NMBU

Abstract

Although indoor air radon concentration cause a number of premature deaths due to increased risk of lung cancer, very few studies have been conducted to document the health damage costs; and thus the social benefits of measures to reduce indoor air radon concentrations. In the absence of any such studies in Norway, a Contingent Valuation (CV) survey of 751 households is conducted in order to elicit Norwegian households' willingness-to-pay (WTP) for reductions in radon induced lung cancer risk. In addition to estimating mean WTP, this paper has sought to determine what factors affect households' WTP, whether people are willing to pay more for larger lung cancer risk reductions (i.e. a scope test), and what factors affect indoor radon detection measures. As this study reveals the WTP for risk of an illness with very high mortality rate, the Value of a Statistical Life (VSL) could also be calculated. In the survey, respondents were asked their WTP for two CV scenarios: i) scenario 1 reducing radon induced lung cancer risk by 0.19 percent, and ii) scenario 2 with an even bigger reduction of 0.23 percent. When excluding "don't know" answers and "protest zeroes" from the sample, WTP for scenario 1 was 9800 NOK and 9997 NOK for scenario 2 respectively. The estimates were found to be significantly different, and thus passing the internal scope test. The econometric analysis found household income, knowledge of the radon issue, and having positive attitudes towards saving money; all to be affecting WTP positively. Further, the analysis suggests that both increased age and having a job decrease the probability of passing the scope test, while having bright prospects for future income and positive attitudes toward saving money increase the probability of scope. Also, the design of the payment card used to elicit their WTP affects scope, as being introduced to both lump sums and monthly payments seems to have confused the respondents and reduced the probability of passing the scope test. In determining factors explaining why they had conducted radon measurements in their dwelling; knowledge of the radon issue, the feeling of being exposed to radon, and having received sensors from local authorities were the most significant factors; all had a significant positive effect. The estimated VSL was low compared to the recommended values for Cost-Benefit Analyses of public projects in Norway. This is probably due to the fact that respondents used a high discount rate when providing WTP due to the latency period between being diagnosed with lung cancer and actual death; and that WTP was stated to reduce mortality risk on behalf of all the members of their household.

Helserisiko ved radonkonsentrasjon i inneluften er et tema som ikke er særlig berørt i økonomiske verdsettingsstudier. I det komplette fraværet av slike studier i Norge, har norske husholdningers betalingsvillighet for reduksjoner i lungekreft-risiko forårsaket av radon blitt funnet ved hjelp av en betinget verdstingsstudie der et spørreskjema har blitt sendt ut og besvart av 751 respondenter. I tillegg til å finne betalingsvilligheten, har studien også prøvd å avsløre hvilke faktorer som påvirker betalingsvilligheten, rasjonell verdsetting, og husholdningenes villighet til å måle radon i inneluften. Pga. denne studien finner betalingsvilligheten for reduksjoner i helserisiko, har også verdien av statistisk liv blitt regnet ut. I spørreundersøkelsen har respondentene blitt forespeilet med to scenarioer; scenario 1 der lungekreft-risiko forårsaket av radon er redusert med 0,19 prosent, og scenario 2 med en større reduksjon på 0,23 prosent. Da respondentene ble forespeilet med begge scenarioene, ble de bedt om å oppgi sin høyeste betalingsvillighet for hver av dem. Ved å ta vekk «vet ikke» og «protest» svar, er den estimerte betalingsvilligheten 9800 NOK for scenario 1 og 9997 NOK for scenario 2. Gjennom en statistisk test ble disse estimatene funne signifikant forskjellig fra hverandre, noe som avdekker at respondentene verdsetter scenarioene etter rasjonelle preferanser. Av resultatene fra analysen fremkommer det at husholdningens inntekt, kunnskap om radon temaet, og positive holdninger til sparing påvirker betalingsvilligheten positivt. Med tanke på rasjonell verdsetting, viser resultatene fra analysen at både en økning i alder og det å ha en jobb gir negativ påvirkning, mens å ha lyse utsikter for fremtidig inntekt og å ha en positiv holdning til sparing gir positiv påvirkning. I tillegg ser det ut til at utformingen av betalingskortet som er brukt i verdsettingsspørsmålet påvirker rasjonell verdsetting, da det å bli forespeilet med både engangssummer og månedlige beløp forvirrer respondentene. I avdekkingen av hva som påvirker husholdningenes villighet til å måle radon i inneluften, fant vi ut at kunnskap om radon temaet, det å føle seg utsatt for radon gass, og å ha fått utdelt radonmålere fra kommunen var de mest signifikante faktorene. Disse faktorene økte sannsynligheten for at husholdningene hadde målt radon i inneluften. Utregnet verdi av statistisk liv gav lave estimater, mest sannsynlig på grunn av at respondentene diskonter risikoen med tanke på latens perioden fra lungekreft blir påvist til faktisk død, og at de oppga sin betalingsvillighet for redusert lungekreft risiko på vegne av alle boere i husholdningen.

Acknowledgements

First of all, I would like to thank my supervisor Ståle Navrud, professor at the School of Economics and Business, for professional guidance throughout the entire process and help in forming this thesis. There have been days where I felt there was no end to this, but hours of tutoring and encouraging emails made me to stick in and complete the task I had started.

I am grateful for the financial support received from the Centre for Environmental Radioactivity (CERAD CoE), which made this study possible. Without this support, the survey would not have reached out to such a big amount of respondents. Regarding the survey, I would also like to thank Peder Røsand at Norstat for giving a helping hand when needed in understanding the data.

I would especially thank Mattew James Kirk for having helped edit parts of this thesis, which made me realize my knowledge of English grammar is far from complete. You are a legend.

Christina Hassfjell and Lill Tove Nilsen, thank you for teaching me about radon and the health risk that follows.

To all my friends and family, thank you for all the support you have given me and for your feedback on the first drafts of the questionnaire.

Table of Content

List of Figures

List of tables

List of Abbreviations

WTP = Willingness to Pay

CV = Contingent Valuation

VSL = Value of Statistical Life

NRPA = Norwegian Radiation Protection Agency

OLS = Ordinary Least Squares

NOK = Norwegian Kroner

CBA = Cost-Benefit Analysis

CV´ = Compensated Variation

EV´ = Equivalent Variation

1. Introduction

1.1 The Thesis and its Relevant Issue

Radon is an invisible, tasteless and odorless gas, naturally occurring as an indirect product from the decaying of both uranium and thorium. Rooted in most of Norway's vast array of bedrock, radon is a commonly present gas. In fact, Norway is one of the countries with the highest radon concentrations in the world, leading to radon becoming a problem in society; occurring in households and often resulting in in a reduction of indoor air quality. Along with the poor indoor air quality that radon causes; it also poses significant health risk in terms of e.g. increasing the risk of lung cancer (Strålevern, 2014b). The higher the concentration of radon is, the higher the lifetime risk of contracting lung cancer. The Norwegian Radiation Protection Authority (NRPA) has set a justifiable measurement threshold explaining how high indoor air radon concentration could be as to not induce serious health risk. It is justifiable in the way that if any indoor air concentration exceeds this threshold, the NRPA strictly recommends measures to be done as to lower concentration. Even though this threshold is promoted, it does not seem to be taken too seriously as some work or lives in buildings with very high concentrations, ignoring the fact that their health is at stake. However, some households measure their radon concentrations in indoor air, and take action if the concentrations are above the recommended threshold. Through quite simple averting measures they are able to reduce their radon concentration, and subsequently, the health risks. As one would expect, households differ in how they perceive the health risks caused by the same level of indoor radon concentration.

Radon induced lung cancer is one of the many health risks Norwegians are exposed to. The question is how people perceive this health specific risk, and what benefits they see in reducing their risk of radon induced lung cancer. This paper seeks to answer this very question by eliciting people's willingness-to-pay (WTP) for reducing their risk of radon induced lung cancer in a Contingent Valuation (CV) survey. In this survey people also state their general level of information about radon and the accompanying health risks along with questions about smoking and tanning habits, in which were designed to reveal their behavior regarding these health risks.

While the social costs of measures to reduce indoor radon concentrations can be estimated from market prices, there is little information about the monetary value of the social benefits in terms of reduced health risks from these measures. Market institutions for radon reduction initiatives are established, and one can hire companies which specify in the reduction of indoor concentrations. On the other hand, little research is conducted in Norway on how people value the benefits of reduced health risk by radon reduction measures. Knowing these social benefits will enable us to perform Cost-Benefit analyses of radon reducing measures and plans.

This thesis serves as the first of its kind in Norway, addressing this very issue. Even though such studies have been conducted in other countries, for example (Kennedy, 2002) , it might be difficult to transfer the results (i.e. benefit transfer) to the Norwegian population, due to differences in income levels, demographics, attitudes, averting behavior and institutions, including the Norwegian government policy on this issue compared to other countries. This thesis will contribute to the scarce literature on the economic valuation of the less known health benefits from reducing indoor air radon concentrations, especially in Norway but also internationally.

1.2 Problem Statement and Research Questions

The problem statement in this thesis is to find Norwegian households' WTP, and thus aggregated social benefits, for a reduction in health risk due to radon induced lung cancer prevention for two specific scenarios; *one scenario with a reduction in indoor air radon concentration down to the current threshold for measures, and one even bigger reduction past this threshold.* In this way we can test for scope, i.e. whether people are willing to pay more for the larger reduction in risk of radon induced lung cancer; and whether the social benefits of reducing radon levels beyond the current threshold can justify the additional costs of stricter measures needed for this to be achieved. Further, we will seek to identify the factors explaining households´ variation in WTP. As household express their WTP for specific reductions in the risk of lung cancer, which has a very high and known mortality rate, the results can also be seen as expressions of peoples WTP to reduce their risk premature death due to lung cancer. Therefore, the Value of Statistical Life (VSL) for lung cancer induced death can also be estimated from these WTP results, under the assumption that households assume the risk of premature death if they attract lung cancer to be the same as the national average used to calculate VSL from their responses. In addition, the thesis also tries to explain what factors determines initiatives towards detecting indoor air radon concentration. By detection, we mean using sensors to measure the level of indoor air radon concentration.

Using this survey for our specific purpose brings about the first research question:

Research question 1:

What are the social benefits of lung cancer risk reductions from reducing indoor air radon concentrations?

To answer this, the average willingness to pay is used as a measure of the economic value of marginal reductions in health risks. Knowing the social benefits will be of interest to government agencies when evaluating public programs to reduce indoor air radon concentrations, and to insurance companies as this value might elicit the importance of incorporating measures done to abate indoor air radon concentrations into housing insurances.

In addition to the value of health risk reductions, as there are two scenarios pictured in the survey, it is important to check if there is any significant difference between the WTP in the two scenarios as to reveal if there is any effect of scope. This gives an implication whether respondents thinks the difference in risk reduction is significantly big enough as to pay a higher amount for the biggest reduction.

To test the theoretical validity of the CV survey, an important aspect for this study is to test whether WTP increase with income (as predicted by economic welfare theory), whether they are willing to pay more for larger lung cancer risk reductions (i.e. the scope test in CV surveys), and if higher stated levels of risk aversions increase people´s WTP.

Research question 2

What determines whether a household have measured indoor air radon concentrations or not?

Amongst the many different questions of the survey in hand, one is whether the respondents have detected indoor radon concentration or not. Knowing this, one can reveal what factors determine why respondents have done such initiatives. Considering the new regulations for rental properties implemented by January 1st, 2014, making house lords responsible of detecting radon in rental properties, it can be interesting to see if this policy gives an impact to initiatives towards detection measures. Briefly summarized, this can give substantial information about what policy is the most effective towards increasing the awareness of the problem, and what factor that triggers detection initiatives the most.

Research question 3

Do health status and smoking affect WTP?

The WTP stated in the survey, might be influenced by the respondent's health status. If respondents consider their own health status as low, they might have a higher WTP for measures preventing it to get even worse. In addition, by natural causes, smoking is related to a lower health status.

People, who smoke on a regular basis, are most likely to have a much bigger risk of getting lung cancer than non-smokers. Since the lung cancer risk from smoking cigarettes is much higher relative to the risk stemming from radon gas, WTP might differ between smokers and non-smokers regarding the risk reductions depicted in the CV-survey[1].

Research question 4

What socio-economic factors and household characteristics affect WTP for health risk reductions from radon induced lung cancer prevention?

Regarding the very different aspects affecting WTP, socio-economic factors and household characteristics could explain some of WTP's variation. Income, age, gender, kids and education are factors able to influence the outcome in valuation studies. As this study provides the respondents with two scenarios of risk reductions, one bigger than the other, it will be interesting to see whether these socio-economic factors affect them both and in the same way.

Research question 5

Does risk-averse behaviour affect WTP for health risk reductions from radon induced lung cancer prevention?

Considering the fact that this study seeks to find the WTP for reductions in a specific health risk, variation in respondents´ WTP could be explained by their level of risk averse attitudes and behaviour. The survey is designed to reveal risk-averse behaviour, with questions regarding speeding behaviour in road traffic, sunscreen application habits, being worried of the radon issue and so on.

---

1 The way smoking affects WTP in this study is uncertain. One would implicitly think, as smokers have the highest risk of getting lung cancer when combining the risk from both smoking and radon, that they would have a higher WTP than non-smokers. But as the risk of getting lung cancer from radon is quite small compared to the lung cancer risk from smoking, smokers might trivialize the effect of radon measures as it makes no significant effect in reducing their chances of getting lung cancer.

Research question 6

Do respondents´ WTP depend on the design of the payment card; i.e. being introduced to only lump sums versus both lump sums and monthly payments?

In a split - one group is introduced to a payment card screening both lump sums and ten years of monthly payments, while the other group is screened with just lump sums. Considering the ability to plan a budget when screened with both lump sums and monthly payments, these respondents are expected to have a higher WTP.

Research question 7

What factors determines effects of scope in WTP regarding the two different scenarios?

Having in mind the survey's two scenarios, one with a bigger risk reduction than the other, it is expected to be an effect of scope in WTP. However, the difference between the two scenarios is rather small and the perception of this difference as significantly big enough might vary between respondents. Also, as one of the scenarios depicts a reduction in radon concentration down to the measurement threshold while the other scenario is an even further reduction, respondents might perceive a reduction to the threshold limit as enough. That is, they will not have a bigger WTP for the other scenario, even though a further reduction lowers the risk of getting lung cancer even more. The purpose of this research question is to explain which factors influence the rationality behind valuing the scenario with the biggest reduction higher or equal to the scenario with the lowest reduction.

Table 1.1. The different hypothesis underlying each research question.

Hypothesis	*Expected relationship*	*Expected sign*
Problem Statement	**What are the Norwegian households WTP for a reduction in health risk due to radon induced lung cancer prevention**	
Research question 1	*What are the social benefits of lung cancer risk reductions from reducing indoor air radon concentrations?*	
H11	Mean WTP per household for reduced for lung cancer risk is positive	+
H12	Mean WTP per household is higher for the larger than the smaller lung cancer risk reduction due to reduced radon exposure	
Research question 2	*What determines whether a household have measured indoor air radon concentrations or not?*	
H21	Knowledge of radon increase the probability that respondents have done measures to detect radon concentration	+

H22	Feeling exposed to radon increase the probability that respondents have done measures to detect radon concentration	+
H23	Detection of radon in previous resident increase the probability that respondents have done measures to detect radon concentration	+
H24	Having received an offer to detect radon from the authorities increase the probability that respondents have done measures to detect radon concentration.	+
H25	Not living in a detached house decrease the probability that respondents have done measures to detect radon concentration	-
H26	Being worried that current radon concentration increases the probability of getting lung cancer increase the probability that respondents have done measures to detect radon concentration	+
H27	Risk averse behavior increase the probability that respondents have done measures to detect radon concentration	+
H28	Having a job increase the probability that respondents have done measures to detect radon concentration	+
H29	Socio economic factors affect to whether respondents have done measures to detect radon concentration	+/-
H210	Respondents renting property decrease the probability of having done measures to detect radon concentration	-
H211	Respondents who lease out properties increase the probability of having done measures to detect radon concentration	+
Research question 3	*Do health status and smoking affect WTP?*	
H31	Smoking on a daily basis, compared to those not smoking, affects WTP	+/-
H32	Smoking every once in a while, compared to those not smoking, affects WTP	+/-
H33	Having used to smoke, both on a daily basis and every once in a while, in less than five years ago, compared to those not smoking, affects WTP	+/-
H34	Having used to smoke, both on a daily basis and every once in a while, in more than five years ago, compared to those not smoking, affects WTP	+/-
H35	Planning to quit smoking by 2014 affects WTP negatively	-
H36	A lower subjective health status affects WTP positively	+
Research question 4	*What socio-economic factors and household characteristics affect WTP for health risk reductions from radon induced lung cancer prevention?*	
H41	Income affects WTP positively	+
H42	Age affects WTP negatively	-

H43	Number of kids living in household affects WTP positively	+
H44	Level of education affects WTP positively	+
H45	Amount of years lived in current household affects WTP negatively	-
H46	Having a job affects WTP positively	+
H47	Prospects for future income affects WTP positively	+
H48	Importance of saving will affect WTP positively	+
H49	Being married affects WTP positively	+
H410	Having problems with paying unanticipated expenditures affects WTP negatively	-
H411	Not living in a detached house affects WTP negatively	-
Research question 5	*Does risk-averse behavior affect WTP for health risk reductions from radon induced lung cancer prevention?*	
H51	Being worried that current radon concentration increases the chances of getting lung cancer affects WTP positively	+
H52	A high degree of skin protection at a sunny day in Southern Norway affects WTP positively	+
H53	A high degree of skin protection at a sunny day somewhere near the equator affects WTP positively	+
H54	Respondents often driving in 20 km/h beyond the speed limit affects WTP negatively	-
Research question 6	*Do respondents´ WTP depend on the design of the payment card; i.e. being presented with only lump sums versus both lump sums and monthly payments?*	
H61	Presented with only lump sums affects WTP in scenario 1 negatively	-
H62	Presented with only lump sums affects WTP in scenario 2 negatively	-
Research question 7	*What factors determines effects of scope in WTP regarding the two different scenarios?*	
H71	The level of education positively affects scope in WTP	+
H72	Having a job positively affects scope in WTP	+
H73	Age negatively affects scope in WTP	-
H74	Importance of saving positively affects scope in WTP	+
H75	Risk-averse behavior positively affects scope in WTP	+

2. Background

In Norway, radon and the problem that follows have not been given much attention until recent years. Smoking and asbestos are among the sources to lung cancer given the most attention, but the fact that 300 lung cancer deaths in Norway is caused by radon annually, changed the focus a bit (Strålevern, 2014c). Rules and regulations for how to deal with high concentrations of radon are implemented, and people are starting to get more enlightened about the subject and its health effects.

2.1 Radon policy in Norway

2.1.1 The Different Thresholds

As to deal with the severe radon problem in Norway, the NRPA have set two different thresholds as guidelines for indoor air concentration. The two thresholds are being called the measurement threshold and the maximum threshold. The measurement threshold serves as a benchmark and is interpreted as the maximum value for indoor air radon concentration as to not impose any serious health risk. This threshold is set at 100 Bq/m^3 (Becquerel per square meter). If detected any value beyond this threshold, a limitation of radon concentration is recommended. However, concentrations lower than this threshold still imposes some health risk, so as long as the concentration is possible to reduce, the NRPA recommends households to take further actions as far as possible. The other threshold, referred to as the maximum threshold, is in principle the level of air radon in which the NRPA considers all rooms in a household should at least satisfy. If any values beyond this level, measures should consistently be done until concentrations at least satisfy the maximum threshold. The maximum threshold is set to 200 Bq/m^3.

Considering cases where the level of concentration ranges between 100 - 200 Bq/m^3, the indicative policy is that measures reducing concentration are recommended done until the measurement threshold is reached. If the concentration after implementing relevant measures still is beyond 100 Bq/m^3, and further action does not give any improvement in air quality, then the NRPA might accept the value for that certain case.

Like the NRPA, the Worlds Health Organization (WHO) also recons 100 Bq/m^3 as a reference level to minimize health hazards due to indoor radon exposure (WHO, 2009). This reference level is justified in the light of newly scientific facts regarding a public health perspective, and they use these facts as guidelines for reducing radon induced health risk (Strålevern, 2014a). WHO refers to this as a national reference level, and claim that this level "represents the maximum accepted radon concentration in a residential dwelling" (page xi, WHO 2009). In Norway, the legitimacy of these thresholds is a bit vague, but at least they work as legit guidelines for landlords leasing out properties.

2.1.2 New Law for Rental Properties

After the 1st of January, 2014 all owners of rental properties must measure indoor radon concentration at their leased cites. This new regulation forces rental property owners to follow the policy imposed with the different thresholds, and take action if necessary. Owners have to do actions as far as possible if concentrations go beyond the justifiable threshold, and prove the in-effectiveness of eventual further actions if failure to limit concentrations. However, the level of in-house radon concentration can never exceed the maximum threshold of 200 Bq/m^3. If so, then the owner is not allowed to lease the property, unless applied for exemption.

2.2 Mappings of the Indoor Radon Concentration in Norway

In past recent decades, the NRPA have done some mappings as to control for Norway's variety of radon concentration (Strand, Lunder Jensen, Ramberg, Ruden, & Ånestad, 2003) (Strand et al., 2001). In 2001 to 2003 they mapped the average radon concentration in numerous municipalities, by handing out censors to some random ten percent of these municipalities' households as to detect the average concentration. When reported back, the NRPA summed up all values and used these to state the average indoor concentration for each municipality. In addition, the NRPA have also conducted mappings of outdoor radon concentration at different sites were you can find sources to radon gas.

These mappings of indoor concentration were meant to play a big part in this thesis, as the intention was to use the values found in the mappings to compare if attitudes towards radon differed between areas of radon concentration. Unfortunately, the content of these mappings are most likely not promoted in a way that would increase the awareness of the subject and give any effect to people's attitude. This was also tested in STATA, in which gave no significant effect. However, in this study the municipalities of these mappings are used as a stratified sample, as the CV-survey is sent to random households within these municipalities. The reason why these areas are used as the target sample, is that we know there at least have been done some measures to detect radon amongst respondents, and that some information about the subject have been given due to the fact that radon censors have been handed out by local authorities. This will make the hypothesis underlying each research question easier to test.

3. Theory

3.1 Non-market valuation

In a world where the opportunity cost of every policy implementation needs to be measured in monetary terms, goods and resources typically not traded in markets are more often an interest of valuation. Today, the typical resource evaluation could be for example a measure of the economic value inherent to the different losses people experience when a local river is polluted by firms releasing hazardous chemicals down the river banks. Another task could be for example evaluating the external cost experienced when a new type of technology is implemented at a local power plant. The examples of non-market valuations are many, and most often such valuations include environmental resources. When valuating impacts of environmental resources, such evaluations consequently focus on the benefits or damages households would face, whether impacts are positive or negative. These households would be at least willing to pay the damage cost to avoid negative effects, if an implicit payment vehicle existed. Nevertheless, valuation of non-market resources, for example a reduction of external impacts, would be a measure of the benefits provided with avoided damage (Smith, 1996).

3.2 Cost-Benefit Analysis

In decision making, policymakers often use the very different tools of analysis, and one of them is commonly known as the Cost-Benefit Analysis (CBA). This is simply an analysis that addresses all the costs and benefits of the different projects, and then finds their net present values. The use of net present values makes the different projects comparable, and the decision upon which project to choose is the one project giving the highest value. The golden rule is that no projects can be implemented if the net present value does not have a positive sign (Perman, 2003). If the net present value is negative, the project is perceived as an evil to society. It is argued that “the sign of the net benefits indicates whether it would be possible to compensate those who bear costs sufficiently so that no one is made worse off and at least one person is better off” (Page 31, Boardman 2011). One alternative version of this decision rule is the Kaldor-Hicks criterion, which in case is quite feasible. It implies that a policy should be implemented if and only if those who will gain from it, could compensate those who would suffer from the policy and still be better off (Boardman, 2011).

3.3 Contingent Valuation

In order to conduct CBA's one need to know both the benefits and the costs of a policy implementation. In this study, the costs are already known but the households' benefits from improvements in indoor air quality are rather unknown and need to be specified. When finding the utility of a radon induced reduction in lung cancer risk, knowing the market agents WTP for such risk reductions, is a vital factor. The fact that no other studies have been conducted in Norway about social benefits of the health risk reductions caused by radon induced lung cancer prevention, make the use of an extensive contingent valuation (CV) study necessary. Through a CV study, a survey to elicit information about respondent's preferences will help finding the WTP from the very different groups of the Norwegian society. Considering the vast differences in perception of risks, WTP is expected to differ between groups. The procedure in finding the value of the benefits is as follows; first, a sample of the population relevant to the study is identified. Then, respondents are asked to participate in a survey, stating their preferences and valuation of the relevant good. Third, responses from the survey give data to further analysis as to estimate WTP for that good. Finally, this WTP from the sample can be used as a representative for the whole population (Boardman, 2011).

The ways of conducting surveys are many. In this study, WTP for a radon induced risk reduction of death by lung cancer is needed, not the WTP for per Bq/m^3 of radon reduced, nor the WTP for a certain amount of reduction in radon concentration. Thus, the Open-Ended Willingness-to-Pay method with a Payment Card is used, as to measure how people actually value a risk reduction of lung cancer death by investing in radon initiatives. This is a method asking questions directly about respondent's preferences, and is one of the earliest methods used in contingent valuation. In the Open-Ended Willingness-to-Pay method with a Payment Card, people are simply asked to state their maximum WTP on the payment card, in which is screening a range of values for a good or policy that is being assessed. Hence, we ask what respondents maximum willingness to pay would be for a specific reduction in radon concentration, in which would give a certain reduction in the risk of getting lung cancer. The method is criticized for giving unrealistic responses as some analysts has the opinion that respondents need further guidance on valuations. It has been found that in Open-Ended Willingness-to-Pay questions, respondents with low valuation of the good in question often state a zero value (Boardman, 2011). Moreover, people seem to find it hard to answer open-ended questions compared to closed-ended ones. The notion of buying an item stating how much they are willing to pay is an easy task, but stating the maximum WTP is a somewhat hard thing to do. Hanemann argues, as the maximum WTP is an extreme value, errors of cognition seems to fall on the low side, giving understated maximum WTP in open-ended questions (Willis & Corkindale, 1995). However, this is a method that does not give respondents' any guidance when stating WTP, in which can give biased estimates as their perception of cost is revealed through guidance. Halvorsen and Sælensminde (1998) argues in their study comparing the difference between open ended and discrete choice methods, that even though respondents respond better to discrete choice methods, the statistical uncertainties and biases are still a major problem (Halvorsen & Sœlensminde, 1998). In that case open ended methods may be a better option considering the statistical discrepancies due to discrete choice models. Also, it is argued that Dichotomous Choice methods, is influenced by "Yea-saying" as respondents respond "yes" or "no" to certain values, in which can differ from actual behavior (Ready, Navrud, & Dubourg, 2001). The two different methods can be characterized by asking questions that take the form; "what are you willing to pay?" or "are you willing to pay £X?"

3.4 Welfare economics

In economics, the concept of the welfare works as the fundamental basis for decision making, and efficiency and optimality serves as basic principles for maximizing welfare. In policy making, economists always try to maximize social welfare in search of the best outcome. Both of these principles relates to allocation problems, and the maximization of utility. An efficient allocation is said to be a situation where there is not possible to do any improvement for some agents, on the expense of other agents. On the other hand, an allocation is inefficient if it is possible to improve someone's utility without worsening anyone else's utility. Known from elementary economic theory, an efficient allocation is often referred to as Pareto optimal or Pareto efficient. In this study, one have to find out what preferences agents got in order to know what state of the outcome will make them better off. When conducting a CV study like this one, respondents state their preferences through a survey. The survey asks both questions about the agents many perceptions given their different characteristics and questions about WTP, in which is helpful in understanding the utility and welfare measure related to the issue. Knowing this makes a maximization of welfare feasible. A more in-depth explanation of welfare theory is presented in appendix A.

3.5 Compensating and Equivalent Variation

When using WTP as a measure for the value of lung cancer prevention by doing radon measures, one have to take in to account the budget constraints, and that money spent on radon initiatives will give less money available to spend on other goods. The term of both compensated and equivalent variation is important to mention as to understand respondents behavior and the utility of the different outcomes. As one observed behavior of choice can be explained by a utility function, we can use this function to evaluate changes in both prices and consumption levels. Compensated Variation explains how much income an agent needs to be compensated with as to maintain the same utility level if price changes. Utility is then measured in monetary units (Varian, 2006). A pretty much similar utility measurement is the concept of equivalent variation. It measures the impact from a price change, and explains the change in income that would be equivalent to this certain price change. The change in income would then give the same level of utility as if the price change had occurred (Perman, 2003).

