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Does Proximity Matter?

A quantitative study of residential return after a hypothetical nuclear accident in Sweden

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Abstract

After observing an unwillingness to return among the residents in Fukushima following the nuclear accident in 2011, the question has been raised whether a similar response to a nuclear fallout should be expected among Swedish residents. One determinant of this response is the geographical proximity of the resident to the nearest nuclear plant. This could be due to differences in risk perception and preferences between residents living close, and farther away from the plant. This study aims to answer if geographical proximity matters for the response among residents in a hypothetical situation of a nuclear fallout, by investigating whether residents living close to a nuclear plant are 1) more likely to return after a fallout, and 2) less likely to express high level of concern for exposure to radioactive substances. To answer these questions, a citizen-panel data has been analyzed by means of an ordered logistic regression model. The findings reveal that residents in close proximity are not more likely to return, yet they are less likely to express high levels of concern which in turn could affect the likeliness to return.

Keywords: Nuclear accident, Geographical proximity, Residential return, Hypothetical scenario, Ordered logistic regression

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1. Introduction

To this day, two nuclear accidents reaching the highest possible value on the seven-grade INES scale have occurred: Chernobyl in 1986 and Fukushima Daiichi in 2011. To avoid health damages due to radiation, residents were evacuated, and expected to return within a short period of time. However, more than thirty years after the Chernobyl accident, residents are still not allowed back home (Yankovska & Hannam, 2014). In contrast, approximately ten months after the Fukushima accident, residents were allowed back to the first safely declared village, Kawauchi (Yamakawa & Yamamoto, 2016). As the ambitious reconstruction work of the Japanese government proceed, larger areas and cities has been declared safe. However, even though levels of radiation are at a safe level, many of the former residents have not wanted to return home (Mukarakami, Ono, and Nakatani, 2015; Zhang, Yan, Oba, & Zhang, 2014)

The recent occurrence of the Fukushima accident and risks it exposed lead to an increased awareness of the potentially severe risks of nuclear power. Three months after the Fukushima accident, Germany decided to enact a nuclear phase-out (Arlt & Wolling, 2016), and a few months later, the European Commission enforced a series of stress tests for the 143 nuclear power plants in Europe (Jorant, 2011). Around the same time, a temporary decrease in trust towards nuclear power was observed in Sweden (MSB, 2014). And in response to these events, the Swedish Contingencies Agency (MSB) initiated a multidisciplinary research project, with the aim to define the best combination of measurement to protect resident from radiation if a nuclear accident would occur in Sweden.

As in the cases of Chernobyl and Fukushima, a likely first course of action in Sweden would be the evacuation of local residents. Since previous studies have shown the unwillingness to return in the Fukushima prefecture, a survey with a hypothetical scenario was conducted within the MSB research project to assess whether similar behavior among Swedish residents is expected – i.e., an unwillingness to return, even though the area had been proven safe for repatriation. Rasmussen, Ewald, and Sterner (2020; forthcoming) have used the survey-data, to show that socioeconomic- and demographic factors affect residents' likeliness to return home. An aspect not explicitly studied by Rasmussen et al., that might affect the residential likeliness to return is geographical proximity to the nuclear power plant among the residents in question. Residents living closer to the plant might express different perceived risks or risk preferences compared to those living more far away and, thereby, be more likely to return. The aim of this study is, therefore, to investigate if Swedish residents' current geographical proximity to a nuclear power plant prior affects their likeliness to return after a nuclear fallout. If the expected response differs across affected areas, it can be valuable information for the ongoing MSB research project in terms of potential measures in case of a nuclear fallout.

Previous literature regarding geographical proximity towards nuclear facilities mostly focuses on awareness and acceptance of the use of nuclear power (e.g., Cale & Cromer, 2015), or how proximity affects risk perception (e.g., Parkhill, Pidgeon, Henwood, Simmons & Venables, 2009). However, there is a shortage of research investigating potential difference in risk perceptions with regards to geographical proximity, and if such differences affect the expressed willingness to move back after case of hypothetical nuclear fallout. If such differences do exist, it could be valuable information for policy-decisions of potential measurements in case of a nuclear fallout, and if these measurements should differ depending on the areas affected. E.g., if the aim from a policy-perspective for an affected area close to the plant should be returning of residents while relocation should be the aim for an area farther away. There is, in other words, a gap in information on how geographical proximity towards nuclear facilities in Sweden might affect resident's response and likeliness to return after decontamination due to a nuclear fallout. This study aims to contribute with quantitative analysis on this issue, by conducting a quantitative analysis on the survey data collected by MSB.

The analysis considers two survey questions, one which captures the likeliness to return, and another that captures level of concern for being exposed to radioactive substances after decontamination. Two variables characterize the resident's geographical position towards a nuclear plant; one that describes if the resident lives in one of the three nuclear regions, and one self-reported variable of the distance in kilometers. These variables will be used in an ordered logit regression model to answer the two hypotheses of this study:

- H1: residents living closer to a nuclear power plant are more likely to return after decontamination due to a nuclear accident compared to residents living farther away
- H2: residents living closer to a nuclear power plant are less likely to express high levels of concern for exposure to radioactive substances after a fallout than residents living more far away

This study makes two main contributions: firstly, the analysis reveals that geographical proximity is not generally significantly correlated to the likeliness to return after a nuclear fallout. Results indicate that proximity may matter when residents live very close, yet further research would be warranted to better assess this relationship. Secondly, this study also finds that residents living in close proximity to a nuclear plant are less likely to express higher levels of perceived concern for being exposed to radioactive substances after decontamination due to nuclear fallout. These findings do not suggest that two affected areas with different distance to the nuclear plant should be treated differently from a policy perspective in terms of actions for residential return after a nuclear fallout.

The thesis is structed as follows. Section 2 provides background information on nuclear power in Sweden, the potential mobility of fallout, and some of the risk of living close to a nuclear power plant. Section 3 presents previous studies in a literature review, followed by a theoretical framework and hypothesis in Section 4. In Section 5, a description of data and variables used will be presented, followed by Section 6 presenting the methodology. This will be followed by the results in Section 7, and the result will be discussed in Section 8. The closing Section 9 will present the conclusions of this study. References and Appendices are to be found at the end of the study.

2. Background

2.1. Nuclear power in Sweden

In Sweden, there are three active nuclear power plants with a total of seven reactors. The three nuclear plants provide approximately 40 percent of the Swedish electricity production (Swedish Radiation Safety Authority, n.d.). As per the result of a highly contested 1980 referendum, the use of nuclear power will gradually be phased out (Swedish Government Offices, 2014) and no further plants are planned for construction.

2.1.1. In case of an accident

If a nuclear accident would occur, the authority with the primary responsibility is the county administrative board. The board will carry out actions plans developed in collaboration with other Swedish authorities. Today, there are inner readiness areas 12-15 km from each nuclear power plant, with an exterior area approximately 50 km from each plant. Within these areas, preparation for evacuation should be available, as well as shelters with indoor stay and access to iodine tablets. The Swedish Radiation Safety Authority (2017) has suggested an extension of the areas and a complementary planning area of 100 km from each plant. If a severe accident would occur, residents in affected areas will be evacuated, and decontamination will most likely need to be performed before residents are allowed back in order to guarantee safe levels of radiation (Länsstyrelsen, 2016).

The three nuclear power plants are located in Uppsala county (Uppsala), Kalmar county (Kalmar) and Halland county (Halland). Henceforth, references to the three counties are done using their unique names Uppsala, Kalmar and Halland. Uppsala is the fifth largest county in Sweden by population, with 378,246 residents (SCB, 2019a) and located approximately an hour north from Stockholm. Almost one third of the inhabitants live in the city Uppsala, famous for one of the country's most established universities. Kalmar is located in the center-South of Sweden along the coastline and has 244,856 inhabitants (SCB, 2019a). Halland has 330,310 (SCB, 2019a) inhabitants and is located in the Southern part of the West-cost, approximately one and a half hour from Gothenburg.

2.1.2. The potential mobility of nuclear fallout

The consequences of a nuclear accident do not only depend on the accident itself. Factors such as the geographical position of the plant, weather conditions, and population density will affect the aftermath of nuclear fallout. For instance, in 1986, wind caused radioactive substances to be transported from Chernobyl all the way to Gävle, Sweden, more than 1,000 km away. In case of a nuclear accident, the surrounding area of the plant is not necessarily the only area affected by the fallout, i.e., not only the residents living close by that might be affected by evacuation and later on; decisions to return or not after decontamination.

2.2. Health risks of living close by a nuclear power plant

For the decision to return or not after a nuclear fallout, it is relevant to consider the health risks associated with living close to a nuclear plant as well as the potential risks of moving back after a fallout. Since the scenario used for this study[1] do not define the level of contamination, this paragraph aims to provides general information on the potential risk of living close by a nuclear plant as the potential risk of moving back to a contaminated area.

[1] The scenario will be more closely described under Section 5, Data description, and the full version can be found in Appendix A1.

2.2.1. Potential cancer risks of living close by

After Black (1984) found an association between childhood leukemia and residential proximity to nuclear plants in Sellafield, studies have been conducted to investigate this issue. In a local cohort study, Spycher et al. (2011) found a weak, yet, similar result in Switzerland. When investigating the same issue in Finland, Heinävaara et al., (2010) does not find any indication that proximity would increase the risk of developing cancer. Another result with no indications was observed by Waller et al., (1995) when investigating the same issue in Sweden. Nevertheless, in a case-controlled study, Kaatsch et al., (2008) find a significant increase in childhood leukemia among children less than five years, living close to nuclear plants in Germany. Those most affected lives within 5 km from the plant. Even though Sermage-Faure et al., (2012) find similar results as Kaatsch et al., in France, Sermage-Faure et al., emphasize that the estimated doses of radioactivity in the vicinity of nuclear plants were very low compared to natural radiation sources. Further conclusions are therefore difficult to state regarding the effect of increased cancer risk and geographical proximity to nuclear plants.

To summarize, previous studies have found a relationship between close proximity to nuclear plants and an increased risk of developing cancer, especially among children. However, it is uncertain how valid this relationship is, and even more so if it is applicable to distances more than 5 km away.

2.2.2. Potential risk of moving back after a nuclear accident

Following the accident in 2011, the Fukushima Health management survey was launched, with the aim to investigate long-term effect of low-dose radiation exposure on residents' health. From the survey conducted, Suzuki et al., (2015) observes a relationship between concern of radiation exposure and psychological distress. To investigate potential development of cancer, whole-body counters were used together with a thyroid ultrasound examination for all children (Yasumura et al., 2012). The first screening cycle (ended 2014) identified 113 cases of thyroid cancer among 300,476 screened children in the Fukushima prefecture (Takamura et al., 2016). Though this is a relatively small number in relation to those affected, it is important to note that cancer due to ionizing radiation at a relatively low-dose exposure develops over time, and it is therefore possible that more individuals will develop cancer due to the Fukushima disaster.

