals experience better health than elderly people. These inequalities stemming from age differences will normally be deemed as just due to the fact that age is an unavoidable dimension, and inequalities associated with this dimension will therefore not be viewed as unfair and unequal. Differences in infant mortality that are due to ethnicity will, on the contrary, be viewed as an inequity in health. The difference in infant mortality can be attributed to factors such as differences in level of education and access to prenatal care and health care in general (Centers for Disease Control and Prevention and others, 2013). Hence, such inequity can be prevented (or at least reduced) through interventions aimed at enhancing education and prenatal care for the worse-off groups (Heckman et al., 2012; Campbell et al., 2014).

The significance of defining, measuring and, possibly, reducing inequities in health is particularly great when considering the priority setting in health care. During the recent years, new and better treatment methods have arisen within the health care system. These new methods enable the targeting of a broader share of the population, but they are often costlier than older and less expensive treatment options (Kantarjian et al., 2014). This advancement, combined with an increasing older population, has exerted an immense amount of financial pressure on the publicly funded health care sectors across the world, rendering prioritisation across and within patient groups un-

avoidable (Vincent and Velkoff, 2010; Sorenson et al., 2013). The question is then of how one should prioritise without introducing more inequity in health than is socially preferable. Viewed from a purely utilitarian point of view, resources within a health sector should be distributed to optimise the total health of the population. This will, for instance, be the case if prioritisation is purely driven by efficiency concerns in accordance with the decision criteria in economic valuation, which favours treatment methods that deliver the greatest benefit for the lowest possible cost. A more sophisticated manner of prioritising needs to be implemented if policymakers wish to take possible health inequities and inequalities, for that matter, into account.

To improve our understanding of determinants of individual welfare and inequalities in health, we also need to recognise that a health shock might impact the individual beyond the direct effect it has on the overall level of utility. It might be the case that individuals' preferences for consumption and also redistribution are impacted by a health shock.

1.1 Aim

The overall aim of this thesis is to provide new insights into pertinent issues related to prioritisation in health through examining determinants of individual and social welfare. This is approached from three different angles focusing on: 1) determinants of possible inequalities in health care, 2) the impact of health on individual utility, and 3) public preferences for distribution of health care . The thesis will contribute to our understanding of the nature of socioeconomic inequalities in health care, and of the need to integrate concerns for equity with efficiency objectives in a health care system under increasing financial pressure.

To fulfil the aim, I first assess whether access to hospital care in Denmark is subject to inequalities across groups with different socioeconomic statuses. Subsequently, I investigate whether the state of health impacts the individual's preferences regarding consumption and how this might affect welfare and the optimal distribution of

resources. Lastly, considering a societal perspective, I examine how individuals' altruistic preferences affect the optimal allocation of resources through concerns for others. The overall aim of the thesis is clarified through the three papers that accompany this thesis. The specific research questions are addressed in each of the three papers are as follows:

- **Paper 1** assess whether socioeconomic factors such, as income or level of education impact the waiting times for commonly performed non-emergency hospital procedures in Denmark.
- **Paper 2** provides new and comprehensive empirical evidence on how health state affects the individual's marginal utility of consumption.
- **Paper 3** investigates whether individuals act as pure altruists and whether such other-regarding preferences lead to a biased valuation owing to incorrect beliefs of other individuals preferences.

The remainder of the thesis is structured as follows: Section 1.2 provides background information related to the thesis, while Sections 2 to 4 provide a summary of the three papers accompanying this thesis and Section 5 highlights the contributions that each paper makes and discusses their possible implications. Finally, Section 6 presents a brief discussion on possible future perspectives.

1.2 Background

This section provides a brief review of the literature and theory that provided the basis of this thesis and motivated the aim of the thesis.

1.2.1 Defining inequities

Measuring inequalities in health is an important first step to take irrespective of whether the goal is to describe or reduce inequalities or to understand and prevent specific inequities. Even when focusing only on health inequalities, there might be

an economic or purely utilitarian argument for reducing these due to possible cost savings. In a report by LaVeist et al. (2009), it was estimated that, between 2003 and 2006, the direct cost of health inequalities attributed to race or ethnicity amounted to $ 230 billion in the US alone.

The task of describing and explaining differences in health is a positive question, whereas the task of classifying which inequalities are also inequitable requires a normative view on what is fair and what is unfair, as not all health inequalities can be defined as unfair per se. Different fairness ideals can be used to provide this normative division.

Fleurbaey and Schokkaert (2009) make a distinction between what they call legitimate and illegitimate health inequalities. A legitimate health inequality is concerned with inequalities that are causally linked to individual responsibility, such as lifestyle, whereas the an illegitimate one is causally linked to factors residing outside the individual's own responsibility, such as social background.

A way of defining the normative distinction between legitimate and illegitimate inequalities is through the, equality of opportunity, approach proposed by Roemer (1993, 1998). This approach is an egalitarian ideal that seeks to equalise the advantages for all individuals instead of the actual outcomes. The terminology defines the individual's success, y_i, as a function y of, *circumstances* defined as c_i and, *effort* denoted e_i:

$$y_i = y(c_i, e_i). \tag{1.1}$$

Applying the perspective of Fleurbaey and Schokkaert (2009), the circumstances are illegitimate factors, as these are beyond one's control, while efforts are legitimate factors. Roemer defines equality of opportunity as individuals who exert the same amount of effort having the same level of success. This entails that *ceteris paribus*, at any given level of $\tilde{e}$, the social perspective could be to maximise the success of those

individuals who are worst off, i.e., have the lowest level of success:

$$\max_{c} \min \; y(c, \tilde{e}). \tag{1.2}$$

This entails that in a society with no inequity, for two individuals with the same level of effort e_i but different levels of circumstances, c_i, the redistribution between them should be such that the success of these two individuals is equal. This redistribution between individuals with different circumstances, known as types, is handled by the function y. This manner of redistributing is known as *the compensation principle*. According to this principle, when there are two individuals with the same level of effort e_i, priority should be given to the worse-off individual.

1.2.2 Preferences for inequities

The normative view regarding what people should hold each other responsible for has received a great degree of focus in the literature (Roemer, 1998; Dworkin, 1981). The more positive view on what people actually hold each other responsible for has received relatively less focus in the literature. Looking within the experimental literature, a small branch of studies exists that examines this matter. A classic example within this literature is the dictator game. In this game, one participant, the, dictator, is given the decision task of distribution a fixed amount of money between himself and another participant known as the recipient. The recipient has no control over how large a share of the money is allocated to him, and both participants are anonymous.

The standard economic predictions from the dictator game would be that the dictator has no incentive for allocating money to the recipient and should hence take all the money for himself. This prediction is based on the assumption that individuals exhibit a positive marginal utility of income, always preferring more money over less.

Transferring the dictator game to the laboratory and observing individuals' actual behaviour, however, reveals a different picture than the standard economic predictions. One of the earliest results showed that dictators redistributed 20% of the funds on

average (Forsythe et al., 1994). A more comprehensive review of the literature indicates that the proportion of dictators choosing not to redistribute varies from 0 to 93%, with an average of 33.9% (Camerer, 2011). The average amount redistributed amounts to around 20% of the initial endowment (Camerer, 2011). These results were some of the first to contradict the model of homo economicus and provided suggestive evidence towards the presence of preferences for fairness and altruism.

Although interesting, the above-mentioned results from the dictator games does not provide much insight into the attitudes towards individual responsibility or effort, as none of the participants contribute to the production of the endowment available. Cappelen et al. (2010) modified the dictator game by adding a preceding production phase. In this phase, participants were randomly assigned to a production task with either a high or low rate of return and given the freedom to individually choose the amount of time they wanted to devote to production. Participants hence effectively decided their own potential returns from the production by altering the amount of time they devoted to it, although the rate of return was decided at random. After the production phase, they were paired with a sequence of other participants assigned both types of returns. Then, the dictator game was played multiple times but with participants who were assigned both high and low rates of return. The results illustrated that the dictators did not hold recipients responsible for the rate of return randomly assigned to them, but did hold them responsible for the amount of effort that they devoted to the production phase. The results of the study conducted by Cappelen et al. (2010) showed that only 4.6% of the sample behaved strictly as choice egalitarians, which implies holding people responsible for their choices. This result is particularly interesting, as the chosen egalitarian view has a quite prominent position in the normative literature, and the result thus provides suggestive evidence of a misalignment between the normative distribution principles and the fairness aspects demonstrated by individuals.

The previous sections highlight the importance of establishing individuals' preferences regarding inequalities when one tries to decide whether a certain inequality is

just or unjust and, hence whether it is a source of inequity. Methods of identifying inequalities in health and uncovering the preferences for these will be presented and discussed in the remainder of this thesis.

2 Paper 1: What explains differences in waiting times for health care across socioeconomic status?

The aim of Paper 1 is to assess whether socioeconomic factors, such as income and level of education, affect the waiting time for non-emergency hospital procedures. Based on the high volume and previously investigated procedures within the waiting time literature, we chose to analyse five procedures performed on both men and women, one procedure performed only on women and one performed only on men. The seven chosen procedures are hip and knee replacement, hernia, cataract and gallstone surgery, knee and hip replacement, hysterectomy for women, and prostatectomy for men. The analysis is performed for the years 2013—2015, as this is the most recent period with stable institutional settings and reliable data quality[1].

In Denmark, patients who receive a referral to a hospital are covered by a waiting-time guarantee. The guarantee entails that if the expected waiting time on the date of the referral is longer than a specific threshold, the patient is given the legal right to receive care from a private provider at the state's expense. The threshold can either be one or two months depending on the severity of the patient's condition (Danish Ministry of Health, 2013). The classification of the severity is based on a medical assessment performed by the hospital, following guidelines formulated by the regional councils.