If we interpret the theory to the specific subject in hand, we could picture a scenario where the radon concentration is high, which implies bad air quality. By doing radon measures, air quality can be improved, in which would change the consumer’s consumption pattern and give a higher utility. However, such a change would come at a certain cost, implying having less income to spend on other goods. How much better off the consumer is with this improved air quality is how much income the consumer needs to be compensated with as to consume the same consumption bundle as before the improvement. This compensation in income is called “Compensated Variation”.

Let’s say the consumer somehow is not doing measures, having indoor air quality at status quo. If the consumer wants the same utility as when improved indoor air quality and compensated income, then the additional income needed is what the consumer needs to be bribed to accept the lower air quality in status quo. Then the consumer is as well of as he would be with improved air quality, and such compensation is called “Equivalent Variation”.

Both CV´and EV´are monetary measures of a change in utility between two different points of utility, but the values of these two measures are not equal in general. One might be willing to pay a certain amount to face a better air quality, but when facing that better quality one might be unwilling to give up that state, and go back to the original quality. In fact, one usually will demand a higher amount in compensation to go back and face that lower air quality. CV´and EV´are two important concepts of economic theory, and a Contingent

Valuation study like this one, gives the ability to calculate such variations for non-market goods. However in this study, when eliciting WTP for a reduction in lung cancer risk by doing radon measures, we are finding the compensated variation. A more in-depth explanation of the theory behind CV´and EV´is found in appendix A.

3.6 Criticism of the Contingent Valuation Method

Even though the contingent valuation method sounds reasonable, it has its throwbacks that give ground to criticism. It is commonly argued that CV gives biased WTP answers, in which makes it not too comprehensive when a policy is implemented in the real world. The marginal distributions of answers to nonfactual questions should not be taken too seriously as response errors can distort survey results. This occurs i.e. when respondents misunderstand the questions asked, or the order in which the questions are asked affect response behavior (Mitchell & Carson, 1989). Respondents' cognitive capacity, the social nature of how the survey is presented, and motivational mysteries are also issues regarding the validity of the CV method (Mitchell & Carson, 1989). Surveys must adjust to human frailties in understanding different questions, as cognitive capacity varies between people. Frailties in understanding "simple" questions and instructions, and difficulties in recalling certain and recent events are small but implicit factors able to harm the effectiveness of the CV method. Also, where there is a shift in the meaning, response effects might follow. Words like "allow" might not be the same as "not forbid", as "subsidies" is not the same as "lower prices", and for some respondents it might be hard to distinguish between such words (Hanemann, 1994).

The way a survey is conducted, either it is by telephone, in person, by mail or internet, provides different social situations in which humans respond in complex ways. Idiosyncratic answers and institutional influenced responses may affect the variety in survey-responses, as social and linguistic norms shape assumptions and expectations by the participants (Hanemann, 1994). Ideally the respondent should be motivated to devote as much time and effort needed to answer the interview and answer questions truthfully. Anyhow, the awful truth is that respondents are more likely to depart from this ideal way, in which fluctuate with respondents very different backgrounds.

Another issue is the problem of overstating WTP in CV studies compared to when agents are confronted with the problem in real life and reveals their actual WTP. Duffield and Patterson argue that these differences are small and predictable enough to make a discounted WTP estimate from an overstated CV-study as a conservative estimate of WTP (Arrow et al., 1993).

Also, strategic reasons to state a value less than one's full value of the change in hand, which is strongly supported by experimental evidence, is a major problem with the open ended format. The NOAA panel argues that with a closed-ended format, such strategic reasons are absent and respondents' can do nothing else than give the true value when answering the WTP question (Pearce & Özdemiroğlu, 2002). The Report of the NOAA panel on contingent valuation discusses six other issues and weaknesses arising in CV studies:

1. The contingent valuation method can produce results inconsistent with rational choice. In CV studies, one needs some simple assumption of rationality of preferences as to understand the choices being made. However, some studies have found irrationality when asked WTP for further improvement of a scenario, in which have not given any significant difference in WTP. This can often happen when the improvement is not significant enough as to increase WTP, but it can also be a case of poor survey design in which the choices have not been presented clearly to the respondents.

2. Stating WTP for only one program might be plausible, but when summing up WTP for many programs, this can be a too big fraction of the personal income so the respondents would in reality never actually act upon the way they answered in the survey. Thus, this will give an overestimated result if many programs or policies are being valued.

3. Reminding respondents of their budget constraints have often been absent in CV-studies. When respondent chose without thinking of the constraints considering their own income, estimates can be too high. The NOAA panel recommends that budget constraints regarding their own income is explicitly reminded of when asking WTP questions.

4. Information about the program or policy being valued might be difficult to absorb by respondents, and the basis behind their responses might be skewed. Respondents need to understand exactly what they are being asked to value. Microeconomic theory assumes full information for markets to work in a rational way, and for a survey respondent to do rational choices, enough information is needed in the questionnaire.

5. Difficulties when determining the extent of the market, is one of the greatest weaknesses when generating aggregate estimates. Subgroups of the relevant

population might have too low valuation of the resource in hand, in which can give estimates too low to justify examination. It is important to limit the survey sample to the ones having purchasing power enough to actually deal with the problem in hand. I.e. a student might be in a subgroup not able to afford any increase in expenditures, and would automatically be a zero-answer participant. In my case students, mostly living in rented properties, would maybe consider the radon problem as none of their business, giving a low or zero value.

6. “Warm glow” effects makes some respondents elicit their WTP as a reflection of the good feeling when supporting a good case and not as a reflection to their real preferences. This is also called “Yea-saying”, and does not reveal the behavior that would have been revealed in a market situation.

These six issues are something to be aware of when designing a CV survey, in which when conducted, need to elicit an as close as possible estimate of the respondents true WTP.

3.7 Stated Preferences and Revealed Preferences

Observation of past and present market behavior either monitored by researcher or market agents themselves over one or more time periods, is known as stated preferences (Ben-Akiva et al., 1994). If environmental valuation is based on observed behavior this means that people reveal their preferences without having to be asked. When using market prices of a public good as a shadow price of the WTP, this could be an appropriate value estimate of the provided public good if it represents the average amount users would be willing to pay for such a good (Boardman, 2011). However, the problem is that it might not reflect the maximum WTP for the good, as some consumers might value the good in question even higher.

For some public goods inferring preferences from observations are hard to find, as there are poor, or simply no market proxies. Analysts then prefers, in the absence of observations, to ask a sample of people about their valuations. Questionnaires are designed in order to elicit people’s valuations, where respondents state their maximal willingness to pay for specific goods. These values are, as mentioned above, the foundation of the CV method, in which implicitly works as the respondents stated preferences. When asked the hypothetical question of what a respondent is willing to pay for a good or the likes, they then give a hypothetical answer too, as they are not actually required to pay as their stated valuations (Boardman, 2011). These answers might not expose their actual WTP as some respondents might have problems relating to the question in hand and having problems understanding the consequences. As earlier mentioned about the issues of the CV method, clear and informative surveys need to be made as to cope with the hypothetical answers potential deviation from real life action.

In this study, the estimated WTP is based on stated preferences. However, some respondents might have detected their radon concentration or even done measures to decrease it. That might affect the responses, but as the survey asks whether respondents have detected and done measures, one is able to reveal this effect. One could ask; why not compare the WTP of stated and revealed preferences as to explain whether the two estimates differ significantly. The problem would then be the difference between hypothetical measures compared to revealed market observations, as stated preferences might overstate their WTP and revealed preferences might not be the maximum WTP.

3.8 Value of Statistical Life

A very typical term commonly used in economic analysis, like this one, is the value of statistical life (VSL). A general definition of the term is as follows*; the economic value to society of reducing the probability of premature death in the population by one*. This is the value stated to changes in the risk of losing human life. Considering the fact that increased health risk is undesirable, other aspects in market choices makes increased health risk activities attractive. VSL estimates developed by economists are using evident market choices, involving tradeoffs between risk and money (Viscusi & Aldy, 2003). In this study, more specifically in the analysis of the data, estimates of VSL will be calculated. These calculations will compare the two scenarios depicted in the survey to see the difference. Most likely, these calculations will exert decreasing returns to scale, as reductions satisfying the measurement threshold will most likely be given the highest value per life saved while further reductions decrease in value per saved life.

3.10 The Econometric Methods

3.10.1 Multiple Regressions

As a part of the econometric analysis, the multiple regression method is used. This is a proper method to use in ceteribus paribus analysis, as it allows to control for the many factors that simultaneously affect the dependent variable (Wooldridge, 2009). Compared to single regression, the ability to incorporate many explanatory variables in multiple regressions can naturally explain more of the variation in the dependent variable. Thus, in this study the multiple regression method by ordinary least squares (OLS) estimates will be used to explain the variation in WTP. When trying to explain the factors influencing WTP, this implicitly seems to be the right method to use (Navrud, 2014).

It is expected that the regressions fulfill the four multiple linear regression assumptions; linear in parameters, random sampling, no perfect collinearity, and zero mean and zero correlation. The assumption of zero mean and zero correlation, is somewhat weaker than the original Gauss-Markow assumption of zero conditional mean. With zero conditional mean any function of the explanatory variables is uncorrelated with the error term, while with zero mean and zero correlation it is required only that the error term is uncorrelated with each x_j. Under these assumptions the OLS turns out to be biased but consistent, if we expect there is some correlation between the error term and the explanatory variables (Wooldridge, 2009). As there is, most likely, something outside the model that does explain the variation in WTP in which the survey does not include, the residuals and the regressors is expected to have some correlation. Having this in mind, the R-squared value is expected to be low in which is common in contingent valuation (Navrud, 2014).

3.10.2 Probit modelling

When explaining what factors influence whether respondents have done measures to detect radon, or what factors determines the effect of scope in WTP, a binary response model is needed. In a binary response model the dependent variable takes the value of either zero or one. For example it takes the value of zero for respondents that have not done any measures to detect radon, and the value one otherwise. When using binary response models, the main objective is to explain the effects explanatory variables impose on the response probability $P(y=1|x_j)$ (Wooldridge, 2009). The response probability is in general the probability of the value the dependent variable takes given the independent variables. When using binary dependent variables one can distinguish between two pretty much similar models; the probit and logit models. The difference in them is that the probit model assumes normal cumulative distribution and the logit model assumes a log distribution of the dataset (Wooldridge, 2009). Considering the size of the dataset, in which can be considered as a big sample, these two methods will have quite similar results. However, I will use probit estimation as the distribution of my dataset has thick tails, in which is a recommended model regarding this (Navrud, 2014).

4.0 Description of the Survey and Data

4.1 General Criteria when Conducting Surveys

The main goal when conducting a survey is that the commodity or policy in hand is described and worded in such a way that it sounds plausible and meaningful. Considering the fact that respondents are making a hypothetical payment during the interview, only expressing their intention to pay, the latter is of extreme importance. Detailed specification as to ensure that changes only occur with respondents' payment makes such methods plausible. With vague and less specific commodity and payment mechanisms respondents are more likely to give a symbolic value to the specific issue. The sense of commitment should be easily recognized as i.e. if the program in hand gets approved, firms will raise prices, government taxes increase or so on, to clarify that once the decision is made there is no avoiding of payment (Hanemann, 1994).

Other ways as to make a CV questionnaire more reliable is to provide accurate and adequate information, make the survey balanced and objective, give respondents a remainder of the different substitutes and of their budget constraint, make the ability of providing "don't know" responses, and allowing for reconsideration at the end of the questionnaire (Hanemann, 1994).

4.2 The Survey in Question

Considering the survey conducted in this study, it follows Pearce and Özdemiroğlu's (2002) questionnaire structure thoroughly, only with a few modifications. This questionnaire structure is explained in appendix A. It starts, of course, with introducing the purpose of the study, explaining why it is important to answer the questions as honest as possible. It stresses the importance that there are no wrong or right answers, and the respondents answers will be anonymous. It presents the subject in hand in an objective way, and does not reveal that radon gas is a part of the subject.

In the next step a question is asked as to reveal the respondent attitude towards general issues concerning the subject. In this survey the question "do you think the government should use a mutch more, more, the same as now, less or much less resources on the following problems?" seeks respondents' attitudes. Participants get to choose between social problems as; improving healthcare, mitigating residential radon gas, mitigating greenhouse gases, mitigating local air pollution, and improving national emergency preparedness against radioactive fallout from nuclear accidents abroad.

When determining what knowledge respondents have and what kind of actions they have done towards indoor radon gas, the survey asks questions detailed enough to distinguish between the different respondents' "use" of the "good". Questions like "have you ever heard of radon?", "do you know the indoor radon concentration in your house?" and "have you done any measures as to reduce the radon concentration?" are asked to test familiarity with radon, and to reveal who have done measures and who have not.

Defining a valuation scenario to elicit the WTP has been a very tough job. Having in mind the complexity of giving enough information about a subject without "overloading" the respondents, the WTP scenario in hand might have confused some respondents or even made them loose motivation. The scenario first explains what radon gas is and how it enters households, and then it addresses the Norwegian radon policy. Further, the risk aspect is explained and then the hypothetical scenarios are presented. Regarding the risk aspect, the two scenarios picture situations where indoor air radon concentration is reduced from 400 to 100 Bq/m^3, in which satisfy the measurement threshold, and from 400 to 50 Bq/m^3 respectively. These measures causes lung cancer risk to be reduced from 67 to 48 in 10 000, and from 67 to 44 in 10 000 (Darby et al., 2006). At last, the WTP question is asked, explaining the change in risk by going from one state to the other. Throughout the scenario the respondent is explained how the payment is institutionalized and reminded about the budget constraints.

Explaining the problems of indoor radon gas and risk aspects about this might sound like an easy task, while it in fact can be biased by the knowledge of the specific issue the maker of the survey has in which take some information for granted. However, as it has been evaluated over and over again, the scenario with its WTP question seems clear as for respondents to understand both the problem in hand and the risk aspects of the proposed change. The only problem could be the length as there is a lot of information mediated to give the scenario the understanding and credibility it needs. When giving value to the change, a payment card with lump sum values from zero to 36.000 NOK is presented to the respondent. An option is given to a split sample of the respondents; if their WTP is beyond their existing budget, they can consider it as monthly payments in a time frame of ten years. These monthly payments are presented under the different lump sums on the payment card. In addition to the use of a payment card, the question also uses a grid with 10.000 squares where the shaded squares explains the risk connected to the different states of radon concentration. After the first scenario is introduced and valued, the respondents are faced with a new situation where the change in reduced risk is even more severe. Respondents are then asked to value this reduction in the same matter, and the new change in risks is also presented by the grids of 10 000 squares.

After giving both scenarios their value, the respondents are asked follow-up questions if, and only if, they gave a zero value or if both scenarios were valued equally. In addition to the follow-up questions, respondents are asked about their health status and risk perceptions. The health questions try to reveal their subjective understanding of their own health status in addition to questions about experience with various cancer types, and about smoking habits. Also, some skin-cancer related questions, mainly about sun care, are asked for the purpose of revealing risk attitudes, in which will also be used in another study. In addition, a more specific risk question is asked about speeding attitudes.

At the very end of the survey, socio-economic questions are asked where sex, employment, income, age, amount of years lived in current household, economic power and patterns, marital status, perceptions about future income, and if whether they own a rental property or not, are the general subjects. At last, respondents were able to give feedback if they found it difficult answering the questions.

4.3 Sample Selection

4.3.1 Population of Choice

When selecting the target population, one has to consider who will be affected by radon and who will benefit from measures done to reduce it. It is of high importance that the right population is sampled, as not to have problems with skewedness in which can affect the aggregate WTP estimate. As any radon concentration promotes lung cancer, though the risk varies with concentration, respondents with concentrations below the recommended measurement threshold are also relevant. Considering the fact that Norway is one of the countries in the world with the highest level of radon concentration, and that radon gas is found all over the vast country, the whole population is relevant to the sample. As earlier mentioned, the mappings created by the NRPA make the basis for the relevant sample, as to ensure variety in conception about the radon issue.

Regarding the target sample, it is however, of utmost importance that all respondents are randomly selected as to have equal probability of being drawn from the population. In this study, in which uses a semi-stratified sample from groupings in a database, each member of a particular group have the same probability of being sampled. This is ensured by the specific procedure used, as respondents are randomly selected within the areas included in the mappings. Knowing the selection probabilities allows researchers to base assumptions about the characteristics of the representative population to the characteristics of the sample selection. So, if properly selected and administered, then sample biases can be avoided. It has also been given considerable evidence that the observed WTP estimates in CV studies have problems with skewedness as they go toward extreme values. Thus, CV samples should be larger than samples drawn for many other purposes to obtain valid estimates of population aggregates (Boardman, 2011).

When selecting the sample of choice, Boardman et.al (2011) suggests four important criteria's to the sample. First, who specifically should be included in the sample are those "users" directly affected by the project in hand. That is, those agents who would directly utilize from the project. Second, the understanding of the scope coherent in the WTP-question is important. Survey respondents need to understand whether they are being asked to give an estimate of the WTP for only themselves or as a representative for the whole household. Third, exclusion or inclusion of passive use benefits should be decided explicitly, as inclusion or exclusion typically affects the estimated WTP. Fourth, the sample in hand should have a fair enough geographic spread or reach as to capture all affected individuals.

However, it is suggested that three categories of respondents should be excluded when estimating the WTP; people who implicitly rejects the notion of placing a value on the specific good, or the way in which the payment for the good occurs; unserious respondents; and respondents incapable of understanding the survey (Boardman, 2011). These three types of respondents can provide zero valuations or extremely high valuations. Respondents with extremely high values, often called outliners, are normally handled by simply eliminating their valuations as they are above some certain threshold or that their income is above a specified percentage of the respondent's average gross income. Also, problems of nonresponse bias might be severe in all survey research. This problem has grown over the last 20 years as respondents sometimes question the motives of the many who claim to be survey researchers. By increasing the sample size one can cope with nonresponse, if nonresponse is purely random. The problem is, however, that nonresponse is seldom random (Boardman, 2011). Such responses are unlikely to be below 20 percent of the total response sample, even though the survey is of very high quality. Anyhow, often in official national referendums such biases can occur, in which give grounds for a partially justification for the use of these sources (Arrow et al., 1993).

Nonresponse can be divided in two types; those who refuse to respond, and those who are unavailable to response. To cope with refusal, the most common procedure is to highlight the validity of the survey, or to offer various response incentives. When unavailability is the problem, researchers typically respond to it by accounting for overrepresentation and underrepresentation in the sample when extrapolating to the relevant population (Boardman, 2011).

One important criterion when sampling household data is to consider who within a household should be selected to answer the survey. The person selected must be able to speak for the whole household, if the aim is to get households' valuations (Pearce & Özdemiroğlu, 2002). The survey handed out in this study is given, as earlier mentioned, to people who are voluntarily registered in a database, so these people are most likely respondents functioning as spokespersons for their respective household.

4.3.2 Channel of Distribution

As to reach out to the respondents in the sample, there are four ways to sample data from the survey; in person interviews, phone interviews, postal mail questionnaires or internet surveys. This survey will use internet responses, where respondents are sent a link to a website by e-mail in which they access by a simple click. The respondents are registered in a database owned by an analyst enterprise called NORSTAT. Their database consists of a random selection of respondents who voluntarily participate in such surveys. The pitfall with using such a channel and database is that there might be a problem with the demographic spread and reach, as many of society's older generations might not have access to internet or maybe have little knowledge in how to use it (Boardman, 2011). Also, in which is a major problem, are respondents understanding and interpretation of the survey. Considering the possibility for interviewers of in-person and phone interviews to properly explain to respondents the questions and the problem in hand, internet surveys have limits regarding explaining the problem as respondents must use their own cognitive knowledge to understand and interpret it (Carson, Flores, & Meade, 2001). The fact that respondents are signed up for voluntarily participating in such surveys, might question the representativeness of the sample to the population in hand. Responses to such surveys are usually low, and the ones responding might not represent the specific population as a whole (Carson et al., 2001).

On the other hand the costs of producing internet surveys are very low, and the time used in sampling the responses is short compared to the other options (Boardman, 2011). The possibility of handing out the survey to a large number of people in a short amount of time makes internet surveys very comprehensive. Considering the limits of time regarding this thesis, the latter argument is the main reason for using such a distribution channel. Also, interviewer biases, where the answers by the respondent are influenced by the interviewer, are absent.

5. Results

After enough respondents finished the survey, the results were handed back and the answers were analyzed. This chapter will first go through the sample characteristics of the respondents, followed by a sensitivity analysis. Further, the variables used in the analysis will be introduced and described, before presenting the analysis, in which subsequently will try to answer research question two to seven. At last, a discussion of the different hypotheses will be presented.

5.1 Sample Characteristics

Looking through the descriptive statistics, there is a fairly equal distribution of gender. The distribution of household income tends towards a normal distribution, but “don´t know” answers constitute of a relatively high share of the respondents compared to other questions. The level of education seems quite normal, as most respondents have a high school degree or higher education. However, the rate of respondents having craft certificate is a bit low. But what might be a worrisome distribution is the amount of respondents over 50 years old and the predominance of respondents from the eastern region of Norway. However, the objective of this study was not trying to target a representative sample

Table 5.1. Sample Characteristics

Variable	Distribution		
Gender	**Total**	**Males**	**Females**
Males	**54 %**		
Females	**46 %**		
Age			
15-29	**14 %**	9 %	21 %
30-39	**14 %**	13 %	15 %
40-49	**17 %**	17 %	18 %
50-99	**54 %**	61 %	46 %
Region of Norway			
Northern	**6 %**	5 %	7 %
Middle	**3 %**	2 %	4 %
Western	**9 %**	10 %	7 %
Eastern	**68 %**	67 %	68 %
Southern including Telemark	**6 %**	6 %	6 %
Oslo	**8 %**	8 %	8 %
Income			
0 – 100.000	**1 %**	0 %	1 %
100.101 – 200.000	**2 %**	1 %	3 %
200.001 – 300.000	**4 %**	2 %	6 %
300.001 – 400.000	**6 %**	3 %	9 %
400.001 – 500.000	**9 %**	11 %	8 %
500.001 – 600.000	**10 %**	10 %	9 %
600.001 – 700.000	**9 %**	11 %	6 %
700.001 – 800.000	**7 %**	9 %	4 %
800.001 – 900.000	**11 %**	13 %	8 %
900.001 – 1.000.000	**9 %**	10 %	6 %
1.000.001 – 1.100.000	**5 %**	5 %	5 %
1.100.001 – 1.200.000	**3 %**	2 %	3 %
1.200.001 – 1.300.000	**3 %**	3 %	2 %
1.300.001 – 1.400.000	**2 %**	2 %	2 %
1.400.001 – 1.500.000	**2 %**	2 %	2 %
Above 1.5 million	**2 %**	3 %	1 %
Don´t know	**16 %**	10 %	24 %
Education			
Elementary school	**8 %**	8 %	8 %
Craft Certificate	**8 %**	12 %	4 %
High school	**24 %**	21 %	28 %
3 years of education at university level	**27 %**	26 %	28 %
4 years or more of education at university level	**29 %**	30 %	29 %
PHD	**1 %**	2 %	1 %
None of the above	**1 %**	1 %	2 %

of the Norwegian population. Rather, it is trying to capture a specter of respondents having done measures to detect indoor air radon concentration and eventual preventive behavior as to reduce concentration levels, in addition to those who have not. Having in mind the discarded research question of trying to compare WTP between respondents living different areas of concentration, the survey response rate is made as to get a fairly distribution of people living in these areas.

5.2 Knowledge of and experience with radon

Through the survey, the respondents reveal their knowledge and experience with radon. In table 5.2 below the questions about radon knowledge and experience, and respondents answers are summarized. Almost all respondents (96 percent) answered yes when asked if they ever had heard of radon gas.

Table 5.2. Respondents knowledge and experience with radon gas

Question	Response		
Have you ever heard of radon gas?	**Total**	**Males**	**Females**
No	**4 %**	2 %	6 %
Yes	**96 %**	98 %	94 %
Do you have any knowledge of how to measure indoor air radon concentration?			
No	**35 %**	28 %	42 %
Yes	**65 %**	72 %	58 %
Have you done any measures to detect indoor air radon concentration in your current residence?			
No	**75 %**	72 %	78 %
Yes	**25 %**	28 %	22 %
Have the local authorities sent you any equipment in order to detect indoor air concentration			
No	**66 %**	67 %	64 %
Yes	**17 %**	17 %	16 %
Don´t know	**18 %**	16 %	20 %
Have you done any measures to reduce indoor air radon concentration?			
No	**83 %**	84 %	82%
Yes	11 %	13 %	8 %
Don't know	**6 %**	3 %	9 %
Did you know radon gas increases the chance of getting lung cancer?			
No	**26 %**	19 %	34 %
Yes	**74 %**	81 %	66 %
Have you ever heard of the measurement threshold of 100 Bq/m^3?			
No	**74 %**	69 %	81 %
Yes	**26 %**	31 %	19 %
Do you own or rent your residence?			
Own	**89 %**	91 %	88 %
Rent	**11 %**	9 %	12 %
Do you rent out parts of your residence and/or other residents?			
No	**88 %**	90 %	87 %
Yes	**12 %**	10 %	13 %

However, the percentage of respondents having any knowledge of how to measure radon gas was quite small. Only 36 percent knew how to measure indoor air concentration, and 25 percent of the respondents had done any measures to detect the indoor concentration. This might indicate a low knowledge of the issue among respondents as also, only 26 percent knew about the measurement threshold and the health effects caused by radon. About 17 percent of the respondents had received radon sensors from local authorities, and one can assume these respondents both have been given more information about the issue and that they have detected indoor air radon concentration at their residence. Amongst all respondents, relatively few had done measures to reduce indoor air concentration. This could indicate that either most respondents having a level of concentration that does not exceed the measurement threshold, finding little grounds for a further reduction, or it could indicate that most respondents simply have not heard of the issue as to bother caring about it. Also the costs of implementing preventive measures can be somewhat high, and could be a cause of this low ratio. Regarding the issue of reducing indoor air radon concentration, initiatives to do so might vary between educations and could be affected by experience with preventive initiatives and cognitive knowledge. For example a person having a Craft Certificate in carpentry might have experience with the implementation of such initiatives, affecting their perception of the durability attached to such measures, compared to a person having a master's degree in development studies. Such differences in perception caused by level of education might affect most questions in the survey. Unfortunately, the specific effects from level of education will not be possible to estimate due to a high degree of correlation between the different dummy variables. However, tests have been done with dummy variables representing education above elementary school, and education above high school and Craft Certificate.

5.3 Sensitivity Analysis

A sensitivity analysis has been conducted in order to know how WTP changes when the representative sample changes, and to find both the two scenarios mean WTP. This analysis have tested how WTP subsequently changes when the following are dropped from the sample; all protest answers, all respondents' having a WTP beyond 100.000 NOK, respondents having a WTP higher than 5 percent of their household income, and respondents having a higher WTP for the lowest health risk reduction (scenario 1).

When doing such an analysis, it is important to know what the distribution of the variables in hand looks like. As respondents state their WTP for two scenarios, both scenarios are graphed below. There are two graphs depicting each scenario; one graph showing how WTP is originally distributed, and one showing the logarithmic distribution.