Since the affected areas in Chernobyl until this day remain an exclusion zone (Yankovska & Hannam, 2014), long-term effects among returned residents cannot be observed. Yet, Waddington, Thomas, Taylor and Vaughan (2017) has investigated the aftermath of the Chernobyl accident by comparing safety expenditures against life expectancy in a so-called Judgement value approach. Waddington et al., claim that approximately 74 percent of residents (85 500 individuals) evacuated 1986 would have lost, on average, about 3 months in life expectancy if they would have stayed in their residence instead of being relocated. Thomas (2017) compares this to the average Londoner, who faces an average decrease in life-expectancy of 4.5 months due to air pollution. The physical risks of returning after a nuclear fallout, especially vis-a-vis an increased risk of developing cancer, could thereby be seen as quite moderate. The mental health effect is more difficult to estimate; however, they seem to have an effect on the psychological well-being (Suzuki et al., 2015)

2.3. The MSB research project

To identify the potential consequences and suitable countermeasures in case of a nuclear fallout in Sweden, the Swedish Civil Contingencies Agency (MSB) is managing a multidisciplinary research project in collaboration with the Universities of Lund, Örebro and Gothenburg between 2018 and 2021. The project aims to provide administrative authorities, and decision-makers with information on how to best respond if a nuclear accident occurs, affecting Swedish conurbations. A part of the project investigates the potential responses of residents in the hypothetically affected areas and inquires which factors that might influence their decision to return or to not return after the fallout. To contribute to this analysis, this study will investigate if geographical proximity to the plants affect residents' decision to return or not.

2.3.1. Residents living in the affected area

If a nuclear fallout would occur, potential measures range from permanent relocation of the resident, to full decontamination, which enables residents to return. When considering decontamination, an aspect to account for is the response of the residents living in the affected area. For instance, if it is not likely that residents will return, an extensive decontamination could be difficult to motivate from a policy-perspective. To provide information on this issue, project members from the Universities of Örebro and Gothenburg are working with two articles (Rasmussen et al., 2020; forthcoming). The articles aim to investigate how demographical and socioeconomic aspects affect resident's likeliness to return and stay after performed decontamination and levels of concern for being exposed to ionizing radiation.

2.3.2. Potential differentiate of measures and contributions of this study

Another aspect that could affect the likeliness to return as well as the perceived level of concern is the geographical location of the residents in relation to the nuclear plant. Whether such differences in perceived levels exist is valuable information for decision-makers, as it would allow them to tailor action plans to the area affected. As mentioned in 2.1.2., it is not necessarily only the area close to the plant that will be affected in case of a nuclear fallout. If residents in two affected areas, one area close to the plant and the other farther away, has different likeliness to return due to e.g., different risk preferences, it may be suitable to implement different measures for the two areas from a policy-perspective.

Consider for instance the following. In the scenario that is considered in this study, residents have been living in a temporary housing up to a year, which is a reasonable minimum of time in the light of the Fukushima clean-up (Yamakawa & Yamamoto, 2016). Then if the residents, or a majority of them, do not wish to return after preformed decontamination, policymakers may wish to offer them to convert their temporary housing to permanent, and by that reduce the extent affected areas are decontaminated. If the residents, on the other hand, are expected to return, the preferable policy-decision could be a more extensive decontamination to ensure safe levels of radioactive substances. Yet, resident's response may differ across the affected areas, and to allow decision-makers to differentiate measures accordingly, it is important to know whether this is indeed the case. The purpose of this study is to contribute investigate if the expected response differs between neighborhoods close to, or far away, from the plants. As such, it adds to the aforementioned already ongoing research project.

2.3.3. Limitations of this study

As per previous discussion above, this study aims to provide a quantitative analysis and discussion of the expected response of proximate residents to a nuclear fallout. However, due to the scope of this study, the findings should not be seen as comprehensive enough to base action plans on it, but rather, as a contribution to further research within the field. Another limitation is, that since this study is based on a hypothetical scenario, it potentially suffers from problems such as hypothetical bias; even if the respondent answers the questionnaire as truthfully as possible, the situation is still only hypothetical, and it is not certain they would react and respond the same if this were a true case. However, in order to investigate the residential response to a nuclear accident in Sweden, a stated preference theory is needed. This will be more closely described under limitations of data in Section 5.

3. Literature review

The literature of residential returns after a nuclear accident has mainly focused on the Fukushima prefecture, inquiring which factors affecting the choice to return or not. Some of the main findings are presented in this literature review. In addition, previous studies have investigated geographical proximity to nuclear facilities and attuites of the use of nuclear power, as for perception of risk. A selection of these studies is included in the literature review.

3.1. Residential return after a nuclear accident

Research regarding residential return after a nuclear accident has mostly been centered around the Fukushima Daiichi accident in 2011. Besides the recency of the Fukushima accident, there are difficulties studying potential returning in Chernobyl since the area is still an exclusion zone, forbidding residents to return home (Yankovska & Hannam, 2014). During the third most considerable nuclear power plant accident observed, Three Mile Island in Harrisburg, in 1979, no evacuation order was executed. Residents chose to leave their homes temporarily but were able to return within a couple of days (OECD, 2000). Hence, the case of Fukushima Daiichi is the sole case that can be used to study the ex post willingness to return after a nuclear accident.

After the Fukushima accident, the Japanese government was determined to make the affected areas habitable again, and in the action plan for 2017, the equivalent of 250 billion euros were commissioned for interim storage, decontamination and compensations (Kanamori & Kåberger, 2019). Studies have shown that, despite the large-scale decontamination and reconstruction, many residents are not willing to return home. Murakami, Ono, and Nakatani (2015) evaluate to two surveys conducted shortly after the Fukushima accident, showing that only 30 percent of the former residents of the villages Namie and Katsurao were willing to return after decontamination. Murakami, Ono, and Yasutaka (2013) also found that the number of resident willing to return decreased as time passed since the accident. Likewise, Murakami et al. (2015) conducted a survey study investigating willingness to return home after the Fukushima Daiichi accident. The authors found that fear for negative health effects as a result of ionizing radiation, together with lack of knowledge of radiation and distrust towards government or science, were the most influential factors determining resistance toward repatriation. In another study, Morita et al. (2018) investigate demographic aspects affecting the decision to remain in place after the Fukushima accident. The results reveal that men are more likely to remain in place compared to women, and that those between 40-64 are more likely to stay than those aged 75 or older. Those living together with an elderly (>70) are more likely to remain compared to those who are not, and, those living alone are more likely to remain than those living together with at least another person.

Little research has been conducted regarding residential return after a potential accident in Sweden, investigating whether residents have a similar (expected) response as the resident in Fukushima. Rasmussen et al., (2020) shows that being female, under the age of 60 and living with a child decreases the reported likelihood to return as well as an increase in the perceived level of concern for being exposed to radioactive substances after preformed decontamination in a hypothetical scenario. In Rasmussen et al., (forthcoming) higher education and income is associated with a decreased likelihood to return after a nuclear accident. As for Rasmussen et al., as well as above mentioned research, demographic and socioeconomic aspects seem to matter for the decision to return. Another aspect that appears to affect the likeliness to return is the perceived risk of being exposed to radioactive substances. The perceived risk might have different explanations and affect the decision whether to return or not after decontamination.

3.2. Emotions related to risks

To explain the mechanism behind perceived risks, Slovic, Finucane, Peters and McGregor (2004) developed a framework of the so-called *risk as feelings*, which is referred to as the intuitive and instinctive reactions to danger. Central in the framework is *the affect heuristic*, defined as a process of making judgments of an activity based on not only what the individual thinks about it, but also on how the individual feels about it. If the individual possesses positive feelings, they are more likely to judge the risk as low and the perceived benefits as high – and vice versa for negative feelings. Slovic et al., discuss further that this process, and the judgment of perceived benefits and risks, can be manipulated by providing different kinds of information. As an example, the use of nuclear power is mentioned. If an individual is provided with information that the use of nuclear power will have an overall positive affect, the perceived benefits will increase while the perceived risks will decrease. Slovic et al., also state that in a situation of uncertainty, individuals are more responsive to the possibility of strong positive or negative consequences, rather than the probability of the occurrence for such an outcome.

3.3. Geographical proximity towards nuclear facilities

Previous studies regarding geographical proximity towards nuclear facilities in Europe and North America have mainly focused on local residents' acceptance, attitudes, and support for the use of nuclear power and the new establishment of power plants. Regarding this issue, a common assumption is that residents living close to nuclear facilities would show higher levels of support, due to economic benefits received by the resident, e.g., job opportunities (Parkhill, Pidgeon, Henwood, Simmons & Venables, 2009). Cale and Cromer (2015) observe a positive relationship between geographical proximity and awareness of the existence of close-by nuclear facilities. However, no significant effect between proximity and opinions for the use of nuclear power was observed. In addition, no significant result was found between awareness and opinions of use. So, even if there could be an expectation of more positive attitudes towards nuclear facilities among residents living close by, it is not certain this is reflected in their attitudes regarding the use of nuclear power.

3.4. Risk perception and geographical proximity towards nuclear facilities

Concerning the question of whether geographical proximity to nuclear facilities affects the risk perception of the local residents, Parkhill et al., (2009) find that residents close to nuclear facilities in the UK view the risks associated to living close by as a standard, non-unique situation. Parkhill et al., (2009) argue that this perception is a result of an adaptation process; a process that is carried out through familiarization and, or, normalization, making both the physical presence of the facility ordinary, as well as a potential risk, mainly through social contact and network. Parkhill et al., also find that residents do notice the extraordinary risks of their living. This awareness, which is accompanied by higher levels of concern, seems to be temporary and occurs when the non-ordinary living situation is being paid particular attention. Relatedly, Venables et al., (2012) investigates whether there is a relationship between public risk perception, Sense of a Place (SoP), and geographical proximity towards nuclear power facilities. SoP is defined as the idea of a local identity throughout collective memories, histories, and cultures among the residents. Venables et al., (2012) find a negative relationship between residential proximity towards nuclear facilities and perceived risks, i.e., the perceived risk decreases as the geographical distance to the power plant gets smaller.

4. Theoretical Framework and Hypotheses

The decision to return or not after a nuclear fallout could be described as a decision under uncertainty since the likelihood of a fallout is indefinite. In the scenario survey participants were confronted with, residents had been evacuated to temporary housing while authorities performed decontamination. After decontamination, the levels of radioactive substances are not at a dangerous level, yet, some parts of the neighborhood are still contaminated. Parents are advised not to let their children play in the surrounding natural areas, and activities such as mushrooming are dissuaded.[2] The resident is, therefore, faced with a decision to be made under uncertainty: whether or not to return, where one could face potential health risks due to radiation and restrictions compared to the previous state.

