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Sven Tengstam

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Department of Economics
School of Business, Economics and Law at University of Gothenburg
Vasagatan 1, PO Box 640, SE 405 30 Göteborg, Sweden
+46 31 786 0000, +46 31 786 1326 (fax)
www.handels.gu.se info@handels.gu.se

Disability and marginal utility of income

Sven Tengstam*

* Department of Economics, University of Gothenburg, Box 640, SE 405 30 Göteborg, Sweden, Tel.: +46-31-7861000, e-mail: sven.tengstam@economics.gu.se

Abstract:
It is often assumed that disability lowers the marginal utility of income. In this article individuals' marginal utility of income in two states, (1) paralyzed in both legs from birth and (2) not mobility impaired at all, are measured through experimental choices between imagined lotteries behind a so-called "veil of ignorance". The outcomes of the lotteries include both income and disability status. It is found that most people have higher marginal utility when paralyzed than when not mobility impaired at all. The median ratio of the two marginal utilities is estimated at between 1.16 and 1.92. The two marginal utilities are evaluated at the same levels of income.

Quite little of the heterogeneity in this ratio can be explained by socio-economic background, but having personal experience of mobility impairment and supporting the Left party, the Social democratic party, the Green party or the Liberal party are associated with having a high ratio. The results suggest, in contrast to e.g. Finkelstein et al. (2008) and Viscusi and Evans (1990) that more than full insurance of income losses connected to being disabled is optimal. The results further suggests, in contrast to e.g. Sen (1997) and Roemer (1985, 1996, 2001), that given a utilitarian social welfare function resources should be transferred to, rather than from, disabled people. Finally, if the transfers are not large enough to smooth out the marginal utilities of the disabled and the non-disabled, distributional weights based on disability status (in opposite to income) should be used in cost-benefit analysis.

Keywords: disability, mobility impairment, marginal utility, hypothetical lotteries, risk.

JEL classification: D10, D60, D63, I10, I30.

1. Introduction

It is often explicitly or implicitly assumed that disability generally makes it more difficult to benefit from consumption, or in other words, that disability lowers the marginal utility of income. This view is theoretically justified by assuming that disability makes an individual less efficient in transforming income into utility (see e.g., Sen, 1997, and Roemer, 1985, 1996, 2001). Sloan et al. (1998) and Viscusi and Evans (1990) are two frequently referred to empirical studies that support this line of reasoning. One potential weakness in these studies is that their results to a large extent rely on the authors' assumptions on the functional form of the utility function.[1]

In this paper we test the relationship between disability and marginal utility of income, and find that the former actually increases the latter. Individuals' marginal utilities (measured by a

[1] Sloan et al. (1998) assume that the utility function is a state-dependent logarithmic function in income; i.e., the functional form is $u = \beta \ln y$, where β varies between the states. This means that they more or less have assumed what they intend to show (if utility is lower when disabled, then marginal utility also must be lower, given the logarithmic form). Viscusi and Evans (1990) make a first-order Taylor approximation and thereby neglect the second and higher order terms. We discuss the important effect of this negligence in Appendix 1.

von Neumann-Morgenstern, 1947, utility function) of income in two states is measured through experimental choices between imagined lotteries behind a so-called "veil of ignorance" (this term was introduced by Rawls, 1971). The two states are (1) paralyzed in both legs from birth and (2) not mobility impaired at all. Early empirical studies that utilize a veil of ignorance to measure the shape of the utility function include Johannesson and Gerdtham (1995; 1996) and Johansson-Stenman et al. (2002), which both deal with risk aversion in income. Our study is to our knowledge the first to utilize a veil of ignorance to measure how disability affects marginal utility. When it is feasible real outcomes should be preferred to hypothetical (see e.g. Glaeser et. al., 2000), but when the topic is e.g. death, as in van der Pol and Ruggeri (2008), or disability, as in our study, real outcomes cannot be used.[2]

We design and perform a new choice experiment, and we develop a theoretical framework to analyze it. The respondents are asked to choose what is best for their hypothetical grandchild (or another close person living two generations into the future). This idea was first used by Johansson-Stenman et al. (2002). It is a way to avoid the risk that respondents are not able to disregard her personal circumstances and environment when taking part in the experiment. The respondents choose between hypothetical lotteries, where the outcomes include both income and disability status. Assuming that the respondents use their own preferences while choosing on their grandchild's behalf this allows for estimation of whether the respondent's marginal utility of income when paralyzed is higher or lower than when not mobility impaired at all. An interval for the ratio of the two marginal utilities can also be estimated.

This ratio is interesting for many reasons; for example, when maximizing the utilitarian social welfare function it is not the level of individuals' utility or marginal utility that matters, but rather the relative size of marginal utilities. Simply put, utilitarianism recommends that resources should be transferred from persons with lower marginal utility of income to persons with higher marginal utility of income. If the transfers are not large enough to smooth out the marginal utilities of the two groups, there is implications for optimal provision of public goods. We should then over-provide public goods that are in general preferred by persons with higher marginal utility of income. In other words, distributional weights based on disability status (in opposite to income) should be used in cost-benefit analysis, given that the marginal utilities of income (for the same income level) differs between disabled and non-disabled persons. Therefore the relative

[2] This is further discussed in section 5.2.

size of the marginal utilities of different groups is very important to study. Sen (1997) and Roemer (1985, 1996, 2001) assumes that disabled people have lower marginal utility of income. Based on that, they conclude that utilitarianism recommends that resources should be transferred from disabled people to non-disable people.[3] This recommendation seems unpleasant and nasty, and highlights the need to study the relative size of the marginal utilities of disabled and non-disabled persons. This relative size also has fundamental implications for optimal insurance theory.

We get two strong results. First, for most people the marginal utility of income when paralyzed is higher than when not mobility impaired at all. Second, the median ratio of the two marginal utilities is in the 1.16–1.92 interval. This should be interpreted as the marginal utility of income being between 16 % and 92 % higher for a paralyzed person than for a person with no physical disability. Note that all our results are based on the two marginal utilities being evaluated at *the same levels of income*.

The remainder of this paper is organized as follows. Section 2 presents the theoretical framework and section 3 describes the design of the choice experiment. Section 4 reports the results, and section 5 discusses ordering and design effects, and it also includes a robustness discussion. Section 6 concludes the paper.

2. The model

2.1. Introduction to our theoretical framework

We assume that individuals' preferences (over choices including risk) satisfy the von Neumann-Morgenstern (VNM) axioms, and therefore can be represented by a VNM utility function (i.e., a utility function with the expected utility property). This means that everybody is an expected utility maximizer. Following the state-dependent utility approach, we let $u(y)$ denote the utility of income y when not mobility impaired and $v(y)$ the utility of income y when paralyzed.