2.1 Data

For the analysis, we utilise data from the Danish National Patient Registry and socioeconomic registries from Statistics Denmark. The sample includes all patients over the age of 18 who have undergone one of the selected procedures during the years 2013—2015. The analysis only focuses on patients treated at public hospitals and publicly funded patients treated under the waiting-time guarantee at private providers. Both

[1]The Capital Region of Denmark implemented a new data system "Sundhedsplatformen" in 2016. It's introduction might have affected the registration of waiting times, which is why we have not included data from the years after 2015.

these types of patients are publicly funded.

The dependent variable is the waiting time for a hospital surgical procedure and is defined as the number of days between when the hospital registers the referral and when the actual procedure is performed. The waiting time is separated into an active component and a passive component as defined by the Danish Health Data Authority. The active waiting time refers to periods when the patient is waiting for a diagnosis, treatment or assistance. The passive waiting time refers to delays that occur if the patient cancels the appointment, takes time to consider whether to get treated, has a scheduled checkup, has a different condition that needs to be treated first or is undergoing examinations or treatment (Statens Serum Institut, 2015).

For assessing the SES of the patient, we consider the highest level of completed education and household disposable income. These two parameters are of primary interest, but we also control for labour market status, marital status, number of children, having an adult child, immigrant status, age, and comorbidity (we use the Elixhauser-van Walraven Comorbidity Index). We do not control for gender directly, as all analyses are performed separately for men and women.

2.2 Methods

We model waiting time w_{it} as a function of additively separable determinants for patient i in year t using the following linear model:

$$ln(w_{it}) = \mathbf{s}'_{it}\beta_s + \mathbf{y}'_{it}\beta_y + \mathbf{d}_t + \epsilon_{it} \tag{2.1}$$

Where $\mathbf{s}_{it}$ is a vector of variables measuring the patient's severity of illness, $\mathbf{y}_{it}$ is a vector of variables measuring the patient's SES, $\mathbf{d}_t$ is a vector of year-fixed effects and, finally, ϵ_{it} is an idiosyncratic error term. We log-transform waiting time for the sake of interpretation.

The estimate of primary interest is $\hat{\beta}_y$, as it measures the association between patients' waiting time and SES. If $\hat{\beta}_y < 0$, it should be interpreted as implying that

patients with a higher SES are associated with shorter waiting times.

We estimate Eq. (2.1) as both a *basic* and an *extended* model. In the *basic* model, we only include the two core socioeconomic variables in the vector y, while, in the *extended* model, we include the full set of controls.

If a patient's waiting time is expected to exceed the threshold (one month for severe patients, otherwise two months), the patient will be covered by the waiting-time guarantee. To actually receive treatment from a private provider requires the patient to play an active role in exercising the right. If the patient does not take any action they will just continue to wait at the public provider until the next available date even though the waiting time might exceed the threshold. Due to this, patients with higher SES might be socioeconomically advantaged and, hence, use the guarantee more frequently. To account for the fact that socioeconomic inequalities in waiting times might be driven by a selection into use of the guarantee, we also estimate endogenous switching regressions for cataract surgery and prostatectomy, as these present a non-negligible share of patients who are treated at private providers.

The switching regression framework includes a correction term to control for possible self-selection caused by patients using the waiting time guarantee. Following the works of Moscelli et al. (2018) and Toomet and Henningsen (2008), we estimate the models in two steps. In the first step, we model whether patient i in year t exercised the guarantee, using a probit model:

$$g_{it} = \mathbf{I}(\mathbf{s}'_{it}\gamma_s + z'_{it}\gamma_z + \mathbf{y}_{it}\gamma_y + \mathbf{d}_t + \upsilon_{it} > 0) \tag{2.2}$$

Where g_{it} is a dummy for whether the patient made use of the guarantee. We use the same set of controls as in Eq. (2.1), as the propensity to use the guarantee might be affected by the same factors that impact the waiting time. The variable z_{it} is an instrument that measures the difference in travel time between the closest public hospital and the closest private hospital. The instrument exploits these travel time differences as an exogenous source of variation in the propensity to use the guarantee

and is included in the model to avoid issues with collinearity (Newey, 1999). From this model, we will be able to examine whether patients with higher SES are more likely to use the guarantee by looking at $\hat{\gamma_y}$.

In the second step, we estimate two separate OLS models, one for patients who made use of the guarantee ($g_{it} = 1$), and one for those who did not ($g_{it} = 0$):

$$ln(w_{it1}) = \mathbf{s}'_{it1}\beta_{s1} + \mathbf{y}'_{it1}\beta_{y1} + \mathbf{d}_{t1} + \varrho_1\sigma_1\lambda_1(\hat{p}) + u_{it1} \quad \text{if} \quad g_{it} = 1 \tag{2.3}$$

$$ln(w_{it0}) = \mathbf{s}'_{it0}\beta_{s0} + \mathbf{y}'_{it0}\beta_{y0} + \mathbf{d}_{t0} + \varrho_0\sigma_0\lambda_0(\hat{p}) + u_{it0} \quad \text{if} \quad g_{it} = 0 \tag{2.4}$$

Once again, we include the same set of controls as in Eq. (2.1), but we also include selection correction terms $\lambda_1(\hat{p})$ and $\lambda_0(\hat{p})$. From this model, we will be able to infer whether patients with higher SES are associated with shorter waiting times by looking at $\hat{\beta}_y$.

2.3 Results

2.3.1 Descriptive

Table 1 provides descriptive statistics for the dependent and independent variables used, split by gender. On average, patients wait 74 days if male and 76 days if female, and around 9–10 of these days are passive and, hence, attributed to the patient. Around 12% of the patients end up using the waiting-time guarantee.

2.3.2 Regressions

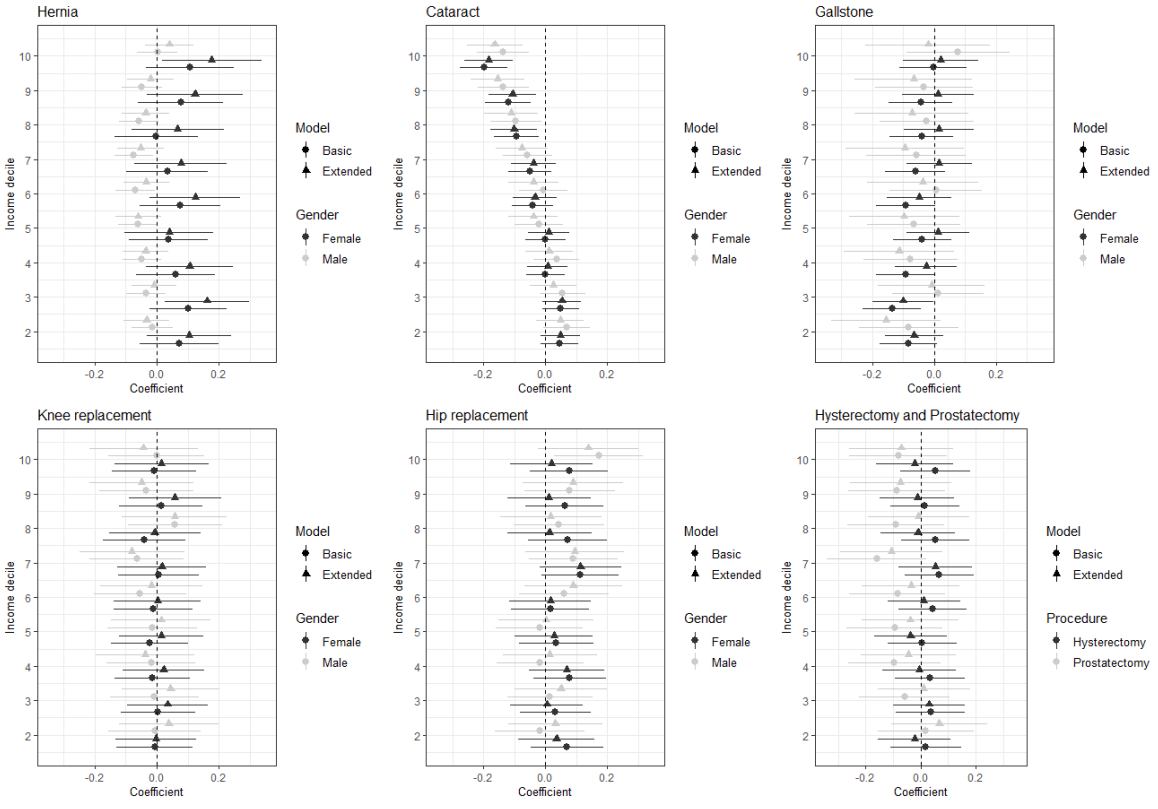
Figures 1 and 2 provide a graphical illustration of the estimates for the two core socioeconomic measures (income and level of education). We see that, for cataract and hernia surgery, there seems to be a socioeconomic gradient. For the other procedures, namely knee replacement, hip replacement, gallstone surgery, hysterectomy and prostatectomy, we find no indications of a gradient. The waiting time is shorter for