To analyze this decision, and its' dependence whether residents living close to the nuclear plant or further away, a modified version of a framework presented by Nguyen and Leung (2009) will be used. Nguyen and Leung use Cumulative Prospect Theory (CPT) to investigate differences in risk attitude between Vietnamese fishermen and individuals in other occupations. CPT is an economic theory treating decision in an uncertain situation and was introduced by Kahneman and Tversky (1979). Compared to expected utility theory, the classic utility function is replaced with a value function with decision weights instead of probabilities. The theory assigns value to gains and losses rather than final outcomes, and the decision will be relative to the individual's specific situation – the reference point. The use of potential gains and losses, as well as the possibility to use CPT in an uncertain situation, makes it suitable for this framework. So, by imposing a prospect theory approach to the utility function, the following expression is formulated for the utility function, depending on whether the resident chooses to return (option A) or not (option B):

$$U_i = \begin{cases} PT_i^A(\mathrm{D}; \mathbf{X}_i;\ \mathbf{Z}_i) & if\ returning \\ PT_i^B(\mathrm{D}; \mathbf{X}_i;\ \mathbf{Z}_i) & if\ not\ returning \end{cases}$$

In this function, D captures damages, and $\mathbf{X}_i$ is a vector of socioeconomic and demographic characteristics of resident i. The vector $\mathbf{Z}_i$ captures resident i's risk preferences regarding living close to a nuclear plant and moving back to a contaminated area.[3] $\mathbf{Z}_\mathrm{i}$ is assumed to capture the

[2] The full scenario description can be found Appendix A1.

[3] This is a simplified assumption and $\mathbf{Z}_\mathrm{i}$ is not assumed to capture the risk preferences in general, only those who can affect the decision to return or after a nuclear fallout.

perceived extra benefit from returning to the original neighborhood, B, as well as the disutility from returning, γ. To simplify the analysis, the vector $\mathbf{X}$ is assumed to not systematically differ between residents living close to nuclear plants and those living farther away.[4] To observe the probability for the resident to choose option A (reverse order for option B) the following expression is formulated:

$$PR(A) = \{PT_i^A(\mathrm{D}; \mathbf{X}_i; \mathbf{Z}_i) - PT_i^B(\mathrm{D}; \mathbf{X}_i; \ \mathbf{Z}_i)\}$$

In case of a positive sum within the curly brackets, $PT_i^A > PT_i^B$, the resident will value the expected, under prospect theory defined, utility of returning as higher than not doing so. Likewise, if $PT_i^A < PT_i^B$, the resident will choose to not return. To explain how the geographical distance to the nuclear plant might affect the decision to return or not, the decision of returning will first be analyzed in a setting with homogeneous preferences, due to the more simplistic framework. Thereafter, the decision of returning will be discussed in terms of a heterogenous preference setting, both in terms of exogenous- and endogenous preferences.

4.1. Homogenous preferences

By assuming homogenous preferences among residents, it is assumed that all residents have the same preferences (Boxall & Adamowicz, 2002; Costinot, & Kartik, 2007). Hence, the vector $\boldsymbol{Z}_i$ is the same for all individuals. The decision whether to move back or not will, therefore, be solely a function of the damages, *D*, and the socioeconomic and demographic characteristics of resident i, $\mathbf{X}_i$. For this setting, the damages for the area close to the nuclear plant can be assumed more extensive compared to the other affected area. Residents living close to the plants should, therefore, be less willing to move back after decontamination, since they would receive less utility due to the damages compared to the choice to move away.

However, in the scenario, the respondent has not been faced with multiple options regarding the level of damages. The scenario only states that the neighborhood has been affected by the nuclear fallout in ways as described above. Due to this construction, the level of damages can be assumed to be equally extensive, no matter the area's distance to the plant. The damage

[4] An assumption made due to the equal distribution of residents in the three nuclear regions and remaining population in the sample. This can be observed in Table 3, Section 5.

factor in the equation presented can, thus, be assumed constant between the two groups of residents investigated – those living close by and farther away from the nuclear power plant.

Given the assumptions of fixed damages and homogenous preferences, the decision to move back will depend on the socioeconomic and demographic characteristics of the residents. With the previously given assumption of no systematical differences in **X** between the two groups of residents, it can be expected that the proportion of residents choosing option A to be the same. In other words, it can be expected that the same proportion of residents living close to a nuclear plant will choose option A, as residents who live farther away if the socioeconomic and demographic characteristics are assumed to be the same.

However, it might be restricted to assume a setting with strict homogenous preferences (Boxall & Adamowicz, 2002; Mazzocco, & Saini, 2012). The decision to return or not is not a solitary decision due to maximizing perceived utility, but a question of gains and losses in relation to the reference point. If the decision to return is taken with reference to the situation before the accident, the decision will be in terms of potential losses. If the resident moves back, the remaining contamination may cause a potential risk to health and limitation of activities. If the resident, on the other hand, chooses to move, she has to leave everything associated with the original home and might also face a potential economic loss (e.g., lower house prices due to the fallout).[5] Yet, if the decision is set in reference to the current situation in the temporary housing, it is possible to view the decision as a choice of potential gains. If returning, the resident will receive the former home, a permanent living compared to the temporary housing. If choosing not to return, there is a chance of starting a new and permanent life compared to the temporary living situation. It might, therefore, be reasonable to assume that the perceived utility is not only a function of the extension of damages but rather a function of heterogeneous preferences with respect to gains or losses.

4.2. Heterogeneous preferences

With heterogeneous preferences, it is assumed that the preferences differ across individuals (Boxall & Adamowicz, 2002). The preferences for returning or moving should, therefore, depend on the last vector in the presented equation, $\boldsymbol{Z}_i$. The vector captures resident i's risk

[5] The interested reader is referred to e.g. Kawaguchi & Yukutake (2017) and Yamane, Ohgaki, & Asano (2013) for studies of local property values and nuclear contamination after the Fukushima nuclear accident.

preferences regarding living close to nuclear power and moving back to a contaminated area. The preferences can be assumed to differ between the two groups of residents – those living close and far away from the plant, by different reasons, and thereby affect the valuation of potential gains or losses. These potential differences will be discussed in terms of exogenous and endogenous preferences.

4.2.1. Exogenous preferences

The difference in preferences across individuals can be exogenous (Bar-Gill, & Fershtman, 2005; Gerber & Jackson, 1993) and thereby cause individuals to "naturally" choose to settle down and live in different places. To express this, a modification of the model presented by Tiebout (1956) will be used. The Tiebout model describes how different preferences for public goods affect where the resident chooses to settle down.[6] The decision to return after a nuclear fallout can be seen in the light of where the residents chooses to live. For this setting, it can be assumed that few individuals have a preference for living close to a nuclear facility, and that it is more common to have a preference for not living close. Compared to the original model, the decision of living far away from a nuclear plant is not a function of provision of public goods, but rather a subtler factor of the preferences, which can be described as an unwillingness to live close to a nuclear plant. This unwillingness could be due to different factors, such as a relative higher level of risk aversion in general, or higher levels of risk aversion for the specific situation of nuclear power. These preferences should also affect the perceived disutility from moving back to a nuclear contaminated area. The disutility from returning can be captured in a parameter γ, which is defined as the following:

$$\gamma \geq 0$$

The disutility for moving back to the affected neighborhood, γ, can take a value between zero and some infinite number, $\bar{\gamma}$. A more specific version of the previously presented utility function can then be given by the following:

$$U = \begin{cases} C + B - \gamma & Option\ A\ (to\ return) \\ C & Option\ B\ (to\ not\ return) \end{cases}$$

[6] To see the full assumptions for the model, see A Pure Theory of Local Expenditures, by Tiebout (1956).

Where C denotes consumption, which is assumed to be similar between the two groups. The first expression captures the utility if the residents chooses to return, receiving the extra benefit from moving back to the original neighborhood, B, as presented in the first model. If $B > \gamma$, the utility of returning will be greater than the associated disutility. If on the other hand $B < \gamma$, the disutility of returning will exceeds the utility of doing so, and the resident will choose to not return. With the assumption that residents living farther away from a nuclear plant has higher risk aversion in their preferences, it can be expected that they will assign a different value on γ, and thereby be likely to value the potential gains lower and potential losses higher, compared to residents living closer, and thus assign a higher value on γ. With a higher value on γ, it is more likely that B < γ, with the disutility from returning exceeding the benefits. It can, therefore, be expected that the proportion of residents who chooses option A to be higher closer to the plants, given exogenous preferences and the same socioeconomic and demographic characteristics between the two groups.

4.2.2. Endogenous preferences

Preferences are endogenous when they cannot be taken as given but are rather affected by the surrounding environment (Bowles, 1998). Living close to a nuclear plant for instance, could affect residents' preferences. Residents living close to the plant might be used to having a radiation meter in their home or know someone with experience from the plant; the so-called familiarization and normalization process, discussed in Section 3.4. This should be reflected in the resident's preferences, leading to a different valuation of potential gains or losses compared to residents living farther away. This can be captured by the following expression:

$$\gamma = \gamma_0 - \Delta Distance$$

Where γ, as previously, represents the disutility received by the resident if she chooses to return to the contaminated area. However, γ will in this setting not be exogenous given, but a function of γ_0 and the distance to the nuclear plant. γ_0 can be described as the externally given risk attitude, however, compared to the exogenous preferences; γ will not be constant since the resident's preferences change as becomes more familiarized with living close to a nuclear power plant. The effect is assumed to increase the closer to the plant the resident lives. The disutility γ will thereby decrease as the distance to the plant decrease. Residents living in close proximity will thus value the potential gains as higher and potential losses as lower compared to residents living farther away and, therefore, be more willing to return. It can thus be expected that the proportion choosing option A will be higher among residents living closer to the nuclear power plant compared to residents living farther away, if the socioeconomic and demographic characteristics are assumed to be the same between the groups.

To summarize what has been discussed in this theoretical framework: if preferences among residents are homogenous, it can be expected that the proportion of residents choosing option A will not differ between the two groups of residents. However, as discussed in this framework, it is likely that the preferences will differ between the groups. The preferences can thereby be assumed to be heterogeneous rather than homogenous. As discussed above, it is therefore reasonable to believe that residents living in close proximity to a nuclear plant will value the losses as lower and the gains as higher in the decision to return compared to residents living farther away. This will hold independently if the risk preferences are exogenous or endogenous. Hence, it can be expected that a higher proportion of residents living closer to the nuclear plant will chose option A, to return, compared to residents living farther away.

4.3. Hypotheses

By assuming differences in preferences between residents living in close proximity and farther away from a nuclear plant, it is reasonable to assume they will value the potentially gains and losses differently and in the prolongation the decision to return or not. This will be tested by the first hypothesis presented below. The potential differences in preferences might not only affect decisions with a clear outcome (returning or not) but also more subtle aspects. Due to these differences, residents living close to nuclear plants might experience the risk of being exposed to radioactive substances differently compared to residents living farther away. Residents in close proximity might, therefore, express different risk attitudes, which in this case can be the perceived level of concern for being exposed to radioactive substances after performed decontamination. This will be tested by the second hypothesis presented below.

So, to answer this study's research question whether geographical proximity affects likeliness to return after a nuclear fallout, the two hypotheses have been formulated, which follows:

- H1: residents living closer to a nuclear power plant are more likely to return after decontamination due to a nuclear accident compared to residents living farther away

- H2: residents living closer to a nuclear power plant are less likely to express high levels of concern for exposure to radioactive substances after a fallout than residents living more far away

5. Data description

This section will present, describe and discuss the data used in this study. Firstly, a presentation of the survey-set that has been used, followed by descriptive statistics of the sample and a comparison with the national population. After that, the response variables, variables of interest as well as the control variables will be presented. The section will conclude in a discussion of potential concerns of the data and how these concerns will be handled throughout the analysis.