We are interested in $v'(y)$ in relation to $u'(y)$. There are two approaches to measure this relationship. The first is to look at this relationship for a particular y, and the second is to look at this relationship in general for y in an interval. In the first approach one can ask two questions. One can ask which of the two marginal utilities that is highest. One can also ask how much higher it

[3] See Sen (1997: 15-18) for a very clear review of this reasoning.

is by studying the ratio of the two marginal utilities. This ratio[4], which we can call “relative marginal utility of income when disabled”, is then:

$$(1) \qquad \tilde{R}(y) = \frac{v'(y)}{u'(y)}$$

It is not possible to construct a choice experiment with a finite number of choices that allows us to answer any of these two questions without making assumptions about the shape of *u(y)* and *v(y)*. To be able to get answers with any reasonable precision, either the alternatives the respondents choose among have to be so similar that it is difficult for the respondents to contemplate, or very strong assumptions about the shape of *u(y)* and *v(y)* has to be made.

The second approach is to look at an interval for y, e.g. $y_1 < y < y_2$. One can then ask two questions, which differs slightly from the two questions one can ask in the first approach. One can ask which of the two marginal utilities that is highest on average in this interval. One can also ask how much higher it is by studying the ratio of the average marginal utilities of the two utility functions in the interval. This ratio[5], which we can call “relative average marginal utility of income when disabled”, is then a function of y_1 and y_2:

$$(2) \qquad R(y_1; y_2) = \frac{\frac{1}{y_2 - y_1}\int_{y1}^{y2} v'(y)dy}{\frac{1}{y_2 - y_1}\int_{y1}^{y2} u'(y)dy}$$

The first of these two questions can be answered by a choice experiment if assuming *v’(y)* > 0, which is a trivial assumption. For the second question, a not unreasonable wide interval for the answer can be given if assuming that the level of concavity of *v(y)* is within a certain interval, which is a not too strong assumption.

[4] Since VNM utility functions are unique up to positive affine transformations (i.e., cardinal), this ratio is uniquely determined.

[5] See previous footnote.

In this paper the relationship between *v'(y)* and *u'(y)* is measured using the second approach, e.g. we ask and try to answer two questions about the average marginal utilities of the two utility functions. The second approach is chosen not only because the first approach cannot be used, but also because the second approach gives more general results. The choice experiments were constructed in such a way that an estimate of $R(14{,}000SEK;20{,}000SEK)$ can be made. Ten SEK (Swedish kronor) is approximately one PPP US dollar. The median net monthly wage in Sweden is in the 14000 – 20000 SEK interval. This second approach gives information about a much wider range of income levels than an estimate of e.g. $\tilde{R}(17000SEK)$ would do. In all practical applications it is the relation of *v'(y)* and *u'(y)* not for one exact value of *y* that is of use, but what the relation looks like in general for income levels that are common.

2.2. The theoretical framework applied on our experiment

The interpretation of the experimental results is based on individuals' preferences satisfying the VNM axioms and individuals acting in line with their preferences. Two outcomes are possible in each lottery, both with a probability of 50 %. In one of the outcomes the hypothetical grandchild ends up paralyzed in both legs, and in the other outcome she ends up not mobility impaired at all. She earns income y_p if she is born paralyzed and income y_{np} if she is not. The expected utility of a lottery is given by:

(3) $$E(U) = 0.5u(y_{np}) + 0.5v(y_p).$$

Let us now consider two lotteries, *A* and *B*. The income she gets in lottery *l* if she is born paralyzed is denoted $y_{p,l}$, and the income she gets in lottery *l* if she is not born mobility impaired is denoted $y_{np,l}$. The lotteries were constructed in such a way that the income levels in all lotteries further satisfy $y_{npB} = y_{pA}$, $y_{npB} > 0$, $y_{pB} > y_{npB}$ and $y_{npA} > y_{npB}$. Let us now explore what conclusion can be drawn if it is known that an individual is indifferent between lotteries *A* and *B*. The indifference translates into:

(4) $$0.5u(y_{np,A}) + 0.5v(y_{p,A}) = 0.5u(y_{np,B}) + 0.5v(y_{p,B}).$$

Which is equivalent to

(5) $$\int_{y,p,A}^{y,p,B} v'(y)dy = \int_{y,np,B}^{y,np,A} u'(y)dy$$

How much conclusions we can draw on *R* from equation (5) depends on how strong assumptions we do on the functional forms of *u(y)* and *v(y)*.

First, if we make no assumptions at all we can say the following by rearranging equation (5)

(6) $$\frac{1}{y_{pB} - y_{pA}} \int_{y,pA}^{y,pB} v'(y)dy \Bigg/ \frac{1}{y_{npA} - y_{npB}} \int_{y,np,B}^{y,np,A} u'(y)dy = \frac{y_{npA} - y_{npB}}{y_{pB} - y_{pA}}$$

This means that $\frac{y_{npA} - y_{npB}}{y_{pB} - y_{pA}}$ provides a rough approximation of $R(y_{npB}; y_{npA})$. This ratio is only an approximation since it is the ratio of average *v'* in the interval $y_{npB} < y < y_{pB}$ divided by average u' in the interval $y_{npB} < y < y_{npA}$. Unfortunately there is no way to arrange the choice experiments in such a way that it gives an estimate of $R(y_{npB}; y_{npA})$ (or for any other interval) without adding at least some assumptions of the form *v(y)*. That would require not only that $y_{npB} = y_{pA}$, but also that $y_{npA} = y_{pB}$ in all the choices the respondents make, and it would only be able to produce one estimate: unity.

Second, by making the standard assumption that *v'(y)* > 0 we can conclude a very important result:

(7) $$\begin{aligned} y_{pB} < y_{npA} &\Rightarrow R(y_{npB}; y_{npA}) > 1 \\ y_{pB} > y_{npA} &\Rightarrow R(y_{npB}; y_{npA}) < 1 \\ y_{pB} = y_{npA} &\Rightarrow R(y_{npB}; y_{npA}) = 1 \end{aligned}$$

This means that if $y_{pB} < y_{npA}$, then we know that in the interval $y_{npB} < y < y_{npA}$ the average of *v'(y)* is larger than the average of *u'(y)*. Thereby, by estimating the proportion of people that are indifferent between lotteries *A* and *B* such as $y_{pB} < y_{npA}$, we would get an estimate of the proportion of the people that have *v'(y) > u'(y)* (on average in the interval at hand).

Third, to get an estimate of $R(y_{npB}; y_{npA})$ beyond whether it is under, equal to or over one, some additional assumption except *v'(y) > 0* is needed. By assuming that the relative risk aversion of *v(y)* is constant in the interval $y_{npB} < y < \max\{y_{npA}, y_{pB}\}$ we can calculate the implicit $R(y_{npB}; y_{npA})$. Relative risk aversion is defined as $-yv'' \quad v'$. This is constant for the special class of utility functions proposed by Atkinson (1970):

(8)

$$v = a\,y^{1-\rho} \quad 1-\rho \quad + b \qquad if\rho \neq 1$$

$$v = alny + b \qquad if\rho = 1$$

where a and b are constants. For this class of utility functions the relative risk aversion is ρ for all income levels. They are in other words characterized by constant relative risk aversion (CRRA) which is ρ, where $\rho = 0$ implies a linear utility function and risk neutrality and $\rho \to \infty$ corresponds to extreme risk aversion of maximin type.