Table 1: Descriptive statistics

	Men N = 76,138					Women N = 85,053				
Variable	Mean	St. Dev.	Min	Median	Max	Mean	St. Dev.	Min	Median	Max
Total waiting time (days)	73.66	59.79	0	58	483	76.49	63.70	0	60	485
Public providers	77.98	60.81	0	63	483	81.00	65.09	0	64	485
Private providers	41.75	38.79	0	32	324	43.67	39.05	0	34	338
Active waiting time (days)	64.15	54.46	0	50	359	67.50	59.01	0	52	365
Passive waiting time (days)	9.51	26.67	0	0	262	9.00	25.05	0	0	237
Waiting-time guarantee	0.12	0.32				0.12	0.33			
Income										
Decile 1	0.04	0.19				0.04	0.19			
Decile 2	0.11	0.32				0.14	0.35			
Decile 3	0.16	0.37				0.20	0.40			
Decile 4	0.13	0.34				0.14	0.35			
Decile 5	0.11	0.31				0.11	0.31			
Decile 6	0.10	0.29				0.09	0.28			
Decile 7	0.09	0.28				0.08	0.26			
Decile 8	0.08	0.28				0.07	0.26			
Decile 9	0.09	0.29				0.07	0.25			
Decile 10	0.09	0.29				0.07	0.25			
Education										
Level 1	0.30	0.46				0.40	0.49			
Level 2	0.50	0.50				0.39	0.49			
Level 3	0.11	0.31				0.16	0.36			
Level 4	0.07	0.25				0.03	0.18			
Missing	0.02	0.16				0.02	0.15			
Family status										
Married	0.66	0.47				0.50	0.50			
Single	0.12	0.33				0.10	0.29			
Widow	0.09	0.29				0.25	0.43			
Divorced	0.12	0.33				0.16	0.37			
Number of children	1.82	1.20				1.87	1.14			
Adult child	0.76	0.42				0.78	0.41			
Labour market status										
Employed	0.26	0.44				0.23	0.42			
Self-employed	0.03	0.17				0.01	0.10			
Retired	0.66	0.48				0.70	0.46			
Unemployed	0.05	0.22				0.06	0.25			
Immigrant status										
Dane	0.94	0.24				0.93	0.25			
Western immigrant	0.03	0.16				0.03	0.17			
Non-western immigrant	0.03	0.18				0.04	0.19			
Severity of illness										
Age	66.63	13.54	18	69	103	66.15	14.95	18	69	107
Comorbidities	2.62	4.94	-11	0	45	1.75	4.58	-16	0	47
Travel time by car (minutes)										
Nearest public provider	22.94	16.02	2	19	381	22.61	15.77	2	19	381
Nearest private provider	43.88	44.75	1	33	388	44.34	42.92	1	33	388

the men (10-13%[2], 9-12 days[3]) and women (9-18%, 8-17 days) from the highest (8th-10th) income deciles undergoing cataract surgery as well as for the men in the higher (5th-8th) income deciles for hernia surgery (6-7%, 4-5 days), as compared to patients from the lowest (1st) income decile. We also find that men (3-11%, 3-10 days) and women (9-16%, 8-15 days) wait less for cataract surgery if their highest level of completed education exceeds primary school. Meanwhile, contrary to our expectations, we find longer waiting times for men (3-9%, 2-6 days) and women (5-19%, 4-15 days) undergoing hernia surgery as well as for women undergoing a hysterectomy (6-15%, 3-8 days) if their highest level of completed education exceeds primary school.

Figure 1: Estimates for the association between income and total waiting time for the basic and extended model across procedures and by gender



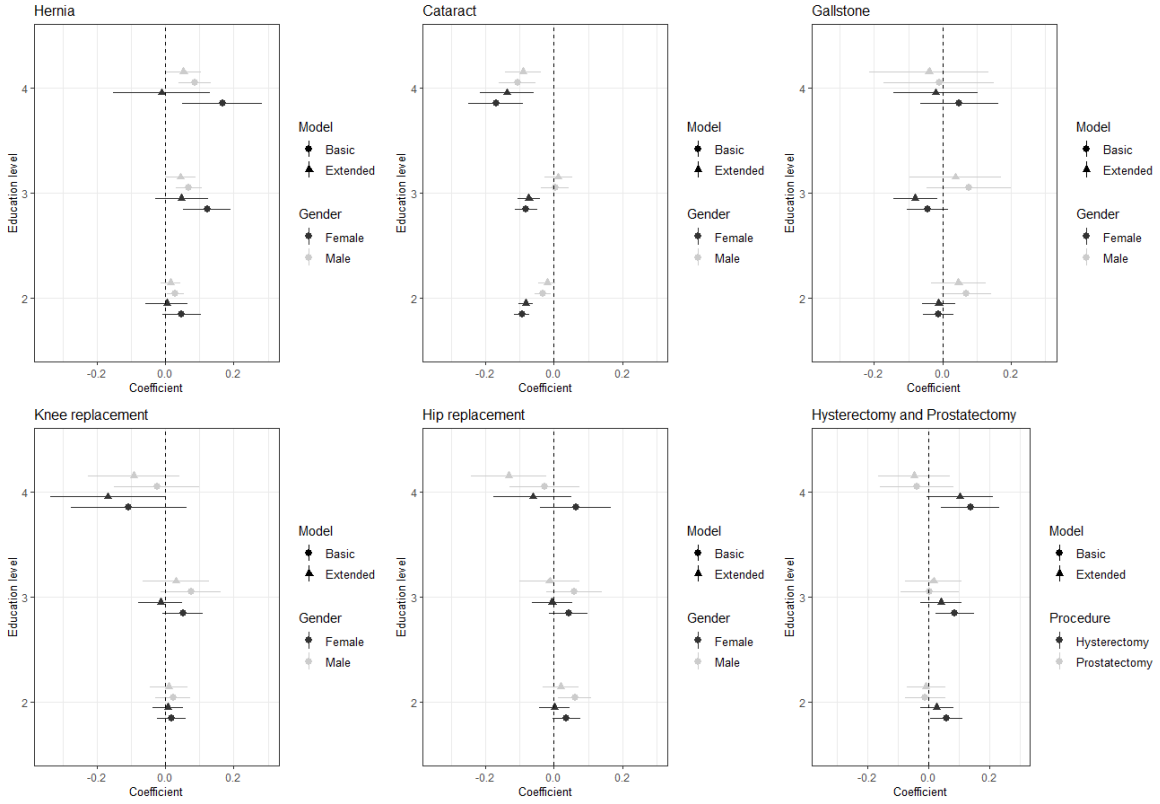
The results from the selection equation are reported in the paper which can be found in **??**. The estimates indicate that there is a gradient in the propensity to use

[2]We use the coefficient estimates β to calculate the marginal percentage change in waiting times as $\%\Delta w = 100 \cdot (e^{\beta} - 1)$.

[3]Changes in days are calculated at the mean waiting time for a given procedure and gender. See Appendix A3 in the paper for reported mean waiting times.

the waiting-time guarantee. It clearly shows that patients with higher SES, measured as income and level of education, are more likely to make use of the guarantee. When we adjust for this selection into the use of the guarantee in Eqs. (2.3) and (2.4), we still find a socioeconomic gradient in waiting times for patients undergoing cataract surgery. We find that men in the highest income deciles (7th-10th) wait less (16-20%, 9-11 days) for cataract surgery at private providers, but no there was gradient at public providers. For women, we find that they wait less (6-23%, 5-21 days) for cataract surgery, at both private and public providers, if they have a high income (7th-10th decile).

Figure 2: Estimates for the association between education and total waiting time for the basic and extended model across procedures and by gender



On a broad level, we find a socioeconomic gradient in waiting times for only a few of the procedures. We do, however, find that non-western immigrants wait significantly longer (11-26%, 8-18 days) for most of the procedures as compared to Danes[4]

[4]See **??**.

2.4 Discussion

Using rich individual-level administrative data, we uncover the effect of SES on the experienced waiting time. A socioeconomic gradient could be an indication of inequalities in the access to health care. If such inequalities are primarily driven by SES, one could argue that they are unjust and, thus, a source of inequity in health care.

Due to the fact that we are not able to control for all unobserved factors that might affect both waiting time and SES, we are cautious about interpreting the results causally. Factors, such as health literacy of the patient and relatives, might impact both SES and waiting time and, hence, lead to an omitted variable bias. To reduce the likelihood of this, we therefore include a broad set of controls to minimise the concern of unobserved confounders.

We find suggestive evidence of a social gradient in waiting time for a few of the procedures investigated. Without controlling for the possible self-selection into using the waiting time-guarantee, we find that patients with higher income or higher level of completed education wait less for cataract surgery and men with higher income wait less for hernia surgery. Controlling for the possible self-selection is only relevant for cataract surgery and prostatectomy, as the other procedures have extremely few patients who make use of the guarantee. Controlling for the selection reveals that there is a high degree of inequality in the propensity to use the guarantee, as higher income and education are associated with a higher probability of using the guarantee. Taking this selection into account, the socioeconomic gradient in the waiting time for cataract surgery still persists and prostatectomy still shows no indications of a gradient.

Interestingly, the inequalities that we do find seem to be due to the differences in waiting times across the hospitals in which patients seek care and not due to factors within said hospital. This finding stems from the fact that when we control for individual hospital factors, using hospital fixed effects, the previously demonstrated gradients disappear. This could indicate that patients with higher SES tend to live in areas where the hospitals in general are more well equipped in terms of both capacity

and skilled labour.

Among the factors for which we control, the immigrant status led to some interesting and unexpected results. For most of the procedures[5], we find that non-western immigrants wait significantly longer than Danes. This gradient is robust to the inclusion of hospital fixed effects and, thus also exists within hospitals. We are unfortunately not able to ascertain if the inequality is driven by direct or indirect discrimination.

[5]Men: hernia, gallstone, knee replacement and prostatectomy. Women: hernia, gallstone and knee replacement

3 Paper 2: New Evidence of Health State-Dependent Utility of Consumption: A Combined Survey and Register Study

It is commonly assumed that an individual's marginal utility of non-medical consumption is independent of their health state (Mitchell et al., 1999; Hall and Jones, 2007; Meyer and Mok, 2019). On the other hand, if adverse health effects alter the shape of the individuals' utility function, it will impact intertemporal decisions, such as optimal insurance and savings (Arrow, 1974). If such a health state dependence does exists, not controlling for it could lead to biased estimates and have implications for policies concerned with the allocation of health care (Finkelstein et al., 2009).

We define negative and positive state dependence as an decrease and increase in the marginal utility of consumption when health deteriorates. If the shape of the utility function does not change when health deteriorates, it is said to exhibit an independence from the state of health.