5.1. The survey-set

The data used for this study is, as previously mentioned, survey data, conducted as a Swedish Citizen Panel by the SOM Institute for the multidisciplinary research project run by MSB. The survey was conducted between 22 February 2019 and 28 March 2019 by email to 3,800 participants, of which 2,291 participated.[7] Non-participants received a maximum of three reminders. 1,068 of the participants are from a national probability-based sample, stratified on gender, age and education. The remaining 1,223 respondents are residents living in one of the three nuclear regions in Sweden: Uppsala (573 respondents), Kalmar (204 respondents) and Halland (446 respondents). The sampling of these respondents was stratified on gender. Before the respondents answered the survey, a hypothetical scenario was presented. In the scenario, a nuclear accident has occurred in Sweden, affecting the respondent's vicinity. The respondent has been evacuated, waiting for decontamination to take place, which has now been completed and the respondent is allowed to return. The full scenario description is to be found in Appendix A1. The answers from respondents who took less than five seconds to read the instruction has been dropped from this study, affecting 46 responses.

5.1.1. Descriptive statistics

The Swedish Citizen Panel is one of the most extensive surveys in Sweden. This, together with the stratification on gender, age and education should provide a representative sample of the population. In table 1, the summary statistics for gender, age, education, income and family

[7] This corresponds to 60 percent in participation, which can be compared to the average response rate for national surveys conducted by the SOM Institute; 53 percent for year 2018 (Tipple & Weissenbilder, 2019).

situation of the sample are presented. In table 1, column 3 and 4, the population average is presented as well. To review if the sample can be considered representative, a single sample t-test has been performed to inquire if the sample means is statistically different from the population average.[8]

Table 1: Descriptive variables

	N	%	Mean† or median‡ value	Population (%, unless else given)
Gender				
Male	1163	51,80		50,31 ***
Female	1082	48,20		49,69 ***
Total	*2245*	*100*		*100*
Age				
≤ 40 years	543	25,35		
40-59 years	762	35,57	52 years†	49,3 years ***
≥ 60 years	837	39,08		
Total	*2142*	*100*		
Education				
Upper secondary edu.	544	25,38		29,0 ***
Post-secondary edu.	575	26,83		43,0 ***
University degree	1024	47,78		28,0 ***
Total	*2142*	*100*		*100*
Income				
≤ 37 000 SEK	624	31,79		
37 000 – 74 000 SEK	855	43,56	416 KSEK‡[9]	
≥ 75 000 SEK	484	24,66		
Total	*1963*	*100*		
Family situation				
No child in the household	1552	72,25		69 ***
≥ 1 child	596	27,75		31 ***
Total	*2148*	*100*		*100*

The significant levels are: *** p<0.01, ** p<0.05, * p<0.1.

As can be seen from the table above, the sample cannot be considered representative. From table 1, it is observed that there is statistically significance difference in gender, age and family situation. The slight overrepresentations of male respondents compared to the population (SCB, 2019b) should, however, not have a substantial effect on the internal validity of this study due to the relatively small difference between the sample and the population average. The same can be assumed for family situation with a slight overweight of respondents not living with a child

[8] The tables of the t-tests can be found in the Appendix.
[9] A direct comparison cannot be made. See discussion below for the income-variable.

compared to the population (SCB, 2018a). This overweight may be due to a slightly higher average age, which differs approximately three years from the national population over the age of 18[10] (SCB, 2018b; SCB 2019c). The difference in age is, however, not likely to have a substantial effect on the analysis of this study.

The largest difference observed is education. From Statistics Sweden (2018b; 2018c), 43 percent of the Swedish population has post-secondary education and 28 percent is considered highly educated (corresponding to "university degree" in table 1). The sample thus has an overrepresentation of highly educated respondents as well as an underrepresentation of the middle education segment. To assess whether this affects results, a weighted robustness test will be performed, which is described more detailed in Section 6, Methodology. In the survey, income refers to household gross salary, which unfortunately cannot be compared to household disposable income, as used by Statistics Sweden. It can, however, be observed that the individuals in the sample has a higher income compared to the population (SCB, 2018d). The difference is roughly estimated to be in the neighborhood of 4000 SEK a month. The higher income is in line with the higher level of education. Yet, due to a lack of roper population comparison, a separate robustness test will not be conducted here. As income is correlated with education, the weighted robustness test for education can be considered as a proxy for the income test.

5.1.2 Response variables

The survey consists of 59 questions. Out of those, two questions will be central for estimating the likeliness to return and level of concern for exposure. To measure the likeliness to return, the question *"How likely is it that you would continue to live in your home after it has been declared safe by the authorities?"*[11] was chosen. The question corresponds with four finite answer options, reaching from "Very likely" to "Not at all likely," bellow presented in table 2.

Table 2: Response variables	**N**	**%**
Likeliness to stay in a decontaminated area		
Not at all likely	345	15,79
Not very likely	890	40,73

[10] This limitation has been set due to the fact that the survey was only sent out to Swedish adults.
[11] The questions used for the response variables as for the variables of interest has been translated from Swedish to English by the author of this study.

Somewhat likely	732	33,50
Very likely	218	9,98
Total	*2185*	*100*
Level of concerns for exposure		
To a very small extent	132	6,01
To a somewhat small extent	444	20,20
Neither small nor large extent	348	15,83
To a somewhat large extent	830	37,76
To a very large extent	444	20,20
Total	*2198*	*100*

To estimate concerns of being exposed to radioactive substances after decontamination, respondents were asked: "*To what extent would you feel anxiety for radioactive substances in your home, even though that measurements show that the radiation levels are harmless?".* The respondents were given five possible levels of answers, from "To a very small extent" to "To a very large extent".

5.1.3. Variables of interest

The variables of interest are nuclear power plant regions and geographical distance. The nuclear plant regions are defined as Uppsala, Kalmar, and Halland, with the remaining population as the national control group (named Sweden). Geographical distance - proximity, estimates the geographical distance to the nearest nuclear plant: <20 km, 20-50 km, 60-100 km, >100 km, or Do not know. Those responding, "do not know" have been included even though "do not know" and nonresponses may cause a selection bias if a certain type of respondent chooses not to answer. Fink (2003) describes that nonresponses can be due to the respondent does not know the answer or refuses to answer the question. If one refuses to answer, it is usually because the question is perceived as sensitive. For this case, it might be assumed that the respondent has chosen "Do not know" due to not knowing the geographical distance to nearest nuclear power plant, rather than refusing to answer. By including this group, it enables an analysis of how potential information about distance might affect questions of interest.

Table 3: Variables of interest	**N**	**%**
Nuclear regions and national sample		
Sweden	1043	46,46
Uppsala	567	25,26

Kalmar	198	8,82
Halland	437	19,47
Total	*2245*	*100*
Proximity in km		
< 20 km	70	3,26
20-50 km	328	15,26
60-100	814	37,88
> 100 km	734	34,16
Do not know	203	9,45
Total	*2149*	*100*

5.1.4. Control variables

Due to the previous discussion in 5.1.1., the demographic and socioeconomic characteristics of the respondents are not representative of the population. The descriptive variables presented in table 1 will therefore be included in the econometric strategy as control variables. Apart from the potential effect on representativeness, demographic and socioeconomic variables seem to have an effect in previous studies, e.g., Morita et al., (2018) and (Rasmussen et al., 2020; forthcoming), and should therefore be included as control variables in this study.

In addition, level of government trust and membership in organizations are included as well. In the scenario, it has been specified that authorities are the ones performing the decontamination. Due to this formulation, a respondent trust towards government might affect the response even though it was not specified in the question. Through the questionnaire, the respondent is asked to express their trust in government agencies communicating correct and objective information on a five-point Likert scale. It is the closest to measuring trust for government agencies in general and is therefore included as a control. Membership in sport/outdoor association, environmental organization, political party, and workers union will be included as well, mostly as an effort to capture potential local engagement of the resident.

5.2. Potential issues with the data used

For this study, four potential concerns have been identified regarding the validity of the data. These are presented below together with a strategy to handle them when possible.

5.2.1. Selection bias

A potential issue concerning selection bias could be that a certain type of residents chooses to live in close proximity to nuclear plants. What is aimed to be investigated in this study is if the choice to live close or far away from a plant is due to difference in risk preferences, as discussed in the theoretical framework. However, if the choice of living close or not is made due to other aspect, it could cause a selection bias. This might be the socioeconomic aspects such as income and education, e.g., lower house prices due to close distance to a hazardous facility. If so, residents with lower income might be the ones living in close proximity, which might affect the response to a nuclear accident. This will be controlled for by including income as a control variable together with other socioeconomic aspects.

5.2.2. Omitted variable bias

In addition to the socioeconomic characteristics, there will be aspect that might affect the resident's response to nuclear fallout that is no possible to observe, a so called omitted variable bias. These aspects might be for how long the resident has lived in the neighborhood and level of emotional connection to the area. A person who recently moved in might be assumed less likely to move back compared to another person that has lived in the area for a more substantial period of time. Since no such question has been included in the survey, it is not possible to control for such aspects. In an attempt to control for a local engagement, membership in different organizations are included as control. It might, however, be assumed that these controls will not capture the full effect, arising a potential issue with an omitted variable bias.

5.2.3. Self-estimated variable of interest

Another potential problem is the self-estimation of the proximity (in km) variable. Since the distance in kilometers are self-reported by the respondents, it is not possible to control for if it is accurate. The citizen-panel guarantees anonymity which does not enable to match the respondents to e.g. postal codes to control for, and perhaps fill in the true distance for those who responded, "do not know". If the estimations are highly incorrect, it could provide non-accurate estimation results. E.g., if the estimations from the analysis show that residents living less than 20 km to the plant are very likely to return, when these residents in fact lives 100 km away. However, it might be of more importance what the resident "believes" the distance is rather than their exact position. A resident who answered "20-50 km" can be assumed to actually believe that it is the true distance, and therefore base their decision to return or not on the believed distance, which decreases the potential problems with self-estimated variable of interest.

5.2.4. Hypothetical bias

Another potential problem is the hypothetical bias. Even if the respondent fully understands and follows the instructions of the survey, the nuclear accident described is a hypothetical scenario. Since it is a hypothetical scenario, it can be hard for the respondent to truly picture oneself in the situation (Kolstad, 2011). No cheap talk was included in the survey set-up, encouraging the respondent to answer as thoughtfully as possible, a simple action in the aim of decreasing the hypothetical bias. The implications of hypothetical bias in the context of this study will be more rigorously discussed in Section 8, Discussion.

To conclude, there are potential issues with the data used that may affect the estimations and interpretations of the result. Nevertheless, by conducting the actions described, it is assumed that these potential problems are not likely to affect the final results.

6. Methodology

This section will present this study's empirical strategy. After presenting the empirical strategy, the two models for econometric analysis will be described, firstly the non-parametric analysis followed by the regression analysis. The section will conclude with a presentation a robustness test in which the sample is reweighted according to populations shares.