Defining $r_1 = \frac{y_{npA}}{y_{npB}}$ and $r_2 = \frac{y_{pB}}{y_{npB}}$ (and utilizing $y_{npB} = y_{pA}$) we see that

(9) $$v(y_{npA}) - v(y_{npB}) = D\left[v(y_{pB}) - v(y_{npB})\right]$$

Where

$$D = \frac{r_1^{1-\rho} - 1}{r_2^{1-\rho} - 1} \qquad \text{if } \rho \neq 1$$

(10)

$$D = \frac{\ln r_1}{\ln r_2} \qquad \text{if } \rho = 1$$

(9) and (5) now implies

(11) $$R(y_{npB}; y_{npA}) = D$$

Equations (7) and (11) are our main results. It can be shown that the value of ρ does not affect whether D is larger than, smaller than, or equal to unity. It can also be shown that equation (7) and equation (11) never contradict each other. (Proofs are available from the author upon request.) This means that we do not have to actually use equation (7) in our calculations; it is enough to use equation (11) and calculate $R(y_{npB}; y_{npA})$. The value of $R(y_{npB}; y_{npA})$ calculated with equation (11) holds given the CRRA assumption, and for a particular ρ. But the conclusion drawn from equation (11) concerning whether $R(y_{npB}; y_{npA})$ is larger than, smaller than, or equal to unity, holds given the less restrictive assumptions that equation (7) is based on.

There is considerable variation in the results in the literature trying to empirically estimate individual relative risk aversion. Values in the 0.5 – 3 interval are often estimated for ρ (see e.g. Dasgupta, 1998 and Blanchard and Fischer, 1989). To make conservative estimations of $R(y_{npB}; y_{npA})$ we will allow for $0.5 < \rho < 4$.[6] For example, if a person is indifferent between lottery *A* and *B*, and $y_{npB} = 14{,}000$, $y_{npA} = 20{,}000$ and $y_{pB} = 17{,}000$, then equation (11) implies that $1.49 < R(14{,}000; 20{,}000) < 1.92$ assuming that *v(y)* has CRRA property in the interval $14{,}000 < y < 20{,}000$ and $0.5 < \rho < 4$. We can also conclude that $R(14{,}000; 20{,}000) > 1$ making only one assumption about the shape of *u(y)* and *v(y)*, namely that *v'(y) > 0*.

[6] The higher the relative risk aversion, the closer to unity our estimations with equation (11) will be.

3. The choice experiments

A total of 354 respondents, all intermediate level undergraduate students from the University of Gothenburg and Chalmers University of Technology in Gothenburg, Sweden, participated in the choice experiments. The respondents were distributed among the engineering, law, social work, and education programs. The choice experiments were conducted at the end of a lecture. Participation was voluntary and there was no show-up pay. The approximate participation rates were as follows: 90% for engineering students, law students and social work students, and 75% for education students. The questionnaire consisted of two parts to be answered by all respondents: the lottery experiment and questions about socioeconomic status (summary statistics are presented in Table 1, and the questionnaire is presented in Appendix 2). The respondents were only given information and instructions in writing (included in the questionnaire). The total time for answering the questionnaire was 15 minutes.

The respondents made pair-wise choices between hypothetical lotteries characterized by income and disability outcome. The respondents were asked to consider the well-being of an imaginary grandchild or another close person two generations into the future. In line with Johansson-Stenman et al. (2002:369), we motivate this with the assumption that asking about hypothetical grandchildren is a way to avoid the risk that respondents are not "able to disregard her personal circumstances and environment in the experiment". The assumption is that the respondents really end up using their own preferences, since they have no information suggesting that their grandchildren's preferences should be any different than their own. What we intend to measure is each respondent's utility function. If the respondents rather than stating their own preferences state what they think people in general prefer, then this is what we actually get an estimate of, which might grind down extreme values.

The respondents were told that the grandchild would have a predisposition giving her a 50% probability of being born with both legs irreparably paralyzed, and a 50 % probability of being born without any mobility impairment at all. 50 % - 50 % was used since it is generally found to be difficult to communicate small probabilities (see, e.g., Kahneman and Tversky, 2000). They were further told to imagine that this was decided in a lottery, and that the grandchild's monthly net income was determined in the same lottery. If paralyzed, there would not exist any device able to give the grandchild her mobility back.

It was stated that: "Society pays all extra economic costs (e.g., for special trips and for adjusting her house) that arise due to being mobility impaired. The income differences thereby are actually differences in the amounts of goods and services she can buy and consume." We can picture this (compared to a situation with no welfare state whatsoever) as that society gives a transfer to paralyzed people. This transfer gives them a lower marginal utility of income (than without the transfer) due to the marginal utility of income being diminishing in income. This means that for most people, R would be even higher without than with a welfare state. Therefore, had we stated the question without a welfare state, then our estimate of R would probably have been higher.

Table 1. Summary statistics

Variable	Description	Obs.	Min	Max	Mean	S.D.
Male	1 = male	290	0	1	0.345	
Age		291	20	49	26.5	5.8
Siblings	1 = having at least one sibling	291	0	1	0.938	
Middle income	1= did grow up in a middle income family	291	0	1	0.646	
High income	1= did grow up in a high income family	291	0	1	0.168	
Experienced	1 = "I (or a family member/close friend) am paralyzed in one or two legs"	291	0	1	0.089	
Married	1 = married or cohabiting	291	0	1	0.395	
Credits	University credits, one semester = 20 credits	288	30	260	104.7	41.8
Law	1 = law student	292	0	1	0.257	
Social	1 = social work student	292	0	1	0.216	
Teacher	1 = education student	292	0	1	0.288	
Engineering	1 = engineering student	292	0	1	0.240	
Left	1 = supports the Left Party	270	0	1	0.115	
Social Dem.	1 = supports the Social Democratic Party	270	0	1	0.307	
Green	1 = supports the Green Party	270	0	1	0.159	
Liberal	1 = supports the Liberal Party	270	0	1	0.093	
Centre	1 = supports the Centre Party	270	0	1	0.044	
Christian Dem.	1 = supports the Christian Democrats	270	0	1	0.052	
Moderaterna	1 = supports Moderaterna (a liberal-conservative party)	270	0	1	0.159	
Other party	1 = supports a party not today represented in the Swedish parliament	270	0	1	0.070	
Religious	1 = visits church / mosque / synagogue / equivalent once a month or more often	291	0	1	0.117	
Low Anchor	Corrects for a potential anchor effect toward low R, see Section 5.2 for a discussion	292	0	1	0.616	

The respondents were also told that the outcome of the lotteries would not influence their grandchild's job satisfaction or how hard she would have to work. They were also informed that society as a whole would not be affected by their choices or by the outcome of the lotteries, and that the grandchild's monthly net income would have the same percentage growth as incomes in society in general. After being presented with two lotteries, they were asked to choose the lottery they thought would be best for the imaginary grandchild. After making the selection, the procedure was repeated several times (there were nine rounds – see below), but with different sets of lotteries in each round.

We used four slightly different versions of the questionnaire. Let us first look at Version 1. For all choices, lottery *A* remained unchanged and had two possible 50-50 outcomes. Outcome 1 was a 20,000 SEK (approx. PPP US$ 2,000) monthly net income and no disability, and outcome 2 was a 14,000 SEK (approx. PPP US$ 1,400) monthly net income and both legs paralyzed. Nine different *B* lotteries were presented; thus, the respondents made nine pair-wise choices. Also all the *B* lotteries had two 50-50 outcomes.