Figure 5.1. Linear and logarithmic distribution in WTP for scenario 1

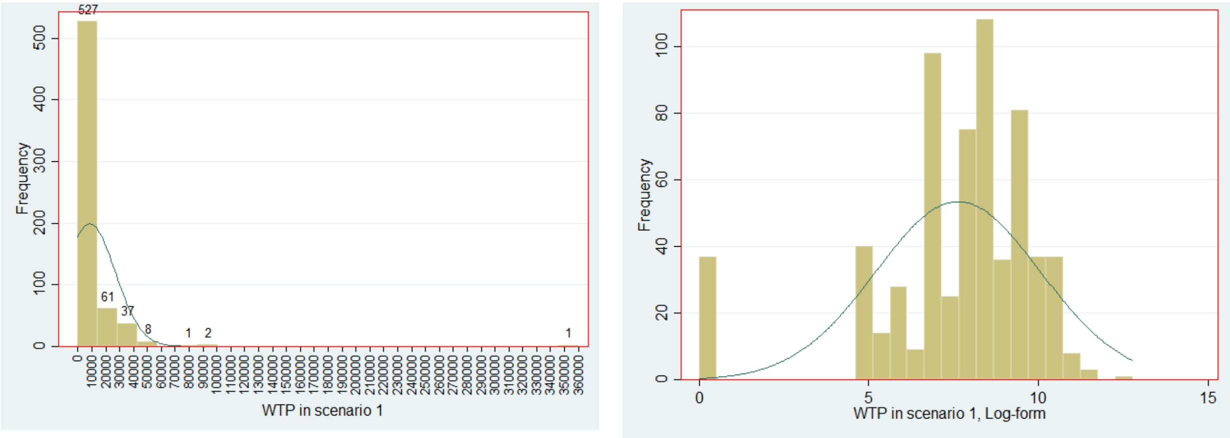
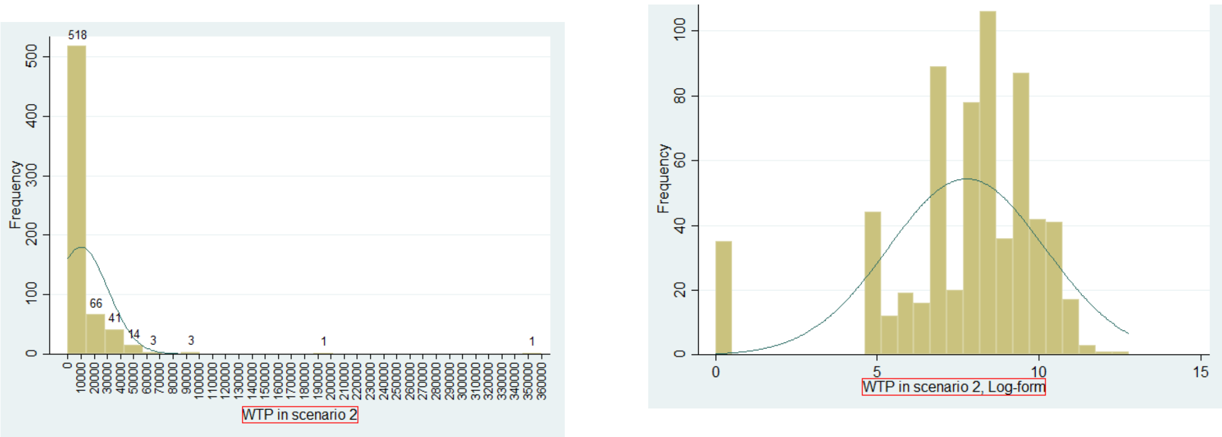


Figure 5.2. Linear and logarithmic distribution in WTP for scenario 2



Looking at the graphs one can clearly see that most respondents have a WTP between 0 and 10.000 NOK, in which is not surprising considering the fact that only 25 percent of respondents have done any measures to detect radon, making most respondents unfamiliar with the cost of measures reducing indoor concentrations. However, one can clearly see a difference in the distribution between the linear and the logarithmic form.

The WTP have also been tested for normality and for significant difference between the two scenarios. To test for normality, a skewedness and kurtosis normality test is used as this test combines both skewedness and kurtosis tests in an overall test statistic (Corporation, 2013). The test can be interpreted as follows; if the p-value exceeds a 5 percent level (probability >

critical value), then you can reject the null hypothesis that the variable is normally distributed. In the sensitivity analysis, none of the normality tests showed normality in WTP.

When testing the difference in WTP between the two scenarios, the Wilcoxon signed rank sum test will be used. This is a non-parametric version of a paired sample t-test, where a violation of the Normality assumption is expected. Considering the absence of normality in WTP, this test suits its purpose. When interpreting the test, the null hypothesis is that the two variables have equal means. The null hypothesis can be rejected if the p-value is below a certain threshold, as with the test for normality. In this case, a five percent level is used. The Wilcoxon signed rank sum test gave significant p-value for all tests, and the null hypothesis that both scenarios have equal means can be rejected at a five percent level. This is shown in appendix C[2].

The results from the sensitivity analysis will now be presented.

Table 5. 3. WTP of Initial Sample

Scenario	***Observations***	***St. deviation***	***Min. value***	***Max. value***	***Mean WTP***
Scenario 1	680	20750.06	0	360.000	9588
Scenario 2	677	20572.91	0	360.000	9775

Table 5.3 gives a brief overview of the WTP for both scenarios including all respondents', except those who answered "don´t know" in the CV-question. The response-ratio of "don't know" answers were about ten percent for both scenarios, in which is assumed to be very small seen in context of the more common response-rate in CV-surveys (Boardman, 2011). However, the standard deviation is quite big for both scenarios in which is caused by the very spread between the minimum and maximum value, which is expected as there is no sign of normality in WTP. In sum, the mean WTP is respectively 9588 NOK for scenario 1 and 9775 NOK for scenario 2. Both WTP estimates differed, in which is explained by the Wilcoxon signed rank sum test.

2 In order to test for this difference, t-tests has also been used. They found all of the WTP estimates to differ significantly between the scenarios, except when excluding those respondents stating a WTP greater than 5 percent of their household income. However, as these tests assume normality, they do not give valid conclusions. Nevertheless, these tests can be found in appendix C.

Table 5.4. WTP of sample without "protest zeroes"

Scenario	***Observations***	***St. deviation***	***Min. value***	***Max. value***	***Mean WTP***
Scenario 1	650	21120.82	0	360.000	9800
Scenario 2	647	20938.38	0	360.000	9997

If dropping the protest answers from WTP, some observations are deleted from the sample. Without “protest zeroes”, ten observations stating zero WTP and 22 observations valuing both scenarios equally, are deleted from the sample. As “protest zeroes” states that the radon issue should be a government matter, one can assume those of “protests” giving the same value to both scenarios having a quite low WTP compared to the mean. Thus, by deleting “protest” answers from the sample, the WTP automatically increases slightly. Without them, WTP is still not normally distributed, and the standard deviations are even bigger compared to initial WTP. However, the Wilcoxon signed rank sum test states that both WTP estimates differ significantly.

Table 5.5. WTP of a sample without responses over 100.000

Scenario	***Observations***	***St. deviation***	***Min. value***	***Max. value***	***Mean WTP***
Scenario 1	643	11740.09	0	80.000	8258
Scenario 2	641	11920.78	0	60.000	8593

When dropping responses stating a WTP bigger or equal to 100.000 NOK, the mean decreases by about 16 percent in scenario 1 and 14 percent for scenario 2, respectively. In addition to the “protest zeroes”, some seven more respondents are dropped from the first scenario and six more respondents are dropped from the second scenario. The reason why dropping these respondents, is just to check how much WTP changes, as considering a WTP equal to or bigger than 100.000 NOK as significantly higher than most others in which might not be representative to the target population. The standard deviations are about half the size of the previous ones, but still, WTP for both scenarios are not normally distributed. Both WTP estimates differ significantly.

Table 5.6. WTP of a sample without responses higher than 5 % of household income

Scenario	***Observations***	***St. deviation***	***Min. value***	***Max. value***	***Mean WTP***
Scenario 1	620	17675.72	0	360.000	7754
Scenario 2	613	17476.22	0	360.000	7870

It is recommended as a rule of thumb to drop respondents stating a WTP higher than five percent of their own income (in this case, household income). The reason why is because such respondents are having an unrealistic WTP, unlikely to be able paying for the inconvenience if it actually occurred. In addition, "protest" answers are also dropped in table 5.6 as well as "don't know" answers. In total, 60 observations are dropped from the sample in scenario 1, and 64 observations in scenario 2 compared to initial WTP. Still, the maximum value is unchanged, but both standard deviations and mean WTP's are lower. Stated by the Wilcoxon signed rank sum test, the mean WTP's differ significantly.

Table 5.7. WTP of a sample without respondents having a higher WTP for scenario 1

Scenario	***Observations***	***St. deviation***	***Min. value***	***Max. value***	***Mean WTP***
Scenario 1	548	21713.46	0	360.000	9561
Scenario 2	548	22444.61	0	360.000	10872

In table 5.7 are both protest answers and respondents with a higher WTP for the first scenario dropped from the sample. Thus, scenario 1 is reduced by 132 observations, while scenario 2 is reduced by 129 observations. By excluding these respondents, the mean WTP increases and so does the standard deviation. With no normality and significant difference between them, the mean WTP for both scenarios is 10217 NOK. None of the WTP's exhibits normality, but they differ significantly from each other.

5.4 The Variables of the Analysis

The survey used in this study, consisted of 53 questions. Thus, in the analysis a lot of variables have been made as to check for partial effects. Most of the variables are dummy variables, except for a few ordinal and continuous variables such as WTP and income. Considering the fact that a lot of the variables were correlated, like the different kinds of education, new variables have been made combining some of the correlated variables into one dummy variable. For example one variable for knowledge of the radon issue is combining several questions asked about radon knowledge, due to the very positive correlation between them. Below, table 5.8 list all the different variables used in the analysis, explaining what they mean and which questions they are combined with.

Table 5. 8. The Description of the variables

Variable name	Description
wtp1	Stated WTP for the first scenario with a reduction from 400-100 Bq/m^3
wtp2	Stated WTP for the second scenario with a reduction from 400-50 Bq/m^3
lwtp1	Stated WTP for the first scenario with a reduction from 400-100 Bq/m^3 in log-format
lwtp2	Stated WTP for the second scenario with a reduction from 400-50 Bq/m^3 in log-format
wtp1rational	WTP in scenario 1, without respondents stating a higher WTP for the lowest risk reduction
wtp2rational	WTP in scenario 2, without respondents stating a higher WTP for the lowest risk reduction
incwtp2	Respondents with a higher WTP in scenario 2 than scenario 1
age	The respondents age
age60	Respondents over 60 years old
gender	Respondents gender. Male = 0, Female =1
education1	Respondents with higher level of education than elementary school
householdinc	Household income
lhouseholdinc	Household income in log-format
Maritalstatus	Respondent's marital status. Married = 1, otherwise = 0
job	Respondents having a job
rot0te	Respondents with a payment card only screening lump sums
q11	Question 11; Respondents who have done measures to detect indoor air radon concentration
received	Respondents who have received sensors from local authorities to detect indoor concentration
detect	Respondents who have done measures to detect radon voluntarily or who have done measures by receiving sensors from local authorities.
knowledgeagree	Respondents who agree that they to some degree have knowledge about measures reducing indoor concentration
knowledgedisagree	Respondents who disagree that they to some degree have knowledge about measures reducing indoor concentration
knowledge	Knowledge of radon. A combination of question 2, 6, 22b and 50c.
detectprevious	Respondents who have done measures to detect radon in their previous household

q4	Question 4; Respondents who rent their residence? Own = 0, rent = 1
q50b	Question 50b; Respondents renting out parts of their own residence and/or other residents
q50c	Question 50c; Respondents knowing the government's new regulation on rental properties
q25	Question 25; Respondents subjective health status
currentsmoke	Current smokers
formersmoke	Former smokers
more5years	Quitted smoking for more than 5 years ago
less5years	Quitted smoking for less than 5 years ago
planquit	Respondents planning to quit smoking by 2014
detectbq	Level of indoor air radon concentration amongst those respondents who have done measures to detect radon
threshold	Respondents having detected radon levels above the recommended measurement threshold
averseboth	Respondents who would use high, very high or just hide in the shadows if experiencing a sunny day in both southern Norway and somewhere around equator.
speeding	Respondents who somewhat agrees with always driving 20 km/h above the speed limit
notspeeding	Respondents who somewhat disagrees with always driving 20 km/h above the speed limit
unexpected	Respondents having to some degree problems with paying an unexpected expenditure of 5000 NOK
saving	Respondents attitudes toward saving, stating values in an interval between 1-7 where 7 means saving is of high importance
worried	Respondents being worried that current radon concentration in their residence leads to increased risk of getting lung cancer
otherresident	Respondents who live in other residents than detached houses
infoeffect	Respondents who have received some kind of information about the health effects caused by exposure to radon gas
q22a	Question 22a; Respondents who know radon causes lung cancer? No=0, Yes=1
q37	Question 37; How many kids at an age lower than 18 years old lives in the household
feelingexp	Respondents who to some degree feels exposed to radon
q31a	Question 31a; How many times the respondents have applied sunbeds for tanning during the last 6 months
economicfuture	Respondents prediction of how their future income will be like in the coming ten years

As it was, for some reason, difficult for STATA to check for multicollinearity amongst all variables, VIF (Variance inflation factor) tests were made after almost each and every OLS and Probit regression. An interpretation of the test is; the higher VIF-value, the bigger chance of multicollinearity. A rule of thumb is that values greater than ten, gives grounds for further investigation, and one can expect a high degree of collinearity (Wooldridge, 2009). The VIF tests showed no sign of multicollinearity as they never was even close to ten.

5.5 The Difference in WTP between Scenarios

In the CV-scenario one can find three groups of respondents; those who value scenario 1 the highest, those who value scenario 2 the highest, and those who value them equally. Considering the assumption that there should be an effect of scope in WTP, one would assume most respondents to have a higher WTP for the second scenario. However, some respondents, as mentioned earlier, does not seem to perceive the risk difference between the two scenarios as significant enough, valuing one over the other. In addition, they might see a reduction down to 100 Bq/m^3 as a reduction enough, as this satisfies the measurement threshold. Nevertheless, explaining why respondents value the scenario with the lowest risk reduction the most is not an easy task. Such respondents might lack some crucial cognitive knowledge as to understand the difference in risk reductions between them. They could also be "protesters" simply boycotting the survey, or maybe just think satisfying the measurement threshold as an enough risk reduction not bothering about the other scenario. However, such respondents constitute of "only" a 15 percent share of the sample, making them the smallest group of the three. Below, the three groups are listed in table 5.9.

Table 5.9. Three groups of respondents with respect to whether they had higher, equal or lower WTP for Scenario 2 versus 1

Group	Valuation	Frequency	Percentage
Group 1	Scenario 1 > Scenario 2	110	15.3 %
Group 2	Scenario 1 = Scenario 2	423	58.8 %
Group 3	Scenario 1 < Scenario 2	186	25.9 %

From table 5.9 it is noteworthy that respondents valuing the two scenarios equally, group 2, constitute the largest share of the respondents. Considering the many reasons for such an outcome, one is that when introduced to the scenarios, respondents might have been given too much information as to actually bother reading it all. Then, essential information about the differences between the scenarios might have been neglected. Those having the highest WTP for the second scenario, in which exhibits effects of scope, amount to 186 respondents. This is a relatively low number, but big enough to perform valid statistical analysis'. Looking at the ones who value the first scenario the most, they represent the lowest amount of respondents.

Anyhow, this amount is quite high and worrisome considering the fact that one expects scope effect, or at least that respondents value the scenarios equally.

5.6 Income elasticity

According to economic theory, WTP is expected to increase with income. The higher household income, the higher is WTP. Explained in the vast amount of literature introducing elementary economics, income elasticity is in general the percentage of change in demand by a one percent change in income. In this study, the income elasticity is the percentage change in WTP due to a one percent change in household income. The income elasticity is calculated through the many different logarithmic regressions. These OLS regressions allow the researcher to control for how much WTP changes by a one percent change in the regressors. In sum, 33 regressions including calculations of income elasticity have been done. The income effect has been significant for all the logarithmic regressions, but with coefficients varying in magnitude. Coefficients have ranged from 0.38 percent to 0.80 percent in magnitude, making an average income elasticity of about 0.52 percent. That is, if income increases by one percent, then WTP increase, on an average, by 0.52 percent.

By doing regressions separating income from other variables, one can see the gross effect of a one percent increase in income on the WTP when other independent variables are not controlled for. Such regressions have been done for both scenarios, revealing a difference between them:

Table 5.10. Gross income elasticity for both scenarios

Scenario	***Coefficient***	***St. Deviation***	***t-value***
Scenario 1	0.62	0.17	3.61*
Scenario 2	0.48	0.17	2.77*

**Both estimates are significant at a one percent level.*

When looking at both regressions, one can clearly see that the income elasticity in the first scenario is relatively bigger than in the second scenario. In the first scenario the elasticity is 0.62 percent and in the second the elasticity is 0.48 percent, in which makes a difference of 0.14 percent between them. One reason why the elasticity differs between the scenarios is that WTP exhibits decreasing returns to scale. That is, for each unit increase in risk reduction, WTP decreases (Varian, 2006). Another reason why the elasticity differs is that the estimate only excludes “don’t know” and protest answers. This can cause a lot of disturbance considering all other respondents included in the estimate. However, both estimates coefficients lie within the interval of all calculated income elasticities from the other regressions controlling for other variables. The STATA estimates are shown in Appendix A. When controlling for the three different groups of respondents and excluding those with a WTP greater than 100.000 NOK, the gross income elasticities are somewhat different. They do differ between groups, but not between the scenarios within each group. The results are shown in table 5.11 below.

Table 5.11. Gross income elasticity between the 3 groups of respondents, excluding those with WTP over 100.000 NOK

Scenario	*Observations*	*Coefficient*	*St. Deviation*	*t-value*
		Group 1 (Scenario 1 > Scenario 2)		
Scenario 1	77	0.52	0.18	2.82*
Scenario 2	90	0.52	0.30	1.72**
		Group 2 (Scenario 1 = Scenario 2)		
Scenario 1	283	0.57	0.18	3.07*
Scenario 2	283	0.57	0.18	3.07*
		Group 3 (Scenario 1 < Scenario 2)		
Scenario 1	428	0.47	0.13	3.48*
Scenario 2	432	0.45	0.13	3.44**

**Estimates are significant at a 1% level. **Estimate is significant at a 10% level.*

This in-depth analysis of gross income elasticity reveals that those who value the scenarios equally, have the highest income elasticity. On the other hand, those respondents exhibiting scope are the ones with the lowest income elasticity. These findings might explain the decreasing returns to scale claim mentioned earlier.

5.7 Value of a Statistical Life Calculation

From the estimates of mean WTP per household for the reductions in the risk of having lung cancer and the expected average probability of premature death (i.e. dying prior to expected average expected life length) if one contracts lung cancer, the Value of Statistical Life (VSL) has been calculated. Three alternative ways of calculating mean WTP (based on the sensitivity analysis performed for mean WTP) are used in the VSL calculations: i) WTP without "don't know" and "protest" answers, ii) WTP without responses higher than 5 % of household income, and iii) WTP without respondents placing a higher value to scenario 1. For calculating VSL, the following equation is used:

$$VSL = \frac{Mean\ WTP/households}{Reduced\ mortality\ risk * Probability\ of\ premature\ death}$$

This equation is quite easy to interpret. Mean WTP/household is mean WTP per household for each of the three ways of estimating mean WTP. Considering the reduced mortality risk, this number varies between the scenarios. For example, having a concentration of 400 Bq/m^3 means having a mortality risk of 0.0067 (67 of 10000 in the population). However, having a concentration of 100 Bq/m^3, in which satisfies the measurement threshold, mortality rate is 0.0048. Regarding scenario 1, mortality rate is then reduced by 0.0019, and for scenario 2, reducing the indoor radon level to 50 Bq/m^3 means a reduction in mortality rate by 0.0023. The probability of premature death when having lung cancer is calculated to be 95 percent, with a latency period of ten years (UK, 2012). Regarding the equation, VSL is quite easily calculated.

The results are presented in the table that follows:

Table 5.12. Calculations of VSL

WTP Sample Category	*Scenario 1*	*Scenario 2*
WTP without "don't know" and "protest" answers	9800/(0.0019 * 0.95) = 5 429 363	9997/(0.0023 * 0.95) = 4 575 286
WTP without responses higher than 5 % of household income	7753/(0.0019 * 0.95) = 4 295 291	7870/(0.0023 * 0.95) = 3 601 830
WTP without respondents placing a higher value to scenario	9560/(0.0019 * 0.95) = 5 296 399	10872/(0.0023 * 0.95) = 4 975 744

When looking at the table, one can clearly tell that VSL differs between categories in which is caused by the different WTP estimates. On the other hand, there is a tendency towards decreasing returns to scale as all VSL calculations for scenario 1 is greater than scenario 2. But if the experiment had more scenarios, the decreasing effect would have been more evident.

The VSL estimates ranges from about 3.6 to 5.4 million NOK in which is quite low considering the VSL estimates recommended by the Norwegian Ministry of Finance. In a paper stressing the requirements for valid economic analyses, an estimate from 2012 states that VSL is set at 30 million NOK (Finansdepartementet, 2014). Our estimates are quite low compared to what the Ministry of Finance uses, but this could be due to the fact that their estimate is obtained by looking at current accident rates. In a similar CV study, VSL estimates proved to be quite low compared to other estimates, but this was due to the fact that respondents discounted WTP as the risk reductions had a latency period. When discounting their estimates, VSL estimates were within the range of commonly found WTP literature for current accident rates (Carson & Mitchell, 2006). According to their findings, our VSL estimates have also been discounted using the formula:

$$VSL_{t+1} = VSL_t(1+r)^k$$

Here, *t* is current time period, *r* is the discount rate and *k* is the latency period. By using the same rate as Carson and Mitchell (2006), in which was the common consumer credit card rate of 18 percent, our VSL estimates was not too far from the estimate set by the Fiscal Department. Our discounted VSL estimates ranges from about 18.8 to 28.4 million NOK, in which is depicted in table 5.12.

Table 5.13. Discounted VSL estimates using the common credit card rate of 18%

WTP Sample Category	***Scenario 1***	***Scenario 2***
WTP without "don't know" and "protest" answers	$5\ 429\ 363*(1.18)^{10}$ = <u>28 416 393</u>	$4\ 575\ 286*(1.18)^{10}$ = 23 946 295
WTP without responses higher than 5 % of household income	$4\ 295\ 291*(1.18)^{10}$ = <u>22 480 847</u>	$3\ 601\ 830*(1.18)^{10}$ = <u>18 851 386</u>
WTP without respondents placing a higher value to scenario	$5\ 296\ 399*(1.18)^{10}$ = <u>27 720 481</u>	$4\ 975\ 744*(1.18)^{10}$ = <u>26 042 225</u>

This estimate also assumes that the WTP stated by the respondent was only for reducing his/her risk of lung cancer. As radon measures will reduce the risk of lung cancer for all members of the household, and the WTP stated by the respondent is for all the household members – the WTP should be divided by the average number of household members, which is 2.45, resulting in VSL estimates ranging between 1 470 135 to 2 216 067 NOK without discounting. These results will lead to even higher discount rates. Accounting for household members could also explain why our VSL estimates are low.

5.7 Findings from the different models

In the process of finding the different variables affecting WTP, both linear and logarithmic OLS regressions have been calculated. Using both methods enables to see the variables real effects and the percentage effects on WTP. In the lack of any empiric method of how do regressions with such a big dataset, implying many variables, a custom made approach has been used. Variables have been put in different categories, in which each category has been regressed separately. In addition, socio-economic variables are included in these regressions. For example are risk averse variables put in one category and regressed together with socio-economic variables like gender, age, income, education, having a job and so on. Following this method, the variables for each category are a bit more isolated in which can reveal if there is any significant partial effect. At last, after all variables in the different categories have been regressed separately, a regression with all the significant variables from the separate regressions has been carried out. These last regressions are the most important ones, and will be the ones mostly referred to. In addition, these last regressions have been tested for a sample excluding all respondents valuing scenario 1 the most, in which gave different results compared to not excluding those respondents.

The same approach has been used in both of the probit model regressions. Variables have been categorized, and regessed together with socio-economic variables, and then, if significant, they are carried out in one regression with only significant variables from the other regressions. Now, findings from each of the different models will be presented.

5.7.1 Linear OLS models

In the linear OLS models, the two scenarios ended up with partly different variables when explaining WTP. After all categories had been separately regressed scenario 1 ended up with twelve variables. Nevertheless, after regressing these twelve variables together, only seven proved to be significant. Three variables related to smoking were included in that regression, but two of them were insignificant. However, these insignificant variables had to be included in the model as to give a proper estimation of the partial effects of the one significant smoking variable. The significant variables when excluding only “don’t know” and protest answers from the sample, were *householdinc, rot0te, q50b, knowledge, more5years, averseboth* and *saving* for scenario 1.

For scenario 2, after all categories had been separately regressed, the result was a bit different and it ended up with only six variables. All variables ended up being significant when regressed together. A regression including some socio-economic variables such as *education1, age60* and *rot0te* also gave significant results for all of the six other variables. The significant variables in explaining WTP in scenario 2 were *householdinc, detectprevious, knowledge, q50b, averseboth,* and *saving*. The results from the OLS models in both scenarios are presented in table 5.14 below.

Table 5.14. Significant variables from linear OLS models

Variables	**Scenario 1**	**Scenario 2**
householdinc	0.00339*	0.00354***
rot0te	-3271.62*	
q50b	5007.12*	5343.706**
knowledge	3308.804*	2856.944***
detectprevious		9513.178*
more5years	2051.14***	
averseboth	2877.751*	4198.039*
saving	633.06***	1050.434**
F-value	6.22	6.34
Adjusted R^2	0.0809	0.0557
Observations	535	544

**Significant at a 1% level. **Significant at a 5% level. ***Significant at a 10% level.*

What are noteworthy from these findings are the differences and equalities in variables explaining WTP for both scenarios. A variable that have been significant for only one of the two scenarios is the variable *rot0te*. This variable has been highly significant for scenario 1, but insignificant for scenario 2. Thus, being screened for a payment card with only lump sums affects WTP negatively for a reduction satisfying the measurement threshold, but does not affect WTP at all for a further reduction. Considering this finding, it seems like WTP for a further reduction is somewhat not affected by respondents need to plan future expenses. However, the sign of the coefficients are negative in either scenario in which is as expected.

Another variable in which is significant for only scenario 1 is the variable *more5years*. This variable explains that respondents who used to smoke on a regular basis or every now and then for more than five years ago affects positively to WTP. This can be explained by the assertion that those who have quitted smoking are doing more preventive measures regarding their health, as a reaction to the dangers exposed to when smoking. As 185 respondents used to smoke on a regular basis or every now and then for more than five years ago, this result does certainly not seem like a coincidence. On the other hand, a respondent who *do* smoke on a regular basis or every now and then or quitted less than five years ago does not affect WTP significantly. This result is a bit notable, considering the severe health risk smokers are exposed to, and one should expect these two groups to explain more of the variance in WTP.

The variable *detectprevious* is the one variable who affects WTP significantly only in scenario 2, but not in scenario 1. It gives a positive effect to WTP for doing further measures beyond the measurement threshold. This can be explained by the fact that those respondents who did measures to detect radon in their previous household, might have some more information and knowledge about the consequences indoor radon gas can cause. Anyhow, this group of respondents is quite small and could be a cause of coincidence or disturbance, but as the variable is highly significant at a one percent level that might not be the cause.

One variable that is significant for both scenarios is *householdinc*. Thus, household income explains a significant part in WTP for both scenarios, as H_0 can be rejected at a five percent level for both scenarios. This result is anticipated, as one would expect income to play a significant part in explaining WTP for both scenarios.

Another variable playing a significant role in both scenarios is the variable *knowledge*, in which is a dummy variable for those having some knowledge regarding radon and the current domestic policies about it. To possess some knowledge of the issue in hand indicates that respondents might be aware of the rules and regulations imposed by the government, and the importance of having low indoor air concentration. Thus, such knowledge affects positively to WTP at a one percent level in the first scenario, and at a ten percent level for the second scenario.

The two variables explaining risk averse behaviour, *averseboth* and *saving*, both affects WTP positively in both scenarios. The findings reveal that these respondents have a preventive behaviour, in which they might be willing to pay more for radon preventive initiatives compared to respondents not that risk averse. Respondents using high levels of sunscreen in both Norway and somewhere near the equator might have the same degree of precautions towards lung cancer as to skin cancer. WTP also increases with the degree of importance regarding savings, as considering savings as important can be a driving force for doing preventive measures to improve prospects for future health condition. Thus, respondents who consider savings as important, most likely gives an increase in WTP.

The last variable who affects WTP significantly for both scenarios is the variable *q50b*. This indicates that respondents renting out parts of their own residence and/or other residents affect WTP positively. This is almost obvious considering the responsibility land owners have towards meeting the radon regulations imposed by the NRPA. Some of them might have some experience in doing preventive measures and knows the cost of such initiatives, implying a high WTP. Not being willing to pay a high enough amount for preventive initiatives implies not satisfying the rules and regulations, in which prevents land owners from renting out, causing lost revenues. This can be perceived as some sort of "vicious cycle", by which increase WTP for land owners.

As earlier mentioned, a subset of the sample by excluding respondents valuing scenario 1 the most has been analysed when carrying out some regressions. Regressions for scenario 1 gave almost the same results, only excluding the smoking variables as they were insignificant. This regression gave a higher F-value, but a lower R-squared. However, the regressions got reduced by 85 observations.