6.1. Empirical strategy

The empirical analysis is divided into two parts. The first part consists of a non-parametric analysis, to assess whether the mean score in the response variables differ depending on the geographical location of the resident. This analysis will be conducted using a t-test as well as a Mann-Whitney U-test, making no underlying assumption of the data distribution. The non-parametric analysis will provide a first assessment of the relationship between the response variables and the variables of interest. Since this analysis does not account for the control variables, the estimation might suffer from omitted variables, and the analysis will be considered as a first indication of potential differences between the groups. To enable an analysis which does account for the control variables, the second part of the analysis consist of a regression analysis. This provides the opportunity to identify the effect of the variable of interest holding everything else constant. This analysis will thereby address the potential issue with omitted variable bias. To account for categorical nature of the response variables, an ordered logit model is estimated. The main analysis uses an unweighted regression; to assess whether results are sensitive to the non-representative nature of the sample (see Section 5.1.1), a robustness test will be where observations will be weighted.

6.2. Non-Parametric analysis

As a first step of the econometric analysis, a non-parametric test will be performed. A non-parametric analysis makes it possible to test the overall relationship between the response variables and variables of interest without any underlying assumptions of the data distribution (Greene, 2002). A t-test will firstly be used to calculate the mean score of the two response variables; likeliness to return and level of concern, over each of the variables of interest; nuclear regions and proximity in km. Secondly, a Mann-Whitney U-test will be performed to identify if there is significant differences between the groups. By performing these test, it will be determine whether there is significant difference between the mean score in likeliness of returning and levels of concerns among the three nuclear regions compared to the national sample, and among those living less than 100 km to a nuclear power plant compared to those living farther away and those not knowing the distance to the nearest plant. For these tests, the variables need to be binary. Those responded living more than 100 km away has therefore been grouped together with those responded “do not know” since those not knowing their distance to the nearest plant might be assumed to not be the ones in the closest geographical proximity. The control variables will, as described above, not be included in the non-parametric analysis.

6.3. Regression analysis

The second part of the econometric analysis consist of a regression analysis. As a first step of a regression analysis, a least squared estimator is generally prefeed due to its relatively simple interpretation. However, for this study, with survey-questions with finite answer options, the dependent variables are categorical. When facing a dichotomous dependent variable, a probability model is preferred over a least squared estimator since the assumptions for OLS are violated when a non-interval dependent variable is used (Park, 2005). If a linear model would be used, it may provide unbounded predicted values for the dependent variable as well as possible unlikely outcomes due to the linearity in probability. A linear model used on a discrete distribution could also provide specification errors due to a high degree of heteroscedasticity (Stock & Watson, 2015). So, in case of categorical dependent variable, conditional probabilities, such as logit and probit, are a more suitable method compared to OLS, since OLS can no longer give the best linear unbiased estimator (Park, 2005).

The categorical dependent variables follow a meaningful ordinal order (Torra, Domingo-Ferrer, Mateo-Sanz & Ng, 2006), e.g., “To a very small extent” to “To a very large extent”, making a multinomial logit or probit regression model unsuitable. This since such a model will not account for the ordinal nature of the variable (Greene, 2002). To ensure to account for the ordinal nature, an ordered logit or probit model is most appropriate (Williams, 2018). The choice between ordered logit or probit is often described as a matter of taste due to different interpretations of the coefficients from different distribution functions. In the light of this discussion, ordered logit has been chosen as the regression model for this study, a suitable method for a categorical dependent variable on an ordinal scale (Hanushek & Jackson, 1977).

6.3.1. Model specification

The regression equation below will be used to analyze whether geographical proximity to a nuclear power plant affects residents 1) likeliness to return, and 2) level of concern for being exposed to radioactive substances despite safely declared levels.

$$Y = \beta_0 + \mu_R + \mu_P + \beta x_i + u_i$$

Where Y is the dependent variable, representing either the likeliness to return or levels of concerns for being exposed. The vector μ_R captures the three nuclear regions with the national sample as reference group, while the vector μ_P represents proximity in km, with the distance > 100 km as reference group. βx_i represents the control variables, presented in 5.1.4., which captures socioeconomic, demographic and local engagement aspects. u_i is the error term. Table A2:1 in Appendix A2, presents a full overview of variable abbreviations and descriptions.

To obtain a first indication whether living in one of the nuclear regions affects the likeliness to return, μ_R will first be analyzed separately with the dependent variables in model 1. In model 2, the control variables are included in order to isolate the effect of living in the regions. To inquire if it is not living in the regions, but rather if it is the distance that affects the dependent variable, μ_P will be analyzed in the same way as μ_R; first separate with the dependent variables (model 3) and then together with the controls (model 4). To control for geographical distance within the regions, e.g., if all respondent who live less than 20 km from nearest plants lives in Uppsala, both μ_R and μ_P will be included in model 5, providing an indication of the effect of residents location. In model 6, the joint analysis of μ_R and μ_P will include the control variables to isolate the effect of the geographically location of the resident.

For the first dependent variable, likeliness to return, an extra analysis will be conducted, including μ_R and μ_P as well as the other dependent variable; level of concern. This to see how the perceived concerns might affect the likeliness to return, isolating the effect of geographical distance as well as the other control characteristics. Since the coefficient in the output of an ordered logistic regression only can be interpreted by sign and not size, the marginal effect will be estimated as well. It is the average marginal effect (AME) that will be estimated, since Williams (2020) suggest it is a suitable choice for categorical dependent variables.

6.3.2. Model explanation and modification

An ordered logit regression uses the independent variables to predict the likely response to the dependent variables. For the model to provide unbiased estimates, the data need to meet the proportional odds assumption, meaning that the logarithm of differences between the consecutive odds is constant, i.e., the odds form an arithmetic series (Wooldridge, 2010). In practice, this implies that the relationship between categories are the same for all categories; a more extensive discussion of the assumptions is to be found in Appendix A2. If this assumption is not satisfied, a modification of the model can be used, called generalized ordered logit.[12] A generalized ordered logit relaxes the assumption of proportional odds, and may therefore provide a more correct and complete estimation (Williams, 2006). To test the proportional odds assumption, a likelihood ratio-ratio test is conducted, with the null hypothesis of no differences in the coefficient between models. A significant result then mean that the proportional odds assumption is violation. In table 4 below, the four main models are presented with the dependent variable on the x-axis, coefficients, standard errors (in parenthesis) and the corresponding p-value for the model. As can be observed at the last row in column 1, table 4, the null hypothesis is rejected for the model including likeliness to return together with regions (p-value =

[12] The interested reader is referred to Williams (2006) *Generalized ordered logit/partial proportional odds models for ordinal dependent variables,* for a more thoroughgoingly discussion of the construction of generalized ordered logit regression, as well as comparison with the ordered logit regression model.

0.0123)[13], which indicates that the ordered model may provide incorrect, incomplete or misleading results. To overcome this issue, a generalized ordered logit can be used instead.

Table 4: Likelihood-ratio test

	1) Likeliness to return	2) Level of concern		3) Likeliness to return	4) Level of concern
Uppsala	0.302	- 0.246	20-50 km	- 0.395	0.245
	(0.119)	(0.117)		(0.245)	(0.246)
Kalmar	0.270	- 0.135	60-100	- 0.348	0.107
	(0.162)	(0.154)		(0.232)	(0.234)
			> 100 km	- 0.437	0.246
Sweden	0.09	0.035		(0.232)	(0.235)
	0.107)	(0.104)	Do not know	- 0.419	0.777
				(0.257)	(0.259)
P-value	0.0123	0.8338	P-value	0.3747	0.1434

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

In the light of the above, the models including regions, with likeliness to return as dependent variable, will additionally be estimated using a generalized ordered logit. As the differences in the results found using the generalized ordered logit and standard ordered logit model are small, and the ordered logit is more straightforward to interpret, results for the standard ordered logit model are presented in the text. The additional estimation results for the generalized ordered logit model can be found in table A3:7 in Appendix A3 and is shortly presented in Section 7.

6.4. Robustness test

Following the discussion in Section 5.1.1., there is an overrepresentation of highly educated respondents compared to the national sample. Since it is possible that level of education is correlated with the likeliness to return as well as the levels of concerns, which in turn could affect the external validity, a robustness test will be performed, wherein the endogenous weights are assigned to observations. More specifically, the weight will equal using the inverse share of being sampled, enabling to follow the proportions of the population (Dupraz, 2013). As an example, if a population contains an equal share of males and females, yet, a sample drawn from that population contains 25 percent males and 75 percent females, the weighted robustness test will assign the inverse probability. Hence, males will be counted three times and the females only once. The assigned weight will thereby ensure that the weighted sample properties follow the population properties. The same process will be applied for level of education in this study's weighted robustness test, where the different levels of education will be assigned a weight, so

[13] The full tables can be found in Appendix A2

it follows the population proportions presented in 5.1. 1.. The test will be applied on the ordered logit regression models to verify if the findings are affected when the assumptions of education changes.

7. Results

In this section, the results of the study are presented. The results are structured in three sections; non-parametric-, regression- and robustness analysis. The tables from the non-parametric analysis and robustness analysis can be found in Appendix A3. A shortened version of the regression result is presented, where the full tables can be found in Appendix A3 as well. Under 7.2., Regression analysis, the result from the generalized ordered logit regression and the extra analysis of level of concern's effect on the likeliness to return are presented as well. The result will be more rigorously discussed in the following section 8, Discussion.

7.1. Non-parametric analysis

The question of likeliness to returning after preformed decontamination reaches from "not at all likely" to "very likely". In this four-point Likert scale, respondents in the national sample report a mean score of 2.35, while the residents in the nuclear regions has a mean of 2.40. To compare the two groups, a Mann-Whitney (MW) test is conducted, reporting a non-significant difference between the groups (MW p-value = 0.215). This indicates there are no differences in reported likeliness to return between residents in the nuclear regions and the remaining population. When investigating whether the distance in km affects the likeliness to return, respondent living less than 100 km from the nearest nuclear plant presents an average score of 2.40 compared to the mean of 2.34 for the respondents living more than 100 km away and those responding, "do not know". There is not a significant difference (MW p-value = 0.247), indicating that geographical proximity to the nearest nuclear plant is not correlated with the likeliness to return.

Regarding the question of perceived concerns for radioactive exposure, the national sample has a mean of 3.52 at the five-point Likert scale, compared to the three nuclear regions with a mean of 3.41. The difference is statistically significant (MW p-value 0.024), indicating that perceived levels of concerns are lower for the residents in the nuclear regions compared to the remaining population. For the proximity in km, those living less than 100 km from the nearest nuclear plant reports a mean score of 3.40 compared to those living more than 100 km away and those responded "do not know", which corresponds to a mean of 3.53. The difference between the groups is again significant (MW p-value = 0.005), which indicates that geographical proximity is linked to higher levels of perceived levels of concerns.

The non-parametric analysis indicates that the geographical location of the resident in relation to the nearest nuclear plant matter for the perceived level of concern; closer distance is associated with lower a level of concern. Although, no such relationship is observed for the likeliness to return. To enabling an inclusion of the control variables to further deepen the analysis, the regression analysis will be conducted.