Viewed from a pure theoretical perspective, the state dependence can be both positive or negative depending on how health and consumption are interconnected. If health and consumption are complements, the state dependence will be negative. Whereas, if health and consumption are substitutes, the state dependence will be positive. Both scenarios are theoretically possible, and an empirical approach is therefore required to draw any conclusions regarding the sign of the state dependence.

A significant volume of empirical literature has evolved since the first attempt by Viscusi and Evans (1990). Our review of the literature found 15 published studies that estimated the sign of the state dependence. Among these, eight have found the marginal utility of consumption to decreases when health deteriorates, five have found it to increase, and two have found it to be independent of the health state.

The aim of the paper is twofold. First, we want to reexamine the findings of Finkelstein et al. (2013) using a richer combination of longitudinal survey data and register data. Second, we wish to extend the current literature by analysing the impact

that the type and size of the health shock might have on the HSD.

3.1 Methods

We follow the conceptual framework set up by Finkelstein et al. (2013) and define a two-period model wherein individuals maximise utility with respect to consumption and use of health care. The individual is healthy during the first period and, with probability p, sick during the second period. Without knowing his future health state, the individual must determine their consumption in Period 1 and save for Period 2. In the second period, the health state is revealed, and the individual must then divide their savings from the first period between consumption and health care if sick. For a more thorough review and deviation of the model, please see the study conducted by Finkelstein et al. (2013, Empirical Approach).

The solution to the maximisation problem is a two-period utility function of the following form:

$$U = \left(\frac{1}{1-\gamma}\right)\left(C_1^{1-\theta} + \frac{1}{1+\delta}\left((1-\gamma)\left(1+\varphi_1 S\right)\frac{1}{1-\gamma}C_2^{1-\gamma} + S\cdot\Psi\left(H\right)\right)^{\frac{1-\theta}{1-\gamma}}\right)^{\frac{1-\gamma}{1-\theta}} \tag{3.1}$$

Where γ denotes the coefficient of relative risk aversion, C_1 and C_2 are consumption in the first and second period, respectively, δ is the discount rate, $\frac{1}{\theta}$ denotes the elasticity of intertemporal substitution and $\Psi(H) \coloneqq \varphi_2(1-\gamma)^{-1}H^{1-\gamma}$ represents utility derived from the utilisation of health services. Both θ and γ are assumed to be non-negative. According to Eq. (3.1), it becomes apparent that the individual's health has a direct effect on the marginal utility of consumption during the second period through the parameter φ_1.

For the empirical estimation of the parameter φ in Eq. (3.1), we employ the same estimation strategy as Finkelstein et al. (2013). We estimate the latent utility function

using a fixed effect model specification of the following form:

$$SWB_{it} = g\left(\beta_1 S_{it} \cdot \bar{Y}_i^{1-\gamma} + \beta_2 S_{it} + \beta_3 \cdot \bar{Y}_i^{1-\gamma} + \lambda \mathbf{X}_{it}^{'} + \kappa_t + \alpha_i\right) \tag{3.2}$$

Where i indexes the individuals, t indexes the years, SWB is subjective well-being (SWB) and acts as a proxy for utility, S is the health of the individual, $\bar{Y}$ is permanent household income and $\mathbf{X}$ is a vector of control variables. The function $g(...)$ maps the latent utility into the observed SWB. The parameter of primary interest is β_1, as it measures the change in the marginal utility of income when health, S, changes.

When estimating Eq. (3.2), the coefficient of permanent income will be captured by the individual fixed effects α_i and will hence need to be recovered by other means. We do this by regressing permanent income and the vector of controls on the estimated fixed effects from Eq. (3.2), $\hat{\alpha}$:

$$\hat{\alpha}_i = \mu_a + \beta_3 \cdot \bar{Y}_i^{1-\gamma} + \lambda X_{it}^{'} + \eta_i \tag{3.3}$$

By using $\hat{\beta}_1$ from Eq. (3.2) and $\hat{\beta}_3$ from Eq. (3.3), we are able to quantify the magnitude of the state dependence by taking the ratio $\frac{\hat{\beta}_1}{\hat{\beta}_3}$.

3.2 Data

The study uses Danish administrative data combined with data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) (Börsch-Supan et al., 2013). The combination of the two is known as REGLINK-SHAREDK (Survey of Health and in Europe, 2020) and contains 9,944 observations from 3,560 individuals over a period of 10 years. Due to the fact that both the SHARE survey and the administrative data are keyed with the respondents' social security number, we are able to combine the accuracy from the registers with the versatility of the SHARE survey and, thus perform the analysis on an extremely unique data source. From the registers, we obtain individual-level information on objective measures, such as income, level of

education, age, health care utilisation and comorbidities. These measures are likely to suffer from recall bias and heterogeneity in reporting behaviour if taken from a survey, whereas, when obtained from administrative sources, they provide uncensored and precise measurements. From the survey, we extract information that, by construction, is preference-based such as SWB. Furthermore, the REGLINK-SHAREDK provides us with a control sample matched on gender and age for the SHARE respondents of approximately 22,000 individuals.

The three most important measures used are SWB, family disposable income and health state. From the SHARE survey, we obtain SWB, which is used to proxy utility and a measure for health. SWB is obtained from the SHARE survey via the following question: *On a scale from 0 to 10, where 0 means completely dissatisfied and 10 means completely satisfied, how satisfied are you with your life in general?* Out of 21 possible chronic conditions, the number of conditions the respondent has ever been diagnosed with is measured by the health parameter from SHARE.

From the registers, we extract the information required to construct our health and income measures. Health is measured using both the Charlson Comorbidity Index (Charlson et al., 1987) with updated weights (Quan et al., 2011) and the Elixhauser-van Walraven Index (Elixhauser et al., 1998; van Walraven et al., 2009). For the income measure, which is used to proxy consumption, we rely on household disposable income corrected for the size and age distribution of the family (Hagenaars et al., 1994). We then average the household disposable income over time within each household to account for the possibility that families might smoothen out consumption over time by means of savings. Lastly, we demean the measure for interpretation purposes.

3.2.1 Imputations

To increase the power of the following statistical analysis, we impute SWB for all the control individuals and, hence, effectively boosting our sample size from 9,944 to 155,844. We are able to do this because, in the main specification, we are only relying on one measure from the SHARE survey, namely SWB, as we can extract all the

other measures from the registers. We treat the problem of imputing SWB for all the controls individual as a pure prediction problem, as we are not interested in during inference in this stage. We use supervised machine learning[6], as such methods have proven superior compared to more traditionally used methods within economics in providing precise and consistent predictions (Mullainathan and Spiess, 2017; Varian, 2014).

3.3 Results

3.3.1 Descriptive

Table 2 provides descriptive statistics for the two samples: the Danish SHARE respondents and the REGLINK-SHAREDK sample. The data is averaged over all individuals and years. For the SHARE sample, it also provides information regarding SWB and number of chronic diseases as measured from the survey. As can be seen from the table, the two samples are not completely identical. On average, respondents from the SHARE survey are a bit wealthier than the individuals from the REGLINK-SHAREDK sample, with an average yearly disposable income of 278,000 DKK compared to 267,000 DKK for SHARE respondents. In terms of health we see that both the Charlson and Elixhauser Van-Walraven Index is higher for the REGLINK-SHAREDK individuals. Taken together, it can be assumed that the more socioeconomically advantaged individuals participate in the SHARE survey.

3.3.2 Regressions

Table 3 shows the primary estimation results from Eq. (3.2). For the sake of clarity and readability, we have left out all the coefficient estimates for the control variables in $\mathbf{X}$. The table provides results for four different specifications of Eq. (3.2). Model 1 is a replication of the main results of Finkelstein et al. (2013). The coefficient on health, β_2, indicates that the number of self-reported chronic diseases is negatively and

[6]More specifically, we apply the Random Forest algorithm (Breiman, 2001).

Table 2: Descriptive statistics

	SHARE N = 9,944			REGLINK-SHAREDK N = 155,844		
Variable	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median
			Demographics			
SWB	8.6	1.39	9	.	.	.
Income (000s)	278.09	112.79	257	266.69	109.3	246.56
Female	0.55	0.5	1	0.52	0.5	1
Age	65.13	10.09	64	62.21	9.76	61
Household size	1.83	0.53	2	1.88	0.74	2
			Education			
Primary and preparatory	0.27	0.44	0	0.32	0.47	0
Upper secondary level	0.45	0.5	0	0.45	0.5	0
Medium/long	0.2	0.4	0	0.16	0.36	0
Long/higher	0.07	0.25	0	0.05	0.22	0
Missing	0.02	0.13	0	0.02	0.14	0
			Marital status			
Married	0.71	0.45	1	0.73	0.45	1
Divorced	0.11	0.31	0	0.12	0.32	0
Widow	0.12	0.32	0	0.08	0.27	0
Single	0.06	0.24	0	0.08	0.27	0
			Occupation			
Retired	0.54	0.5	1	0.49	0.5	0
Employed	0.43	0.5	0	0.47	0.5	0
Unemployed	0.03	0.17	0	0.04	0.2	0
			Health			
Number of chronic diseases	1.55	1.44	1	.	.	.
Charlson	0.28	0.77	0	0.34	0.89	0
Elixhauer Van-Walraven	0.76	2.53	0	0.96	2.92	0
Anti-anxieties	0.05	0.22	0	0.06	0.25	0
Anti-depressants	0.1	0.3	0	0.1	0.3	0

significantly associated with SWB for an individual with average income. The second coefficient, β_3, indicates that consumption, proxied by average income, is positively and significantly associated with SWB, for an individual with no reported chronic diseases. The third coefficient, β_1, indicates that the interaction between health and income is positively and insignificantly associated with SWB. The implied magnitude of the state dependence is calculated as β_1/β_3 and is expressed for either a one-unit increase in the health measure or a one standard deviation[7] increase in the health measure. The implied state dependence for Model 1 is 0.257, meaning that the marginal utility of consumption increases by 25.7% when the number of chronic diseases increases with one standard deviation ($\sigma = 0.68$). This result has the opposite sign as compared to that of Finkelstein et al. (2013), but it is also insignificant.