When following the same procedure for scenario 2, excluding respondents valuing scenario 1 the most, the results were a bit more remarkable. The variable *detectprevious* proved not to be significant, and got exchanged with *rot0te*, in which became highly significant at a one percent level. It seems like the design of the payment card does matter after all when stating a WTP for a further reduction, but only when excluding respondents who do not exhibit scope effects. The variable *rot0te* proved to be negatively significant, explaining that being screened to only lump sums affects WTP negatively. However, none of the other variables changed, so the result with the further manipulation was pretty much the same as before. The results from both models excluding respondents valuing scenario 1 the most are depicted in table 5.15 below.

Table 5.15. Significant variables from OLS models excluding respondents not exhibiting scope effects

Variables	***Scenario 1***	***Scenario 2***
householdinc	0.0033**	0.00367**
rot0te	-3333*	-3812*
q50b	5239*	5759*
knowledge	3174*	3209**
averseboth	2566**	3376**
saving	704***	977**
F-value	7.20	7.14
Adjusted R^2	0.0766	0.0758
Observations	450	450

**Significant at a 1% level. **Significant at a 5% level. ***Significant at a 10% level.*

5.7.2 Logarithmic OLS models

After the many categorical models, regressed separately, had been carried out, the last tests for scenario 1 included eleven variables. Combining these variables in one regression, made some insignificant findings and a few variables got ruled out. In the end, the most significant variables explaining the variation in WTP for scenario 1 were *gender, education1*, *lhouseholdinc*, *knowledge*, *unexpected, saving* and *worried.* Some of them were also significant in the original OLS models, but a few of them were not. Through the regressions carried out, economic factors, risk averse behaviour, knowledge of the issue in hand and type of gender seems to affect this scenario's WTP. In this regression most variables were significant at a five percent or one percent level, with only *gender* exhibiting a ten percent level.

Also for scenario 2, eleven variables were used in the last regressions. After regressing them together, only 7 variables were significant; *education1*, *lhouseholdinc, knowledge, q25, saving*, *averseboth*, and *worried*. The results from both scenarios in the logarithmic OLS models are depicted in table 5.16 below.

Table 5.16. Significant variables from the logarithmic OLS models

Variables	***Scenario 1***	***Scenario 2***
lhouseholdinc	0.4446**	0.3619***
gender	0.4150***	
education1	0.7788***	0.8133**
unexpected	-0.5201**	
worried	0.6228**	0.5067***
q25		0.0096***
knowledge	0.8353*	0.5881**
averseboth		0.4362***
saving	0.2159***	0.2734*
F-value	7.37	5.75
Adjusted R^2	0.0870	0.0818
Observations	469	481

**Significant at a 1% level. **Significant at a 5% level. ***Significant at a 10% level.*

The two variables that were significant in both scenarios at a one percent level were *knowledge* and *saving*. Having some knowledge of the issue and having a perception of savings as important, is decisive for explaining WTP in both scenarios, in which also were true for the linear OLS models.

Unlike the linear OLS models, *education1* were significant for both scenarios. That is, having a higher level of education than elementary school affects WTP positively. However, there are some uncertainties considering these estimates as the reference level is quite low. Only 53 respondents have elementary school as their highest education, opposed to those 656 respondents having an educational level above elementary school. On the other hand, regressions using a dummy variable for those having a higher education than high school and Craft Certificate, gave non-significant findings.

The variable *worried* was significant for both scenarios, but *averseboth* was only significant for scenario 2. This might come as a bit strange considering that these variables are both associated with risk averse behaviour. In addition, *worried* was not significant in any of the linear OLS models, implying there might be something disturbing the outcome of significance regarding this variable. Anyhow, it seems that risk averse behaviour explains more of the variation in the second scenario than in the first.

Regarding the variable *lhouseholdinc*, in which is household income in log-form, this variable is significant for both scenarios. That is, household income explains variation in WTP for both scenarios.

Apparently, *gender* seems to be a significant factor in explaining WTP for the first scenario. The variable is positive and of borderline significance, explaining that females are more likely to have a positive impact on WTP. This effect is partially confirmed in a study of financial decision-making, suggesting that men are more risk-prone toward gains, while women are more risk-prone towards losses (Schubert, Brown, Gysler, & Brachinger, 1999). Also, according to Eckel and Grossman (2008), field studies reveals that women are more risk averse than men. However, as most field studies are consistent with laboratory experiments, they emphasize that enough counter evidence is found as to warrant caution to such conclusions (Eckel & Grossman, 2008). Considering the fact, that gender has not been a significant factor in the linear OLS models, this finding should be handled with care.

Subjective health-status plays a part in explaining WTP in the second scenario, as the variable *q25* showed significance at a ten percent level. The variable is positive, in which means WTP increases as subjective health status increases. One might intuitively think it should be the other way around that decreasing health-status increase WTP, in which is supported by a similar study of mortality risk reductions (Alberini, Cropper, Krupnick, & Simon, 2004). But this result could be due to some respondents thinking that it is only when you have good health status that you consider paying for radon measures, whereas if you have bad health status you would rather pay for measures that reduce the particular illness you are affected by in which is reducing your health status.

When excluding those respondents placing the highest value on the risk reductions in scenario 1, the group of variables explaining WTP for scenario 1 changes a bit. The model ended up with only four significant variables; *lhouseholdinc, knowledge, saving* and *averseboth*. The variable *education1* were also significant, but only if the variable *worried* were included in the model. On the other hand, without these sample manipulations, *averseboth* were not significant for scenario 1. This reveals that other factors of risk averse behaviour explains WTP for scenario 1, when excluding respondents placing the highest value on the risk reductions in scenario 1. In fact, factors concerning income, risk averse behaviour and knowledge are all affecting WTP in scenario 1, but to a lower degree in these regressions.

With the same subset of the sample, the significant variables explaining WTP in scenario 2 are; *lhouseholdinc, knowledge, q25, saving* and *averseboth*. This is almost the same result as the models without the manipulation, only excluding *education1* and *worried*. But like in scenario 1, education1 is of borderline significance when including other variables to the model. An interesting observation is that subjective health-status (*q25*) is highly significant at a one percent level, still explaining that better health status exhibits higher WTP. The results from both scenarios are presented in table 5.17 below.

Table 5.17. Significant variables from logarithmic OLS models excluding respondents not exhibiting scope effects

Variables	***Scenario 1***	***Scenario 2***
householdinc	0.4253*	0.3870*
q25		0.0113*
education1	0.5170***	
more5years	0.3490***	
knowledge	0.4660*	0.3858*
averseboth	0.3560**	0.3588**
saving	0.1262**	0.1366**
F-value	4.56	7.50
Adjusted R^2	0.0634	0.0705
Observations	422	429

**Significant at a 1% level. **Significant at a 5% level. ***Significant at a 10% level.*

5.7.3 Probit model explaining detection

As earlier mentioned, a probit model has been carried out explaining what factors determining whether respondents have done measures to detect indoor radon or not. Here, the same variable elimination process has been followed as in the OLS regressions, emphasizing the variables significance, the model's chi-square value, the model's pseudo R-squared value and the model's percentage correctly classified. After eliminating insignificant variables, the final model consisted of six variables; *knowledge*, *feelingexp*, *age60*, *detectprevious*, *received* and *otherresident*. The significant variables from the model are depicted in table 5.18 below, and a more in-depth STATA analysis is found in appendix C.

Table 5.18. Significant variables from the probit model explaining detection of indoor air radon concentration

Variables	**z-value**
knowledge	4.04*
feelingexp	4.55*
age60	-1.92***
detectprevious	-2.11**
received	9.29*
otherresident	-1.92***
knowledgeagree	1.73***
Chi-square value	269.61
Pseudo R^2	0.3924
Observations	586
Percentage correctly classified	83.28%

**Significant at a 1% level. **Significant at a 5% level. ***Significant at a 10% level.*

Finding knowledge of the issue in hand (*knowledge*) as a significant factor for doing measures to indoor air radon concentration, did not come as an unexpected surprise. Having some knowledge of the specific issue is crucial for doing such initiative voluntarily. If having no knowledge of the issue, no initiative towards detecting indoor air radon concentration would have been done. On the other hand, some respondents have received sensors from local authorities, doing measures to detect indoor radon without having any knowledge of the issue. The variable *received* explains this, and is highly significant caused by the fact that all the 118 respondents receiving sensors also had measured indoor concentration.

Also, the variable *feelingexp* affect positively to whether respondents have detected indoor concentration. It is significant at a one percent level, explaining that respondents feeling exposed to radon have most likely done such initiatives.

An interesting finding is that there is an age effect to this issue. As the variable *age60* is negative and significant at five percent level, respondents 60 years old or more are most likely to not have done such initiatives. This can be explained by the attitudes towards health risk, as initiatives to reduce mortality risk might not have a significant effect on older people.

Having done measures to detect indoor air radon concentration in previous resident, help explain whether respondents have done such measures in their current resident. This is pictured by the variable *detectprevious*, as such an experience might make people more aware of the consequences related to indoor air radon. However, this variable is negative and only significant at a ten percent level when controlling for average marginal effects. It might be that respondents to this survey have experienced low concentrations in their previous resident, not even bothering try to detect concentrations in current resident.

Considering the fact that apartments above ground floor and the likes, are most likely to not have any indoor air radon concentration, the variable *otherresident* is significant with a negative coefficient. That is, respondents living in other than detached residents are more likely to not have done any measures to detect indoor air radon concentration.

5.7.4 Probit models explaining effects of scope

Probit models revealing what factors explain effects of scope in WTP between the two scenarios have been carried out. In the end, two models with variables of borderline significance proved to be the most comprehensive ones in explaining the scope effects. The reason why two models are used is that two correlating variables are separated between the two models. The variables used in these models are *rot0te, job, saving, economicfuture* and *age*, in which *age* and *economicfuture* are separated due to correlation. The model including *economicfuture* exhibits higher chi-squared and pseudo R-squared values, but had a slightly lower percent correctly predicted value than the model including *age*. However, both models should be emphasized as both variables are significant at a one percent level when separated from each other. The results from both models are presented in the table below, and the STATA estimates can be found in appendix C[3].

---

3 An analysis has been made for irrational respondents, valuing the first scenario the most, where the same variables have been used as in the probit model just mentioned. From the estimates, only the variable *rot0te* resulted in a significant opposite effect (negative) at a ten percent level, explaining that being screened for only lump sums when stating WTP affects negatively to irrational order valuation. The results are presented in appendix C.

Table 5.19. Significant variables from the probit model explaining scope effects.

Variables	***z-values model 1***	***z-values model 2***
rot0te	2.06**	2.24**
job	-1.97**	-1.76***
saving	2.08**	2.64*
economicfuture		2.89*
age	-2.60*	
Chi-square value	20.26	23.65
Pseudo R^2	0.0249	0.0301
Observations	712	688
Percentage correctly classified	74.16%	74.13%

**Significant at a 1% level. **Significant at a 5% level. ***Significant at a 10% level.*

Considering the variable *rot0te*, one would not expect this to have anything to do with explaining scope effects. Anyhow, it does and its coefficient is positive, telling that respondents being introduced to a payment card designed with only lump sums are more likely to exert scope effects. One could think a payment card designed with both lump sums and monthly payments could be confusing and mislead respondents when valuing the scenarios due to too much information and text given. Considering the fact that 109 of the respondents that wielded scope were faced with only lump sums, compared to the 77 wielding scope that were faced with both lump sums and monthly payments, this should be a quite fair distribution between respondents, thus making the findings valid.

Another variable significant for explaining scope effects in WTP, but only at a ten percent level, is *job*. This explains that having a job affects negatively to exerting effect of scope in WTP. One could think that respondents having a job do have better cognitive knowledge, in which would make them consider the difference in reduced health risk between the scenarios as insignificant.

The variable *saving* shifts between being significant at a one percent level and five percent level for the two models. While at least being significant, *saving* affects scope positively, explaining that the more respondents perceive savings as important, the more likely respondents are to exert effects of scope.

Having a more positive prospect for future income makes respondents more likely to exert scope effects in WTP. It could be that respondents having a bright forecast for future income might consider an increase in WTP between the scenarios as affordable. The variable *economicfuture* gives ground to such a theory, as it is positively significant at a one percent level. Unfortunately, this variable correlates with age as older people are most likely to have lower prospects for future income than younger people.

Respondent´s age has a significant negative effect at a one percent level on scope in WTP; meaning that people at older age display scope effect in WTP to a lesser extent than young people. Such an effect can be explained by the likes that people of older generations might value the scenarios equally, as the health risk reductions does not improve their situation. Some might perceive such measures as “too late”, as they could have been exposed to radon gas or other factors for such a long time that initiatives to improve their health status will be ineffective.

5.8 Discussion of the different hypothesis and the findings

In the following, each hypothesis will be analysed and compared with the findings, as to sum up what objectives were correctly predicted. Research question one and its underlying hypothesis’ are discussed in the sensitivity analysis, explaining why only research question two to seven, with their underlying hypothesis, are discussed in this section.

5.8.1 Research question 2: What determines whether a household have measured indoor air radon concentrations or not?

> ***H21): Knowledge of radon increase the probability that respondents have done measures to detect radon concentration***

Findings from the probit model revealed that some knowledge of the radon issue is a crucial factor to whether respondents have done measures to detect radon or not. The estimate gave a positive coefficient of the variable *knowledge*, explaining that having heard of radon, having some knowledge of how to measure indoor air radon concentration, knowing about the measurement threshold or knowing about the authorities’ new regulation regarding rental properties, is most likely to explain why respondents have done measures to detect indoor concentrations. The null hypothesis can be rejected as H21 is true.

H22): Feeling exposed to radon increase the probability that respondents have done measures to detect radon concentration

The variable *feelingexp* proved respondents that to some degree are feeling exposed to radon, to be significant factor in explaining whether having done measures to detect radon concentration or not. When feeling exposed to radon, the probability of having done such an initiative increases. Thus, H22 is true and the null hypothesis can be rejected.

H23): Detection of radon in previous resident increase the probability that respondents have done measures to detect radon concentration

Having detected radon in earlier households does affect the probability that respondents have done measures in current household to detect radon. However, the sign of the coefficient is not as expected, as the variable *detectprevious* is negative. Thus, by these findings, detection of radon in previous resident decrease the probability of respondents having done measures in current household, and the null hypothesis is not rejected.

H24): Having received an offer to detect radon from the authorities increase the probability that respondents have done measures to detect radon concentration.

The variable *received* is the most significant variable in the model, telling that respondents received radon sensors from local authorities is most likely to have detected indoor air radon concentration. This finding did not come as a surprise as all respondents who received radon sensors, had detected indoor concentration. This give valid ground to reject H_0 as H24 is true.

H25): Not living in a detached house decrease the probability that respondents have done measures to detect radon concentration.

Living in some other house form than a detached house, is according to the probit model, found to decrease the probability of having done initiatives to detect indoor concentration. As the estimated coefficient of the variable *otherresident* has a negative sign, it gives ground to state that H25 is true at a ten percent level and the null hypothesis can be rejected. This is well anticipated as for example living in an apartment one floor above the ground or more, the chance of having high indoor concentrations, if any, is quite small. A few respondents also mentioned this as a cause for not having detected concentration, when giving feedback at the end of the survey.

H26): Being worried that current radon concentration increases the probability of getting lung cancer increase the probability that respondents have done measures to detect radon concentration.

In the survey respondents were asked a yes or no question to whether they are worried that current in-house air radon concentration increased the probability of getting lung cancer. By probit modelling, the variable *worried* proved to be insignificant. Thus, being worried that current radon concentration increases the chance of getting lung cancer does not increase the probability that respondents have done measures to detect indoor air radon concentration, and the null hypothesis is not rejected.

H27): Risk averse behavior increase the probability that respondents have done measures to detect radon concentration

In the probit model, no variables explaining risk averse behavior were significant. Thus, risk averse behavior does not increase the probability that respondents have done measures to detect radon concentration, and the null hypothesis is not rejected. This finding is unexpected, considering the fact that risk averse behavior has been a significant factor in the many regressions explaining WTP. Certainly, one would expect risk averse respondents to be the first ones to detect indoor air radon concentrations, but as detection is partly explained by knowledge of the radon issue, it might seem like some risk averse respondents don't have this knowledge.

H28): Having a job increase the probability that respondents have done measures to detect radon concentration.

The variable *job* has not been included in the final probit model due to insignificance, explaining that having a job, in which incur regular income and some level of education, does not increase the probability that respondents have done measures to detect radon concentration. Thus, one cannot reject the null hypothesis, as H28 is not true.

H29): Socio-economic factors affect to whether respondents have done measures to detect radon concentration.

Only one socio-economic factor is found significant in the probit model, in which is the variable *age60*. That is, respondents aging 60 or beyond decrease the probability that respondents have done measures to detect indoor air radon concentration. This can be explained by the fact that people over 60 years old is most likely not able to reduce health risk by doing preventive measures, as they might have been exposed to factors increasing health risk for a too long time. Other factors than age, such as education, gender, income and the likes were not significant. Modifying H29 for this simple finding, age affect to whether respondents have done measures to detect radon concentration. The null hypothesis is not rejected for all other socio-economic factors.

H210): Respondents renting property decrease the probability of having done measures to detect radon concentration

The variable *q4*, controlling for whether respondents own or rent their current residence, proved not to be significant. This finding can be explained by the fact that respondents care/does not care about their health risk regardless of whether they own or rent their respective residents. However, one would expect owners of property to feel some sort of responsibility regarding their own household, as to control for having a level of radon concentration satisfying the measurement threshold. By this finding, the null hypothesis cannot be rejected, and H210 is false.

H211): Respondents who lease out properties increase the probability of having done measures to detect radon concentration

Respondents leasing out property does not increase the probability of having done initiatives to detect indoor concentration, as the variable *q50b* proved to be insignificant. This is an unexpected finding considering the regulations imposed by the NRPA at January 1st, 2014, stating that land lords renting out properties is obliged and responsible for detecting indoor air radon concentration. However, this regulation has recently come into force, which might explain why it is not giving any significant effect.

5.8.2 Research question 3: Do health status and smoking affect WTP?

H31): Smoking on a daily basis, compared to those not smoking, affects WTP

H32): Smoking every once in a while, compared to those not smoking, affects WTP

Current smokers, which smokes on a daily basis or every once in a while, does not affect WTP in any way. None of the regressions, either linear or logarithmic, give significant coefficients for either scenario. As separate variables for those currently smoking on a daily basis, and those currently smoking every once in a while did correlate, the variable *currentsmoke* were made as a combination of the two. Even though, such a combination did not prove to give any significant effect. However, this finding is similar to a study of health risks due to air-pollution in China, were current smokers proved to be insignificant in explaining WTP (Hammitt & Zhou, 2006). Thus, both H31 and H32 are not true, and the null hypothesis is not rejected.

H33): Having used to smoke, both on a daily basis and every once in a while, in less than five years ago, compared to those not smoking, affects WTP

Former smokers, having quit smoking in less than five years, are not found significant in affecting WTP. In neither scenario was the variable *less5years* significant, tested in both the linear and logarithmic OLS models.

H34): Having used to smoke, both on a daily basis and every once in a while, in more than five years ago, compared to those not smoking, affects WTP

The variable *more5years* proved significant at a ten percent level with a positive coefficient in the linear OLS model for scenario 1 only. That is, having quit smoking, both on a daily basis and every once in a while in more than five years ago, affects WTP positively for a reduction in radon induced health risk by 0.19 percent. Such a finding can be explained by the fact that former smokers did most likely quit smoking for preventive health reasons, and could perceive a reduction in radon concentration as some sort of compensation for the mortality risk increase by the years of smoking. Why such respondents do not explain WTP in scenario 2 is unknown, but could be caused by respondents perceiving satisfying the measurement threshold as a big enough reduction. However, why the significance of former smokers varies between having quit in more or less than five years ago is unclear, and no theory supporting this finding is found. Regarding the finding, the null hypothesis can only be rejected at a ten percent level, for scenario 1 in the linear OLS models.

H35): Planning to quit smoking by 2014 affects WTP negatively

Respondent planning to quit smoking by 2014 is proven not significant for explaining variation in WTP. The variable *planquit* is not significant for any of the scenarios in either the logarithmic or linear models.

H36): A lower subjective health status affects WTP positively

Subjective health status proved to be significant at a ten percent level only for scenario 2 in the logarithmic OLS model, but the coefficient is positive explaining that respondents considering own health status as good increases WTP. One would expect respondents with low subjective health status to have a higher WTP trying to improve their health or prevent it from getting worse. On the other hand, respondents with a high health status might want to maintain their good health being willing to pay more, in which might have been the case in this study.

5.8.3 Research question 4: What socio-economic factors and household characteristics affect WTP for health risk reductions from radon induced lung cancer prevention?

H41): Income affects WTP positively

Household income has been positively significant for both scenarios in all OLS models. This is as expected, as most economic theory suggests a higher demand for normal goods, in this case radon preventive initiatives, as income increases. Thus, H41 is true and the null hypothesis can be rejected.

H42): Age affects WTP negatively

The variables *age* and *age60* were insignificant for either scenario in both the linear and the logarithmic OLS model. This is similar to Alberini et al. (2004) findings in their study of whether VSL changes with age and health status, in which age was not significant. Their finding implicitly means WTP was unaffected by age. However, their study is restricted to respondents ageing 40 years or older, in which is a slightly different approach compared to this study.

H43): Number of kids living in household affects WTP positively

One would automatically assume number of kids to be significant in explaining WTP, as parents most likely is doing their best to secure bright prospects for their descendants' future health. However, the variable *q37* was not significant in any of the scenarios in neither linear models nor logarithmic models. It seems like parents in this sample, emphasize other factors when valuing the scenarios. Thus, the null hypothesis cannot be rejected.

H44): Level of education affects WTP positively

Results from the regressions found that having a higher level of education than elementary school, is significant for explaining WTP in the logarithmic OLS model. The variable *education1* was significant in both scenarios, but at a ten percent level for scenario 1 and a five percent level for scenario 2 respectively. However, as earlier mentioned, the reference group of this variable is quite small, leaving the estimate in doubt.

H45): Amount of years lived in current residence affects WTP negatively

Findings from both linear and logarithmic models reveal that respondents amount of years lived in current residence are not significant in explaining variation in WTP. One would maybe expect that having lived in current residence for a relatively long time, respondents might have planned moving somewhere else, and not bothering doing measures to reduce indoor air radon concentration. In addition, this variable correlated to a high degree with age, making age explain more of the variation in WTP than the amount of years lived in current residence. Anyhow, the null hypothesis cannot be rejected.

H46): Having a job affects WTP positively

Having a job has proved to be insignificant in regressions, being unable to explain the variance in WTP. The variable *job*, a dummy for those respondents having a job, has not been significant mostly due to the fact that it is highly correlated with household income. Considering this, the null hypothesis cannot be rejected.

H47): Prospects for future income affects WTP positively

The variable *economicfuture* was proven insignificant in either model, explaining that prospects for future income do not affect WTP. On the other hand, it would be reasonable to assume that having bright prospects for future personal income would make some respondents value the scenarios higher as it would be easy to pay back an eventual loan. Regarding the findings, the null hypothesis cannot be rejected.

H48): Importance of saving will affect WTP positively

The variable *saving*, an ordinal variable for how important respondents perceive savings of money is significant for both scenarios in all OLS models. Considering the fact that preventive health risk measures and savings are both initiatives for gaining future benefits, it would be natural to assume attitudes towards savings as significant for explaining variation in WTP. Thus, H48 is true, and the null hypothesis is rejected.

H49): Being married affects WTP positively

The variable *maritalstatus* does correlate with household income, in which probably gives some explanation to why being married is not significant in either model. Regarding this finding, being married does not affect WTP positively. However, one would expect married people to have a higher WTP considering that they, most likely, state their preferences on behalf of their spouse.

H410): Having problems with paying unanticipated expenditures affects WTP negatively

Only in the logarithmic OLS models for the first scenario, revealed that the variable *unexpected* was significant at a five percent level. As the sign of the coefficient is as expected, one can state that having problems with paying unanticipated expenditures, to some degree, affects WTP negatively. Why this variable is only significant for scenario 1, and only in the logarithmic model, is unclear. It is also expected that this variable should make an impact on the second scenario.

H411) Not living in a detached house affects WTP negatively

Not living in a detached house, in this case, means living in townhome, terraced houses, apartments, etc. Respondents not living in a detached house are assumed to have a lower WTP caused by the issue of free riders taking advantage of the indoor measures done by others, or by the diminished dangers of living several floors above the ground. However, the variable *otherresident* was never significant in any of the OLS models, meaning that H411 is not true and not living in a detached house does not affect WTP negatively.

5.8.4 Research question 5: Does risk-averse behavior affect WTP for health risk reductions from radon induced lung cancer prevention?

H51): Being worried that current radon concentration increases the chances of getting lung cancer affects WTP positively

In the logarithmic OLS model the variable *worried* was proved significant in both scenarios. Being worried that current radon concentration increases the chances of getting lung cancer is significant for explaining WTP at a five percent level in scenario 1 and a ten percent level in scenario 2. However, this variable did not prove significant in the linear OLS models. Therefore, the hypothesis H51 is true for the logarithmic OLS models.

H52): A high degree of skin protection at a sunny day in Southern Norway affects WTP positively

H53): A high degree of skin protection at a sunny day somewhere near the equator affects WTP positively

Both H52 and H53 proved to be insignificant in either OLS models. Nevertheless, combining the two questions of sun habits into one variable gave significant results. The variable *averseboth*, combining questions of sun habits in Southern Norway and somewhere near the equator, is positively significant in all regressions, except for scenario 1 in the logarithmic OLS model. However, this is one of the most evident variables revealing risk averse behaviour, and it shows to be significant in explaining the variation WTP, explaining that WTP increases with risk aversion.

H54): Respondents often driving in 20 km/h beyond the speed limit affects WTP negatively

The variables for attitudes towards speeding, both those who are familiar with speeding and those who are not, proved to be insignificant for all models. Assuming speeders to represent risk lovers, and non-speeders to represent risk averse respondents, one would expect these variables to affect WTP in some way. Nevertheless, H54 is not true, and the null hypothesis is not rejected.

5.8.5 Research question 6: Do respondents´ WTP depend on the design of the payment card; i.e. being presented with only lump sums versus both lump sums and monthly payments?

H61): Presented with only lump sums affects WTP in scenario 1 negatively

The variable *rot0te* proved significant in scenario 1 only for the linear OLS model. That is, presented with only lump sums affects WTP in scenario 1 negatively, according to the linear OLS model. One remarkable finding from the analysis is that *rot0te* was never significant for scenario 1 in any log-regression. On the other hand, H61 is true for the linear model.

H62): Presented with only lump sums affects WTP in scenario 2 negatively

Findings from the analysis showed that *rot0te* is partially not significant in explaining WTP for scenario 2. The reason why using the word “partially”, is that *rot0te* was significant in many log-regressions during the elimination process, but came up short when regressing the final models. Also, when significant in the elimination process, the coefficient sign was positive and not as expected. Regarding this finding, one cannot reject the null hypothesis.

5.8.6 Research question 7): What factors determines effects of scope in WTP regarding the two different scenarios?

H71): The level of education positively affects scope in WTP

The variable *education1* was insignificant in the probit models explaining scope effects. This explains that having an education of a higher level than elementary school does not positively affect scope in WTP. Maybe if controlled for those having a level of education beyond high school would give some significant effect, but due to technical difficulties with correlation, such effects were not possible to measure.

H72): Having a job positively affects scope in WTP

Findings suggests that having a job is significant in explaining scope effects in WTP as the variable *job* was significant at a five percent level. Nevertheless, the sign of the coefficient was negative, explaining that having a job affects scope in WTP negatively. Thus, H72 is not true and the null hypothesis cannot be rejected at a five percent level.

H73): Age negatively affects scope in WTP

Through the probit analysis, age is a significant factor explaining effects of scope in WTP. When regressed separately from the variable *economicfuture*, age proved to be significant at a one percent level. The sign of the coefficient was negative, explaining that as age increases the probability of respondents exhibiting scope effect decreases. This is can be caused by the claim that elderly people might perceive mortality risks from both scenarios as insignificant, and by this, is most likely to value them equally or even state a zero value. Regarding the findings, H73 is true.