7.2. Regression analysis

In the regression analysis, six models have been used for the likeliness to return as well for the level of concern. The models follow the structure described under 6.3.1. A feature of the ordered logit model is that estimations will be relative to the reference group. For the nuclear regions, the remaining population is the reference group, and residents living more than 100 km away is the reference group for proximity in km. As described under 6.3.1., coefficient in the ordered logit will only be interpreted by the sign and not size, since the sizes has no meaningful interpretation in this context. The estimation results are presented in table 5 and 6. The tables omit the regression coefficients for the control variables, signaling only if they are included (Y) or not (-). The full tables can be found in Appendix A3.

7.2.1. Likeliness to move back after a nuclear fallout

To assess if living in one of the nuclear regions have an effect on the likeliness to return, model 1 is estimated, without the control variables. This gives a positive and significant effect (p-value = 0.027) for Uppsala. This indicates that residents in Uppsala would be more likely to return compared to the national population. To see if this effect remains when controlling for socioeconomic, demographical and local engagement, the control variables is included in model 2. With the controls included, Uppsala is still positive and significant (p-value = 0.026), and the marginal effect shows that living in Uppsala decreases the probability of answering "not at all likely" by 3.3 percentage point on the question of likeliness to return, compared to the national base-sample[14]. These results indicate that residents in Uppsala are more likely to return

[14] The tables of marginal effects can be found in Appendix A3, table A3:12 and table A3:13

compared to the remaining population. The other two regions, Kalmar and Halland, are not significant in either model 1 or 2.

To investigate if it is the geographically distance, rather than the regions, that affect the likeliness to return, a first indication is provided in model 3, where the proximity in km is included without the controls. As can be observed in table 5, residents living less than 20 km to the nearest nuclear plant are more likely to return (p-value = 0.071) compared to resident living more than 100 km away. When adding the controls in model 4 in ordered to isolate the effect of the geographical distance due to above mention aspect, the significance is lost (p-value = 0.152), indicating parts of the effect may be captured by other characteristics.

To control for the relationship between regions and geographical distance in km, both variables are included in model 5, giving a first indication with no controls included. In model 5, living in Uppsala (p-value = 0.072) as well as living less than 20 km from the plant (p-value = 0.025) are positive and significant. In order to see if this relationship holds, the control variables are included in model 6, in which Uppsala is still significant (p-value = 0.054), while proximity in km loses the significant effect. This indicates that the observed increase in likeliness for returning among residents in Uppsala is still significant when controlling for geographical distance as well as socioeconomic, demographic and local engagement aspects.

Table 5: Regression results – Likeliness to return

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Uppsala	0.212**	0.271**			0.186*	0.255*
	(0.096)	(0.122)			(0.104)	(0.133)
Kalmar	0.180	0.179			0.096	0.144
	(0.156)	(0.191)			(0.168)	(0.203)
Halland	-0.090	0.023			-0.209	-0.101
	(0.108)	(0.139)			(0.133)	(0.166)
< 20 km			0.437*	0.401	0.584**	0.477
			(0.242)	(0.280)	(0.260)	(0.298)
20-50 km			0.042	0.170	0.137	0.212
			(0.122)	(0.143)	(0.141)	(0.165)
60-100			0.089	0.084	0.061	0.025
			(0.093)	(0.113)	(0.104)	(0.125)
Do not know			0.017	0.245	-0.006	0.221
			(0.145)	(0.183)	(0.147)	(0.186)
Controls	-	Y	-	Y	-	Y
Observations	2,185	1,620	2,143	1,620	2,143	1,620
Pseudo R sq.	0.002	0.036	0.001	0.036	0.003	0.037

Standard errors are in parenthesis
*** *p<0.01*, ** *p<0.05*, * *p<0.1*

As can be seen from the full model estimation in Appendix 3, table A3:5, gender, age, education and governmental trust affect on the likeliness to return after a nuclear fallout. Being female is associated with a less likeliness of returning compared to males. Residents 60 years or older are more likely to return compared to those aged 40 or younger. Higher education is associated with a decreasing likeliness to return. The marginal effect of having a post-secondary education is associated with 2.2 percentage point less likeliness of choosing the option "very likely" to move back, compared to those with upper secondary education in model 6. For the average person with a university degree, the marginal effect is 6.9 percentage point less likeliness for the same levels in model 6, significant at a 90 percent level. The relationship is similar throughout model 2 and model 4 as well. Governmental trust is negative and significant throughout all models. The reference group are those stated to trust the governmental agencies to communicate correct and objective information to a very small extent. The average person trusting the agencies the most (to a very large extent) has a marginal effect of 11.9 percentage point less likeliness of choosing "very likely" to return in model 6. In addition, trade-union members seem less likely to return; the estimated coefficient is negative and significant across all models including the controls.

7.2.2. Generalized ordered logit regression analysis

To assess whether the failure to satisfy the proportional odds assumptions affects the ordered logit results, a generalized ordered logit regression analysis has been conducted.[15] The analysis provides a similar result for Uppsala as observed above, as well as a positive and significant effect for Kalmar, meaning that residents in Kalmar are more likely to return compared to the national population. This effect holds when the control variables is included, however, decreases when geographical distance is controlled for. This indicates that the ordered logit model likely provides a conservative estimate. Two of three regions seem therefore to have an effect on the likeliness to return. However, this is not sufficient enough to draw a general conclusion that the residents in the nuclear regions would be more likely to return.

7.2.3. Level of concern for being exposed

To inquire if the geographical location of the residents affects the perceived level of concern for radioactive substances despite safe levels, the region variable is firstly analysed with the dependent variable in model 1, proving a negative and significant effect (p-value = 0.003) for

[15] The table can be found in Appendix A3, table A3:7

Uppsala. This indicates that residents in Uppsala are less likely to be in a higher category of concern compared to the national population. To see if this effect holds when controlling for socioeconomic and demographic aspects as well as local engagement, the control variables are included in model 2. Uppsala is still negative and significant (p-value = 0.002), and the marginal effect shows that living in Uppsala increases the likeliness of choosing "to a very small extent" by 2 percentage points on the question of concern, compared to the national base-sample. Kalmar and Halland are also negative, however, not significant.

To determine whether the geographical distance effects the levels of concerns, the proximity variable is firstly analysed without controls in model 3. The model reports a positive and significant effect (p-value = 0.000) for the "do not know", which indicates that residents not knowing their distance to the nearest nuclear plant to be more likely to express higher level of concern. However, when including the controls in model 4, the effect is lost, an indication that the effect may be mediated by other characteristics. In model 4, residents living closer than 20 km to the nearest plant is negative and significant (p-value = 0.082), indicating that resident living closer are less likely to express higher levels of concerns compared to those living more than 100 km away, holding everything else constant. The marginal effect shows that living less than 20 km away decreases the likeliness to choose "to a very large extent" by 7.5 percentage points compared to living more than 100 km away.

To control for the relation between regions and proximity, both of the variables are included in model 5. The model shows that Uppsala is still negative and significant (p-value = 0.029) while the "do not know" is positive and significant (p-value = 0.000). When the controls are included in model 6, the significance for the "do not know" is decreased (p-value = 0.068). Uppsala is still negative and significant (p-value = 0.007) and residents living less than 20 km to nearest plant is negative and significant (p-value = 0.048). This indicates that residents in Uppsala as well as residents living close to a plant are less likely to express higher levels of concern, while those not knowing the distance seem to be more likely to express higher level of concern.

Table 6: Regression results – Level of concern for being exposed

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Uppsala	-0.281***	-0.386***			-0.228**	-0.357***
	(0.095)	(0.123)			(0.104)	(0.132)
Kalmar	-0.171	-0.181			-0.016	-0.103
	(0.135)	(0.170)			(0.148)	(0.181)
Halland	-0.035	-0.008			0.101	0.150
	(0.105)	(0.134)			(0.124)	(0.155)
< 20 km			-0.246	-0.520*	-0.313	-0.624**
			(0.268)	(0.299)	(0.278)	(0.316)
20-50 km			-0.004	-0.094	-0.055	-0.170
			(0.119)	(0.142)	(0.134)	(0.161)
60-100			-0.140	-0.105	-0.098	-0.037
			(0.091)	(0.112)	(0.104)	(0.124)
Do not know			0.531***	0.314	0.559***	0.354*
			(0.150)	(0.193)	(0.151)	(0.194)
Controls	-	Y	-	Y	-	Y
Observations	2,198	1,624	2,148	1,624	2,148	1,624
Pseudo R sq.	0.001	0.043	0.004	0.043	0.005	0.045

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

A similar pattern from the full model estimation in Appendix A3, table A3:6, can be observed for the control variables as in the question of likeliness to return. Females express a higher likeliness of being at a higher level of concerns compared to males. Having at least one child in the household increases the likeliness of higher concern compared to residents without a child. Those with post-secondary education seems to be more likely to express higher levels of concern compared to those with only upper secondary school level. There is, however, no finding of a linear effect of education on level of concern, since university degree is not significant. As for governmental trust, all of the levels are positive and significant throughout models. So, compared to those with little trust, these individuals are more likely to express higher levels of concern for being exposed. Members in a political party does also seem to express higher levels of concern for being exposed, which is positive and significant throughout all models including the controls.

7.2.4. The effect of level of concern on the likeliness to return

To assess how the perceived levels of concerns may affect the likeliness to return after decontamination, a separate analysis of the models presented in table 5 has been conducted, including the level of concern as an independent variable. As can be observed from table A3:8 in Appendix A3, levels of concerns have a negative and statistically strong effect throughout all models. This means that higher levels of perceived concern decrease the likeliness to return.

The effect holds when controlling for the residents geographically location as well as socioeconomic and demographic aspects, as for local engagement and governmental trust. It can also be observed from table A3:8 that the significant effect of Uppsala is lost across all models. This indicates that the level of concern could explain the geographical effect on the likeliness to return. In other words, the level of concern could be a more significant factor of the likeliness to return, which, in turn, is affected by the geographical proximity to the nuclear plant.

7.3. Robustness analysis

The regression analysis established that residents in Uppsala are more likely to return compared to the remaining population, and a similar result is observed for residents in Kalmar throughout the generalized ordered logit model. The coefficient for those living less than 20 km to the nearest plant is only significant when the controls are not included. Regarding the level of concern; residents in Uppsala are less likely to be in a higher category of concern. The same applies to residents living less than 20 km in two out of four models. The "do not know" seem more likely to express higher levels of concerns compared to those living more than 100 km away.

A potential issue with the findings from the regression analysis could be that the level of education in the sample is substantially higher compared to the population. As can be observed from table A3:5 and A3:6, Appendix 3, higher education decreases the likeliness to return and increases the perceived concerns. This could be a significant factor that drives the results, which would affect the external validity of this study due to the non-representative sample. One way to overcome this problem is to adjust the weight of education characteristics so it follows the proportion of the population, by conducting a weighted robustness test. The test[16] has been conducted for all of the models presented in table 5 and table 6. With the characteristics adjusted, living in Uppsala still significantly increase the likeliness to return across all specifications, except specification 5, where the controls are not included. However, for proximity in km, residents living less than 20 km to the nearest nuclear plant is now positive and significant in all models. For the level of concern, the test confirms the findings for residents in Uppsala, while the residents living less than 20 km to a plant are now significant in all models.