Table 3: Main results

	Dependent variable:			
	Subjective well-being			
	Model 1	Model 2	Model 3a	Model 3b
Health, β_2	-0.0359**	-0.0587**	-0.1158**	-0.1941***
	(0.0149)	(0.0248)	(0.0383)	(0.0048)
$log(\bar{y}_i), \beta_3$	0.1791**	0.3406***	0.2967***	0.3344***
	(0.0686)	(0.0697)	(0.0602)	(0.0115)
$Health \times log(\bar{y}_i), \beta_1$	0.0677	-0.0729	-0.053	-0.0866***
	(0.0428)	(0.0763)	(0.0988)	(0.0133)
	Implied state dependence			
1 unit increase in β_2	0.378	-0.214	-0.1786	-0.259***
	(0.2617)	(0.2284)	(0.2991)	(0.0586)
1 σ increase in β_2	0.257	-0.092	-0.0768	-0.1464***
	(0.1779)	(0.0982)	(0.1286)	(0.0331)
Observations	9,872	9,872	2,832	155,844
Health measure	Number diseases (survey-based)	Charlson (register-based)	Charlson (register-based)	Charlson (register-based)
Sample	SHARE (DK)	SHARE (DK)	SHARE (DK)	REGLINK-SHAREDK
Demographic controls	✓	✓	✓	✓
Fixed effects	✓	✓	✓	✓

Notes: * < 0.10, ** < 0.05, *** < 0.01.
Standard errors in parentheses.

To overcome potential problems with measurement errors in the self-reported number of chronic diseases, we replace the health measure with the Charlson Index derived from the registers in Model 2. The sign and significance remain stable for both the

[7]The standard deviation is calculated within individuals.

health and the consumption coefficients. The sign on the interaction between the two now becomes negative, although it is still insignificant.

Both Model 3a and 3b use the imputed SWB as the dependent variable. Model 3a only uses what is called the hold-out part of the SHARE sample[8]. As expected, the coefficients are comparable to those from Model 2. This is strong evidence in favour of the imputed SWB, as it demonstrates that it is capable of capturing the same relations as the self-reported SWB.

Model 3b, which could be seen as the main model of the paper, uses the imputed SWB and the full REGLINK-SHAREDK sample. Comparing with the estimates from Model 2 and Model 3a, we only observe negligible changes in the covariates, and they all become highly significant. The result clearly indicates a negative HSD. The magnitude entails that the marginal utility of consumption decreases by 25.9% when the Charlson Index increases by one and decreases by 14.6% when the index increases by one standard deviation. Both of these estimates of the magnitude are in line with those reported by Finkelstein et al. (2013).

3.4 Robustness

To verify the robustness of our main result, we perform a large range of sensitivity analyses. In the paper by Finkelstein et al. (2013) it is shown that, for some unknown reason, the negative state dependence is only present for women and not for men. To shed more light on this phenomenon we perform our main analysis on both the male and female share of the population to confirm whether the same disparity is present in our case. Interestingly, our results indicate that negative state dependence is present for both genders, and it is actually more negative for men compared to women (18.0% vs. 11.5% for men and women, respectively). Previous studies have found strong evidence of differences in the reporting of health statuses between genders, with men exhibiting a tendency to be more biased in their self-reporting than women (Dowd

[8]The hold-out sample is the part of the SHARE sample that was not used when training the prediction algorithm.

and Todd, 2011). This provides a possible explanation for the stark contrast between the findings of our study and those of Finkelstein et al. (2013).

In addition, we examine the individual commodities that comprise the Charlson Index. This is done to infer whether HSD is sensitive to the type and implied size of the health shock. These results illustrate that, generally being diagnosed with a health conditions alters the utility function. More specifically, we see a tendency towards more negative health state dependence when the experienced health shock is larger. The conditions for which we see the largest decrease in the marginal utility of consumption are rheumatic disease, diabetes with complications, cancer and severe liver disease.

Other than the aforementioned sensitivity analyses we also investigate the different degrees of risk aversion, closeness to death, level of education and different mappings from the underlying latent utility, all of which strengthen the robustness of our main result. For a more in-depth view of all the sensitivity analyses performed, please see **??**.

4 Paper 3: Pure altruism and misjudgement: A driver of wrongful societal willingness to pay?

The use of stated preference methods for estimating the value of mortality risk reduction is increasing. Puzzlingly, surveys seem to find the public valuations of mortality risk reduction to be both higher (Gyrd-Hansen, 2015; Pedersen et al., 2011; Araña and León, 2002) and lower (Johannesson et al., 1996; Gyrd-Hansen et al., 2016) than a comparable private reduction. This issue is especially prominent in the road safety literature, which has greatly focused on the value of a statistical life. A meta-analysis of 74 stated preference studies found that the value of a statistical life is 80% higher when elicited from the private perspective as compared to the public perspective (de Blaeij et al., 2003). This result has been backed up by more recent studies (Hultkrantz et al., 2006; Svensson and Johansson, 2010). The literature that tries to explain these contradictory findings is scarce, and most studies have focused on the distinction between pure and paternalistic altruism (Messer et al., 2013; Gyrd-Hansen et al., 2016; Jones-Lee, 1991, 1992). Paternalistic altruism refers to a utility function that contains a single parameter of other individuals' utility function. Paternalistic altruism can be either safety-focused or wealth-focused depending on whether the individual values the added safety or wealth obtained by others. Pure altruism, on the other hand, relates to situations where the individual is concerned with the overall level of utility of others and, hence, respects their preferences.

The aim of the paper is to first verify whether respondents act as pure altruists and, second, to determine whether the presence of pure altruism leads to biased valuations caused by individuals making incorrect predictions regarding the benefit that the good in question will bring to others.

4.1 Methods

We construct a theoretical framework that enables us to predict the behaviour of an individual who is faced with a risk and simultaneously has the opportunity to buy an insurance. The framework distinguishes between selfishness, paternalistic altruism and

pure altruism. The framework additionally incorporates the beliefs that an individual may hold regarding the benefits that other individuals might derive from the insurance. The constructed theoretical framework enables us to design an online incentivised experiment and associated hypothesis to fulfill the aim of the paper.

4.1.1 Experimental design

We conducted an online incentivised field experiment during the fall of 2019. A representative sample of 10,500 individuals, aged 18-80 was invited through e-Boks[9]. The invitation letter informed the participants that they would have a 10% chance of winning up to 1,000 DKK ($\approx$ 150 USD).

At the beginning of the experiment, the subjects were told that they were going to play three different games, each with a possible payoff of up to 1,000 DKK. At the end of the experiment, it would be decided whether any of the respondents' games would be picked for an actual payoff. After logging in into the experiment, participants were randomly assigned to either high or low risk categories. The participant would be faced with a series of games wherein he would face an 80% risk of losing the initial endowment if categorised as high risk and a 20% risk if categorised as low risk. In each game, the respondent's risk was illustrated graphically using a pie chart. The participant was then given the opportunity to buy an insurance that would provide full coverage (essentially reducing the risk to 0%) against the monetary loss and asked how much he would be willing to pay for said insurance. We employed the Becker–DeGroot–Marschak (BDM) mechanism (Becker et al., 1964) to elicit the WTP from the respondents. The mechanism implies that the price of the insurance be decided by drawing a random number within the interval 1-1000. If the WTP stated by the respondent was higher or equal to the insurance price, he paied the price and got the insurance. If the WTP was lower than the actual price, he did not get the insurance and would thus face the risk of losing the initial endowment. The outcomes

[9]e-Boks is a secure online mailbox that is linked to an individual's civil registration number and has been mandatory for all Danish citizens since 2014 (Agency for Digitisation, 2020).

of the independent games were not revealed to the participants to ensure that their behaviour was not driven by an accumulated payoff.

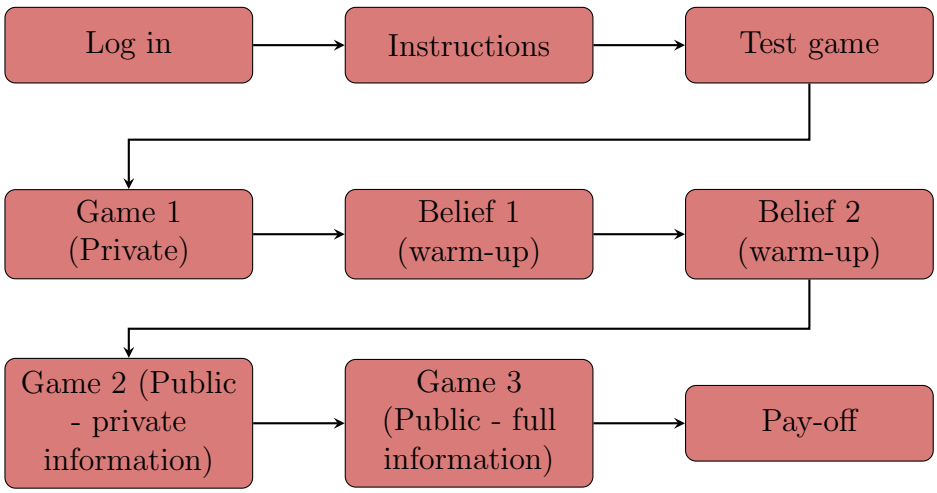
To ease the process of understanding the game and the BDM mechanism, we introduced the respondents to a test game after a set of written instructions was completed. In the test game, the respondents were able to state a WTP for the insurance and, then, get feedback on the insurance price and possible payoff. The feedback included the random price of the insurance, the stated WTP and a brief text informing the participant that he would or would not have been able to buy the insurance had this been one of the forthcoming real games. If the stated WTP was lower than the price of the insurance, the respondent was told that he was not able to buy the insurance and, hence, risked of losing all his money. The respondent was then asked to click a button that would reveal whether he was lucky and, hence, avoided the bad outcome or were unlucky and lost all the money. The test game was repeatable, and participants were encouraged to try at least twice. On average, the respondents tried the test game three times.