H74): Importance of saving positively affects scope in WTP

Respondent's attitudes towards saving money have proved to be a significant factor when explaining scope effects in WTP. In the probit regressions, the variable *saving* has proved to be significant at a one percent level and a five percent level respectively. Perceiving savings as important, increases the probability of scope, as the variable *saving* is a measure of preventive behaviour increasing future benefits. One can interpret decreased health risks reduced by radon measures in the same way; the more mortality risk is reduced, the more future benefits increase. Thus, one can reject the null hypothesis, as H74 is true.

H75): Risk-averse behavior positively affects scope in WTP

Considering the fact that the variable *averseboth*, in which is a direct measure of risk averse behavior, does not explain scope effects in WTP, one can state H75 is not true. On the other hand, perception of savings is a significant factor and could be used as a measure for risk averse behaviour, having in mind the preventive economic effects caused by savings. However, this conclusion is a quite easy one, as importance of savings is a rather vague measure of such behaviour. Regarding this, the null hypothesis cannot be rejected.

5.9 Robustness of findings

Both linear and logarithmic OLS models were estimated using the same variables, and the variables explanatory power varied between the models. Socio-economic factors such as gender and education had some explanatory power in explaining the variance in WTP according to the logarithmic model, while being insignificant in the linear model. Also, subjective health status, feeling worried of being exposed to radon, and having problems with paying unexpected expenses were significant factors in explaining WTP in the logarithmic model, while proving not to be in the linear model. On the other hand, being presented to a payment card only screening lump sums, renting out parts of own property, having detected radon in previous household, and having quit smoking for more than 5 years ago proved significant in the linear model, while not being significant in the logarithmic models. However, household income, knowledge of the radon issue, attitudes towards saving, and risk averse behaviour regarding use of sunscreen proved significant for both models. If the linear model is considered as the correct functional form, then some of the findings from the logarithmic model could be questioned and even considered as wrong.

5.10 Limitations of the study

The disadvantages of using internet surveys and some limited research period are considered as the limitations of this study. Regarding the limitations of guidance in understanding the CV-question, using internet surveys one can only hope respondents have enough cognitive knowledge and patience as to read and understand what is being asked. Thus, it is also difficult to know whether respondents answer their true WTP or not, and if they put in the proper degree of seriousness when answering the survey. Having this in mind, rules of thumb regarding the sample selection are hard to interpret. For example, if excluding respondents based on the time spent on answering the survey, assuming those using a relatively short amount of time to be unserious, one might lose data from serious respondents answering the survey quickly. If using in-person interviews, one is able to reveal such respondents.

Another limitation to this study is the amount of time spent on processing the data and doing research. If been able to spend event more time on data processing, more in-depth conclusions could have been drawn. In fact, with such a dataset containing so many variables, further findings are possible. Nevertheless, other researchers have access to the dataset used in this study, enabling extended analyses.

5.11 Validity of this study

To determine whether the study is valid, five tests are suggested; scope test, convergent validity, calibration factors, protest rates and construct validity (Hanley & Barbier, 2009). Regarding the five "tests", three of them have been conducted in this study, whereas the remaining two has not been possible to carry out. Those tests not conducted are the convergent validity test and the calibration factors test. A convergent validity test, i.e. testing whether other non-market valuation methods, like the Choice Experiment method or the Hedonic Prizing method, would have wielded the same results, could not be conducted due to the very limited amount of time. Also, considering time restrictions and resource constraints, testing for calibration factors, i.e. testing for similarities between hypothetical and actual behaviour, has not been done and is beyond the scope of this study. Even though, some of the respondents had done measures to reduce indoor air radon concentration, meaning they had already stated their WTP. Nevertheless, calculating calibration factors are a somewhat hard thing to do because some aspect of the good/evil (radon) that is being evaluated defies market valuation, in which is the reason why a CV study has been carried out.

A scope test, examining whether WTP varies with the quantity of the good offered, has been conducted. As mentioned earlier, the scope test in this study states that WTP increases with increased quantity (reduction in health risk) of the valued good. Regarding testing for the influence of protest rates, excluding "protesters" from the sample only increased the average WTP with about 2.1 – 2.2 percent depending on the scenario. Respondents considered to be "protesters" are the ones stating a zero WTP or valuing both scenarios equally because they think indoor radon measures are of government responsibility. However, these respondents constitute of only a 4.2 percent share of the sample, which is well within the range of what is recommended (a share of 40% is reckoned as too high) (Hanley & Barbier, 2009).

Regarding tests for construct validity, we distinguish between internal and external validity. Internal validity is defined as whether the relationship between WTP and its influential factors are alike theoretical expectations. Except from a few deficiencies, WTP and its influential factors have a relationship between them as theoretically expected. A strong indicator is the fact that WTP increases with income, in which is in line with economic theory and might be highly expected by many. External validity is defined as whether the relationship between WTP and its influential factors is similar to results from other studies regarding the same issue. In this case, the only conducted contingent valuation study about radon, as far as I know, is the one Kennedy (2002) did, comparing revealed preferences with stated preferences elicited from a contingent valuation study. However, Kennedy (2002) did study the WTP for a reduction in radon concentration using the dichotomous choice method, while this study tries to find the WTP for a reduction in the lung cancer risk caused by radon using the open-ended method, in which makes the two studies incomparable. So, any external validity test has not been conducted.

6. Conclusion

6.1 Results

As mentioned in the introduction, there have been five aims to this thesis;

i) Eliciting respondents WTP for the two specific scenarios

ii) Testing for scope between the two scenarios

iii) Identifying the factors explaining households variation in WTP

iv) Calculating the respondents Value of Statistical Life (VSL)

v) Identifying the factors explaining initiatives towards detection measures

Considering the limited amount of valuation studies concerning radon, especially in Norway, this thesis can hopefully serve as a significant contribution to the prevailing literature.

When eliciting WTP for the two specific scenarios, many different estimates have been made, in which ranged from 7757 to 9800 NOK for scenario 1, and 7870 to 10 872 NOK for scenario 2. However, the estimates mostly emphasized are the ones with and without "protest zeros". The estimate including the "protest zeroes" gave a WTP of 9588 NOK for scenario 1 and 9775 NOK for scenario 2. Nevertheless, most models in this study is based on a sample excluding "protesters", in which makes the WTP estimate without "protest zeroes" the most interesting one. This estimate gave a WTP for scenario 1 of 9800 NOK and 9997 NOK for scenario 2. Whether these estimates reflect the true WTP for the population target can be questioned, due to the fact that biases may occur caused by the design of the payment card. Explaining this further, respondents were introduced to a scroll bar with numbers ranging from zero to 36 000 NOK, and if wanting to state a WTP even higher, respondents had to enter their WTP in a squared area. Thus, the design of the payment card could make some respondents bound to set their value somewhere within the range of numbers depicted in the scroll bar, as they perceive valuing within this range as the common norm.

Regarding the two different WTP estimates, these have been tested for scope. From the sensitivity analysis, scope effects were found as the Wilcoxon signed rank sum test proved the difference in WTP between the scenarios to be statistically significant. A reduction in health risk greater than the measurement threshold yields higher WTP. In addition to testing for scope, this study also determines what factors influence scope effects. It seems like being screened for only lump sums increase the probability of wielding scope effects, as being screened with both lump sums and monthly payment might confuse the respondents, increasing the probability of irrational answers. Also, having a job decreases the probability of wielding scope effects, in which is one of the findings with an unexpected outcome and is found difficult to explain. Positive attitudes towards saving and having bright prospects for future income increase the chance of wielding scope effects. However, as age increases, scope effects decreases which is pretty much expected.

In addition to eliciting respondents WTP, this study provides multiple OLS regressions revealing what factors determine households WTP. The three most significant factors increasing WTP are household income, knowledge of the radon issue, and having positive attitudes towards saving. Another factor proved to be almost just as significant, only not for the scenario 1 using the logarithmic OLS models, is the respondents who, at a hot summer day in both Norway and some place near the equator, would be using a high degree of sunscreen. These four variables however, were found significant in both the linear and logarithmic models, concluding that they are the ones explaining most of the variation in WTP. Nevertheless, as the significant variables in the linear and logarithmic OLS models differed to some degree; significance in socio-economic variables was more present in the logarithmic models, as well as being worried of the issue in question. On the other hand, renting out property and having experience with detection in previous resident proved to be more evident in explaining WTP in the linear regressions.

When calculating the VSL, very low estimates were found compared to what has been set as the reference estimate by the Norwegian Fiscal Department. Three conclusions can be drawn regarding such findings; either do respondents discount the VSL due to the latency period involved, or they have stated a WTP on behalf of all persons living in their household, or both. However, when accounting for discounting using a rate of 18 percent, estimates were close to the Fiscal Department’s reference level. Anyhow, the VSL estimates without accounting for respondents discount rate, is 5 429 363 NOK for scenario 1 and 4 575 286 NOK for scenario 2. These estimates were based on a sample excluding “don’t know” answers and “protest zeroes”.

Additional to the other four aims this study sought to solve, an analysis has been conducted revealing what factors explain whether respondents have detected indoor air radon concentration or not. In this analysis, the most significant findings were that knowledge of the radon issue, feeling exposed to radon, and having received radon sensors from local authorities increased the chance of detection. In addition, three factors proved to decrease the probability of detection; being 60 years old or older, not living in a detached house, and having detected concentration in previous residents. One last factor significantly increasing the probability of detection, although only significant to a ten percent level, was respondents acknowledging that they are having some knowledge of doing measures.

6.2 Benefits from findings

Regarding the WTP estimates, these might be found useful for the construction industry and most firms offering and providing radon mitigation measures. Such agents could look at these estimates as consumer's preferences indicating what price range they should set their products at. These estimates also, in which is the purpose of contingent valuations, provides an estimate of the social benefits of mitigation measures to be used in a cost-benefit analysis of e.g. a government program for radon mitigation measures.

Factors explaining WTP, scope effects, and whether respondents have measured indoor air radon concentration or not, are indicators for telling policy-makers and government agencies what are the most effective policy to bolster radon measures. In addition to socio-economic variables and attitudes towards saving, providing information in which increase peoples knowledge of radon is one crucial factor in encouraging preventive behaviour. This has been one of the most present factors throughout the majority of the analyses, indicating that the more government institutions like the NRPA promotes the problem of the issue, typically enough, the more are people likely to do initiatives.

6.3 Recommendations

According to the experience of this study, a CV survey has proved to be an appropriate method for estimating WTP, and identifying the different factors influencing it, in addition to explaining what ermines whether households have measured radon concentrations. . Considering the new rules and regulations implemented from January 1st, 2014, awareness of the issue might increase among the Norwegian population in the years to come. Thus, I would recommend a more in-depth analysis in a few years comparing revealed preferences with stated preferences from a CV study, making more reliable WTP estimates. In addition, an analysis similar to this one is recommended in the years to come as a bigger share of the population might have conducted radon measurements and countermeasures, making it easier to compare WTP of those who have implemented measures and those who have not. As the knowledge and awareness of the issue increases, a study revealing what determines whether some parts of the population chooses to live in areas with risk of high indoor air radon concentrations while others do not could be interesting to implement in order to explain different attitudes towards risks.

Such studies mentioned above, would provide the NRPA and other government agencies with useful information when implementing new rules and regulations. However, it is difficult to standardize rules and regulations as costs of mitigating indoor air radon concentration varies significantly with the ground concentration levels occurring in the different areas, which most often determines household's indoor concentration.

References

Alberini, A., Cropper, M., Krupnick, A., & Simon, N. B. (2004). Does the value of a statistical life vary with age and health status? Evidence from the US and Canada. *Journal of Environmental Economics and Management, 48*(1), 769-792.

Arrow, K., Solow, R., Portney, P. R., Leamer, E. E., Radner, R., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation: National Oceanic and Atmospheric Administration Washington, DC.

Ben-Akiva, M., Bradley, M., Morikawa, T., Benjamin, J., Novak, T., Oppewal, H., & Rao, V. (1994). Combining revealed and stated preferences data. *Marketing Letters, 5*(4), 335-349.

Boardman, A. E. (2011). *Cost-benefit analysis: concepts and practice*. Boston: Prentice Hall.

Carson, R. T., Flores, N. E., & Meade, N. F. (2001). Contingent valuation: controversies and evidence. *Environmental and resource economics, 19*(2), 173-210.

Carson, R. T., & Mitchell, R. C. (2006). 19 Public preferences toward environmental risks: the case of trihalomethanes. *Handbook on contingent valuation*, 394.

Corporation, S. (2013). *Stata reference manual: release 13*: Stata Corporation.

Darby, S., Hill, D., Deo, H., Auvinen, A., Barros-Dios, J. M., Baysson, H., . . . Figueiras, A. (2006). Residential radon and lung cancer—detailed results of a collaborative analysis of individual data on 7148 persons with lung cancer and 14 208 persons without lung cancer from 13 epidemiologic studies in Europe. *Scandinavian journal of work, environment & health*, 1-84.

Eckel, C. C., & Grossman, P. J. (2008). Men, women and risk aversion: Experimental evidence. *Handbook of experimental economics results, 1*(7), 1061-1073.

Finansdepartementet. (2014). *Prinsipper og krav ved utarbeidelse av samfunnsøkonomiske analyser mv.* (R-109/14).

Halvorsen, B., & Sœlensminde, K. (1998). Differences between willingness-to-pay estimates from open-ended and discrete-choice contingent valuation methods: the effects of heteroscedasticity. *Land Economics*, 262-282.

Hammitt, J. K., & Zhou, Y. (2006). The economic value of air-pollution-related health risks in China: a contingent valuation study. *Environmental and resource economics, 33*(3), 399-423.

Hanemann, W. M. (1994). Valuing the environment through contingent valuation. *The Journal of Economic Perspectives*, 19-43.

Hanley, N., & Barbier, E. B. (2009). *Pricing nature: cost-benefit analysis and environmental policy*. Cheltenham: Edward Elgar.

Kennedy, C. A. (2002). Revealed preference valuation compared to contingent valuation: radon-induced lung cancer prevention. *Health Economics, 11*(7), 585-598.

Mitchell, R. C., & Carson, R. T. (1989). *Using surveys to value public goods: the contingent valuation method*: Resources for the Future.

Navrud, S. (2014, April 24th). [Personal correspondence with supervisor].

Pearce, D., & Özdemiroğlu, E. (2002). *Economic valuation with stated preference techniques: summary guide*: Department for Transport, Local Government and the Regions.

Perman, R. (2003). *Natural resource and environmental economics*: Pearson Education.

Ready, R. C., Navrud, S., & Dubourg, W. R. (2001). How do respondents with uncertain willingness to pay answer contingent valuation questions? *Land Economics, 77*(3), 315-326.

Schubert, R., Brown, M., Gysler, M., & Brachinger, H. W. (1999). Financial decision-making: are women really more risk-averse? *American Economic Review*, 381-385.

Smith, V. K. (1996). *Estimating economic values for nature: Methods for non-market valuation*: Edward Elgar Publishing.

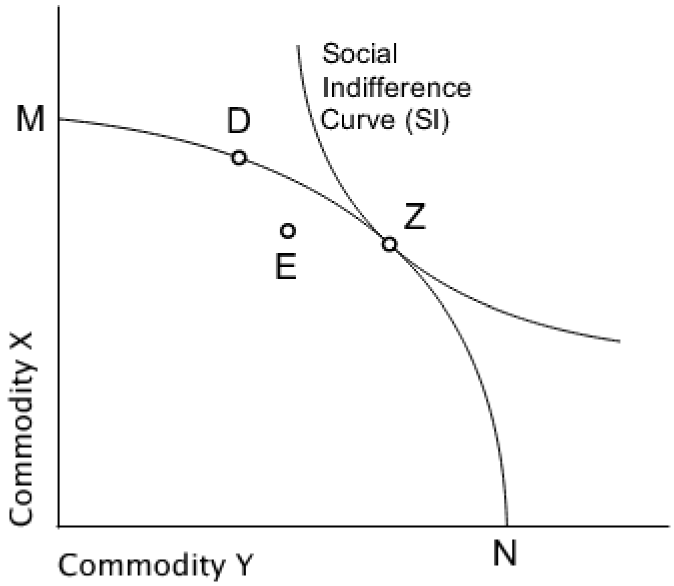
Strand, T., Lunder Jensen, C., Ramberg, G. B., Ruden, L., & Ånestad, K. (2003). *Kartlegging av radon i 44 kommuner 2003. Kort presentasjon av resultatene*. www.nrpa.no: Statens strålevern.
Strand, T., Ånestad, K., Ruden, L., Ramberg, G. B., Lunder Jensen, C., Heiberg Wiig, A., & Thommesen, G. (2001). *Kartlegging av radon i 114 kommuner. Kort presentasjon av resultater*. www.nrpa.no: Statens strålevern.
Strålevern, S. (2014a). Anbefalte grenseverdier for radon. Retrieved 22.01, 2014, from http://www.nrpa.no/fakta/89990/anbefalte-grenseverdier-for-radon
Strålevern, S. (2014b). Helserisiko. Retrieved 20.01, 2014, from http://www.nrpa.no/fakta/89866/helserisiko
Strålevern, S. (2014c, 22.01.2014). Om radon. Retrieved 22.01, 2014, from http://www.nrpa.no/fakta/89991/om-radon
UK, C. R. (2012). Lung cancer survival statistics. Retrieved June 26th, 2012, from http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/survival/lung-cancer-survival-statistics#one
Varian, H. R. (2006). *Intermediate microeconomics: a modern approach*. New York: W.W. Norton & Co.
Viscusi, W. K., & Aldy, J. E. (2003). The value of a statistical life: a critical review of market estimates throughout the world. *Journal of risk and uncertainty, 27*(1), 5-76.
WHO. (2009). *WHO handbook on indoor radon: a public health perspective*: World Health Organization.
Willis, K. G., & Corkindale, J. T. (1995). *Environmental valuation: new perspectives*: Cab International.
Wooldridge, J. M. (2009). *Introductory econometrics: a modern approach*. Mason, Ohio: South-Western Cengage Learning.

Appendix A: Economic Theory

Appendix A.1: Explaining efficiency

Efficiency in allocation requires three conditions to be fulfilled; efficiency in consumption, efficiency in production and efficiency in product-mix (Perman, 2003). When the marginal rate of utility substitution is equal among all market agents, efficiency in consumption is achieved. Then, any reallocation of resources involves decreasing utility for at least one agent. Efficiency in production requires the marginal rate of technical substitution to be equal for production of all commodities in a market. If this condition is not satisfied, then production of one good can be increased without producing less of other goods. For efficiency in the product-mix, marginal rates of utility substitution have to be equal among all market agents, in which also have to equal all market agents' marginal rates of technical substitution.

Figure A. 1. Efficiency in the product-mix

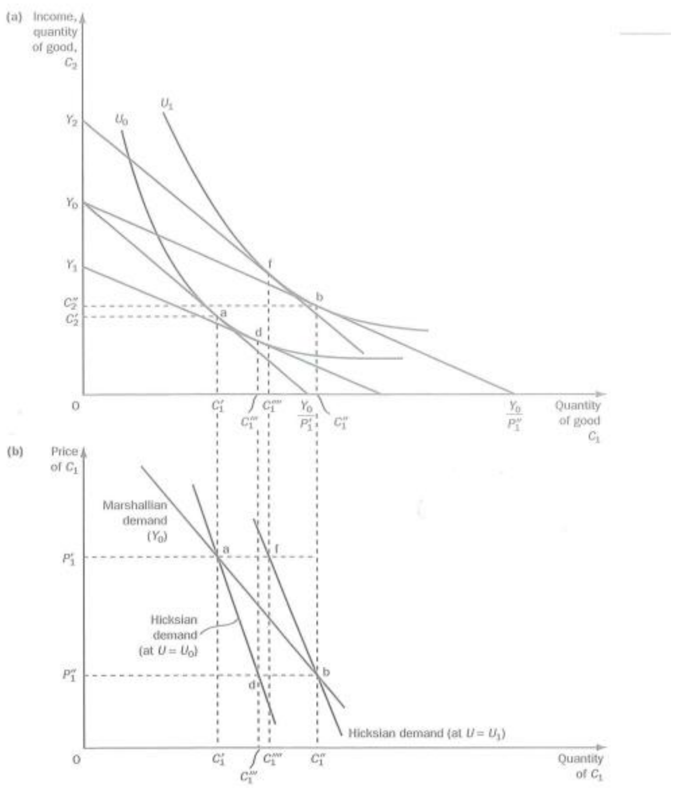


In the graph above, efficiency in product-mix is illustrated. The point where the social indifferent curve is tangent to the production possibility frontier, at point Z, corresponds to a product-mix where the utility of the representative individual is maximized. Any movement away from point Z, given fixed resources available, must mean moving to a point on a lower indifference curve in which gives a lower utility (Perman, 2003).

Appendix A.2: Compensating Variation & Equivalent Variation

Picture a scenario where a consumer is initially consuming at point “a” = (C_1^a, C_2^a) at an indifference curve with utility U^0, given the prices (p_1^a, p_2^a) and income Y^0. If we interpret this specific thesis into the situation in hand, C_1 would be indoor air quality and p_1 would be the price paid for such a bad air quality, point *a* would be the utility of having indoor radon concentration of 400 Bq/m^3 - a state where the risk of dying from lung cancer is relatively high, as well as the spending on detecting and mitigating it. Suppose for instance, air quality can be improved which is equivalent to lowering p_1^a to p_1^b in which changes the consumption pattern to point *b* = (C_1^b, C_2^b), giving a new indifference curve with the utility U^1. This is illustrated in the figure below.

Figure A.2. The relationship between CV´and EV´, and Marshallian and Hicksian demand



This raise the question; how much better off is the consumer when consuming at point *b* instead of *a*, that is, how much better off is the consumer if indoor air quality is improved? To answer this one might try to find out how much income the consumer needs to be compensated with, as to consume the bundle *a* with the same utility as at point *b*. This leads to a parallel shift of the budget line at point *b* to the indifference curve U^0. The point where the parallel budget line is the tangent of U^0 makes the point *d*, in which is a consumption bundle that gives the same utility as the initial bundle at point *a*. The income difference between *d* and *b* is the maximum amount the consumer would be willing to pay for the right to face the improved air quality in *b*. This is the compensated variation.

$$CV = Y^1(C_1^d,C_2^d) - Y^0(C_1^b,C_2^b)$$

Now, consider another question; how much income would this consumer need to be as well off with the initial air quality, as with the improved quality in point *b?* The answer is to parallel shift the initial budget line right towards indifference curve U^1. The point where it is tangent to U^1 gives *f*, a point in which the consumer is indifferent to the two consumption bundles at *b* and *f*. The additional income needed to have the same utility with the bundle at point *a* as with the bundle at point *f*, is what the consumer needs to be bribed to accept lower air quality in *a*.

$$EV = Y^2(C_1^f,C_2^f) - Y^0(C_1^a,C_2^a)$$

This can also be explained as compensating variation for a rise in price.

Considering the Marshallian and the Hicksian demand functions, they both differ in the way they deal with these two effects. Holding both income and other prices constant, the Marshallian demand shows how the air quality varies with p_1 (Perman, 2003). This is the standard demand function presented in most of the microeconomic literature. The Hicksian demand also shows the relationship between the air quality and its price, but it holds utility and all other prices constant. As it holds utility constant, it gives two demand functions; one for U_1 and one for U_0.

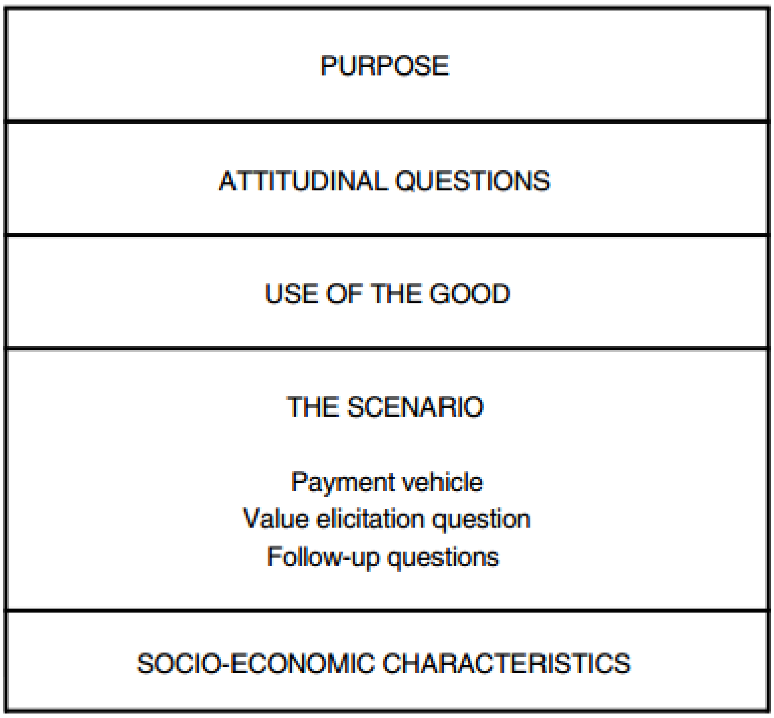
Appendix A.3: Survey design

Pearce and Özdemiroğlu (2002) argue that the structure of the survey should take the form of the figure shown below, and the structure and its different steps will now be explained from their point of view.

Purpose of the survey

Stating the purpose of the survey is essential, as to ensure that respondents understand the context, and are cooperating and participating in an informed manner. In this specific survey, this will mean telling the respondents why they should answer the survey, and to what extent it is important to society.

Figure A. 3. Main contents of a CV-survey



Attitudinal questions

As shown in the figure above, after presenting the purpose of the study, attitudinal questions should be given as to seek the respondents' attitudes towards general issues concerning the good. Questions like "which of the following problems do you regard as the most important for government policy" or "which of the following statements about Forest X do you strongly agree, agree, are indifferent, disagree, or strongly disagree with" are proper questions revealing attitudes towards a subject.

Use of the good

The next stage is to determine the specific problem, good or service in question. Determination of what use the respondent makes of the good is important to test their familiarity with it, and in some cases, distinguish users from non-users. It can also reveal the knowledge about the subject in question and to what sources existing knowledge comes from.

The Valuation Scenario

As the respondent is ought to elicit s/he's WTP, a valuation scenario have to be introduced. The valuation scenario needs to define the good in question and the consequences of a change in the provision of that good. From this specific information, a scenario is made up in which the respondents will value. Also, several scenarios can be presented, but it should be handled with care as survey respondents might get confused about what they are being asked to value. Poorly designed scenarios will, in worst cases, give meaningless answers in which makes a good description of the scenario critical. The scenario defines the problem and who is responsible for improvement, and who bares the cost. It is important that the consequences of the problem in question are believed, and that measures done to cope with the problem are presented in a way that makes the scenario credible. Also, the WTP question should be formed in a way as to avoid strategic behavior. Respondents in CV surveys often have intentions to answer strategically, in which they misrepresent their true preferences in order to achieve a more desirable outcome than if they reveal their true preferences (Boardman, 2011).

In WTP scenarios a payment vehicle is used which in case describes the way a respondent is hypothetically supposed to pay for the improvement.

When eliciting valuations in such a survey, the question in hand is designed to draw out respondent's willingness to trade goods or impacts for money. In the procedure it is very important to elicit the *maximum* WTP in order to be consistent with the underlying economic theory of valuation. In choosing the different elicitation formats, one has to be concise about what one wants to measure as different elicitation formats produce different estimates. Considering the options available, Pearce and Özdemiroğlu (2002) argue that an open-ended elicitation question with payment card is both very informative and cheap compared to other methods. Open-ended questions are also straightforward and it does not result in any anchoring bias as it does not give respondents any cues about what the value of a change might be. They are also very informative as it identifies each respondents maximum WTP, and it requires relatively straightforward econometric techniques. The problems with open-ended elicitation are that it leads to large non-response rates, protest answers, zero answers and outliers. The reason is that it is often very difficult for respondents' to reveal their true maximum WTP for a change they have never thought of valuing before or in which they are unfamiliar with. Also, the notion of stating a maximum WTP is a somewhat very unusual way of stating preferences, as most people are used to market transactions involving a decision on whether or not to buy a certain good given its fixed price. On the other hand, payment cards provide a context to the bids, without resulting in any anchoring bias. It can also reduce outliers as it provides numbers within a realistic interval, in which outliers just state their WTP above the interval without giving it a number. Some payment cards also give values that relate to actual household expenditures or taxes, and serve as benchmarks. However, payment cards are vulnerable to biases considering the range of numbers used in the card. Also, it is not very comprehensive to use in telephone interviews.

Anyhow, the respondents need to be reminded of the different substitutes, or compare the changes of the good in question with changes in other similar goods. This can have implications for the value given in the eliciting process. Also, an implicit reminder of the budget constraints and the consequences of stating a value as it will make less resources available for purchasing other goods.