[16] The full tables can be found in Appendix A3, table A3:10 and table A3:11

The robustness analysis, therefore, show that the findings from the ordered logit analysis for residents in the nuclear regions are consistent when the characteristics of the sample is adjusted to the population level of education. The characteristics of education are thus not the driven factor behind the results and the non-representative sample does not seem to affect the outcome. However, the test shows that the findings for residents living less than 20 km to the nearest plant are likely to be underestimated in the ordered logit regression analysis. This indicate that residents living closer to a nuclear plant are more likely to return. However, due to the non-consistency in the regression analysis, it is not sufficient enough to draw a general conclusion that this is the true case. This issue will be further discussed in the following section 8, discussion.

8. Discussion

In this section, the regression results will be discussed in relation to the two hypotheses: if residents who live closer to a nuclear power plant will 1) be more likely to return after performed decontamination, and 2) be less likely to express higher levels of concern for exposure to radioactive substances. The findings will also be discussed in terms of policy implications, hypothetical bias and future research.

8.1. Likeliness to return

From the non-parametric as well as the regression analysis, no general relationship between the nuclear regions and an increase in likeliness to return is observed. This mean that the hypothesis of likeliness to return cannot be confirmed given nuclear regions. However, as observed from table 5, residents in Uppsala are more likely to return after decontamination compared to the remaining population. This could be a confirmation of differences in risk preferences: that residents in Uppsala have either chosen to settle down in the area due to less unwillingness to live close to a nuclear plant (exogenous preferences) and therefore more likely to return. They could also be affected by the surrounding environment (endogenous preferences), perhaps throughout the familiarization or normalization process, which increases the likeliness to return. There is, however, not a definite explanation to why this effect is observed in Uppsala and not in the other two regions.

A potential explanation could be that residents in Uppsala differ compared to the other two regions due to socioeconomic aspects. Since Uppsala has one of the largest universities in Sweden, it might be a reasonable explanation that the residents, on average, are more highly educated compared to the other two regions and the remaining population. However, the effect for Uppsala persist when education and other socioeconomic aspects are controlled for (models 2 and 6, table 5) as in the robustness analysis. Another explanation that Uppsala differs compared to the other two regions could be differences among the regions that is not possible to control for. As discussed under 6.2.2., omitted variables bias could arise from emotional connection to the area. For instance, there might be cultural or general attitude differences between the regions, which affect the response to return and cannot be explained by differences in risk preferences.

The generalized ordered logit confirms the result for residents in Uppsala and does also shows a similar effect for residents in Kalmar. This indicates that the findings from the standard ordered logit analysis are likely to be underestimated, rather than overestimated or incorrect. It is, however, not sufficient to draw a general conclusion that living in a nuclear region would increase the likeliness to return.

The non-parametric as well as the regression analysis do not provide a significant difference in the likeliness to return between residents living close (in km) to a nuclear plant and those living farther away. As can be observed from table 5, a positive and significant effect is found for those living less than 20 km away in model 3, 5 and 7, when the control variables are not included. This signals that parts of the effect are captured by other characteristics. Another explanation could be, since those living less than 20 km away are such small part of the total sample (70 observations; 3,26 percent), the significance might be lost when the controls are included due to the few numbers of observations. Another analysis with a different sample is needed to confirm if that is the case. However, as shown in the robustness analysis, residents living less than 20 km to the nearest plant are more likely to return compared to those living more than 100 km away when level of education is adjusted for. The robustness test, together with the significance for the models with no controls, does indicate that residents living closer to a nuclear plant are more likely to return after decontamination. However, due to the non-consistency across specifications in the regression analysis, table 5, the result presented is not sufficient enough to confirm the hypothesis.

8.2. Level of concern

The non-parametric analysis indicates that living in the nuclear regions matter for the levels of perceived concern. As can be observed from the regression analysis, table 6, residents in Uppsala are less likely to express higher levels of concern for being exposed to radioactive substances compared to the remaining population. Since no significant effect is observed for the other two regions, it is reasonable to assume it is for the same reasons as discussed above; either due to different preferences across resident or some unobservable factor across regions. As for the likeliness to return, it is not possible to draw any general conclusion that residents in the nuclear regions would be less likely to express higher level of concern compared to the remaining population.

As indicated by the non-parametric analysis, distance to the nearest nuclear plant seems to matter for the levels of concerns. From table 6, residents living less than 20 km to the nearest nuclear plant shows less likeliness to express higher levels of concern compared to those living more than 100 km away. This effect is significant when controlling for socioeconomic and demographic aspect as well as local engagement and governmental trust, which confirms the hypothesis that distance matter for perceived level of concern. From table 6, it is also observed that residents who responded “do not know” are more likely to express higher level of concern compared to those living more than 100 km away. As mentioned under 6.2., those not knowing their position relative to the plant can be assumed to live more far away, which confirms the results for those living in close geographical proximity. These findings indicate that the effects discussed in the theoretical framework; that residents living in close to a nuclear plant will value the risk as lower and the gains as higher in the decision to return compared to residents living farther away, could be accurate for residents living in close proximity (< 20 km). It does, however, only seem to be accurate for a small distance, and not wider areas such as the region of the plant.

From the separate analysis with perceived concern’s effect on the likeliness to return, it can be observed from table A3:8 that level of concern has a strong negative effect throughout all models. This indicates that a higher level of concern decreases the likeliness to return, which could be a confirmation that higher risk preferences lead to a decrease of the likeliness to return. As presented in 7.2.4., the significant effect of living in Uppsala is lost in this separate analysis. An explanation for this could be that the effect of geographical distance on the likeliness to return is a result of the perceived level of concern. However, as discussed above, residents living closer to a nuclear plant express lower levels of concern, which may be due to exogenous- or endogenous preferences, which value the potential gains of returning as higher and the potential losses as lower compared to residents living farther away. It could also be due to, as previously discussed, the familiarization and normalization process. Therefore, the geographical distance to the nearest nuclear plant seems to affect the level of concern, which, in turn, affects the likeliness to return.

8.3. Policy implications

As discussed under 2.3.2., a significant difference in responses between areas close to, or far away from, the nuclear plant could imply that policy measures should differ depending on the area affected. From the results presented, the significant effect of the variables of interest is small. So, even if a difference is observed, it should not be seen as comprehensive enough to base action plans on it. The results from this study cannot, therefore, motivate that different areas should be treated differently from a policy perspective in terms of residential return after a nuclear fallout. Also, the effect found for the distance in km, shows that the resident has to live very close in order to see an effect or indication. There is no observed effect for the next level, 20 – 50 km, which indicate that the effect only is accurate for the smallest distance and cannot be applied to larger areas close to the nuclear plants.

An additional aspect to the likeliness to return is potential group effects. The respondent has answered the survey independent of the response of others. In the survey, a question asking the respondent the likeliness to return depending on others decision to do so, showing that if more people choose to move, the likeliness to return decreases. In what way this group effect might influence the likeliness of return is beyond the scope of this study, but with this aspect in mind, it is likely that the observed likeliness to return is underestimated rather than overestimated.

If the chosen policy would be to make residents move back after decontamination, decision makers should consider putting effort into decreasing the perceived level of concern. This since the perceived concerns seem to have a strong effect on the likeliness to return and could have an accumulated effect due to potential group behavior. Since the effect of concerns on the likeliness to return has not been the primary focus of this study, further investigations are needed to establish a more exact estimation, however, the findings do indicate that a decrease in concerns could improve the likeliness to return. This might be due to that the individual make risk judgement on not only how they think about it, but also how they feel as discussed by Solovic et al., (2004) in the literature review. In addition, the risk judgement can be affected by different provision of information, confirmed by the higher level of concern among those responding, “do not know”. Providing accurate information should therefore be of importance, together with communication with an aim to decrease general concerns for being exposed to radioactive substances. In line with this, as table A3:5 and table A3:6 shows in Appendix 3, there is a negative effect on both likeliness to return and level of concern among those responding to trust governmental agencies to communicate objective and accurate information the most. One might assume the opposite direction, and future studies might want to investigate this further in terms of defining a good communication strategy.

8.4. Hypothetical bias

As described under 5.2.4., a concern arising when facing scenario-based survey is hypothetical bias. The scenario describes a temporary living situation that has been lasting up to a year, before the respondent has to face the decision whether to return or not. In an ideal situation, the respondent will take decision with this as the reference point – the situation after the nuclear fallout. However, due to difficulty to imagining a hypothetical scenario, the respondent might have the original situation, before the accident, as the reference point. Depending on which situation that is the reference point for the resident, it will be a decision of gains or losses – with the scenario situation, moving back is a gain, otherwise, it is a loss. It cannot be certain that the respondent has evaluated it in the same way, which should be considered a hypothetical bias. However, it might be assumed that this valuation will not systematically differ between the respondent living closer to a nuclear plant or more far away and therefore not affect the result in a significant matter.

The scenario presented is adjusted after a severe nuclear fallout, with one year in a temporary living and nuclear remarks after decontamination. It is possible that the effect of geographical proximity observed would have been more visible if a lower level of contamination, due to a smaller fallout, was presented. There might in other words be a threshold for which aspects affecting the likeliness to return and level of concern decreases in influence. For future research, this can be investigated by using different levels of contamination to see if such thresholds exist.

8.5. Future research

In a development of this study or for future research in the field, it would be interesting to more closely study the potential group effects and how it can affect the individual's decision to return or not after a nuclear fallout. This could be analyzed in light of geographical proximity, or other aspects as well. If this effect would be proven strong, it should be an essential part of policy decision regarding the options after a nuclear fallout. It is of importance to investigate on how to best communicate with the residents, and in what way information could decrease perceived level of concern for exposure.

In the scenario used, the exact amount of decontamination has not been defined, only described in how it may affect the everyday life. For future research, a choice experiment or similar, providing different levels of contamination in the neighborhood would be relevant. By including different options, it would enable an analysis of a potential threshold from which residents are likely to return or not. The same can be applied for the time being in the temporary living, which in this scenario is described to be "up to one year".

In this study, close proximity has not, knowingly, been defined. This can be done in future research, which might also enable a better relationship between sample groups.

9. Conclusions

The aim of this study has been to answer the question if residents who live closer to a nuclear power plant will 1) be more likely to return after performed decontamination, and 2) be less likely to express higher level of concern for exposure to radioactive substances. This information is valuable to policy makers who need to determine how to respond to a potential nuclear fallout.

From the results presented, it is not possible to confirm the hypothesis that residents living in close geographical proximity to a nuclear power plant are be more likely to return after a nuclear fallout. However, this study finds an indication that this could be the case for residents living in very close proximity; further research would however be required to confirm this.

This study finds that residents living closer to a nuclear plant are less likely to express higher levels of perceived concern for being exposed to radioactive substances after decontamination due to nuclear fallout. As for the likeliness to return, this is accurate for residents living very close to the plant (less than 20 km), and no effect is found for larger areas close to the nuclear plant.

The finding does show there is no immediate reason to treat two affected areas, one area closer to the plant and the other more far away, differently in case of a nuclear fallout in terms of residential return. If the policymaker wishes to have a high level of return after decontamination, measurement aiming to decrease level of concerns should be considered since the findings from this study indicate that a higher level of concern decreases the likeliness to return.