The first game, which we will be referring to as Game 1 (Private), was a private game, meaning that only the participant risked losing their endowment. After the first game, the respondent was presented with two questions asking what he believed other individuals faced with the same level of risk and the opposite level of risk would be willing to pay for the insurance. We call these two questions Belief 1 and Belief 2. The purpose of these two questions was twofold. First, they enable us to elicit the beliefs that the individual respondent has about other peoples' preferences/WTP; second, they force the respondent to think about the benefit that the insurance might have for other individuals, and thus, the question also acts as a warm-up question for the second game. In the next, game which we will be calling Game 2 (Public – private info), we introduced the participant to a public scenario. Participants were assigned into groups of four, two with high risk and two with low risk, to ensure equipoise. In the public scenario, the insurance provided coverage for all, and the payment was coercive. This meant that either all four respondents paid the same sufficient amount

in order for all to receive insurance coverage or no one received the insurance and faced individual risks of losing their endowment. The mechanism for deciding the price of the insurance was identical to the previous games, and the WTP for the group was decided by randomly drawing a single individual's WTP. The drawn WTP would apply to everyone in the group. This mechanism meant that all individuals had equal probability of deciding the WTP for the entire group, hence ensuring incentive compatibility. Game 3 (Public – full info) builds on Game 2 (Public – private info) by providing full information about the WTP of the other three individuals in the group and, then, asking the participant to once again state his WTP for the group insurance.

Figure 3 provides a flowchart of the composition of the experiment and the order of the different games[10]. The order of the games and questions was deliberately designed to both reduce the increased complexity between each game and to more closely mimic the decision-making process of an individual. First, the individual had to think about his own WTP; then, the WTP of others with the same degree of risk; next, about others with a different risk and, last, about a combination of all three.

Figure 3: Flowchart



[10]For a full version of the experiment, please see the appendix for Paper 3.

4.1.2 Analytical strategy

Based upon our derived theoretical model, we put forward two hypotheses that align with the overall aim of the paper. H1 is designed to test if respondents exhibit preferences that match those of a pure altruist:

Hypothesis 1 (H1): *High-risk individuals value the insurance higher when it is public than when it is private:*

$$H_0 : WTP^{high}_{public} > WTP^{high}_{private}$$

Where $WTP^{high}_{private}$ denotes the WTP from the private scenario in Game 1 (Private), and WTP^{high}_{public} denotes the WTP from the public scenario in Game 2 (Public – private information) for a high-risk individual.

If we are able to reject H1 and confirm the presence of pure altruism, it could lead to biased estimates of the true value of a public good in evaluation studies if the respondent has misjudged the WTP of the other respondents and, therefore, their derived utility from the insurance/public good. To test whether this is in fact the case, we set up our second hypothesis:

Hypothesis 2 (H2): *Individuals have adequate beliefs regarding other individuals' preferences:*

$$H_0 : WTP_i^{belief_j} = WTP^j_{private}$$

Where $WTP_i^{belief_j}$ is what respondent i believes respondent j is willing to pay for the insurance and is obtained from either Belief 1 or Belief 2 depending on the risk that individual i is subjected to. $WTP^j_{private}$ is what individual j is willing to pay for the insurance in a private scenario, and this value is obtained from Game 1 (Private). If the null hypothesis is rejected, it means that individuals are misjudging the true WTP for the other respondents.

4.2 Results

In total, 2,140 of the 10,500 invited respondents completed the online experiment, resulting in a final response rate of 20.4%. Table 4 reports the average stated WTP for the different games/scenarios and the assigned risk of the respondent. We test H1 by comparing the WTP for high-risk individuals between Game 1 (Private) and Game 2 (Public). As can be seen from the table, the high-risk individuals are willing to pay 445 DKK in the private scenario and 393 DKK in the public scenario. The difference is significant at the 5% level, and we thus reject H1.

Table 4: Mean WTP by game and risk type in DKK

	Risk type:	
	High	Low
Game 1: Private	445.05	318.58
Game 2: Public (private information)	392.84[a]	357.34[a]
Belief 1 & 2		
Low	277.71[b]	334.1
High	427.83	518.77[c]

Notes: [a] indicates that the public is WTP significantly different from the private WTP at the 5% level.
[b] indicates that the belief is significantly different from the private WTP of a low-risk individual at the 5% level.
[c] indicates that the belief is significantly different from the private WTP of a high-risk individual at the 5% level.

To test hypothesis H2, we compare high-risk respondents' perceptions of low-risk individuals' WTP for the insurance and vice versa. Looking at Table 4, we can see that high-risk individuals believed that a low-risk individual would be willing to pay 278 DKK for the insurance, while a low-risk individual was actually willing to pay 319 DKK. Further, a low-risk individual believed that a high-risk individual would be willing to pay 519 DKK for the insurance, while a high-risk individual was actually willing to pay 445 DKK. We therefore reject H2 and establish that individuals misjudge the WTP of the other respondents.

4.3 Discusison

The rejecting of H1 proves that respondents act as pure altruists who predict that their own benefit from the insurance is higher than that of the other respondents. This result is in line with that found by Messer et al. (2013) and Gyrd-Hansen et al. (2016) who found that individuals facing a risk higher than that of the average individual lowered their WTP for a risk reduction in a public scenario compared to their WTP in a private scenario. The second hypothesis, H2, is also rejected, and the results from Table 4 indicate that high-risk individuals underestimate the true WTP of low-risk individuals and low-risk individuals overestimate the true WTP of high-risk individuals.

The rejection of both null hypotheses entails that the estimates of public goods could be biased when a public perspective is used to elicit their value. The magnitude and direction of the bias will be dependent on the distribution of the perceived risk/benefit of the individuals from which the valuation is elicited. If individuals who perceived their own benefit to be above the average are over-represented, the elicited value will be negatively biased because these individuals underestimate the benefits that the low benefiting individuals obtain from the good.

Our study clearly illustrates the disadvantages of applying a coercive tax as the payment vehicle and a public perspective when estimating the value of a public good.

5 Contributions and implications

The following section aims to clarify the aspects in which the previously described papers contribute to the existing literature surrounding this thesis. The implications of the results from each paper are also presented.

5.1 Paper 1

On a general level, Paper 1 provides evidence regarding how health care resources are allocated within the Danish health care system. The reasoning behind this is the fact that, within a publicly funded health care system, waiting times act as a mechanism for rationing resources. It is expected that the waiting time will allow patients with the highest need to be prioritised and that SES will have an insignificant effect in this matter.

Using the comprehensive coding system within the Danish hospitals, we are able to classify individuals' waiting times into two types: active and passive. The active waiting time captures waiting time that is related to delays caused by the provider, while the passive waiting time captures waiting time that is caused by factors related to the patient such, as cancellations. In England, they had a similar measure until 2015, as delays resulting from patient behaviours were a part of the official waiting time (NHS England, 2015). However, these data were not linked to the Hospital Episodes Statistics and, hence, not interconnected with the patient's SES. We are the first to decompose waiting time in this manner and simultaneously link it to the patient's SES.

The two types of waiting times can be viewed in terms of the legitimate/illegitimate framework of Fleurbaey and Schokkaert (2009). The active waiting time, attributed to the provider, is beyond the control of the patient, and inequalities in this dimension will thus be considered illegitimate. The passive waiting time, on the other hand, is due to the choices and preferences of the patient. Thus, it can be argued that inequalities

within this dimension will be legitimate. This manner of classifying types of waiting times into legitimate and illegitimate causes of inequalities obviously requires that the patient choices contributing to the passive waiting time are orthogonal to illegitimate determinants, such as SES or ethnicity.

The findings from the paper indicate that at an aggregated level, combining passive and active waiting time, we only find inequalities in waiting times due to SES for a few of the procedures examined. More importantly, when we consider only the active waiting times, none of the inequalities change, indicating that they are not driven by the patient's choices that were captured by the passive waiting time.

Considering the factors that influence the waiting time significantly, being a non-western immigrant stands out as the most illegitimate cause. If the non-western immigrants' preferences are not in favour of longer courses of treatment, due to legitimate causes such as appointment cancellation by the patient or the requirement of more time to consider whether to commence treatment, the observed inequality is unjust. To verify whether the inequalities are in fact unjust or illegitimate, we remove the part of the waiting time capturing delays directly due to the patient (the passive waiting time), and check for inequalities in waiting time due to ethnicity[11]. The results demonstrate that the observed inequalities are not driven by the passive component of the total waiting time and that the observed inequality could therefore be considered a clear indicator of inequity in waiting time with respect to immigrant status.

From a policy perspective, the paper has several implications. First, the proven inequalities due to the ethnicity of the patient would be something to intervene against. From the paper, we know that the inequalities exist both between as well as within hospitals. This result suggests that the discrimination of non-western immigrants should be addressed with interventions focusing on factors within hospitals as opposed to between hospitals. For instance, these include improvements to the waiting list management systems to simplify the process for the patient and to reduce the likelihood of language barriers or difficulties arising while navigating the system due to a lack of

[11]See appendix from Paper 1.

experience with the Danish health system. Second, the results indicate that severity, measured with an comorbidity index, only impacts the experienced waiting time for a few of the reviewed procedures. This result is surprising given the fact that the health care system allows for prioritisation based upon need/severity. As it is now, there is no official method of determining whether a patient was classified as a high-need patient (right to treatment within 30 days) or a low-need patient (right to treatment within 60 days), and, hence, no way of assuring whether the differentiation based on severity actually impacts total waiting time. Recording the severity of the patient would be a good first step to enable the future evaluation of the policy.