Using the choices made by a respondent we can now assess whether the respondent's marginal utility of income when paralyzed is higher or lower than when not mobility impaired at all. An interval for the ratio of the two marginal utilities can also be estimated. Each lottery *B* corresponds to a certain interval within which R (from now on we drop the parentheses from $R(14{,}000;20{,}000)$ and write simply *R*) must be if the respondent is indifferent between lottery *A* and lottery *B*. This interval can be calculated using equation (11) and $y_{npA} = 20{,}000$, $y_{npB} = 14{,}000$ and the value of y_{pB} that were used in that particular lottery *B*. Equation (11) is based on the assumption that *v(y)* has constant relative risk aversion (CRRA) in the interval $y_{npB} < y < \max\{y_{npA}, y_{pB}\}$ that is ρ. By assuming that ρ, the level of CRRA, is in the interval $0.5 < \rho < 4$ we can calculate an interval for *R*. The lotteries are presented in Table 2, along with the implicit intervals for *R*.

Table 2. The lotteries (version 1)

	Income if not mobility impaired	Income if paralyzed	*R* if indifferent between A and B
Lottery A	20,000	14,000	
Lottery B1	14,000	15,000	3.51 – 5.56
Lottery B2	14,000	17,000	1.49 – 1.92
Lottery B3	14,000	18,500	1.16 – 1.31
Lottery B4	14,000	19,500	1.04 – 1.08
Lottery B5	14,000	20,000	1.00
Lottery B6	14,000	20,500	0.93 – 0.96
Lottery B7	14,000	21,500	0.82 – 0.91
Lottery B8	14,000	23,000	0.69 – 0.85
Lottery B9	14,000	25,000	0.58 – 0.80

Using the standard assumption that $v'(y) > 0$ we know that an expected utility maximizer prefers lottery *B2* to lottery *B1*, and lottery *B3* to *B2*, and so on.[7] This means that we expect our respondents to either choose lottery *A* in all nine rounds, or choose lottery *B* in all nine rounds, or choose lottery *A* to start with, and at one point switch to lottery *B* and then do not switch back. The switch can take place after any of the first eight rounds. This leaves us with a total of ten different consistent ways a respondent can act. If a respondent switched from choosing lottery *B* to lottery *A* in later choices this was inconsistent, and the respondent were not included in the analysis. These ten ways to act can be analyzed using table 2. For example, if a person prefers lottery *A* to *B2*, and at the same time she prefers lottery *B3* to *A*, this implies that the interval 1.49 – 1.92 provides an upper bound on her *R* and the interval 1.16 – 1.31 provides a lower bound. This means that her *R* is in the interval 1.16 – 1.92. In this fashion, we can calculate an interval for *R* for each of the respondents. These intervals will inevitably to some extent overlap.

Version 1 of the questionnaire is presented in Table 2. Using four different versions was a way to test for framing effects (all versions are presented in Appendix 3 and discussed in detail in section 5.1). One effect was found to be statistical significant, and might have had an influence on our results. In 50% of the questionnaires handed out to all groups except the engineering group, the names of lottery *A* and *B* were switched. In other words, the lottery that stayed the same in all nine rounds was now called *B*, and the lottery that changed between the rounds was now called *A*. There was a tendency for the respondents to choose *A* rather than *B*, ceteris paribus. Therefore one of the versions turned out to be anchored towards a low *R*, and the other version turned out to be anchored towards a low *R*. 62 % of the respondents got the version that was anchored toward lower *R*, and 38 % got the version that was anchored toward higher *R*. The anchor effect therefore might have made our estimate of *R* downward biased, meaning that our result would have been even higher without it. In the econometric analysis we control for the anchor effect by adding a dummy for the respondents who received a questionnaire anchored toward lower *R*.

[7] It is actually enough to assume that the respondent thinks that "more is better" to conclude that he prefers lottery *B2* to lottery *B1*, and lottery *B3* to *B2*, and so on.

4. Results

4.1. Descriptive results of the choice experiments

Of the 354 respondents, three did not answer the lottery question and 59 gave inconsistent answers,[8] leaving us with 292 valid (consistent) respondents in the choice experiments. Summary statistics are presented in Table 1, and the results are shown in Table 3. The median R is in the interval $1.16 < R < 1.92$.

Table 3. Results of the choice experiment

R	No.	Cumulative no.	Frequency	Cumulative freq.
R < 0.8	68	68	0.233	0.233
$0.58 < R < 0.85$	4	72	0.014	0.247
$0.69 < R < 0.91$	10	82	0.034	0.281
$0.82 < R < 0.96$	5	87	0.017	0.298
$0.93 < R < 1$	19	106	0.065	0.363
$1 < R < 1.08$	29	135	0.099	0.462
$1.04 < R < 1.31$	10	145	0.034	0.497
$1.16 < R < 1.92$	27	172	0.092	0.589
$1.49 < R < 5.56$	70	242	0.240	0.829
R > 3.51	50	292	0.171	1.000

4.2. Statistical analysis of the median R

186 of the 292 valid respondents, 63.7%, had an R higher than one. The estimator of the percentage of the population with an R higher than one has binomial distribution. Therefore the estimator has approximately a normal distribution with a standard deviation not higher than 2.93 percentage points [9]. The null hypothesis is that the median R equals one. The z-value is 4.68 and the null is rejected at the 0.0005% level when making a two sided test (the p-value is 0.0000029). The median R is statistically significantly (at the 0.0005% level) higher than one.

One could argue that the respondents who made choices that imply an R just under or just over one did not clearly state their preferences. We could instead treat these respondents as if they were simply maximizing the expected income and flipping a coin when indifferent, and only look at the respondents with strong preferences. Since 157 had an R clearly over one and 87 had

[8] The 59 gave inconsistent answers in the sense that their answers imply negative marginal utility of income.

[9] Note that we do not use the standard error (an estimate of the standard deviation of the estimator), but instead the standard deviation of the estimator. The standard deviation for the estimator is not higher than (0.5*0.5/292)^0.5 = 2.93 %.

the opposite, we can no doubt reject the hypothesis that these groups have the same size; a larger fraction of the population has an *R* clearly over one than clearly under one.