Follow-up Questions

It is important to have follow-up questions to the answers of the WTP elicitation process, in order to understand the motives behind the very different answers. When there is some form of protest or unwillingness to pay, follow-up questions are especially useful. Note that zero valuations do not implicitly have to be protests, it can also happen to be that respondents simply do not have a willingness to pay anything for the change. The credibility of the scenario can also be tested in such follow-up questions. When asking about their interest of the subject in hand, about the need for public consultations and about the credibility of the institution charged with providing the good, the validity of the scenario gets tested.

Socio-economic Questions

At the end of the survey, questions about the respondents' socio-economic characteristics should be asked. Information from such questions is used to test the theoretical expectations regarding their WTP answers. Age, sex, interests, income, and education are the minimum of factors needed to be asked in this section. Some other questions relevant to this issue are to ask about nationality and the status of their health.

Appendix B: English Questionnaire

Intro

Thank you for participating in this survey. It will take you approximately 15-20 minutes answering all questions.

It is of utmost importance that you are being honest and put in the proper amount of effort while answering these questions. There are no right or wrong answers, we only want to know what you think. The results from this survey might help to inform authorities about people's preferences towards health- and environmental issues, and that is why your answers are important. For this study to make a representative image of the population, it is important that everyone being asked answers the questionnaire.

ALL ANSWERS ARE CONFIDENTIAL AND WILL ONLY BE PRESENTED AS AVERAGE NUMBERS. YOUR IDENTITY WILL BE KEPT HIDDEN, AND THE ANSWERS CAN NOT BE TRACED.

County distribution among respondents:

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Finnmark	1 %	1 %	1 %
Troms	3 %	2 %	3 %
Nordland	3 %	3 %	3 %
Nord-Trøndelag	1 %	1 %	2 %
Sør-Trøndelag	1 %	1 %	1 %
Møre og Romsdal	0 %	0 %	1 %
Sogn og Fjordane	0 %	1 % B	
Hordaland	2 %	4 % B	1 %
Rogaland	6 %	6 %	7 %
Vest-Agder	1 %	1 % B	0 %

Aust-Agder	1 %	1 %	1 %
Telemark	4 %	4 %	4 %
Vestfold	5 %	5 %	6 %
Buskerud	14 %	15 %	14 %
Oppland	6 %	6 %	6 %
Hedmark	10 %	12 % B	7 %
Østfold	21 %	20 %	23 %
Akershus	10 %	9 %	11 %
Oslo	8 %	8 %	8 %
TOTAL	97 %	100 %	99 %

Age distribution among respondents:

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
15-29	14 %	9 %	21 % A
30-39	14 %	13 %	15 %
40-49	17 %	17 %	18 %
50-99	54 %	61 % B	46 %
TOTAL	99 %	100 %	100 %

What is your gender?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Male	54 %	100 % B	
Female	46 %		100 % A

TOTAL	100 %	100 %	100 %

Question 1) Do you think the government should use much more, more, the same as now, less or much less resources on the following problems?

1) Improving Health Care

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Much more	41 %	36 %	46 % A
More	42 %	41 %	42 %
The same as now	15 %	19 % B	11 %
Less	1 %	2 % B	
Much less	1 %	1 % B	0 %
Don’t know	1 %	1 %	1 %
TOTAL	101 %	100 %	100 %

2) Reduce the level of indoor radon concentration

		KJØNN	
	TOTAL	Mann	Kvinne
		A	B
BASE	751	404	347
Much more	7 %	6 %	8 %
More	27 %	25 %	29 %
The same as now	46 %	49 % B	41 %
Less	6 %	8 % B	4 %
Much less	4 %	6 % B	2 %
Don’t know	11 %	6 %	16 % A
TOTAL	101 %	100% %	100 %

3) Mitigate greenhouse gas emissions

	TOTAL	KJØNN Mann	KJØNN Kvinne
		A	B
BASE	751	404	347
Much more	22 %	19 %	26 % A
More	35 %	34 %	36 %
The same as now	29 %	31 %	27 %
Less	6 %	7 %	4 %
Much less	5 %	7 % B	2 %
Don’t know	3 %	1 %	5 % A
TOTAL	100 %	99 %	100 %

4) Mitigate local emissions

	TOTAL	KJØNN Mann	KJØNN Kvinne
		A	B
BASE	751	404	347
Much more	18 %	16 %	19 %
More	41 %	40 %	41 %
The same as now	31 %	32 %	31 %
Less	4 %	6 % B	2 %
Much less	2 %	3 % B	1 %
Don’t know	4 %	2 %	7 % A
TOTAL	100 %	99 %	101 %

5) Improving national emergency preparedness against radioactive fallout from nuclear accidents abroad

	TOTAL	KJØNN Mann	KJØNN Kvinne
		A	B

BASE	751	404	347
Much more	13 %	12 %	15 %
More	26 %	25 %	26 %
The same as now	40 %	43 %	37 %
Less	5 %	7 % B	2 %
Much less	3 %	4 %	2 %
Don’t know	13 %	8 %	18 % A
TOTAL	100 %	99 %	100 %

Question 2) Have you ever heard of radon gas?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	750	404	346
No	4 %	2 %	6 % A
Yes	96 %	98 % B	94 %
TOTAL	100 %	100 %	100 %

Question 3) To what degree do you mean you are exposed to radon gas in your present resident?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Not exposed	37 %	41 % B	33 %
Slightly exposed	25 %	28 %	22 %
Quite exposed	6 %	6 %	5 %
Very exposed	2 %	2 %	2 %
Don´t know	30 %	23 %	38 % A
TOTAL	100 %	100 %	100 %

Question 4) Do you own or rent your current residence?

	TOTAL	GENDER Male	GENDER Female
		A	B
BASE	751	404	347
Own	89 %	91 %	88 %
Rent	11 %	9 %	12 %
TOTAL	100 %	100 %	100 %

Question 5) Are you worried that radon concentration in your current residence leads to increased risk of getting lung cancer?

	TOTAL	KJØNN Mann	KJØNN Kvinne
		A	B
BASE	751	404	347
No	74 %	77 % B	70 %
Yes	13 %	13 %	12 %
Don't know	14 %	11 %	18 % A
TOTAL	101 %	101 %	100 %

Question 6) Do you have any knowledge of how to measure indoor air radon concentration?

	TOTAL	GENDER Male	GENDER Female
		A	B
BASE	751	404	347
No	35 %	28 %	42 % A
Yes	65 %	72 % B	58 %
TOTAL	100 %	100 %	100 %

Question 7) To what degree does this claim suit you? "I know what kind of measures to implement in reducing indoor air radon concentration".

	TOTAL	GENDER Male	GENDER Female
		A	B
BASE	751	404	347
Strongly agree	13 %	17 %	9 %

		B	
Fairly agree	32 %	38 % B	26 %
Neither agree or disagree	24 %	22 %	26 %
Fairly disagree	16 %	14 %	18 %
Strongly disagree	15 %	9 %	21 % A
TOTAL	100 %	100 %	100 %

Question 8) What kind of measures in mitigating indoor radon concentration do you know about?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Pressure release in the building foundation under the household	17 %	20 % B	12 %
Sealing pipes and cracks in building concrete, in addition to exterior walls attached in contact with the ground	43 %	55 % B	30 %
Radon webs	39 %	51 % B	26 %
Increased ventilation/air renewal	60 %	69 % B	50 %
Balanced ventilation (thinning of radon concentration)	25 %	30 % B	19 %
Radon well	12 %	17 % B	6 %
Other measures; what kind:	1 %	1 %	1 %
Do not know about any measures	25 %	15 %	36 % A
TOTAL	222 %	258 %	180 %

Question 9) Have you gathered information about how indoor air radon concentration can affect health?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No	37 %	31 %	43 % A
Yes, through news papers	31 %	34 %	28 %

Yes, through television and radio channels	25 %	29 % B	20 %
Yes, through the internet	16 %	18 %	14 %
Yes, through written information published by local authorities	16 %	21 % B	10 %
Yes, through informations sessions	2 %	1 %	2 %
Yes, other kinds; specify:	6 %	7 %	5 %
TOTAL	133 %	141 %	122 %

Question 10) Have you received an offer from local authorities regarding detection of indoor air radon concentration?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No	66 %	67 %	64 %
Yes	17 %	17 %	16 %
Don’t know	18 %	16 %	20 %
TOTAL	101 %	100 %	100 %

Question 11) Have you detected indoor air radon concentration in your current resident?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No	75 %	72 %	78 %
Yes	25 %	28 %	22 %
TOTAL	100 %	100 %	100 %

If yes, respondents proceed to question 12. Otherwise, respondents proceed to question 14

Question 12) What was the average radon concentration detected at the lowest floor in your current resident?

	TOTAL	KJØNN Mann	Kvinne
		A	B
BASE	190	112	78
Bq/m3 (Becquerel per cubic meter of indoor air)	24 %	30 % B	15 %
Don't remember exactly	76 %	70 %	85 % A
TOTAL	100 %	100 %	100 %

Question 12b) If you don't remember exactly, which of the following intervals did you find it in?

	TOTAL	GENDER Male	Female
		A	B
BASE	144	78	66
0-50	17 %	18 %	17 %
51-100	13 %	17 %	9 %
101-150	8 %	8 %	9 %
151-200	3 %	5 %	2 %
201-400	3 %	4 %	2 %
401-600	1 %	3 %	
601-800	1 %	1 %	
801-1000	1 %		2 %
Greater than 1000; specify roughly how much, if possible:			
Don't know	52 %	45 %	61 %
TOTAL	99 %	101 %	102 %

Question 13a) Approximately, how much did you pay for the detection?

	TOTAL	GENDER Male	Female
		A	B
BASE	190	112	78

0 NOK	27 %	24 %	32 %
100 NOK			
200 NOK	4 %	6 % B	1 %
300 NOK	9 %	12 %	6 %
400 NOK	7 %	10 %	4 %
500 NOK	6 %	6 %	6 %
600 NOK	2 %	3 %	1 %
700 NOK	1 %	1 %	1 %
800 NOK	2 %	2 %	1 %
900 NOK	1 %	2 %	
1000 NOK	3 %	4 % B	
Greater than 1000 NOK	6 %	7 %	5 %
Don’t know	31 %	23 %	41 % A
TOTAL	99 %	100 %	98 %

Question 13b) Were results from detection above the recommended measurement threshold, where measures to mitigate indoor concentration should be implemented as to not impose serious health risk?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	190	112	78
No	72 %	73 %	71 %
Yes	18 %	17 %	21 %
Don’t know	9 %	10 %	9 %
TOTAL	99 %	100 %	101 %

Question 14) Have you done any measures as to reduce indoor air radon concentration?

		GENDER	
	TOTAL	Male	Female

		A	B
BASE	751	404	347
No	83 %	84 %	82 %
Yes	11 %	13 % B	8 %
Don't know	6 %	3 %	9 % A
TOTAL	100 %	100 %	99 %

If yes, respondents proceeded to question 15. Otherwise, they proceeded to question 17.

Question 15) What kind of measures did you do? (You can mark more than one alternative in this question)

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	80	51	29
Pressure release in the building foundation under the household	15 %	18 %	10 %
Sealing pipes and cracks in building concrete, in addition to exterior walls attached in contact with the ground	24 %	22 %	28 %
Radon webs	28 %	33 %	17 %
Increased ventilation/air renewal	48 %	43 %	55 %
Balanced ventilation (thinning of radon concentration)	28 %	29 %	24 %
Radon well	8 %	10 %	3 %
Other measures; what kind:	6 %	8 %	3 %
Do not know about any measures	6 %	4 %	10 %
TOTAL	163 %	167 %	150 %

Question 16) Approximately, how much did your household pay for the measures?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	80	51	29
0 NOK	12 %	14 %	10 %

100 NOK			
200 NOK			
300 NOK			
400 NOK			
500 NOK	2 %	2 %	3 %
600 NOK			
700 NOK			
800 NOK			
900 NOK	1 %	2 %	
1000 NOK	1 %	2 %	
1500 NOK			
2000 NOK	2 %	2 %	3 %
2500 NOK	1 %	2 %	
3000 NOK	1 %	2 %	
3500 NOK			
4000 NOK	2 %	4 %	
4500 NOK			
5000 NOK	4 %	2 %	7 %
6000 NOK	1 %	2 %	
7000 NOK			
8000 NOK	1 %	2 %	
9000 NOK	2 %	2 %	3 %
10.000 NOK	1 %	2 %	
More than 10.000 NOK	26 %	29 %	21 %
Don’t know	39 %	31 %	52 %
TOTAL	96 %	100 %	99 %

Question 17) Did your household detect indoor air radon concentration in your previous resident?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
No	73 %	75 %	72 %
Yes	5 %	5 %	4 %
Don’t know	8 %	5 %	10 % A
Not relevant. This is my first resident.	14 %	15 %	14 %
TOTAL	100 %	100 %	100 %

If yes, respondents proceeded to question 18. Otherwise, they proceeded to question 19

Question 18) Were results from detection above the recommended measurement threshold, where measures to mitigate indoor concentration should be implemented as to not impose serious health risk?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	34	20	14
No	79 %	85 %	71 %
Yes	15 %	10 %	21 %
Don’t know	6 %	5 %	7 %
TOTAL	100 %	100 %	99 %

Question 19) Did your household do any measures as to reduce indoor air radon concentration in previous household?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	585	321	264
No	97 %	98 %	97 %
Yes	1 %	1 %	2 %

Don't know	1 %	1 %	2 %
TOTAL	99 %	100 %	101 %

If yes, respondents proceeded to question 20. Otherwise, they proceeded to question 21a

Question 20a) What kind of measures did you do? (You can mark more than one alternative in this question)

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	8	3	5
Pressure release in the building foundation under the household	12 %		20 %
Sealing pipes and cracks in building concrete, in addition to exterior walls attached in contact with the ground	25 %	33 %	20 %
Radon webs	25 %	67 % B	
Increased ventilation/air renewal	38 %	33 %	40 %
Balanced ventilation (thinning of radon concentration)	12 %	33 %	
Radon well			
Other measures; what kind:			
Do not know about any measures	25 %		40 %
TOTAL	137 %	166 %	120 %

Question 20b) Approximately, how much did your household pay for the measures?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	8	3	5
0 NOK	25 %	33 %	20 %
100 NOK			
200 NOK			
300 NOK	12 %		20 %
400 NOK			

500 NOK	12 %		20 %
600 NOK			
700 NOK			
800 NOK			
900 NOK			
1000 NOK			
1500 NOK			
2000 NOK			
2500 NOK			
3000 NOK			
3500 NOK			
4000 NOK			
4500 NOK			
5000 NOK			
6000 NOK			
7000 NOK			
8000 NOK			
9000 NOK			
10000 NOK			
Over 10.000 NOK	25 %	33 %	20 %
Don’t know	25 %	33 %	20 %
TOTAL	99 %	99 %	100 %

Question 21a) Do you smoke?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No, I have never even tried	48 %	45 %	53 % A

No not now, but I quit smoking on a daily basis more than 5 years ago	23 %	27 % B	17 %
No not now, but I quit smoking on a daily basis less than 5 years ago	6 %	7 %	5 %
No not now, but I quit smoking every once in a while more than 5 years ago	3 %	2 %	5 % A
No not now, but I quit smoking every once in a while less than 5 years ago	1 %	0 %	2 % A
Yes, on a daily basis	13 %	13 %	12 %
Yes, every once in a while	6 %	5 %	6 %
TOTAL	100 %	99 %	100 %

If yes, respondents proceeded to question 21b. Otherwise, they proceeded to question 22a.

Question 21b) Have you planned to quit smoking by this year (2014)?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	139	74	65
No	30 %	38 % B	22 %
Yes	38 %	35 %	42 %
Don't know	32 %	27 %	37 %
TOTAL	100 %	100 %	101 %

Question 22a) Radon is an invisible, tasteless and odorless gas, present in bedrock seeping in to households. Many of the Norwegian households are located in areas where radon concentration is high, increasing the probability of having indoor air radon concentrations inducing lung cancer. Did you know radon causes lung cancer?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No	26 %	19 %	34 % A
Yes	74 %	81 % B	66 %

TOTAL	100 %	100 %	100 %

Question 22b) The Norwegian Radiation Protection Agency (NRPA) recommends indoor air radon concentration to be below an annual mean of 100 Bq/m^3. If radon levels exceed 100 Bq/m^3 implicit measures mitigating concentration should be implemented. Even if indoor air radon concentration is below 100 Bq/m^3, it can still impose lung cancer. Thus, the NRPA prefer implementing measures to reduce concentration as far as possible. Did you have any knowledge of the measurement threshold of 100 Bq/m^3?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No	74 %	69 %	81 % A
Yes	26 %	31 % B	19 %
TOTAL	100 %	100 %	100 %

Question 22 info) The risk of getting lung cancer when having an indoor radon concentration of 100 Bq/m^3 is 48 of 10 000. That is, if 10 000 people were exposed to such a level of indoor air radon concentration through a lifetime, it would cause 48 lung cancer incidents. To be exposed to secondhand smoking through a lifetime imposes the same health risk. On the other hand, if one smokes, the risk of getting lung cancer is 1 010 in 10 000.

Note that 95% of those being diagnosed with lung cancer, dies within 10 years.

Imagine that you own your current resident, and that indoor air radon concentration is 400 Bq/m^3. The probability of getting lung cancer will then be 67 in 10 000.

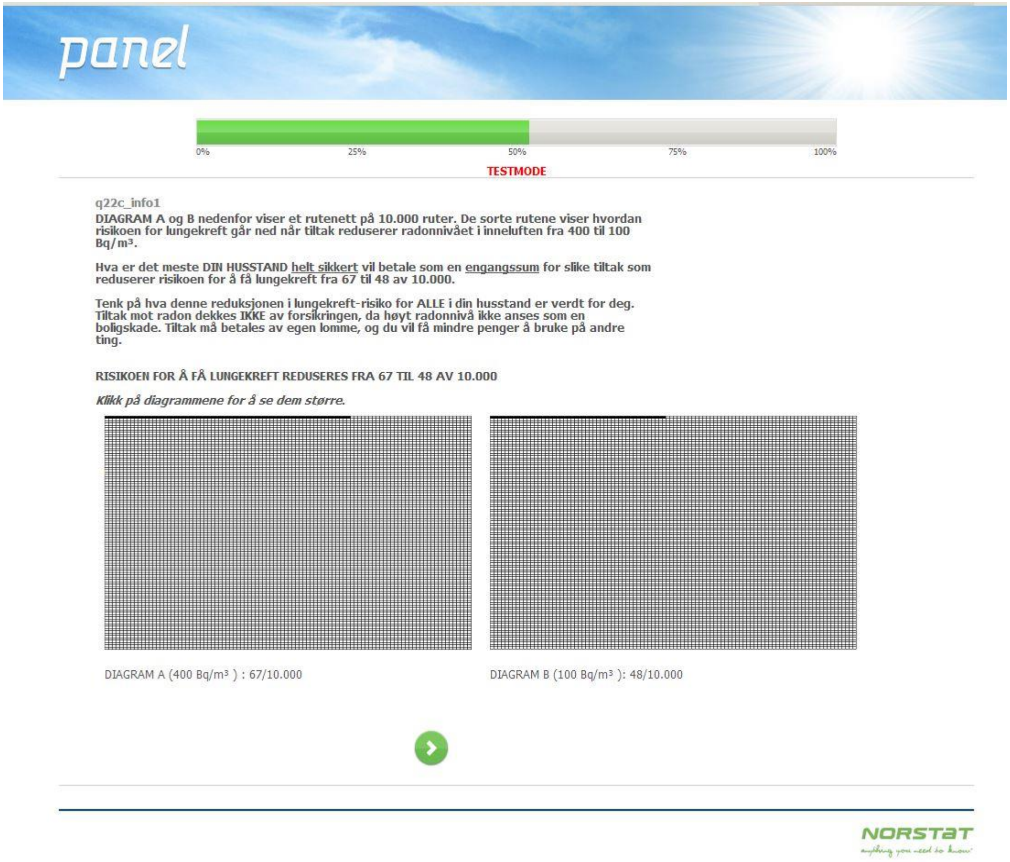
In the following, you will be asked value radon initiatives reducing your indoor air radon concentration down to 100 Bq/m^3 and further down to 50 Bq/m^3 respectively.

Below, both DIAGRAM A and B depicts a grid of 10 000 squares. The black squares shows how lung cancer risk is reduced if implementing initiatives reducing indoor concentration from 400 Bq/m^3 to 100 Bq/m^3.

What is the biggest amount YOUR HOUSEHOLD is willing to pay as a lump sum for such a reduction reducing the risk of getting lung cancer from 67 to 48 in 10 000.

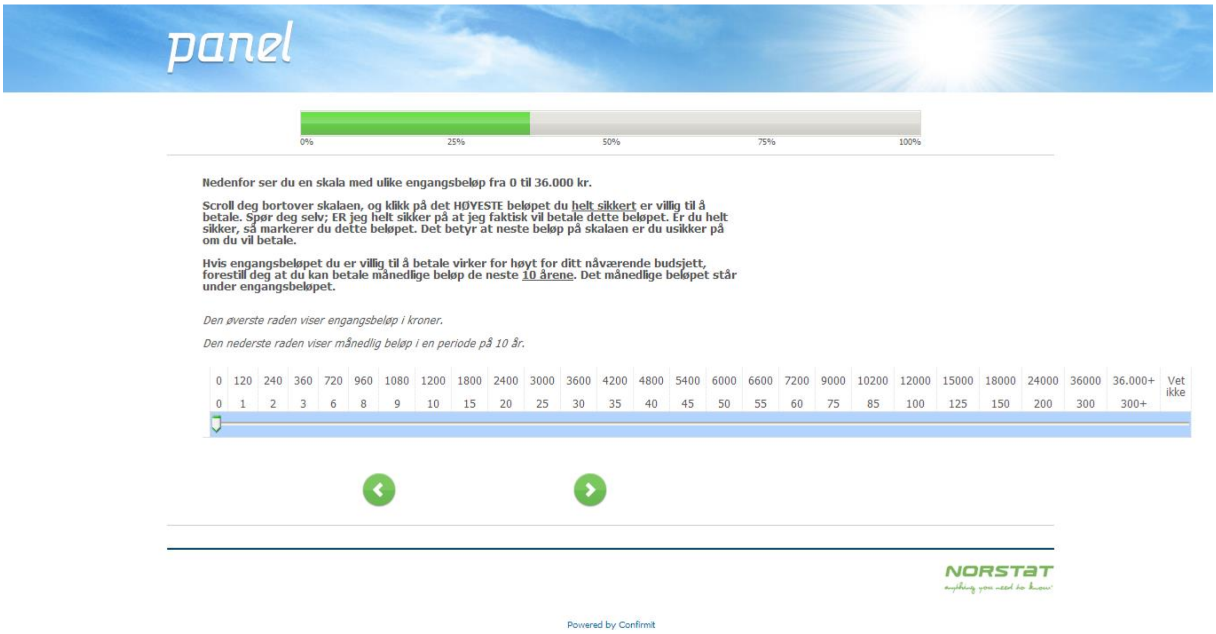
Think of what this risk reduction in lung cancer risk for EVERYONE in your household is worth for you. Costs of radon initiatives are not covered by insurance companies, as a high level of indoor air radon concentration is not perceived as a damage of the household. Such initiatives have to be paid by your own income, resulting in less money to spend on other goods.

REDUCTION IN LUNG CANCER RISK FROM 67 TO 48 IN 10 000:



Question 22c_1) (Screened with both lump sums and monthly payments) Below you can see a scale with different lump sums from 0 to 36 000 NOK. Scroll your way along the scale, and click on the highest amount you truly are willing to pay. Ask yourself; am I truly sure this is what I am willing to pay. If you are sure, mark this amount. This means that you are unwilling to pay any amount higher than this. If the lump sum you are willing to pay seems too high regarding your current budget, imagine that you can monthly pay monthly amounts the next ten years. The monthly amounts are found below the lump sums.

Respondents got screened with this scroll bar in all WTP scenarios:



	TOTAL	GENDER	
		Male	Female
		A	B
BASE	371	191	180
0 (0)	8 %	9 %	6 %
120 (1)	8 %	9 %	7 %
240 (2)	2 %	2 %	2 %
360 (3)	5 %	5 %	4 %
720 (6)	1 %	2 %	1 %
960 (8)	3 %	2 %	4 %
1080 (9)	4 %	5 %	3 %
1200 (10)	4 %	3 %	4 %
1800 (15)	3 %	1 %	5 % A
2400 (20)	2 %	3 %	2 %
3000 (25)	6 %	6 %	7 %
3600 (30)	1 %	1 %	1 %
4200 (35)	0 %	1 %	
4800 (40)	2 %	3 %	2 %
5400 (45)	3 %	3 %	3 %

6000 (50)	8 %	7 %	8 %
6600 (55)	1 %	1 %	1 %
7200 (60)	0 %	1 %	
9000 (75)	4 %	4 %	3 %
10200 (85)	3 %	4 %	3 %
12000 (100)	5 %	5 %	6 %
15000 (125)	3 %	4 %	1 %
18000 (150)	1 %	2 %	1 %
24000 (200)	4 %	4 %	4 %
36000 (300)	6 %	5 %	6 %
36000+ (300+)	5 %	5 %	5 %
Don’t know	9 %	7 %	12 %
TOTAL	100 %	100 %	100 %

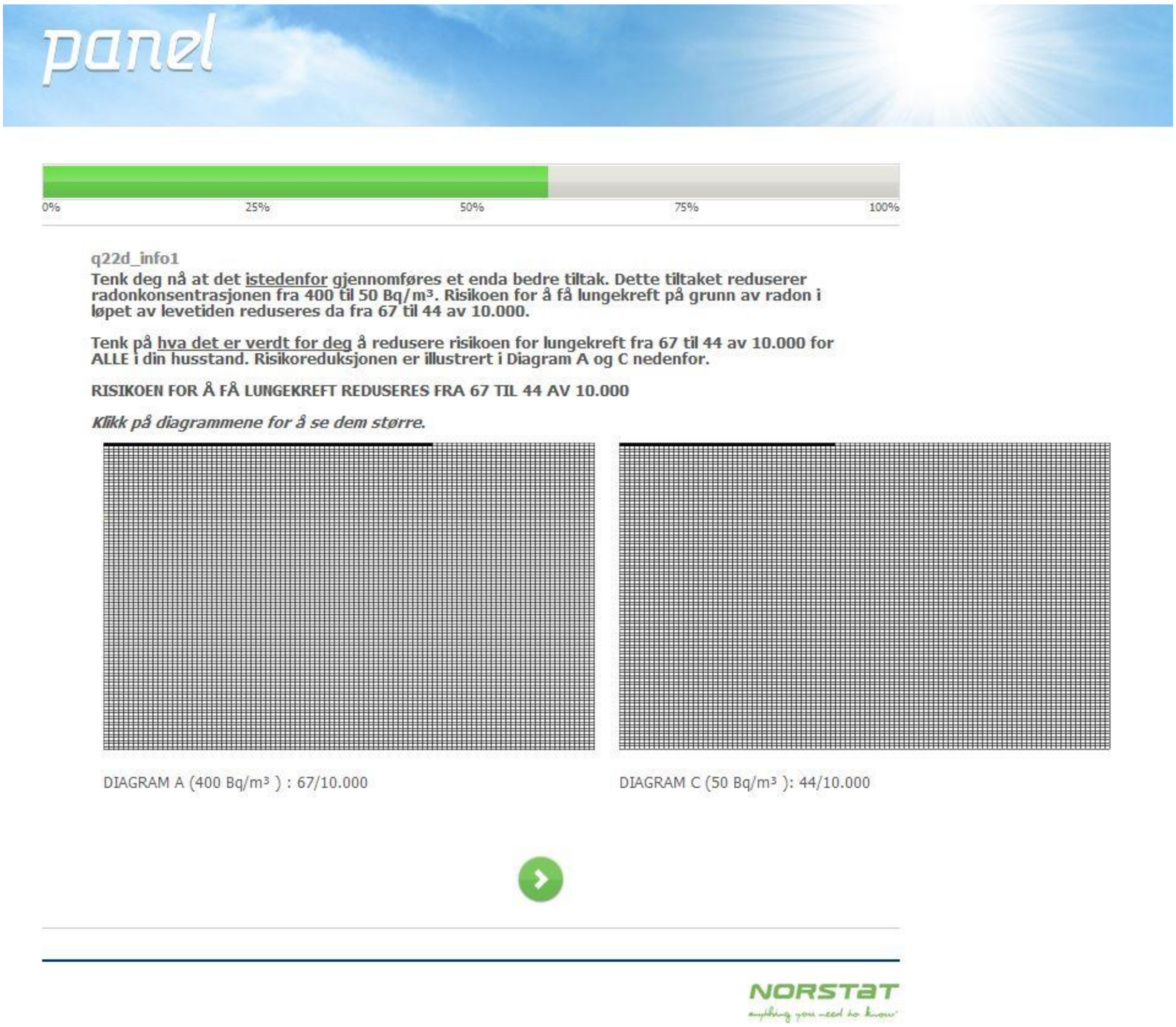
Question 22cx2_1) (Screened with only lump sums) Below you can see a scale with different lump sums from 0 to 36 000 NOK. Scroll your way along the scale, and click on the highest amount you truly are willing to pay. Ask yourself; am I truly sure this is what I am willing to pay. If you are sure, mark this amount. This means that you are unwilling to pay any amount higher than this.