5.2 Paper 2

On a general level, Paper 2 provides evidence regarding how individuals' preferences for resource allocation might change as the result of a health shock. It is broadly accepted that adverse health effects decrease an individual's welfare or utility. The effect that such health shock might have on the shape of the utility function is on the other hand less established.

The paper is the first to examine the HSD in a Danish context. Knowing the sign and direction of the HSD is vital for obtaining an efficient and fair allocation of health care resources. If individuals' preferences for consumption are significantly altered following a health shock (in case of both increases and decreases), it is vital to account for such changes in preferences when designing and implementing redistribution reforms with the purpose of increasing or maintaining fair allocation. The general assumption that adverse health shocks can be considered equivalent to a monetary loss comes with certain attractive analytical properties. The benefit is that the economic theory and empirical evidences of the effect of a monetary loss are well developed (Viscusi, 2019). This approach only requires that the health shock be converted into an equivalent monetary loss. One popular manner of performing this transformation is by using the Compensating Income Variation (CIV) method (Asgeirsdottir et al., 2017). Although

this approach seems attractive due to its straightforwardness, it might also be too simplistic. Previous evidence seems to infer that adverse health effects might not just decrease the level of utility but also alter the individual's ability to derive utility from consumption (Finkelstein et al., 2009), thereby changing the structure of the utility function itself.

The findings from the paper provide strong evidences for a negative HSD. This result implies that when an individual experiences an adverse health shock, such as the onset of a disease, his ability to derive utility from consumption is reduced. Implications following this result are not negligible and influence decisions concerning the optimal level of insurance, prevention policies and valuations of treatment options. The optimal level of insurance will, for instance, be less than the full insurance. This is due to the fact that, in an optimal setting, the insurance should be such that it equalises the marginal utility of consumption between the possible states. Further, interventions, such as prevention and medical treatments, will be impacted by the negative HSD (Crainich and Eeckhoudt, 2017). Medical treatment will, for instance, become more preferable compared to simply transferring resources towards the sick individual. This stems from the fact that treatments that are capable of improving the individual's health state will increase the marginal utility of consumption of that individual. The same goes for preventive initiatives, as the benefits of maintaining a high level of health are increased when the HSD is negative (Viscusi, 2019). Additionally, the result of a negative HSD shows a clear trade-off between efficiency and equality, as devoting resources to the more healthy individuals will increase total welfare more than if resources are devoted to less health individuals.

Another important implication of the negative HSD is the bias that it entails in the valuation of different health conditions, if it is not corrected. When policymakers have to decide whether to introduce or provide a new treatment method, they often use the monetary value of improving the health of the patient as an input for the decision process (National Institute for Health and Care Excellence (NICE), 2020). If the form of the utility function changes based on the health state, as is the case with negative

HSD, the valuation of different health states, using methods such as Compensating Income Variations (CIV) will be negatively biased. This stems from the fact that CIV uses the marginal utility of income (or consumption) as a parameter for estimating the monetary value of a health shock. This also means that higher compensation is needed to restore an individuals utility to pre-sick level, than estimated from an ex ante perspective assuming state independence.

Methodologically, the paper contributes to the branch of literaturethat combines survey and register data. It achieves this by introducing a new manner of thinking about subjective measures within the context of register data. Since we have linked the individual responses from the SHARE survey with the Danish registers, we have, apart from the more subjective measures in SHARE, a lot of objective measures that are obtainable from the registers. This relative special, although not unique, construction of data enables us to treat a single measure from the SHARE–survey (in our case SWB) as if it was simply missing from the registers and, subsequently, impute it. The task of imputing the missing variable can be viewed as a prediction problem. The goal is to predict the missing variable using only the information that is available in the registers from the periods before the missing variable is actually stated. In our case, we wanted to predict individual SWB in a certain year using the information in the registers from the years leading up to that year. For the computational task of predicting SWB, we turned to the field of Machine Learning.

The use of Machine Learning within economics is a fairly new trend but has proven to be extremely beneficial so-far when used correctly (Mullainathan and Spiess, 2017). One of the simplest manners of incorporating Machine Learning in economics is when dealing with problems where out-of-sample predictive powers are of interest (Athey and Imbens, 2019). In our case, it enables us to predict SWB for individuals who have not participated in SHARE but are present in the registers, which effectively boosts the sample size by a factor of 15. This way of thinking of measures from a survey is, to our knowledge, very unique but carries significant potential as an increasing number of surveys get linked with administrative data (Künn, 2015).

When a survey is linked with administrative data, the researchers are often trapped between the subjective measures of the survey, which might be essential to the research question, and the statistical power of the administrative data. If the researchers' interest in the survey evolves around a single measure/variable, we demonstrate that there is a significant increase in statistical power to gain by using the vast amount of information offered by the administrative sources to impute/predict the subjective measure for a much larger population. With the growing interest in Machine Learning within economics and the predictive power and versatility of supervised learning, this is a topic of great potential if explored further.

5.3 Paper 3

Conducting a laboratory experiment is an effective way of isolating a single mechanism of interest as compared to an observational study where a lot of distracting factors need to be controlled for. This is especially the case for experiments that study individuals' behaviour and preferences. Unfortunately, this normally comes at a cost. First, participants of experiments are typically recruited at a university and are commonly students from the field of the experiment (Messer et al., 2013; Cappelen et al., 2019). These students cannot be expected to have the same preferences as, for instance the general population. In a study by Cappelen et al. (2015), the preferences of economics and non-economics students from Norway were compared with those of a representative sample of the general Norwegian population. It was found that both student samples differed significantly from the population sample in terms of moral behaviour (efficiency, equity and reciprocity) as well as selfish behaviour. It was further found that the economics students were more selfish compared to the non-economics students. These findings prove that one needs to be careful when interpreting results from experiments where the subject pool is not representative of the general population, as preferences might differ significantly between the two groups. Second, most experiments are relatively time-consuming to conduct, as only a limited

number of participants can attend simultaneously. They can also be quite expensive to perform due to both the working hours required and the possible payment to the participants, which can be significant. The use of payments in experiments is employed to both increase the number of individuals willing to participate and, more importantly, to provide the participants with a stronger incentive to reveal their true preferences (Gächter and Renner, 2010). Field experiments try to avoid these two disadvantages of laboratory experiment.

Field experiments differ from more controlled laboratory experiments in several ways (Harrison and List, 2004). One important aspect is the difference in subject pool. The participants in a field experiment are rarely limited to students and are often a representative sample of the general population or specifically designed with the purpose of being representative of a target sub-population (Haigh and List, 2005). Furthermore, field experiments reduce the risk of re-recruiting participants. The problem of re-recruiting participants is substantial in most experiments performed in a laboratory, as the subject pool from which the participants are recruited is often the same for consecutive experiments. Subjects with knowledge from prior experiments might be more prone to disobeying the rules or instructions (Lusk, 2019). Studies have also found that subjects with prior experience of deception have a lower probability of participating in a future experiment, and they often exhibit different behaviours compared to subjects who have not been deceived in prior experiments (Jamison et al., 2008; Ortmann and Hertwig, 2002).

The use of online marketplaces, such as Amazon Mechanical Turk (MTurk), is being increasingly employed as a cost-effective manner of recruiting participants for surveys and online field experiments (Berinsky et al., 2012; Bartling et al., 2018). Performing so-called online field experiments often induces larger sample sizes (Parigi et al., 2017).

In Paper 3, we harness these benefits associated with online field experiments and perform a large-scale online incentivised field experiment to study individuals' preferences for the allocation of resources. The experiment was designed so that it

could be performed online and at any given point during the day, to give respondents the highest degree of flexibility, while still ensuring that individuals' choices impacted other participants. This meant that we were able to recruit participants through the secure online mailbox system e-Boks. As more than 92% of all Danish citizens over the age of 15 have an e-Boks account we were able to recruit participants from a highly representative subject pool (Agency for Digitisation, 2020; Ebert et al., 2018). Using Microsoft's cloud computing service (Microsoft Azure, 2020) in conjunction with the open source R package Shiny (Chang et al., 2020) enabled us to develop and run the experiment entirely in-house, dramatically reducing the direct cost of the experiment. The low direct costs of the experiment meant that we were able to increase the economic incentives for participating in the survey and, hence pave the road for a relatively high participation rate, as economic incentives increase the propensity to participate (Perneger et al., 1993).

Turning to the findings from the paper, we demonstrate that the combination of a societal perspective and a coercive payment vehicle in valuation studies can lead to biased valuations of public goods, such as risk reductions due to improved road safety or information campaigns promoting healthier behaviour. This is due to the fact that individuals exhibit a degree of pure altruism, hence considering the impact their own preferences might have on other individuals due to the coercive tax. This in itself would not be a problem if individuals would not simultaneously misjudge the actual preferences of the other individuals.

Although increasing, the use of incentivised economic experiments to address issues in health remains limited. Whereas some studies have looked at altruism in the doctor-patient relationship (Godager and Wiesen, 2013), studies focusing on public preferences for health distributions have relied on stated preference data. This study provides new insights to the public preferences for the allocation of healthcare resources measured at the individual level and derived from revealed preferences following an incentivised experiment.

An implication from our findings is that stated preference studies with the purpose

of valuating public programs should either refrain from combining a public perspective with a coercive tax payment for the program or, at least, ensure that respondents are made aware of the true preferences of the other individuals. This could be done, for instance by showing the respondent a set of actual WTPs from other individuals.