Table 4. Results by subgroup

Subgroup	Obs.	Median *R*	Percentage with *R*>1
Male	100	1 < R < 1.08	60%
Female	190	1.16 < R < 1.92	65.8%
Has siblings	273	1.16 < R < 1.92	64.1%
Has no siblings	18	1.04 < R < 1.08	61.1%
Low income	54	1 < R < 1.08	55.6%
Middle income	188	1.16 < R < 1.92	67.6%
High income	49	1 < R < 1.08	59.2%
Experienced	26	1.49 < R < 5.56	84.6%
Not experienced	265	1.04 < R < 1.31	61.9%
Married	115	1.16 < R < 1.92	64.3%
Not married	176	1.16 < R < 1.92	63.6%
Law	75	1.16 < R < 1.92	62.7%
Social	63	1.49 < R < 5.56	71.4%
Teacher	84	1.16 < R < 1.92	67.9%
Engineering	70	1 < R < 1.08	52.9%
Left	31	1.49 < R < 5.56	74.2%
Social dem.	83	1 < R < 1.08	66.3%
Green	43	1.16 < R < 1.92	69.8%
Liberal	25	1.16 < R < 1.92	68%
Centre	12	0.93 < R < 1	41.7%
Christian dem.	14	1.49 < R < 5.56	71.4%
Moderaterna	43	0.93 < R < 1	48.8%
Other party	19	1.16 < R < 1.92	52.6%
Religious	34	1.49 < R < 5.56	64.7%
Not religious	257	1.04 < R < 1.31	63.4%
All	292	1.16 < R < 1.92	63.7%

4.3. Can observed personal characteristics account for heterogeneity in R?

In the literature on risk, socio-economic factors are often found to be associated with risk preferences. We investigate if this also holds for relative marginal utility of income when disabled, *R*. The question at hand is; can observed personal characteristics account for heterogeneity in *R*? Table 4 shows descriptive statistics by subgroups. We see that there are some differences between socioeconomic groups. Econometric analysis was undertaken to gain better insight into these differences. A probit model is estimated (see Table 5) to describe what determines whether a person's *R* is under or over one. A dummy equal to one if $R > 1$ serves as the dependent variable in this regression.

The first estimation (Table 5, Column 1) only includes the background variables as explanatory variables. The total effect (both the direct and the indirect via, e.g., political ideology and educational choice) is estimated here. We see no significant gender effect on *R*. This can be compared to findings that women tend to be more risk-averse (Croson and Gneezy, 2009 and Borghans et al., 2009). Respondents with (or who have a family member/close friend with) one or two paralyzed legs appear to have a higher probability of having an *R* over one. This effect is strong; in fact, it is estimated to 23.5 percentage points. Individuals from a middle-income family have a higher probability than those from a low-income family (the default) to have an *R* over one, but this is only weakly statistically significant. There are no significant associations with age and number of siblings and family income.

Estimation 2 includes variables capturing political preferences and religiousness, and in estimation 3 we control for the background variables. Even when controlling for background factors, political ideology is associated with whether an individual has an *R* over one. More exactly, voters for the Left Party, the Green Party, the Social Democratic Party, and the Liberal Party are approximately 20 percentage points more likely to have an *R* over one than those who sympathize with Moderaterna (the default). It is somewhat expected that *R* is correlated with political ideology. If a person e.g. supports a party which policies in general imply sizeable redistribution, this person probably thinks that the marginal utility of income varies quite a lot within the population. This variation is the person's reason to support redistribution. It is likely that the belief in such a variation is correlated with the belief that one's own marginal utility varies in different situations. However, there is no significant association with religiousness (how frequent one visits a church/mosque/synagogue/equivalent).

Estimation 4 includes the variables that capture life situation, and in estimation 5 we control for the background variables, and also for political ideology and religion. These "value variables" are included in Estimation 5 since political preferences and religiousness to a large extent precede educational choice and the decision to get married. Either type of subject, university credits or whether or not a person is married, seem to be associated with *R*.

In sum, there are two kind of personal characteristics that can account for part of the heterogeneity in *R*; personal experience and political ideology. Having personal experience of mobility impairment and supporting the Left party, the Social democratic party or the Liberal party are associated with having a high *R*. But the fact that in all specifications the prediction accuracy rates are only slightly higher than the prediction accuracy rate one would get by simply guessing that all respondents have an *R* over one, 63.7 %, tells us that a lot of the variation of *R* is still present when controlling for the observed personal characteristics.

Table 5. Probit regressions, marginal effects

	1	2	3	4	5
Male	-0.023		-0.049		-0.050
	(0.064)		(0.069)		(0.076)
Age	0.006		0.003		0.000
	(0.006)		(0.006)		(0.006)
Siblings	0.045		0.039		0.053
	(0.124)		(0.127)		(0.124)
Middle income	0.134*		0.145*		0.148*
	(0.076)		(0.081)		(0.080)
High income	0.047		0.122		0.135
	(0.092)		(0.093)		(0.094)
Experienced	0.235***		0.240***		0.245***
	(0.074)		(0.075)		(0.071)
Left		0.216**	0.202**		0.169*
		(0.084)	(0.091)		(0.101)
Social Dem.		0.161**	0.194**		0.174**
		(0.081)	(0.084)		(0.086)
Green		0.175**	0.169*		0.138
		(0.086)	(0.091)		(0.096)
Liberal		0.175*	0.211**		0.203**
		(0.096)	(0.087)		(0.090)
Centre		-0.036	-0.036		-0.037
		(0.158)	(0.157)		(0.162)
Christian Dem.		0.178	0.181		0.227*
		(0.135)	(0.134)		(0.124)
Other party		0.033	0.044		0.018
		(0.127)	(0.128)		(0.134)
Religious		0.002	0.028		-0.011
		(0.106)	(0.110)		(0.118)
Law				0.023	-0.057
				(0.087)	(0.103)
Social				0.042	-0.051
				(0.115)	(0.143)
Teacher				0.058	-0.022
				(0.088)	(0.112)
Credits				0.002*	0.002
				(0.001)	(0.001)
Married				-0.050	-0.019
				(0.062)	(0.068)
Low Anchor	-0.084	-0.120**	-0.090	-0.082	-0.101
	(0.060)	(0.060)	(0.065)	(0.064)	(0.070)
Prediction accuracy rate	65.1 %	66.7 %	67.4 %	63.9 %	68.6 %
Observations	289	270	267	288	264

Notes: The marginal effects are evaluated at the mean of the independent variables. The discrete change in the probability for dummy variables is reported. Moderaterna is the default party. Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

5. Ordering and design effects, and a robustness discussion.

5.1. Ordering and design effects

The hypothetical grandchild had a male name (Erik) in 50% of the questionnaires and a female name (Anna) in the remaining 50%. This did not seem to affect the answers, and a Wilcoxon rank-sum test does not reject that the name used had no influence on the answers. The ordering of the answer alternatives was switched in 50 % of the questionnaires; hence, in 50% of the questionnaires the lottery that changed between the rounds started at 25,000 SEK (and fell from round to round) if disabled instead of at 15,000 SEK (and increased from round to round) if disabled. A Wilcoxon rank-sum test does not reject that the ordering used had no influence on the answers. If these two changes do have an influence that we fail to capture, they do not influence our results in any systematic way since the four versions were distributed randomly among respondents.

Finally, we performed one more test of how the formulations in the questionnaire might influence the answers. In 50% of the questionnaires handed out to all groups except the engineering group, the names of lottery *A* and *B* were switched. In other words, the lottery that stayed the same in all nine rounds was now called *B*, and the lottery that changed between the rounds was now called *A*. The versions were distributed randomly. These three tests give in total eight versions of the questionnaire. If we neglect the name of the hypothetical grandchild, we have four versions (presented in Appendix 3). Tables 6 and 7 present the results of each of the four subsamples.