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	380	213	167
0	5 %	8 % B	1 %
120	3 %	3 %	4 %
240	2 %	1 %	4 %
360	3 %	3 %	3 %
720	1 %	1 %	1 %
960	4 %	4 %	5 %
1080	5 %	5 %	5 %

1200	7 %	4 %	12 % [A]
1800	4 %	2 %	7 % [A]
2400	3 %	4 %	2 %
3000	9 %	8 %	10 %
3600	3 %	2 %	4 %
4200	2 %	2 %	1 %
4800	2 %	3 %	1 %
5400	5 %	2 %	8 % [A]
6000	4 %	3 %	4 %
6600	1 %	0 %	1 %
7200	1 %	1 %	1 %
9000	3 %	4 %	2 %
10200	6 %	9 % [B]	2 %
12000	1 %	1 %	1 %
15000	4 %	4 %	4 %
18000	1 %	2 % [B]	
24000	4 %	5 %	4 %
36000	3 %	4 %	2 %
36000+	3 %	4 %	2 %
Don’t know	10 %	10 %	10 %
TOTAL	99 %	99 %	101 %

Question 22d info) Now, imagine implementing an even better initiative, which will reduce indoor radon concentration from 400 to 50 Bq/m^3. The lifetime risk of getting lung cancer will then be reduced from 67 to 44 in 10 000 for EVERYBODY living in your household. The reduction is illustrated in DIAGRAM A and C below.

REDUCTION IN LUNG CANCER RISK FROM 67 TO 48 IN 10 000:



Question 22d_1) (Screened with both lump sums and monthly payments) Below you can see a scale with different lump sums from 0 to 36 000 NOK. Scroll your way along the scale, and click on the highest amount you truly are willing to pay for a reduction down to 50 Bq/m^3, in which reduces lifetime risk of getting lung cancer from 67 to 44 in 10 000. If the lump sum you are willing to pay seems too high regarding your current budget, imagine that you can monthly pay monthly amounts the next ten years. The monthly amounts are found below the lump sums.

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	371	191	180
0 (0)	7 %	9 %	6 %
120 (1)	9 %	12 % B	6 %

240 (2)	1 %	2 %	1 %
360 (3)	4 %	4 %	3 %
720 (6)	3 %	2 %	3 %
960 (8)	2 %	1 %	3 %
1080 (9)	3 %	4 %	2 %
1200 (10)	6 %	6 %	5 %
1800 (15)	1 %	1 %	2 %
2400 (20)	3 %	3 %	3 %
3000 (25)	5 %	5 %	5 %
3600 (30)	2 %	3 %	2 %
4200 (35)	1 %	2 %	1 %
4800 (40)	3 %	3 %	3 %
5400 (45)	3 %	3 %	4 %
6000 (50)	5 %	5 %	4 %
6600 (55)	1 %	1 %	2 %
7200 (60)	1 %	1 %	2 %
9000 (75)	3 %	4 %	2 %
10200 (85)	4 %	4 %	3 %
12000 (100)	5 %	3 %	8 % A
15000 (125)	3 %	4 %	3 %
18000 (150)	2 %	2 %	2 %
24000 (200)	2 %	3 %	2 %
36000 (300)	6 %	5 %	8 %
36000+ (300+)	4 %	4 %	4 %
Don’t know	10 %	7 %	12 %
TOTAL	99 %	103 %	101 %

Question 22dx2_1) (Screened with only lump sums) Below you can see a scale with different lump sums from 0 to 36 000 NOK. Scroll your way along the scale, and click on the highest amount you truly are willing to pay for a reduction down to 50 Bq/m^3, in which reduces lifetime risk of getting lung cancer from 67 to 44 in 10 000.

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	380	213	167
0	5 %	8 % B	1 %
120	3 %	3 %	4 %
240	2 %	2 %	1 %
360	2 %	1 %	2 %
720	2 %	1 %	2 %
960	4 %	2 %	6 %
1080	4 %	5 %	4 %
1200	6 %	3 %	10 % A
1800	4 %	2 %	8 % A
2400	4 %	3 %	5 %
3000	9 %	9 %	10 %
3600	3 %	2 %	3 %
4200	2 %	2 %	2 %
4800	4 %	4 %	4 %
5400	2 %	0 %	4 % A
6000	4 %	3 %	6 %
6600	1 %		1 %
7200	1 %	1 %	1 %
9000	3 %	4 %	2 %
10200	6 %	8 %	4 %
12000	2 %	2 %	1 %
15000	3 %	4 %	2 %

18000	2 %	3 %	1 %
24000	5 %	7 %	3 %
36000	3 %	3 %	3 %
36000+	4 %	4 %	3 %
Don't know	10 %	11 %	9 %
TOTAL	100 %	97 %	102 %

The following questions, question 23 and 24, was only asked to those stating a zero WTP or valued both scenarios equally.

Question 23) What is the main reason why you do not want to pay anything for measures reducing indoor air radon concentration?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	41	31	10
Our household is not exposed to radon.	32 %	32 %	30 %
We does not need to do any preventive measures in our household.	2 %	3 %	
We cannot afford implementing such measures in our household	2 %		10 %
I am not willing to pay anything for something having such a low probability of occurring.	22 %	29 % B	
I think such measures are of government responsibility	24 %	19 %	40 %
I have already paid enough for other measures reducing health risk			
I want to use my income on other things	5 %		20 %
I did not understand the question			
Other reasons; explain:	10 %	13 % B	
Don't know	2 %	3 %	
TOTAL	99 %	99 %	100 %

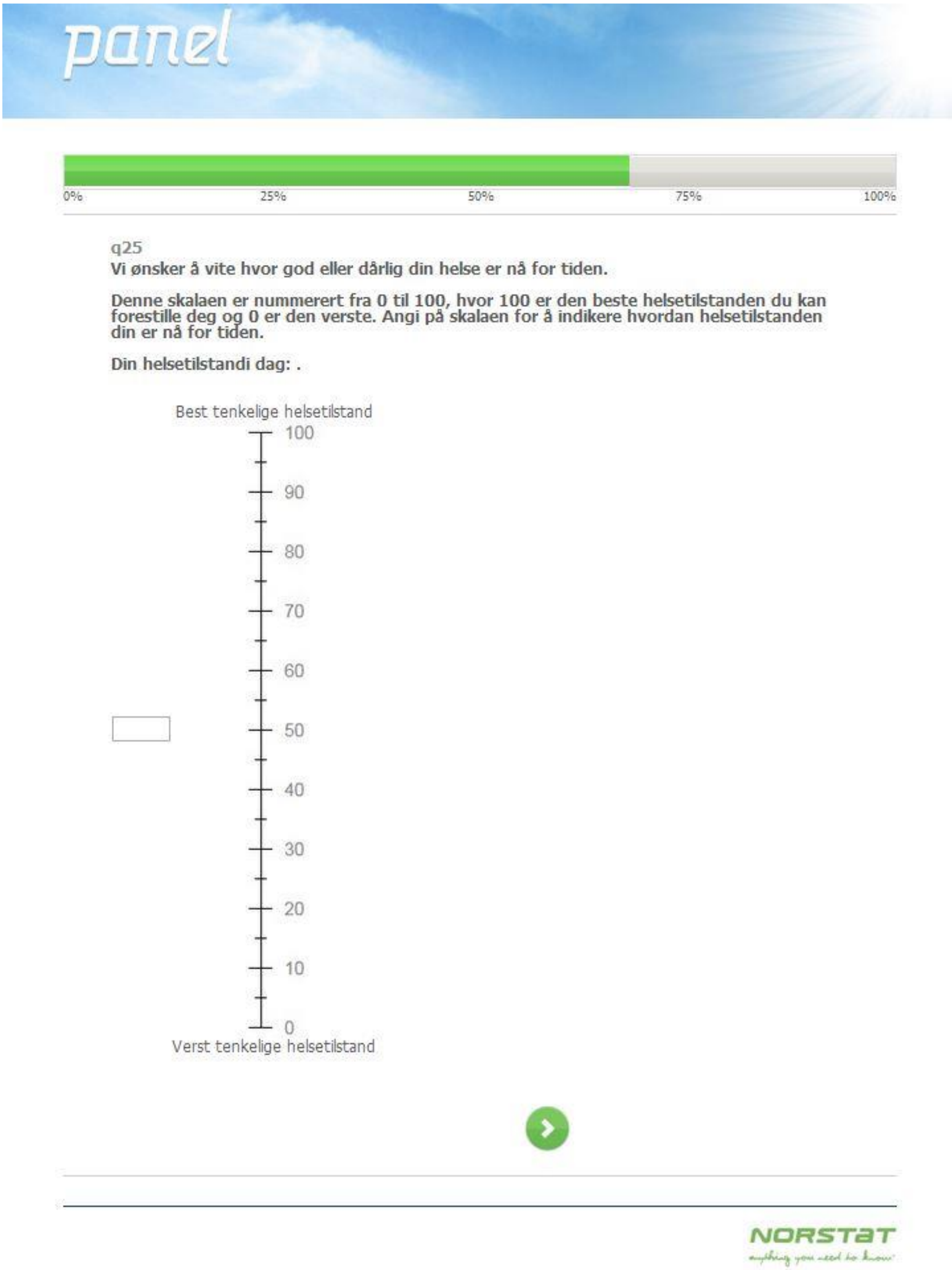
Question 24) What is the main reason why you want to pay JUST AS MUCH for measures reducing indoor air radon concentration to 50 as to 100 Bq/m^3.

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	211	108	103
Our household is not exposed to radon.	25 %	31 % B	18 %
I think a reduction to 100 Bq/m^3 is enough.	9 %	12 %	5 %
I do not think such measures are possible.	2 %	2 %	2 %
I think such measures are of government responsibility.	10 %	6 %	15 % A
I have already stated my maximal willingness to pay.	13 %	13 %	13 %
I cannot afford to pay more for a reduction down to 50 Bq/m^3.	10 %	6 %	15 % A
I want to use my income on other things.	2 %	2 %	2 %
I did not understand the question	7 %	6 %	8 %
Other reasons; explain:	6 %	6 %	7 %
Don't know	16 %	16 %	17 %
TOTAL	100 %	100 %	102 %

Question 25) We want to know how good or bad your current health is.

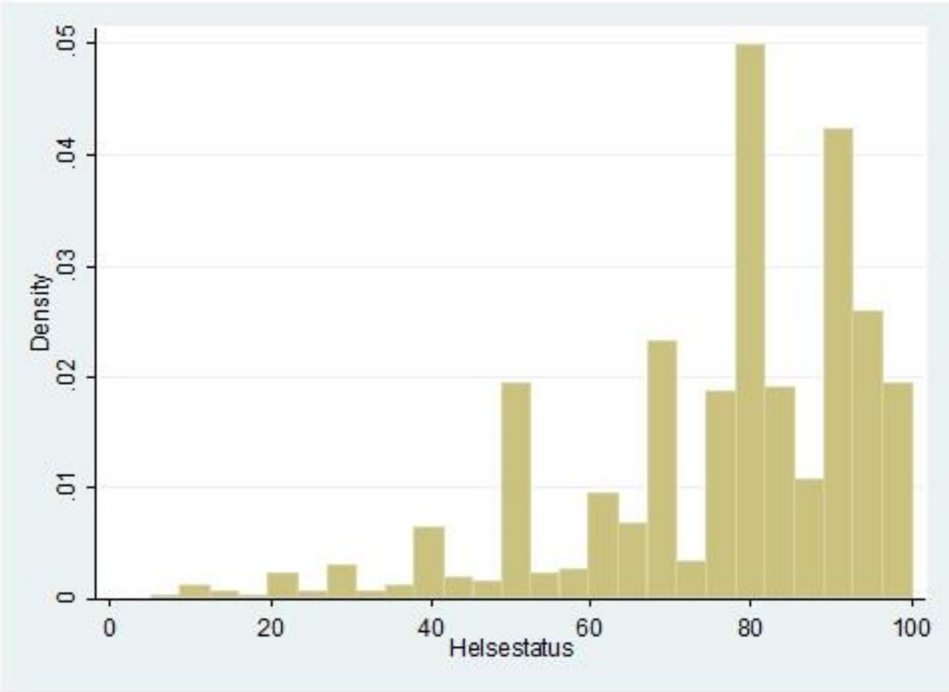
This scale numbered from 0 to 100, where 100 is the best health condition you can imagine, while 0 is the worst. Choose a number on the scale by scrolling your pointer at it, and state your current health status.

Answers are summarized and the distribution is pictured below:



Answers are summarized and the distribution is pictured below:

Variable	Obs	Mean	Std. Dev.	Min	Max
q25	719	76.48261	18.38165	5	100



Question 26) Have you ever been diagnosed for one or more of the following diseases?

Question 26_1) Lung cancer

		GENDER	
	TOTAL	**Male**	**Female**
		A	B
BASE	751	404	347
Yes	1 %	0 %	1 %
No	99 %	99 %	99 %
Don't know	1 %	1 % B	0 %
TOTAL	101 %	100 %	100 %

Question 26_2) Skin cancer

		GENDER	
	TOTAL	**Male**	**Female**
		A	B

BASE	751	404	347
Yes	4 %	4 %	3 %
No	95 %	95 %	96 %
Don't know	1 %	1 %	1 %
TOTAL	100 %	100 %	100 %

Question 26_3) Other kinds of cancer

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Yes	7 %	7 %	5 %
No	93 %	92 %	94 %
Don't know	1 %	1 %	1 %
TOTAL	101 %	100 %	100 %

Question 27) Do or did some of the members of your household suffer from one or more of the following diseases?

Question 27_1) Lung cancer

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Yes	13 %	13 %	14 %
No	84 %	84 %	84 %
Don't know	3 %	4 % B	1 %
TOTAL	100 %	101 %	99 %

Question 27_2) Skin cancer

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347

Yes	11 %	10 %	12 %
No	85 %	85 %	85 %
Don't know	4 %	5 %	3 %
TOTAL	100 %	100 %	100 %

Question 27_3) Other kinds of cancer

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Yes	43 %	39 %	48 % A
No	54 %	57 %	50 %
Don't know	3 %	4 % B	1 %
TOTAL	100 %	100 %	99 %

Question 28) Picture yourself in southern Norway at a hot sunny day, with the heat peaking at +25 °C in the shadows. Which level of sunscreen would you prefer? (Sunscreen level in brackets)

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
None	7 %	10 % B	4 %
Very low (2-6)	2 %	2 %	2 %
Low (7- 14)	13 %	12 %	14 %
Moderate (15 – 29)	48 %	48 %	49 %
High (30 – 59)	20 %	17 %	24 % A
Very high (60 eller mer)	2 %	1 %	2 %
Would have been hiding in the shadows	7 %	8 %	5 %
Don't know	1 %	2 %	1 %
TOTAL	100 %	100 %	101 %

Question 29) Picture yourself somewhere near the equator at a hot sunny day, with the heat peaking at +25 °C in the shadows. Which level of sunscreen would you prefer? (Sunscreen level in brackets)

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
None	3 %	4 %	2 %
Very low (2-6)	1 %	1 %	1 %
Low (7- 14)	4 %	5 %	3 %
Moderate (15 – 29)	23 %	25 %	22 %
High (30 – 59)	40 %	38 %	43 %
Very high (60 eller mer)	11 %	11 %	11 %
Would have been hiding in the shadows	14 %	13 %	15 %
Don't know	3 %	3 %	3 %
TOTAL	99 %	100 %	100 %

Question 30a) How many times have you used tanning beds for the last six (6) months?

Average: 0.75

Question 30b) How many days did you spend on holiday in warm regions last year (2013)?

Average: 9.73

Question 31a) When in the sun for the first time after winter, do you become?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
Never sunburned, always tanned	29 %	29 %	28 %

Sometimes sunburned at first, but then tanned	50 %	51 %	48 %
Always/often sunburned, but then a little tanned	11 %	11 %	12 %
Always sunburned, never tanned	3 %	2 %	3 %
I do never stay in the sun	4 %	4 %	3 %
Don't know	4 %	3 %	5 %
TOTAL	101 %	100 %	99 %

Question 31b) How does this claim suit you? "I always drive 20 km/h above the speed limit in traffic if the limit is 80 km/h".

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Totally disagree	44 %	37 %	52 % A
Disagree	32 %	37 % B	26 %
Agree	14 %	15 %	14 %
Totally agree	7 %	9 % B	4 %
Don't know	3 %	2 %	4 %
TOTAL	100 %	100 %	100 %

Info

At last, we will now ask a few questions regarding you and your household. All answers are confidential and will only be presented as average numbers. Your identity will be kept secret, and answers cannot be traced.

Question 32) Including you, how many persons live in your current household?

Average: 2.45

Question 33) How many kids, under the age of 18, live in your current household?

Average: 0.50

Question 34) What is your highest level of education?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
Elementary School	8 %	8 %	8 %
Craft Certificate	8 %	12 % B	4 %
High School	24 %	21 %	28 % A
University/University Collage, 3 years	27 %	26 %	28 %
University/University Collage (4 years or more)	29 %	30 %	29 %
University/University Collage (PhD)	1 %	2 %	1 %
None of the above	1 %	1 %	2 %
TOTAL	98 %	100 %	100 %

Question 35) What is your marital status?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
Not married	17 %	14 %	20 % A
Married/partner	72 %	77 % B	65 %
Widow/widower	4 %	3 %	4 %
Divorced	8 %	6 %	11 % A
TOTAL	101 %	100 %	100 %

Question 36) For how many years have you lived in your current household?

Average: 14.96

Question 37) How is your current employment situation?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
Working, full time (37.5 hours/week or more)	46 %	53 % B	38 %
Working, part time (less than 37.5 hours/week)	9 %	6 %	14 % A
Self-employed, full time (37.5 hours/week or more)	2 %	2 %	2 %
Self-employed, part time (less than 37.5 hours/week)	1 %	2 % B	0 %
Unemployed	1 %	1 %	2 %
School pupil or student	7 %	4 %	10 % A
Retired	20 %	22 %	18 %
Work-disabled	7 %	6 %	9 %
Vocational rehabilitation	1 %	0 %	1 %
In the army	0 %	0 %	
Working at home	2 %	0 %	3 % A
Other; specify;	3 %	2 %	3 %
TOTAL	99 %	98 %	100 %

Question 38) Would you have problems with paying an unexpected expense of about 5000 NOK during a month?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No, never	64 %	70 % B	58 %
Yes, occasionally	13 %	12 %	13 %
Yes, sometimes	11 %	10 %	11 %
Yes, often	5 %	4 %	6 %
Yes, that would always be a problem	8 %	4 %	12 %

			A
TOTAL	101 %	100 %	100 %

Question 39) How do you think your finances will be in the next 10 years?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
1 Much worse	1 %	0 %	1 %
2	2 %	2 %	2 %
3	9 %	9 %	9 %
4 As now	42 %	42 %	41 %
5	21 %	23 %	20 %
6	12 %	12 %	12 %
7 Much better	10 %	9 %	10 %
Unsure/don't know	4 %	3 %	5 %
TOTAL	101 %	100 %	100 %

Question 40) How important do you think it is to save money for the future?

		KJØNN	
	TOTAL	Mann	Kvinne
		A	B
BASE	751	404	347
1 Not very important	2 %	2 %	2 %
2	2 %	2 %	2 %
3	2 %	3 % B	1 %
4 Neither important or unimportant	10 %	13 % B	7 %
5	19 %	21 %	17 %
6	29 %	29 %	30 %
7 Very important	34 %	30 %	40 % A
Unsure/don't know	1 %	1 %	1 %

TOTAL	99 %	101 %	100 %

Question 41) What type of finance-mix do you have in your household?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
Separated finances	23 %	21 %	26 %
Common finances	48 %	52 % B	43 %
Mixed	23 %	23 %	23 %
Other; what type:	4 %	2 %	7 % A
Don’t know	2 %	1 %	2 %
TOTAL	100 %	99 %	101 %

Question 42) What type of residence do you live in now?

	TOTAL	GENDER	
		Male	Female
		A	B
BASE	751	404	347
Detached house	64 %	64 %	63 %
Kjedet enebolig	6 %	6 %	6 %
Townhouse	8 %	8 %	8 %
Semi-detached; specify floor:	7 %	8 %	7 %
Block condo; specify floor:	15 %	13 %	16 %
TOTAL	100 %	99 %	100 %

Question 43) Do you rent out parts of your current residence and/or eventual second homes?

	TOTAL	GENDER	
		Male	Female
		A	B

BASE	751	404	347
No	88 %	90 %	87 %
Yes	12 %	10 %	13 %
TOTAL	100 %	100 %	100 %

Question 44) By the 1st of January, 2014 the authorities have implemented new rules and regulations regarding all rental properties. Do you have any knowledge of these rules and regulations?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
No	77 %	75 %	79 %
Yes	23 %	25 %	21 %
TOTAL	100 %	100 %	100 %

Question 45) What was your gross personal income last year (2013)?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
0 – 100.000	4 %	1 %	7 % A
100.101 – 200.000	4 %	2 %	7 % A
200.001 – 300.000	11 %	8 %	14 % A
300.001 – 400.000	15 %	13 %	17 %
400.001 – 500.000	18 %	20 %	16 %
500.001 – 600.000	13 %	17 % B	9 %
600.001 – 700.000	8 %	12 % B	3 %
700.001 – 800.000	4 %	6 % B	2 %
800.001 – 900.000	4 %	3 %	4 %
900.000 – 1 million	4 %	6 % B	1 %
Greater than 1 million, specify the approximate amount in millions to	3 %	3 %	1 %

one decimal place:		B	
Don’t know	13 %	8 %	19 % A
TOTAL	101 %	99 %	100 %

Question 46) What was your gross household income last year (2013)?

		GENDER	
	TOTAL	Male	Female
		A	B
BASE	751	404	347
0 – 100.000	1 %	0 %	1 %
100.101 – 200.000	2 %	1 %	3 %
200.001 – 300.000	4 %	2 %	6 % A
300.001 – 400.000	6 %	3 %	9 % A
400.001 – 500.000	9 %	11 %	8 %
500.001 – 600.000	10 %	10 %	9 %
600.001 – 700.000	9 %	11 % B	6 %
700.001 – 800.000	7 %	9 % B	4 %
800.001 – 900.000	11 %	13 % B	8 %
900.001 – 1.000.000	9 %	10 % B	6 %
1.000.001 – 1.100.000	5 %	5 %	5 %
1.100.001 – 1.200.000	3 %	2 %	3 %
1.200.001 – 1.300.000	3 %	3 %	2 %
1.300.001 – 1.400.000	2 %	2 %	2 %
1.400.001 – 1.500.000	2 %	2 %	2 %
Greater than 1.5 million, specify the approximate amount in millions to one decimal place:	2 %	3 % B	1 %
Don’t know	16 %	10 %	24 % A
TOTAL	101 %	97 %	99 %

Question 47) How do you think it was answering this survey?

	TOTAL	GENDER Male	 Female
		A	B
BASE	751	404	347
Very easy	21 %	25 % B	17 %
Quite easy	66 %	66 %	66 %
Quite difficult	11 %	8 %	15 % A
Very difficult	1 %	0 %	1 %
Don’t know	1 %	0 %	1 %
TOTAL	100 %	99 %	100 %

Question 48) In particular, what part was the most difficult answering?

	TOTAL	GENDER Male	 Female
		A	B
BASE	751	404	347
Explained difficulties	25 %	22 %	28 %
I did not find any questions difficult answering	75 %	78 %	72 %
TOTAL	100 %	100 %	100 %

Appendix C: Results from the Analysis

Appendix C.1 Tests for Scope in WTP

In the following figures both the Wilcoxon sign-rank tests and the paired t-tests are presented for the five different samples; one sample excluding "don't know" answers, one sample excluding "don't know" answers and "protest zeroes", one sample excluding those stating a WTP greater than 100,000 NOK plus "don't know" answers and "protest zeroes", one sample excluding those stating a WTP higher than 5% of household income plus "don't know" answers and "protest zeroes", and one sample excluding irrational respondents not wielding scope plus "don't know" answers and "protest zeroes".