This paradox of individuals being altruistic and actually being concerned with the well-being of others while simultaneously stating a WTP that might reduce the well-being of others, as compared to simply stating the individual's private WTP, might extend further than just stated-preference studies. Policymakers often make decisions with the purpose of facilitating the greater good. If policymakers exhibit the same pure altruistic preferences as the participants from our study while lacking the ability to correctly predict the value that the rest of the society will gain from a specific intervention, it might be a topic of concern. If this were in fact the case, policymakers could end up implementing policies believing that these will increase well-being while actually decreasing it. To avoid this, more focus would need to be devoted to ensuring that the beliefs that policymakers hold regarding the preferences of the general population are in fact aligned with their actual preferences.

6 Concluding remarks and future perspectives

This section is devoted to thoughts and discussions about how the findings and implications from this thesis can be progressed in future research.

This thesis has contributed to the literature on optimal resource allocation, inequality and equity in health care. However, there is still an immense amount of knowledge to uncover in future research. The result on the extremely little inequality in the waiting times in Danish hospitals is obviously a reassuring result. The inequalities related to non-western immigrants are still a topic that needs further investigation to identify whether this inequality stems from discrimination, differences in disease paths or other factors. An investigation of the effect that these inequalities might have on the outcomes would also be of interest to better determine the possible unjustness of these inequalities.

When considering the optimal allocation of resources across health states, we find that the marginal value of consumption is higher in general when health is superior, but it might depend on the severity of the illness. This imposes an inherent dilemma between optimal resource allocation and inequalities when an individual turns sick. Viewed from a purely egalitarian view resources should be transferred from the sick individuals to the healthy individuals to maximize welfare. Depending on whether the cause of the health shock is viewed as being either legitimate or illegitimate this redistribution might contradict with the maximization of welfare. Further research into this possible heterogeneity in the HSD is warranted as it is.

Focusing on the Danish context, increasing the length of the panel by including more waves of the SHARE survey, when these become available, is an obvious manner of progressing from here. This will enhance the robustness of the result in multiple ways. First, it might bring enough power with it to infer significant results of the main estimates relying only on the danish SHARE respondents[12]. This would increase the robustness of the results derived using the imputed values of SWB. Although these

[12]The main estimates are those from Model 3 in the paper.

results already demonstrate a high level of robustness, increased robustness is always preferred. Second, this will increase the size of the panel and, hence, increase the number of observations available for training the algorithm used to impute SWB. This should enable better predictive performance of the algorithm and, by extension, more precise estimates of SWB.

Moving to the results from the experiment, we first demonstrated that individuals in general behave as pure altruists. This entail that they are willing to sacrifice own welfare for the welfare of others and at least try to respect the preferences of other individuals. Unfortunately, we also highlight that individuals fail to correctly predict the benefits obtained by others of being insured and hence fail to correctly predict the value to others of a reduced risk of a loss.

A deeper investigation into this behaviour would be an obvious way to progress the research, especially by trying to decompose the degree of pure altruism across different risk sources, such as self-inflicted risk or accidental risk as preferences might be affected by the type of risk, just as we showed in paper 2 that preferences are susceptible to the type of health shock experienced. Different degree of pure altruism across risk sources would be extremely important to account for when prioritising within a health care system and between health conditions with varying degree of self-infliction. Second, we find that respondents have wrong beliefs regarding other individuals' preferences. If these wrong beliefs and pure altruistic preferences are also present within the population of policy-makers, it could lead to the creation of sub-optimal political reforms. Testing the preferences of and abilities to predict others preferences among policymakers is therefore a highly relevant future research topic.

7 English summary

Inequalities within a society and more specific ways of measuring and reducing them are receiving increasing attention. Being one of the United Nations Sustainable Development Goals United Nations (2020) and a main focus for OECD (OECD, 2020), measuring inequalities and, more importantly, understanding what they entail are of significant interest. Inequalities within health are especially interesting due to health's non-market-good characteristics. Defining and measuring inequalities in health is one concept, while establishing which of these inequalities are genuinely unfair or unjust is another. To establish which inequalities are unfair a normative view on what individuals actually perceive as unfair and what individuals are willing to hold each other responsible for has to be considered. This entails uncovering individuals' preferences with respect to inequalities in health and the possible mechanisms that drive these inequalities to establish whether certain inequalities are perceived as legitimate or illegitimate.

This thesis encompasses three papers that all examine either inequalities in health care or preferences associated with such inequalities.

Paper 1: The socioeconomic inequalities in the waiting times for publicly funded elective surgeries are estimated and explained within this paper. Individual-level data from administrative registers is used to establish both the waiting time experienced by the patients as well as their socioeconomic status. Only for a few of the procedures inequalities are found being related to either income or the level of education. However, these inequalities can mostly be explained by geographical and institutional factors across hospitals. Non-western immigrants seem to have to wait significantly longer than Danes, and this finding also holds when looking within hospitals and cannot hence be explained by the geographical differences across hospitals.

Paper 2: This paper provides new and more comprehensive empirical evidence for the changes in the marginal utility of consumption caused by deteriorating health known as health state dependence. We use a rich combination of longitudinal survey

data and administrative register data. The survey data is obtained from the Longitudinal Survey of Health, Ageing and Retirement in Europe (SHARE) and combined with data from the comprehensive Danish registers which include individual-leve income data and data on health care utilisation using the universal ICD-10 classification system. Utility is measured in terms of subjective well-being attained from SHARE. To further increase the statistical power of our sample, we use a state-of-the-art prediction algorithm to enrich the register data with information on subjective well-being. The estimated magnitude suggests that marginal utility of consumption decreases by 14.6% when an individual falls sick.

Paper 3: This paper aims to verify whether the occurrence of pure altruism in stated preferences valuations leads to biased valuations of public risk reductions. The reasoning for the bias comes from the hypothesis that individuals misjudge the preferences of other individuals. We conducted a large-scale online incentivised experiment. The results indicate that individuals do act as pure altruists and, thus respect and try to account for the preferences of others. The results also show that these pure altruistic individuals misjudge the preferences of the others and, therefore, end up stating biased valuations of the good in question. One way to avoid this bias is to apply a private perspective when eliciting valuations of public goods or to inform the respondents about the actual preferences of the other individuals affected by the good. The findings from the paper illustrate that respondents correct their biased valuations when given information regarding the preferences of the other individuals.

8 Dansk resumé (Danish summary)

Uligheder i et samfund og nærmere bestemt måder hvorpå man kan måle og reducere disse modtager øget interesse. Det at kvantificere og endnu vigtigere at forstå hvad der driver disse er af stor interesse og er bland andet ét af FNs Verdensmål (United Nations, 2020) og et hovedfokusområde for OECD (OECD, 2020). Uligheder indenfor sundhed er specielt interessante grundet godets "non-market" karakteristika. Det at definere og måle uligheder i sundhed er én ting, klarlægge hvilket af sådanne uligheder er uretfærdige eller urimelige er en helt anden opgave. Dette kræver en normativ vurdering af hvilke uligheder individer opfatter som uretfærdige og hvad individer er villige til at holde hinanden ansvarlige for. Dette kræver at man får afdækket individers præferencer for uligheder i sundhed og hvilke mekanismer der driver disse, for at kunne fastslå om specifikke uligheder bliver opfattet som legitime eller illegitime.

Denne afhandling består af tre artikler som alle enten undersøger uligheder i sundhed eller præferencer for sådanne.

Artikel 1: Estimerer og forklarer socioøkonomiske uligheder i ventetider for offentligt finansierede ikke-akutte procedurer. Data på individniveau fra de administrative registre benyttes til at bestemme patientens erfarede ventetid samt socioøkonomiske status. Kun for nogle få af de udvalgte procedurer er det muligt at påvise uligheder i ventetider med relation til indkomst eller uddannelsesniveau. Disse uligheder kan dog forklares med geografiske og institutionelle faktorer på tværs af sygehuse. Ikke-vestlige immigranter venter tilsyneladende signifikant længere sammenlignet med danskere og denne ulighed er også til stede hvis fokus blot er indenfor hvert enkelt sygehus og kan derved ikke forklares med geografiske forskelle på tværs af sygehuse.

Artikel 2: Fremsætter ny og mere omfattende empirisk bevis for ændringer i marginalnytten af forbrug som følge af forværret helbred. Vi benytter en detaljeret kombination af longitudinal spørgeskemadata og administrativt register data. Spørgeskemadata stammer fra 'the Survey of Health, Ageing and Retirement in Europe (SHARE)' og sammenkobles med data fra de omfattende danske registre omhandlende indkomst og

sundhedsydelser via ICD-10 klassifikationssystemet på individniveau. Nytte er målt via subjektivt velbefindende (subjective well-being) og stammer fra SHARE. For at øge den statistiske styrke anvender vi det nyeste indenfor prædiktions algoritmer til at berige registerdataene med information omkring subjektivt velbefindende. Resultatet indikerer at marginalnytten af forbrug reduceres med 14,6% som følge af sygdom og derved reduceret sundhed.

Artikel 3: Formålet er at verificere hvorvidt tilstedeværelsen af pure altruisme i stated preferences studier medfører et bias i værdisætningen af offentlige goder, som f.eks. risikoreduktion. Ræsonnementet bag dette mulige bias grunder i hypotesen om, at individer fejlvurderer andre personers præferencer. Vi foretager et omfattende online eksperiment med økonomiske incitamenter for deltagerne. Resultaterne viser at deltagerne faktisk agerer som pure altruister og derved respekterer andre individers præferencer og forsøger at tage højde for disse. Resultaterne viser derudover også at disse pure altruister faktisk fejlvurderer de andre individers præferencer og derfor ender med at udtrykke betalingsvilligheder som er fejlbehæftede. En måde at undgå dette bias på, er ved at vurdere værdien af godet i et rent privat scenarie eller ved at give respondenterne bedre information omkring de andre individers faktiske præferencer. Resultater fra studiet påviser nemlig at respondenter korrigerer deres fejlbehæftede betalingsvilligheder hvis de bliver gjort opmærksomme på deres fejlagtige vurdering af de andre individers præferencer.

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