Switching the names of lottery *A* and *B* were found to affect the answers. A Wilcoxon rank-sum test rejects that switching the names of lottery *A* and *B* had no influence on the answers. This means that we have an anchor effect. There was a tendency for the respondents to choose *A* rather than *B*, ceteris paribus. The more a respondent chooses the lottery that stayed the same in all rounds, the lower *R* she is estimated to have (see table 2). Therefore, if a respondent got the version of the questionnaire where the lottery that stayed the same in all rounds was called *A* (the default version), her answers are anchored towards a low *R*. On the other hand, if a respondent got the version of the questionnaire where the lottery that stayed the same in all rounds was called *B* (the version where the names of lottery *A* and *B* were switched), her answers are anchored towards a high *R*.

This shift was made in 50% of the questionnaires handed out to all groups except the engineering group. In the engineering group, all questionnaires were of the default version. Therefore, the anchor effect has no systematic influence except in the engineering group. If the anchor effect was the same for this group as for the other three groups, we have overestimated the percentage of the engineering students with the lowest *R*. Our estimate of the median *R* is then downward biased, implying that without this bias our result would have been even higher. In the econometric analysis we included a dummy, "*LowAnchor*", for the respondents who received a questionnaire anchored toward lower *R* (i.e. the questionnaire where the lottery that stayed the same in all rounds was called *A*, the default version).

Several kinds of questionnaires were tested in the pilot study. No scale effect of the amount of money at stake was found. Making the answer alternatives asymmetric, with more alternatives corresponding to *R* > 1, did not change the results. Changing the steps in SEK between the alternatives did not have an influence either.

Table 6. Choice experiment results for the respondents who received a questionnaire where the lottery that stayed the same in all rounds was called *A* (the default version)

	B started at 15,000 SEK if paralyzed.				B started at 25,000 SEK if paralyzed.			
R	No.	Cum. no.	Freq.	Cum. freq.	No.	Cum. no.	Freq.	Cum. freq.
R < 0.8	12	12	0.245	0.245	17	17	0.279	0.279
0.58 < R < 0.85	1	13	0.020	0.265	0	17	0.000	0.279
0.69 < R < 0.91	2	15	0.041	0.306	2	19	0.033	0.311
0.82 < R < 0.96	2	17	0.041	0.347	0	19	0.000	0.311
0.93 < R < 1	2	19	0.041	0.388	2	21	0.033	0.344
1 < R < 1.08	2	21	0.041	0.429	8	29	0.131	0.475
1.04 < R < 1.31	2	23	0.041	0.469	3	32	0.049	0.525
1.16 < R < 1.92	4	27	0.082	0.551	3	35	0.049	0.574
1.49 < R < 5.56	15	42	0.306	0.857	19	54	0.311	0.885
R > 3.51	7	49	0.143	1.000	7	61	0.115	1.000

Note: The engineering group is excluded since not all versions of the questionnaire were distributed in this group.

Table 7. Choice experiment results for the respondents who received a questionnaire where the lottery that stayed the same in all rounds was called *B* (the version were the names of lottery *A* and *B* were switched)

	A started at 15,000 SEK if paralyzed.				A started at 25,000 SEK if paralyzed.			
R	No.	Cum. no.	Freq.	Cum. freq.	No.	Cum. no.	Freq.	Cum. freq.
R < 0.8	9	9	0.164	0.164	13	13	0.228	0.228
0.58 < R < 0.85	1	10	0.018	0.182	1	14	0.018	0.246
0.69 < R < 0.91	3	13	0.055	0.236	1	15	0.018	0.263
0.82 < R < 0.96	2	15	0.036	0.273	0	15	0.000	0.263
0.93 < R < 1	2	17	0.036	0.309	1	16	0.018	0.281
1 < R < 1.08	1	18	0.018	0.327	6	22	0.105	0.386
1.04 < R < 1.31	0	18	0.000	0.327	3	25	0.053	0.439
1.16 < R < 1.92	3	21	0.055	0.382	6	31	0.105	0.544
1.49 < R < 5.56	16	37	0.291	0.673	12	43	0.211	0.754
R > 3.51	18	55	0.327	1.000	14	57	0.246	1.000

Note: The engineering group is excluded since not all versions of the questionnaire were distributed in this group.

5.2. Robustness discussion

A concern one might have is that choices made in hypothetical lotteries differ from behavior in real life (see e.g. Glaeser et.al., 2000; Anderson and Mellor, 2008). This suggests that real money should be used when it is possible. Unfortunately that is impossible in our study. Both the disability status and the income level of the grandchild must be hypothetical for obvious reasons. Holt and Laury (2002:1654) find that subjects facing hypothetical choices “typically underestimate the extent to which they will avoid risk”. In our study *R* is estimated to be higher than one. This can be translated into that people are avert towards the risk that the grandchild becomes both disabled and a low income earner at the same time. This suggests that our estimate of *R* is biased downward. That is, we have got the direction right, but have underestimated the magnitude.

There is a risk that individuals do not actually know their utility function when paralyzed simply because they do not know what it is like to be paralyzed. However, the same risk is present in many other choice experiments; for example, do individuals know what it is like to be a millionaire? Furthermore, 84.6 % (22 of 26) of the respondents with personal experience of paralysis had an *R* over one. If we use a wider definition of personal experience we see that 70.2 % (40 of 57) of the respondents with personal experience of mobility impairments had an *R* over one. This means that the individuals who most likely had the best knowledge of their utility function when paralyzed answered in line with the rest of the respondents, in fact, the results were even stronger in this group.

When we consider the effect of disability on utility, we should remember that people have a large capacity to adapt to adverse situations such as disability (Frederick and Loewenstein, 1999). The phenomenon that people in general overestimate the effect of changes is called a "focusing illusion." E.g., Kahneman and Thaler (2006:230) argue that "people often adapt surprisingly well to important changes in their lives, even such dramatic changes as becoming a paraplegic." When studying subjective well-being, psychologists often find that the disabled are happier than non-disabled people expect (see, e.g., Dijkers, 1999, and Schulz and Decker, 1985). Health economists have found similar results (see, e.g., De Wit et al., 2000). Stein (2002) presents an overview of these findings. Therefore one would guess that people also underestimate utility when paralyzed. What does this mean for people's estimates of their marginal utility? If people overestimate the fall in utility when paralyzed, they probably also overestimate the change in the marginal utility, but there is no reason to assume that they get the direction of the change wrong based on overestimating the fall in utility. This means that we probably can trust the direction of our main result (disability generally increases the marginal utility of income) although we might have overestimated its size. In the extreme case where the fall in utility is entirely offset after, e.g., a year, then our results hold this first year. After that, both utility and marginal utility are the same as for people without a mobility impairment. In a recent study using longitudinal data, Oswald and Powdthavee (2008) find that adaptation takes place after the onset of disability, but is incomplete. The degree of adaptation is estimated to be around 30% to 50%.

There is however also the possibility of optimism bias (e.g., Kahneman and Tversky, 1979; Kahneman and Lovallo, 1993; and Lovallo and Kahneman, 2003), giving our results a bias in the opposite direction. Optimism bias would make the respondents overestimate the probability that the grandchild is born without a mobility impairment, even though we clearly stated a 50% probability. In this case respondents tend to prefer lotteries with high income if not disabled, which makes our estimate of the marginal utility when disabled biased downwards.