Sample excluding "don't know" answers:

Figure C. 1. Wilcoxon sign-rank test for sample excluding "don't know" answers

```
8. signrank wtp1=wtp2

 Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       92       49859       72092
    negative |      177       94325       72092
        zero |      401       80601       80601
-------------+---------------------------------
         all |      670      224785      224785

 unadjusted variance     25119724
 adjustment for ties    -2910.125
 adjustment for zeros -5393550.3
                      ----------
 adjusted variance       19723263

 Ho: wtp1 = wtp2
              z =  -5.006
     Prob > |z| =   0.0000
```

Sample excluding "don't know" answers and "protest zeroes":

Figure C. 2. Wilcoxon sign-rank test for a sample excluding "don't know" answers and "protest zeroes"

```
125 signrank wtp1=wtp2

  Wilcoxon signed-rank test

          sign |      obs   sum ranks    expected
  -------------+---------------------------------
      positive |       92       47099       68057
      negative |      177       89015       68057
          zero |      371       69006       69006
  -------------+---------------------------------
           all |      640      205120      205120

  unadjusted variance     21896560
  adjustment for ties    -2910.125
  adjustment for zeros -4272621.5
                        ----------
  adjusted variance       17621028

  Ho: wtp1 = wtp2
               z =  -4.993
      Prob > |z| =   0.0000
```

Figure C. 3. Paired t-test for a sample excluding "don't know" answers and "protest zeroes"

```
Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
    wtp1 |     628    8451.498    728.9539    18267.53    7020.012    9882.985
    wtp2 |     628    8916.212    744.9688    18668.86    7453.276    10379.15
---------+--------------------------------------------------------------------
    diff |     628   -464.7134    225.4871    5650.691   -907.5148   -21.91198
------------------------------------------------------------------------------
     mean(diff) = mean(wtp1 - wtp2)                               t =  -2.0609
 Ho: mean(diff) = 0                              degrees of freedom =      627

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.0199         Pr(|T| > |t|) = 0.0397          Pr(T > t) = 0.9801
```

Sample excluding those stating a WTP greater than 100,000 NOK:

Figure C. 4. Wilcoxon sign rank test for a sample excluding those stating a WTP greater than 100,000 NOK

```
185 signrank wtp1under=wtp2under

 Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       91     46004.5       66750
    negative |      176     87495.5       66750
        zero |      366       67161       67161
-------------+---------------------------------
         all |      633      200661      200661

 unadjusted variance  21186457
 adjustment for ties     -2910
 adjustment for zeros -4102417.8
                     ----------
 adjusted variance    17081130

 Ho: wtp1under = wtp2under
              z =  -5.020
     Prob > |z| =   0.0000
```

Figure C. 5. Paired t-test

```
 Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
wtp1un~r |     624    7550.546    417.0551    10418.03    6731.542    8369.551
wtp2un~r |     624    8018.239    446.3116    11148.86    7141.781    8894.696
---------+--------------------------------------------------------------------
    diff |     624   -467.6923    174.4251    4357.137   -810.2247     -125.16
------------------------------------------------------------------------------
     mean(diff) = mean(wtp1under - wtp2under)                     t =  -2.6813
 Ho: mean(diff) = 0                              degrees of freedom =      623

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.0038         Pr(|T| > |t|) = 0.0075          Pr(T > t) = 0.9962
```

Sample excluding those stating a WTP higher than 5% of household income:

Figure C.6. Wilcoxon sign rank test for a Sample excluding those stating a WTP higher than 5% of household

```
37 signrank wtp1prosent=wtp2prosent

 Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |       90     43729.5     60817.5
    negative |      165     77905.5     60817.5
        zero |      349       61075       61075
-------------+---------------------------------
         all |      604      182710      182710

 unadjusted variance  18408033
 adjustment for ties  -2877.25
 adjustment for zeros -3557618.8
                     ----------
 adjusted variance    14847537

 Ho: wtp1prosent = wtp2prosent
              z =  -4.435
     Prob > |z| =   0.0000
```

Figure C.7. Paired t-test for a sample excluding those stating a WTP higher than 5% of household income

```
Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
wtp1pr~t |     598    7220.134    710.3196    17370.18    5825.105    8615.163
wtp2pr~t |     598    7475.719    706.7223    17282.21    6087.755    8863.683
---------+--------------------------------------------------------------------
    diff |     598   -255.5853    192.2969    4702.436   -633.2459    122.0753
------------------------------------------------------------------------------
     mean(diff) = mean(wtp1prosent - wtp2prosent)                t =  -1.3291
 Ho: mean(diff) = 0                               degrees of freedom =      597

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.0922         Pr(|T| > |t|) = 0.1843          Pr(T > t) = 0.9078
```

Sample excluding irrational respondents not wielding scope:

Figure C.8. Wilcoxon sign rank test for a Sample excluding irrational respondents not wielding scope

```
279 signrank wtp1rasjonell=wtp2rasjonell

  Wilcoxon signed-rank test

        sign |      obs   sum ranks    expected
-------------+---------------------------------
    positive |        0           0       40710
    negative |      177       81420       40710
        zero |      371       69006       69006
-------------+---------------------------------
         all |      548      150426      150426

  unadjusted variance     13751444
  adjustment for ties        -1152
  adjustment for zeros  -4272621.5
                        ----------
  adjusted variance        9477670

  Ho: wtp1rasjonell = wtp2rasjonell
               z = -13.224
      Prob > |z| =   0.0000
```

Figure C.9. Paired t-testfor a Sample excluding irrational respondents not wielding scope

```
Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
wtp1ra~l |     537    8330.244    820.4037    19011.43    6718.643    9941.845
wtp2ra~l |     537    9668.493    860.5215    19941.09    7978.085     11358.9
---------+--------------------------------------------------------------------
    diff |     537    -1338.25    186.8051    4328.882   -1705.209   -971.2897
------------------------------------------------------------------------------
     mean(diff) = mean(wtp1rational - wtp2rational)              t =  -7.1639
 Ho: mean(diff) = 0                               degrees of freedom =      536

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Appendix C.2 Gross Income Elasticities

The figures below depict gross income elasticity for each scenario respectively.

Figure C.10. Gross Income Elasticity Scenario 1

				F(1, 537) =	13.03
Model	67.2232873	1	67.2232873	Prob > F =	0.0003
Residual	2770.32211	537	5.15888661	R-squared =	0.0237
				Adj R-squared =	0.0219
Total	2837.5454	538	5.27424795	Root MSE =	2.2713

lwtp1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
linntekt2	.6243477	.1729596	3.61	0.000	.2845874	.964108
_cons	-.6224264	2.321203	-0.27	0.789	-5.182178	3.937326

Figure C.11. Gross Income Elasticity for Scenario 2

Source	SS	df	MS		
				Number of obs =	548
				F(1, 546) =	7.68
Model	40.53681	1	40.53681	Prob > F =	0.0058
Residual	2880.54369	546	5.27572104	R-squared =	0.0139
				Adj R-squared =	0.0121
Total	2921.0805	547	5.34018372	Root MSE =	2.2969

lwtp2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
linntekt2	.4831557	.1743023	2.77	0.006	.1407704	.8255409
_cons	1.388595	2.339568	0.59	0.553	-3.207061	5.984252

Appendix C.3 Linear OLS regressions

Two linear OLS models for each scenario are pictured in this section accompanied by the a for collinearity; one model regressed with all the significant variables found in the elimination process, and one model regressed with only the final significant variables.

Scenario 1:

Figure C.12. Linear OLS model regressing only variables found significant in the elimination process for Scenario 1

Source	SS	df	MS
Model	7.0724e+09	12	589364523
Residual	6.3872e+10	517	123543722
Total	7.0944e+10	529	134110545

Number of obs	= 530
F(12, 517)	= 4.77
Prob > F	= 0.0000
R-squared	= 0.0997
Adj R-squared	= 0.0788
Root MSE	= 11115

wtp1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
education1	1913.987	1811.177	1.06	0.291	-1644.184	5472.158
householdinc	.0028832	.0013748	2.10	0.036	.0001824	.005584
rot0te	-3187.826	970.8373	-3.28	0.001	-5095.097	-1280.555
q50b	4669.822	1542.633	3.03	0.003	1639.222	7700.423
knowledge	2903.335	1194.713	2.43	0.015	556.2454	5250.425
detect	657.7879	1150.97	0.57	0.568	-1603.365	2918.941
currentsmoke	43.62007	1354.978	0.03	0.974	-2618.319	2705.559
more5years	2120.317	1183.609	1.79	0.074	-204.9576	4445.591
less5years	321.8622	2000.541	0.16	0.872	-3608.327	4252.052
averseboth	2919.992	1117.384	2.61	0.009	724.8194	5115.164
saving	625.328	371.9636	1.68	0.093	-105.4179	1356.074
unexpected	-1117.586	1114.224	-1.00	0.316	-3306.548	1071.377
_cons	-1635.179	3157.535	-0.52	0.605	-7838.355	4567.997

Figure C.13. Final linear OLS model with only significant variables for Scenario 1

Source	SS	df	MS
Model	6.8494e+09	9	761048056
Residual	6.4221e+10	525	122326531
Total	7.1071e+10	534	133091501

Number of obs	= 535
F(9, 525)	= 6.22
Prob > F	= 0.0000
R-squared	= 0.0964
Adj R-squared	= 0.0809
Root MSE	= 11060

wtp1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
householdinc	.0033999	.0012988	2.62	0.009	.0008483	.0059515
rot0te	-3271.623	959.9252	-3.41	0.001	-5157.389	-1385.856
q50b	5007.12	1509.513	3.32	0.001	2041.693	7972.547
knowledge	3308.804	1078.806	3.07	0.002	1189.497	5428.112
currentsmoke	-322.5195	1315.256	-0.25	0.806	-2906.331	2261.292
more5years	2051.14	1160.414	1.77	0.078	-228.4861	4330.765
less5years	-276.3532	1953.725	-0.14	0.888	-4114.432	3561.726
averseboth	2877.751	1103.245	2.61	0.009	710.4338	5045.068
saving	663.0608	368.1455	1.80	0.072	-60.15845	1386.28
_cons	-790.5758	2618.494	-0.30	0.763	-5934.589	4353.438

Figure C.14. Collinearity test for the linear OLS models, Scenario 1

Variable	VIF	1/VIF
detect	1.23	0.810167
knowledge	1.23	0.811417
currentsmoke	1.19	0.842408
more5years	1.18	0.844565
unexpected	1.17	0.853960
householdinc	1.14	0.878777
less5years	1.11	0.896918
education1	1.07	0.933439
q50b	1.05	0.948274
averseboth	1.03	0.974043
saving	1.01	0.989826
rot0te	1.01	0.990406
Mean VIF	1.12	

Scenario 2:

Figure C.15. Linear OLS model regressing only variables found significant in the elimination process for Scenario 2

Source	SS	df	MS
Model	9.5932e+09	9	1.0659e+09
Residual	1.2651e+11	530	238696492
Total	1.3610e+11	539	252509033

Number of obs =	540
F(9, 530) =	4.47
Prob > F =	0.0000
R-squared =	0.0705
Adj R-squared =	0.0547
Root MSE =	15450

wtp2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rot0te	-644.1876	1334.499	-0.48	0.629	-3265.743	1977.368
education1	1194.282	2445.438	0.49	0.625	-3609.66	5998.223
householdinc	.0031882	.001844	1.73	0.084	-.0004343	.0068108
age60	-2088.364	1495.039	-1.40	0.163	-5025.294	848.5664
detectprevious	9724.553	3151.081	3.09	0.002	3534.412	15914.69
knowledge	3088.443	1547.322	2.00	0.046	48.80719	6128.08
q50b	5226.414	2089.209	2.50	0.013	1122.268	9330.561
averseboth	4459.684	1544.771	2.89	0.004	1425.058	7494.309
saving	869.3475	526.9768	1.65	0.100	-165.8722	1904.567
_cons	-2252.592	4309.807	-0.52	0.601	-10718.99	6213.808

Figure C. 16. Final linear OLS model with only significant variables for Scenario 2

Source	SS	df	MS
Model	9.0089e+09	6	1.5015e+09
Residual	1.2721e+11	537	236888045
Total	1.3622e+11	543	250861493

Number of obs =	544
F(6, 537) =	6.34
Prob > F =	0.0000
R-squared =	0.0661
Adj R-squared =	0.0557
Root MSE =	15391

wtp2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
householdinc	.0035408	.0018004	1.97	0.050	4.13e-06	.0070775
detectprevious	9513.178	3134.77	3.03	0.003	3355.264	15671.09
knowledge	2856.944	1498.708	1.91	0.057	-87.10576	5800.994
q50b	5343.706	2078.869	2.57	0.010	1259.994	9427.418
averseboth	4198.039	1525.996	2.75	0.006	1200.385	7195.693
saving	1050.434	509.1533	2.06	0.040	50.25753	2050.61
_cons	-3295.561	3438.233	-0.96	0.338	-10049.6	3458.473

Figure C. 17.Collinearity test for linear OLS models, Scenario 2

Variable	VIF	1/VIF
age60	1.13	0.882704
knowledge	1.10	0.909235
householdinc	1.07	0.933189
saving	1.06	0.943247
education1	1.05	0.948509
detectprev~s	1.03	0.971369
averseboth	1.03	0.973658
q50b	1.02	0.982691
rot0te	1.00	0.995906
Mean VIF	1.06	

Further the final models when excluding those respondents not wielding scope are pictured below for both scenarios respectively.

Scenario 1:

Figure C. 18. Final linear OLS model excluding irrational respondents for Scenario 1

Source	SS	df	MS
Model	5.3178e+09	6	886306611
Residual	5.4500e+10	443	123024348
Total	5.9818e+10	449	133224111

Number of obs =	450
F(6, 443) =	7.20
Prob > F =	0.0000
R-squared =	0.0889
Adj R-squared =	0.0766
Root MSE =	11092

wtp1rational	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
householdinc	.0033068	.0014954	2.21	0.028	.0003677	.0062458
rot0te	-3332.526	1051.266	-3.17	0.002	-5398.613	-1266.438
q50b	5238.966	1567.484	3.34	0.001	2158.338	8319.595
knowledge	3173.882	1179.228	2.69	0.007	856.3054	5491.459
averseboth	2565.671	1199.214	2.14	0.033	208.8145	4922.527
saving	704.2863	403.2594	1.75	0.081	-88.25279	1496.825
_cons	-451.0273	2815.082	-0.16	0.873	-5983.601	5081.547

Scenario 2:

Figure C.19. Final linear OLS model excluding irrational respondents for Scenario 2

Source	SS	df	MS
Model	6.8845e+09	6	1.1474e+09
Residual	7.1220e+10	443	160766760
Total	7.8104e+10	449	173951415

Number of obs =	450
F(6, 443) =	7.14
Prob > F =	0.0000
R-squared =	0.0881
Adj R-squared =	0.0758
Root MSE =	12679

wtp2rational	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rot0te	-3811.978	1201.753	-3.17	0.002	-6173.823	-1450.134
householdinc	.0036738	.0017095	2.15	0.032	.0003141	.0070336
knowledge	3209.159	1348.033	2.38	0.018	559.8247	5858.493
q50b	5759.486	1791.867	3.21	0.001	2237.87	9281.101
averseboth	3375.559	1370.88	2.46	0.014	681.323	6069.796
saving	977.3348	460.9853	2.12	0.035	71.34499	1883.325
_cons	-927.2016	3218.056	-0.29	0.773	-7251.755	5397.351

Appendix C.4 Logarithmic OLS regressions

Two logarithmic OLS models for each scenario are pictured in this section accompanied by a test for collinearity; one model regressed with all the significant variables found in the elimination process, and one model regressed with only the final significant variables.

Scenario 1:

Figure C. 20. Logarithmic OLS model regressing only variables found significant in the elimination process for Scenario 1

Source	SS	df	MS
Model	281.425437	12	23.4521197
Residual	2272.45915	456	4.98346305
Total	2553.88459	468	5.45701835

Number of obs =	469
F(12, 456) =	4.71
Prob > F =	0.0000
R-squared =	0.1102
Adj R-squared =	0.0868
Root MSE =	2.2324

lwtp1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gender	.3661906	.2201487	1.66	0.097	-.0664413	.7988224
education1	.7818358	.4064566	1.92	0.055	-.0169245	1.580596
lhouseholdinc	.4875861	.2000797	2.44	0.015	.0943935	.8807787
knowledge	.7450848	.2621405	2.84	0.005	.2299315	1.260238
detect	.1442023	.2416338	0.60	0.551	-.3306517	.6190563
less5years	-.4543241	.4254794	-1.07	0.286	-1.290468	.3818194
more5years	.1333362	.2536499	0.53	0.599	-.3651316	.631804
currentsmoke	-.1116231	.2913615	-0.38	0.702	-.6842009	.4609548
unexpected	-.4407644	.2408752	-1.83	0.068	-.9141275	.0325988
saving	.2115045	.0802594	2.64	0.009	.0537805	.3692286
worried	.6839022	.2905389	2.35	0.019	.112941	1.254863
averseboth	.3484661	.2372672	1.47	0.143	-.1178067	.8147388
_cons	-1.538584	2.753247	-0.56	0.577	-6.94921	3.872041

Figure C.21. Final logarithmic OLS model with only significant variables for Scenario 1

Source	SS	df	MS
Model	257.174533	7	36.739219
Residual	2296.71005	461	4.98201747
Total	2553.88459	468	5.45701835

Number of obs	=	469
F(7, 461)	=	7.37
Prob > F	=	0.0000
R-squared	=	0.1007
Adj R-squared	=	0.0870
Root MSE	=	2.232

lwtp1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gender	.4150387	.2181324	1.90	0.058	-.0136182	.8436957
education1	.778821	.3962555	1.97	0.050	.0001301	1.557512
lhouseholdinc	.444621	.1983957	2.24	0.025	.054749	.834493
knowledge	.8353327	.2422816	3.45	0.001	.3592196	1.311446
unexpected	-.5201844	.2353109	-2.21	0.028	-.9825993	-.0577695
saving	.2159121	.0800142	2.70	0.007	.0586742	.3731499
worried	.622834	.2880286	2.16	0.031	.0568223	1.188846
_cons	-.913326	2.722228	-0.34	0.737	-6.26284	4.436188

Figure C.22. Collinearity test for the logarithmic OLS models, Scenario 1

Variable	VIF	1/VIF
knowledge	1.25	0.799198
detect	1.21	0.825196
unexpected	1.19	0.841856
more5years	1.18	0.844824
currentsmoke	1.17	0.851333
lhousehold~c	1.17	0.852056
less5years	1.15	0.872929
gender	1.10	0.911280
education1	1.07	0.931361
worried	1.04	0.957806
saving	1.04	0.960677
averseboth	1.04	0.965517
Mean VIF	1.14	

Scenario 2:

Figure C. 23. Logarithmic OLS model regressing only variables found significant in the elimination process for Scenario 2

Source	SS	df	MS
Model	280.738364	11	25.5216695
Residual	2340.34361	469	4.99007165
Total	2621.08197	480	5.46058744

Number of obs =	481
F(11, 469) =	5.11
Prob > F =	0.0000
R-squared =	0.1071
Adj R-squared =	0.0862
Root MSE =	2.2338

lwtp2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rot0te	.3096189	.2050546	1.51	0.132	-.0933206	.7125585
gender	.3233872	.2172506	1.49	0.137	-.1035179	.7502923
education1	.8277878	.4002434	2.07	0.039	.0412956	1.61428
lhouseholdinc	.4155862	.1949442	2.13	0.034	.0325141	.7986584
knowledge	.6493275	.2613166	2.48	0.013	.1358312	1.162824
detect	.2604486	.2374853	1.10	0.273	-.2062184	.7271156
q25	.0090346	.0055646	1.62	0.105	-.0019	.0199692
age60	-.1681135	.2282631	-0.74	0.462	-.6166584	.2804313
saving	.2658159	.0821273	3.24	0.001	.1044328	.4271989
averseboth	.39748	.2352017	1.69	0.092	-.0646995	.8596595
worried	.4866764	.2827596	1.72	0.086	-.0689561	1.042309
_cons	-1.694216	2.64262	-0.64	0.522	-6.887058	3.498625

Figure C.24. Final logarithmic OLS model with only significant variables for Scenario 2

Source	SS	df	MS
Model	259.608722	9	28.8454135
Residual	2361.47325	471	5.01374363
Total	2621.08197	480	5.46058744

Number of obs =	481
F(9, 471) =	5.75
Prob > F =	0.0000
R-squared =	0.0990
Adj R-squared =	0.0818
Root MSE =	2.2391

lwtp2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
education1	.8133768	.4011103	2.03	0.043	.0251896	1.601564
lhouseholdinc	.3619725	.1928012	1.88	0.061	-.0168844	.7408294
knowledge	.5881104	.2592687	2.27	0.024	.0786438	1.097577
detect	.2654553	.2379909	1.12	0.265	-.2022001	.7331107
q25	.0096568	.0055579	1.74	0.083	-.0012646	.0205782
age60	-.2092528	.227924	-0.92	0.359	-.6571265	.2386209
saving	.2734084	.0821012	3.33	0.001	.1120785	.4347384
averseboth	.4362388	.2346228	1.86	0.064	-.0247981	.8972757
worried	.5067985	.2832599	1.79	0.074	-.0498109	1.063408
_cons	-.7149187	2.598532	-0.28	0.783	-5.821068	4.391231

Figure C. 25. Collinearity test for logarithmic OLS models, Scenario 2

Variable	VIF	1/VIF
knowledge	1.29	0.777917
detect	1.20	0.836630
age60	1.14	0.873654
lhousehold~c	1.12	0.889320
saving	1.10	0.906585
gender	1.10	0.911862
q25	1.08	0.928400
education1	1.07	0.935279
worried	1.04	0.965040
averseboth	1.04	0.965082
rot0te	1.01	0.989183
Mean VIF	1.11	

Further the final models when excluding those respondents not wielding scope are pictured below for both scenarios respectively.

Scenario 1:

Figure C. 26. Final logarithmic OLS model excluding irrational respondents, Scenario 1

Source	SS	df	MS
Model	86.3623277	8	10.795291
Residual	977.688638	413	2.36728484
Total	1064.05097	421	2.52743697

Number of obs	=	422
F(8, 413)	=	4.56
Prob > F	=	0.0000
R-squared	=	0.0812
Adj R-squared	=	0.0634
Root MSE	=	1.5386

lwtp1rational	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
education1	.5170049	.2788111	1.85	0.064	-.031061	1.065071
lhouseholdinc	.4253617	.1357963	3.13	0.002	.1584236	.6922998
knowledge	.4660695	.1726116	2.70	0.007	.1267626	.8053764
less5years	.0360789	.3144384	0.11	0.909	-.5820203	.6541781
more5years	.349007	.1805942	1.93	0.054	-.0059915	.7040055
currentsmoke	.2008944	.2133031	0.94	0.347	-.2184007	.6201895
saving	.1262883	.0581548	2.17	0.030	.0119719	.2406047
averseboth	.3560983	.1716405	2.07	0.039	.0187003	.6934962
_cons	.5906244	1.862209	0.32	0.751	-3.069966	4.251215

Scenario 2:

Figure C.27. Final logarithmic OLS model excluding irrational respondents, Scenario 2

Source	SS	df	MS
Model	85.2568249	5	17.051365
Residual	962.128024	423	2.27453434
Total	1047.38485	428	2.44716086

Number of obs	=	429
F(5, 423)	=	7.50
Prob > F	=	0.0000
R-squared	=	0.0814
Adj R-squared	=	0.0705
Root MSE	=	1.5082

lwtp2rational	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lhouseholdinc	.3870854	.1318894	2.93	0.004	.1278452	.6463256
knowledge	.3858501	.1661952	2.32	0.021	.0591788	.7125214
q25	.0113296	.0040733	2.78	0.006	.0033231	.019336
saving	.1366688	.0567767	2.41	0.017	.0250693	.2482684
averseboth	.3588475	.1660357	2.16	0.031	.0324897	.6852054
_cons	1.048301	1.785131	0.59	0.557	-2.460531	4.557132

Appendix C.5 Probit models

Below, probit models are pictured with their corresponding percent correctly classified calculations. The first model is the one determining what factors affects whether respondents have done measures in their current residence to detect indoor air radon concentration or not. The second model is the one determining what factors affect scope. As mentioned earlier, there have been estimated two models for determining factors affecting scope, separating the variables *age* and *economicfuture*. The third model is determining factors affecting respondents not wielding scope.

Figure C.28. Probit model determining factors affecting detection initiatives

```
Iteration 0:   log likelihood = -343.54642
Iteration 1:   log likelihood = -214.64457
Iteration 2:   log likelihood = -209.10423
Iteration 3:   log likelihood = -208.74118
Iteration 4:   log likelihood = -208.73897
Iteration 5:   log likelihood = -208.73897

Probit regression                                 Number of obs   =        586
                                                  LR chi2(8)      =     269.61
                                                  Prob > chi2     =     0.0000
Log likelihood = -208.73897                       Pseudo R2       =     0.3924

------------------------------------------------------------------------------------
               q11 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
         knowledge |   1.365662   .3379042     4.04   0.000     .7033818    2.027942
        feelingexp |   .6471647   .1423811     4.55   0.000     .3681028    .9262266
             age60 |  -.2845755   .1478959    -1.92   0.054    -.5744463    .0052952
    detectprevious |  -.6862789   .3254691    -2.11   0.035    -1.324187   -.0483711
          received |   1.477677   .1591069     9.29   0.000     1.165833    1.789521
     otherresident |  -.3065276   .1593324    -1.92   0.054    -.6188133    .0057581
    knowledgeagree |   .7677558   .4427909     1.73   0.083    -.1000985     1.63561
 knowledgedisagree |   .1121274   .4470052     0.25   0.802    -.7639866    .9882415
             _cons |  -2.689753   .5033184    -5.34   0.000    -3.676239   -1.703267
------------------------------------------------------------------------------------
```

Figure C.29. Probit model determining factors affecting detection initiatives percentage correctly classified

```
Probit model for q11

              -------- True --------
Classified |         D            ~D  |      Total
-----------+--------------------------+-----------
     +     |        98            36  |        134
     -     |        62           390  |        452
-----------+--------------------------+-----------
   Total   |       160           426  |        586

Classified + if predicted Pr(D) >= .5
True D defined as q11 != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   61.25%
Specificity                     Pr( -|~D)   91.55%
Positive predictive value       Pr( D| +)   73.13%
Negative predictive value       Pr(~D| -)   86.28%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)    8.45%
False - rate for true D         Pr( -| D)   38.75%
False + rate for classified +   Pr(~D| +)   26.87%
False - rate for classified -   Pr( D| -)   13.72%
--------------------------------------------------
Correctly classified                        83.28%
--------------------------------------------------
```

Figure C.30. Probit model determining factors affecting scope (excluding age)

```
Iteration 0:   log likelihood = -393.33978
Iteration 1:   log likelihood = -381.55561
Iteration 2:   log likelihood = -381.51666
Iteration 3:   log likelihood = -381.51666

Probit regression                               Number of obs   =        688
                                                LR chi2(4)      =      23.65
                                                Prob > chi2     =     0.0001
Log likelihood = -381.51666                     Pseudo R2       =     0.0301

------------------------------------------------------------------------------
     incwtp2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      rot0te |   .2365355   .1055857     2.24   0.025     .0295915    .4434796
         job |  -.1888065   .1074974    -1.76   0.079    -.3994976    .0218846
      saving |    .110349    .041738     2.64   0.008     .0285439     .192154
economicfuture |   .1231627   .0425514     2.89   0.004     .0397635     .206562
       _cons |  -1.877623   .3137868    -5.98   0.000    -2.492634   -1.262612
------------------------------------------------------------------------------
```

Figure C.31. Probit model determining factors affecting scope (excluding age) percentage correctly classified

```
Probit model for incwtp2

              -------- True --------
Classified |         D            ~D  |      Total
-----------+--------------------------+-----------
     +     |         0             0  |          0
     -     |       178           510  |        688
-----------+--------------------------+-----------
   Total   |       178           510  |        688

Classified + if predicted Pr(D) >= .5
True D defined as incwtp2 != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)    0.00%
Specificity                     Pr( -|~D)  100.00%
Positive predictive value       Pr( D| +)       .%
Negative predictive value       Pr(~D| -)   74.13%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)    0.00%
False - rate for true D         Pr( -| D)  100.00%
False + rate for classified +   Pr(~D| +)       .%
False - rate for classified -   Pr( D| -)   25.87%
--------------------------------------------------
Correctly classified                        74.13%
--------------------------------------------------
```

Figure C.32. Probit model determining factors affecting scope (excluding economicfuture)

```
Iteration 0:   log likelihood = -406.84046
Iteration 1:   log likelihood =  -396.7314
Iteration 2:   log likelihood = -396.70922
Iteration 3:   log likelihood = -396.70922

Probit regression                                 Number of obs   =        712
                                                  LR chi2(4)      =      20.26
                                                  Prob > chi2     =     0.0004
Log likelihood = -396.70922                       Pseudo R2       =     0.0249
```

incwtp2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0088327	.0033953	-2.60	0.009	-.0154874	-.002178
rot0te	.2129422	.1034829	2.06	0.040	.0101195	.4157649
job	-.2128427	.1082986	-1.97	0.049	-.4251041	-.0005813
saving	.0878284	.0421915	2.08	0.037	.0051346	.1705223
_cons	-.7100897	.3545269	-2.00	0.045	-1.40495	-.0152297

Figure C.33. Probit model determining factors affecting scope (excluding economicfuture)percentage correctly classified

Probit model for incwtp2

Classified	True D	~D	Total
+	0	0	0
-	184	528	712
Total	184	528	712

Classified + if predicted Pr(D) >= .5
True D defined as incwtp2 != 0

Sensitivity	Pr(+| D)	0.00%
Specificity	Pr(-|~D)	100.00%
Positive predictive value	Pr(D| +)	.%
Negative predictive value	Pr(~D| -)	74.16%
False + rate for true ~D	Pr(+|~D)	0.00%
False - rate for true D	Pr(-| D)	100.00%
False + rate for classified +	Pr(~D| +)	.%
False - rate for classified -	Pr(D| -)	25.84%
Correctly classified		74.16%

Figure C.34. Probit model determining irrational respondents not wielding scope

```
Iteration 0:   log likelihood = -299.02025
Iteration 1:   log likelihood = -297.05208
Iteration 2:   log likelihood = -297.05016
Iteration 3:   log likelihood = -297.05016

Probit regression                               Number of obs     =        688
                                                LR chi2(5)        =       3.94
                                                Prob > chi2       =     0.5581
Log likelihood = -297.05016                     Pseudo R2         =     0.0066
```

incwtp1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0001931	.0043848	-0.04	0.965	-.0087871	.0084009
rot0te	-.2014401	.1162577	-1.73	0.083	-.4293009	.0264208
job	.0399994	.1251768	0.32	0.749	-.2053426	.2853414
saving	-.0222698	.0445131	-0.50	0.617	-.1095138	.0649743
economicfuture	.0403982	.0546325	0.74	0.460	-.0666795	.1474758
_cons	-.9811993	.5232991	-1.88	0.061	-2.006847	.044448

Figure C.35. Probit model determining irrational respondents not wielding scope percentage correctly classified

Probit model for incwtp1

Classified	True D	True ~D	Total
+	0	0	0
-	108	580	688
Total	108	580	688

Classified + if predicted Pr(D) >= .5
True D defined as incwtp1 != 0

Sensitivity	Pr(+| D)	0.00%
Specificity	Pr(-|~D)	100.00%
Positive predictive value	Pr(D| +)	.%
Negative predictive value	Pr(~D| -)	84.30%
False + rate for true ~D	Pr(+|~D)	0.00%
False - rate for true D	Pr(-| D)	100.00%
False + rate for classified +	Pr(~D| +)	.%
False - rate for classified -	Pr(D| -)	15.70%
Correctly classified		84.30%

Norwegian University
of Life Sciences

Postboks 5003
NO-1432 Ås, Norway
+47 67 23 00 00
www.nmbu.no