A potential misunderstanding could be that a respondent to some extent interprets the lottery as actually being about two different persons, one disabled and one not. If the respondent interprets the lottery in this way, and she is utilitarian, her answers will be the same as if she had not misunderstood it. Therefore our results are not biased in this case. But if the respondent interprets the lottery in this way, and she is not utilitarian, our results might be biased. Then she might answer based on a sense of fairness or some other ethical aspect.

6. Conclusions

It is often explicitly or implicitly assumed that disability generally lowers marginal utility of income. This article tests the relationship between being mobility impaired and marginal utility of income. Individuals' marginal utility (measured by a von Neumann-Morgenstern utility function) of income in two states is measured through experimental choices between imagined lotteries. The two states are: (1) paralyzed in both legs from birth and (2) not mobility impaired at all. An average income level (a monthly net income in the interval 14,000 to 20,000 SEK, or approx. PPP US$ 1400 to 2000) is used.

The main finding is that marginal utility of income is higher when paralyzed than when not mobility impaired at all for a large majority (62.9 %). In other words, in general a paralyzed person would benefit more from additional income (that makes consumption possible) than a person without any mobility impairment would. The ratio of an individual's marginal utility of income when paralyzed to the individual's marginal utility of income when not mobility impaired at all is studied, and are denoted *R*. The median *R* for average income levels is estimated at between 1.16 and 1.92. This should be interpreted as the marginal utility of income being between 16 % and 92 % higher for a paralyzed person than for a person with no physical disability. Note that all our results are based on the two marginal utilities being evaluated at *the same levels of income*. There were 292 valid (consistent) responses.

The econometric analysis shows that there are two kinds of personal characteristics that can account for part of the heterogeneity in *R*; personal experience and political ideology. Having personal experience of mobility impairment and supporting the Left party, the Social democratic party, the Green party or the Liberal party are associated with having a high *R*.

Of the respondents with personal experience of mobility impairment, 70.2 % (40 of 57) had an *R* over one. This means that the individuals with probably the best knowledge of their utility function when paralyzed answered in line with the rest of the respondents. In fact, the result was even stronger in this group.

The results have potentially important implications for the optimal level of insurance. More specifically, it is suggested that more than full insurance of income losses connected to being disabled (paralyzed in both legs) is optimal, since optimal insurance coverage equals the marginal utility of income in each disability state, assuming no moral hazard and that there is actuarially fair insurance available. Our result for optimal insurance is opposite to the implications of e.g. Finkelstein et al. (2008) and Viscusi and Evans (1990).

Our results can also offer an alternative to the worries of, e.g., Sen (1997) and Roemer (1985, 1996, and 2001). The worry is that the utilitarian social welfare function has an unpleasant policy implication: it recommends resource transfers from disabled to non-disabled individuals. This policy implication is based on the assumption that disability makes the marginal utility lower. We found the opposite, and therefore the utilitarian social welfare function instead recommends resource transfers to disabled from non-disabled individuals, at least when it comes to paralysis in both legs.

If these transfers are not large enough to smooth out the marginal utilities of the disabled and the non-disabled, there are implications for optimal provision of public goods. We should then over-provide public goods that are in general preferred by disabled people. In other words, distributional weights based on disability status (in opposite to income) should be used in cost-benefit analysis.

Future research could include other categories of disability. One might also widen the perspective and study other states that could be assumed to lower utility, e.g., social isolation. One hypothesis is that circumstances that decrease utility will in general increase marginal utility of income. However, e.g. addiction problems such as drug addiction or shopping addiction might work in the opposite direction and decrease both utility and marginal utility of income.

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Appendix 1: An illustration of the Viscusi and Evans (1990) method

A chemical worker survey was utilized by Viscusi and Evans (1990) to estimate state-dependent utility functions. The survey elicited each worker's perceived initial probability of suffering a workplace accident p_1. The workers were told that a new chemical would replace the chemical with which they currently worked. They were randomly assigned to either an asbestos, TNT, sodium bicarbonate, or chloroacetophenone group. Then the respondents assessed the posterior risk p_2. The survey ascertained the percentage wage increase δ ("the compensation rate") needed to compensate the surveyed worker for the increased risk. Each worker also reported his base earnings y.[10] Viscusi and Evans let $u(y)$ denote the utility of income in good health and $v(y)$ the utility of income after a job injury. Then a wage increase that equates the expected utility that the worker obtained from his initial job and the transformed job satisfies:

(A1) $$(1-p_1)u(y)+p_1v(y)=(1-p_2)u(y(1+\delta))+p_2v(y(1+\delta)).$$

Viscusi and Evans constructed a first-order Taylor approximation of the utility functions in each health state. The base earnings y was used as point of expansion, and they used δ as the dependent variable in their regression. Substituting the Taylor approximations into equation (A1) and solving for the endogenous value δ, they get:

[10] For simplicity we present their model with no taxes and with the replacement rate (the level of workers' compensation benefits after an injury) being 100 %.

(A2) $$\delta = \frac{(p_2 - p_1)\beta_1}{\{(1-p_2)\beta_2 + p_2\beta_3\}y},$$

where $\beta_1 = u(y) - v(y)$, $\beta_2 = u'(y)$, and $\beta_3 = v'(y)$. It is only possible to estimate two of the three parameters and they set the coefficient $\beta_2 = 1$ with no loss of generality. The Gallant (1975) nonlinear least squares estimator is used to estimate β_1 and β_3. Viscusi and Evans test whether ill health lowers the marginal utility of income, or:

(A3) $$\beta_3 = v'(y) < 1.$$

The Viscusi and Evans (1990) method is based on approximations, leading us to wonder how much this influences their results. Equation (A2) implies that δy, the compensation rate in money value, is independent of y. δy is a function of p_1 and p_2, but is not influenced by income. This is contra-intuitive. Further, they assumed that β_1 and β_2, and thereby $\frac{u(y)-v(y)}{u'(y)}$, are the same for all individuals although individuals start at very different income levels. This could be seen to somehow contradict that $u'(y)$ and $v'(y)$ are allowed to differ. It seems that their approximations are not unproblematic.

In order to illustrate the Viscusi and Evans (1990) method, consider the following example. We have two individuals, the first's risk of an accident goes from 10% to 20%, and the other's goes from 10% to 40%. These are typical risk levels in the Viscusi and Evans (1990) dataset. They both start with a monthly net income of 20 (thousand SEK). We let them both have the following utility functions:

(A4) $$\begin{cases} u(y) = 1 - \frac{5}{y} \\ v(y) = 0.8 - \frac{7}{y} \end{cases}.$$

These utility functions have a CRRA (constant relative risk aversion) equal to two. Given these utility functions, the first individual needs 12.5% compensation and the other 45%. These compensation rates are typical in their dataset. Putting the two individuals' data into equation (A2) gives an equation system. Solving this equation system gives the estimates. β_3 is estimated at 0.286. This means that in their model, $\tilde{R}(y)$ is supposed to be the same for all income levels, and it is estimated at 0.286. The correct value is 1.4. This proposes that the Viscusi and Evans (1990) estimator is at least sometimes rather imprecise.

Appendix 2. The questionnaire (the version where the lottery that stayed the same in all rounds was called A (the default version), and the other lottery started at 15,000 SEK if disable):

What is one thousand SEK (USD 100), real-ly?

A questionnaire survey

The purpose of this questionnaire is to investigate whether people believe that money has the same worth for different people regardless of their living situations. For example, 1,000 SEK can be worth more to a poor person than to a rich person. The study is part of a research project carried out at the Department of Economics and Statistics at the University of Gothenburg.

Responding to our questions is voluntary, but at the same time you can not be replaced by someone else. Your answers will of course be anonymous and we do not want your name. If you have questions, you are welcome to ask them while completing the questionnaire or to contact us afterwards.

Thanks in advance for your participation! Your answers are very valuable to us!

Sven Tengstam
Ph. D. student in Economics
University of Gothenburg
sven.tengstam@economics.gu.se
031-7861276

Handelshögskolan
VID GÖTEBORGS UNIVERSITET

General questions

Question 1. Are you…?

☐ Female ☐ Male

Question 2. In what year were you born?

19 ………

Question 3. How many credits have you earned at the university level?

……… credits

Question 4. How many credits in economics have you earned?

……… credits

Question 5. What is you civil status?

☐ Single
☐ Married / cohabiting
☐ Divorced
☐ Other: ………………………

Questions about income

Now we want you to do a thought experiment and think about your future grandchild, or about another close person living two generations into the future. Let's call her Anna. We know that Anna will have a predisposition giving her a 50% probability of being born with both legs irreparably paralyzed. At the same time, the probability is 50% that she does not become mobility impaired. When you think about what Anna's life will be like, it feels like Anna will participate in a lottery. Whether or not she will have fully functional legs is determined lottery style.

Now imagine that it is in fact determined in a lottery, and that the lottery also determines Anna's disposable income (i.e., the money she will have at her disposal after tax). You will be asked to choose between varying lotteries. You shall choose the lottery that you think will be best for Anna.

No matter which lottery you choose, the probability that Anna becomes mobility impaired is 50%, and the probability that she does not become mobility impaired is 50%. However, her disposable income is influenced by which lottery you choose. You will make several choices between two lotteries (A and B). A will however be the same throughout and B will keep changing. The box shows A and an example of B.

Lottery A	
50 %	Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/month.
50 %	Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/month.
Lottery B	
50 %	Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/month.
50 %	Anna becomes mobility impaired. She gets a disposable income of 20,000 SEK/month.

Which of the lotteries do you feel would be best for Anna? Maybe you think that the lotteries are equally good since they deal with the same amounts of money. However, in lottery A Anna gets a higher disposable income if she is not mobility impaired, and in lottery B she gets a higher disposable income if she is mobility impaired. It is not self evident that these two lotteries are equally good for Anna.

Keep in mind: "Mobility impaired" implies that both of Anna's legs are irreparably paralyzed. No device exists that can give her the mobility back. Society pays all extra economic costs (e.g., for special trips and for adjusting her house) that arise due to being mobility impaired. The income differences thereby are actually differences in the amounts of goods and services she can buy and consume. She does not have access to any inheritance, any insurance money, or any other money besides her disposable income. Your choice of lottery does not influence Anna's job satisfaction or how hard she has to work. Thus, the lotteries only influence the salary and mobility – nothing else.

No matter what lottery you choose, society as to the rest is the same. Even if Anna is living far into the future, we assume that society generally looks like today. Anna will have the same percentage salary increase as in society in general no matter what lottery you choose.

Keep in mind that no matter what lottery you choose, the probability that Anna becomes mobility impaired is 50%. You can not influence her probability of becoming mobility impaired. The only thing you can influence is how her income is related to whether she becomes mobility impaired or not! Society in general is not influenced by your choice.

It is important that you think about what is best for Anna, and not about something else. There are no “right answers” to the questions and we ask you to make your choices as thoughtfully as possible. You are welcome to go back and change your answers if you realize that you have changed your mind.

Question 1.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 15,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 2.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 17,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 3.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 18 500 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 4.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 19 500 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 5.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 20,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 6.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 20 500 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 7.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 21 500 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 8.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 23,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 9.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 25,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Finishing questions

Question 1. Did you think it was difficult to answer the questions about the lotteries? Mark a number below, where 1 means very easy and 10 means very difficult.

1	2	3	4	5	6	7	8	9	10
Very easy									*Very difficult*

Question 2. How many siblings did you grow up with (include half-siblings you grew up with)?

☐ I grew up as an only child.
☐ One sibling
☐ Two siblings
☐ Three or more siblings

Question 3. What would you say that your family's income was when growing up?

☐ Much lower than in most families
☐ Lower than in most families
☐ Average
☐ Higher than in most families
☐ Much higher than in most families

Question 4. What alternative fits you best?

☐ I or a family member/close friend am paralyzed in both legs.
☐ I or a family member/close friend am paralyzed in one leg.
☐ I or a family member/close friend have a mild mobility impairment.
☐ Neither I nor a family member/close friend has a mobility impairment.

Question 5. Which party's policies do you think best match your opinions about how society should be governed?

☐ The Social Democratic Party
☐ Moderaterna
☐ The Center Party
☐ The Liberal Party
☐ The Christian Democrats
☐ The Left Party
☐ The Green Party
☐ Other: ………………………

Question 6. Generally, how often do you visit a church/mosque/synagogue (or equivalent)? Choose the most appropriate alternative.

☐ Every week
☐ Once a month
☐ Once a year
☐ More seldom than once a year

If you have any comments about this questionnaire, kindly write them here:

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

Thanks for taking the time to answer the questionnaire!

Appendix 3. The different versions of the questionnaire

3.1. The two first lottery questions in the version where the lottery that stayed the same in all rounds was called A (the default version), and the other lottery started at 15,000 SEK if disable:

Question 1.

Lottery A
50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B
50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 15,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 2.

Lottery A
50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B
50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 17,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

3.2. The two first lottery questions in the version where the lottery that stayed the same in all rounds was called A (the default version), and the other lottery started at 25,000 SEK if disable:

Question 1.

Lottery A
50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B
50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 25,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 2.

Lottery A
50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Lottery B
50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 23,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

3.3. The two first lottery questions in the version where the lottery that stayed the same in all rounds was called B (the version where the names of lottery A and B were switched), and the other lottery started at 15,000 SEK if disable:

Question 1.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 15,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 2.

Lottery A

50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 17,000 SEK/mth

Lottery B

50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth

50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

3.4. The two first lottery questions in the version where the lottery that stayed the same in all rounds was called B (the version where the names of lottery A and B were switched), and the other lottery started at 25,000 SEK if disable:

Question 1.

Lottery A
50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 25,000 SEK/mth

Lottery B
50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.

Question 2.

Lottery A
50% Anna does not become mobility impaired. She gets a disposable income of 14,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 23,000 SEK/mth

Lottery B
50% Anna does not become mobility impaired. She gets a disposable income of 20,000 SEK/mth
50% Anna becomes mobility impaired. She gets a disposable income of 14,000 SEK/mth

Which of the lotteries do you feel would be best for Anna?

□ Lottery A □ Lottery B

Note that your choice only influences how the income is related to the mobility impairment. You can not influence her probability of becoming mobility impaired, or what society looks like.