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Appendices

Appendix A1: Scenario description

The following scenario where presented to the respondents before answering the questions of the survey set[17]:

A nuclear accident occurs in Sweden, and your neighborhood is contaminated with radioactive substances. You are being evacuated to temporary housing. Meanwhile, authorities will decontaminate parts of your neighborhood. The decontamination will involve removal of contaminated soil, contiguous houses, as well as cleaning and remotion of radioactive substances from roofs, walls, and if necessary, indoor areas. Removal of contiguous soil is likely to damage vegetation such as flowerbeds. The decontamination might take up to one year to complete.

After decontamination, measurements of houses and gardens shows harmless levels of ionizing radiation. However, some parts of your neighborhood do still reveal such high levels of radiation that residents are not allowed to live there, and special permission might be needed to get access to these areas. Authorities advise parents to not let their children play without supervision in the surrounding nature areas. Residents are also dissuaded from hunting and picking berries and mushrooms in the area. Some producers (especially hunters, fishermen, and farmers) might not be allowed, or find it difficult, to sell their products. The following questions aim to estimate how you would feel of living in such neighborhood.

Appendix A2: Data description and methodology

Descriptive statistics

Table A2:1 List of all variables used in the analysis

Variable	Description	Variable type
Response variable		
Tendency to move	The respondents answer to question 1, on a 1-4 scale	Ordinal
Levels of concern	The respondents answer to question 2, on a 1-5 scale	Ordinal
Variables of interest		

[17] The scenario has been translated from Swedish to English by the author of this study.

Regions with an active nuclear power plant	Region of the resident: Uppsala, Kalmar, Halland or the rest of Sweden	Categorical
Proximity in km to nearest nuclear power plant	Self-estimated distance to nearest nuclear power plant by the respondent: <20 km, 20-50 km, 60-100 km, >100 km	Categorical
Control variables		
Gender	Gender of the respondent	Binary
Age	Age of the respondent	Continuous
Parenthood status	If the respondent has at least one child living in the household	Binary
Income	Income group of the respondent	Categorical
Education	Level of education of the respondent	Categorical
Government trust	Level of government trust, on a scale 1-5	Ordinal
Membership in organizations	Membership in in sport/outdoor association, environmental organization, political party, and workers union	Binary

Proportional odds assumption

The proportional odds assumption, also known as the parallel regression assumption, means that the logarithm of odds form an arithmetic series. In other words, an ordered logistic regression assumes that the relationship between the coefficient that describes the relation between categories to be the same. As an example, in the dependent variable likeliness to return, there is four possible answers: not at all likely (p_1), not very likely (p_2), somewhat likely (p_3) and very likely (p_4). If the proportional odds assumption is fulfilled, the logarithms of the odds follows the following order:

Not at all likely, $$\log \frac{p_1}{p_2 + p_3 + p_4}, \qquad 0$$

Not at all likely or not very likely, $$\log \frac{p_1 + p_2}{p_3 + p_4}, \qquad 1$$

Not at all likely, not very likely or somewhat likely,	$\log\frac{p_1 + p_2 + p_3}{p_4},$	2

As can be observed, to obtain the next step in the order, the number added to each logarithm follows the same relationship for every case. In other words, the relation between groups is the same, creating a so-called arithmetic sequence. To test if the proportional odds assumptions is fulfilled, a test has been conducted by the user-written *omodel* in Stata, which performs a likelihood-ratio test, with the null hypothesis of no difference in the coefficients between models. A significant result for the model will therefore mean that there is a violation of the proportion odds assumption. Due to collinearity, Halland has been omitted for the models including the regions, and residents living less than 20 km to the nearest nuclear plant has been omitted for the models including the proximity-variable. The full tables from the test is presented below.

Table A2:2 Likelihood-ratio test Likeliness to return with regions

Ordered logit estimates			Number of obs	=	2185
			LR chi(3)	=	8.44
			Prob > chi2	=	0.0378
Log likelihood = -2734.9165			Pseudo R2	=	0.0015

Likeliness to return	Coef.	Std. Err.	P-value	[95% Conf. Interval]	
Uppsala	.3023371	.1190562	0.011	.0689912	.535683
Kalmar	.2703635	.162325	0.096	-.0477877	.5885146
Sweden	.0902201	.1065406	0.397	-.1185955	.2990358

Approximate likelihood-ratio test of proportionality of odds across response categories:

chi(6)	=	16.28
Prob > chi2	=	0.0123

Table A2:3 Likelihood-ratio test Likeliness to return with proximity in km

Ordered logit estimates				Number of obs	=	2143
				LR chi(4)	=	3.99
				Prob > chi2	=	0.4076
Log likelihood = - 2685.0509				Pseudo R2	=	0.0007

Likeliness to return	Coef.	Std. Err.	P-value	[95% Conf. Interval]	
20 - 50 km	-.3948314	.2445562	0.106	-.8741526	.0844899
60 - 100 km	-.3480808	.231674	0.133	-.8021534	.1059918
> 100 km	-.437092	.2324065	0.060	-.8926005	.0184164
Do not know	-.4198238	.2570884	0.102	-.9237078	.0840601

Approximate likelihood-ratio test of proportionality of odds across response categories:

chi(8)	=	8.63
Prob > chi2	=	0.3747

Table A2:4 Likelihood-ratio test Level of concern with regions

Ordered logit estimates				Number of obs	=	2198
				LR chi(3)	=	9.58
				Prob > chi2	=	0.0225
Log likelihood = -3236.5141				Pseudo R2	=	0.0015

Level of concern	Coef.	Std. Err.	P-value	[95% Conf. Interval]	
Uppsala	-.2458625	.1161591	0.034	-.4735302	-.0181949
Kalmar	-.1352334	.1543609	0.381	-.4377751	.1673083
Sweden	.0353466	.104193	0.734	-.1688679	.2395611

Approximate likelihood-ratio test of proportionality of odds across response categories:

chi(9)	=	5.01
Prob > chi2	=	0.8338

Table A2:5 Likelihood-ratio test Level of concern with proximity in km

Ordered logit estimates				Number of obs	=	2148
				LR chi(4)	=	23.06
				Prob > chi2	=	0.0001
Log likelihood = - 3160.2699				Pseudo R2	=	0.0036

Level of concern	Coef.	Std. Err.	P-value	[95% Conf. Interval]	
20 - 50 km	.2425386	.2458496	0.324	-.2393178	.724395
60 - 100 km	.1066494	.2335633	0.648	-.3511262	.5644249
> 100 km	.2462375	.234853	0.294	-.2140659	.7065409
Do not know	.7769722	.2597689	0.003	.2678345	1.28611

Approximate likelihood-ratio test of proportionality of odds across response categories:

chi(12)	=	17.18
Prob > chi2	=	0.1431

Appendix A3: Results

A3.1. Non-parametric analysis

Table A3:1 Non-parametric analysis Likeliness to return with regions

Two-sample t-test

	Obs.	Mean	Dif.	St. Err.	t-value	p-value
Nuclear regions	1,172	2.404	0.058	0.037	1.55	0.118
Sweden	1,013	2.346				

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

	Obs.	Rank	Sum
Nuclear regions	1172	1298195	1280996
Sweden	1013	1090010	1107209
Prob > z	= 0.2151		

Table A3:2 Non-parametric analysis Likeliness to return with proximity in km

Two-sample t-test

	Obs.	Mean	Dif.	St. Err.	t-value	p-value
> 100 km & "do not know"	936	2.343	-0.053	0.037	-1.4	0.16
< 20 km, 20-50 km, 60-100 km	1,207	2.396				

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

	Obs.	Rank	Sum
> 100 km & "do not know"	936	987888	1003392
< 20 km, 20-50 km, 60-100 km	1207	1309408	1293904
Prob > z	= 0.2474		

Table A3:3 Non-parametric analysis Level of concern with region

Two-sample t-test

	Obs.	Mean	Dif.	St. Err.	t-value	p-value
Nuclear regions	1,177	3.408	-0.112	0.051	-2.2	0.029
Sweden	1,021	3.519				

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

	Obs.	Rank	Sum
Nuclear regions	1177	1261917.5	1294111.5
Sweden	1021	1154783.5	1122589.5
Prob > z	= 0.0241		

Table A3:4 Non-parametric analysis Level of concern with proximity in km

Two-sample t-test

	Obs.	Mean	Dif.	St. Err.	t-value	p-value
> 100 km & "do not know"	937	3.535	0.137	0.052	2.65	0.009
< 20 km, 20-50 km, 60-100 km	1,211	3.398				

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

	Obs.	Rank	Sum
> 100 km & "do not know"	937	1045372	1006806.5
< 20 km, 20-50 km, 60-100 km	1211	1262654	1301219.5
Prob > z	= 0.0050		

A3.2. Regression analysis

Table A3:5 Regression results – Likeliness to return

	(Model 1)	(Model 2)	(Model 3)	(Model 4)	(Model 5)	(Model 6)
Uppsala	0.212**	0.271**			0.186*	0.255*
	(0.096)	(0.122)			(0.104)	(0.133)
Kalmar	0.180	0.179			0.096	0.144
	(0.156)	(0.191)			(0.168)	(0.203)
Halland	-0.090	0.023			-0.209	-0.101
	(0.108)	(0.139)			(0.133)	(0.166)
Sweden						
<20 km			0.437*	0.401	0.584**	0.477
			(0.242)	(0.280)	(0.260)	(0.298)
20-50 km			0.042	0.170	0.137	0.212
			(0.122)	(0.143)	(0.141)	(0.165)
60-100 km			0.089	0.084	0.061	0.025
			(0.093)	(0.113)	(0.104)	(0.125)
Don't know			0.017	0.245	-0.006	0.221
			(0.145)	(0.183)	(0.147)	(0.186)
>100 km						
Female		-0.527***		-0.550***		-0.549***
		(0.097)		(0.097)		(0.097)
≤ 40 years						
40-59 years		0.096		0.130		0.127
		(0.127)		(0.128)		(0.128)
≥ 60 years		0.293**		0.300**		0.316**
		(0.133)		(0.134)		(0.135)
≥ 1 child in household		-0.160		-0.171		-0.167
		(0.127)		(0.127)		(0.128)
≤ 37 000 SEK						
37 – 74 999 SEK		-0.093		-0.081		-0.082
		(0.113)		(0.113)		(0.114)
≥ 75 000 SEK		-0.181		-0.195		-0.182
		(0.147)		(0.146)		(0.147)
Upper secondary edu.						
Post-secondary edu.		-0.228*		-0.257*		-0.244*
		(0.133)		(0.133)		(0.134)

University degree		-0.307**		-0.252**		-0.299**
		(0.130)		(0.125)		(0.131)
Governmental trust (1)						
Governmental trust (2)		-0.443***		-0.454***		-0.449***
		(0.114)		(0.114)		(0.114)
Governmental trust (3)		-0.947***		-0.971***		-0.958***
		(0.159)		(0.158)		(0.158)
Governmental trust (4)		-1.477***		-1.484***		-1.479***
		(0.254)		(0.251)		(0.254)
Governmental trust (5)		-1.994***		-2.025***		-1.981***
		(0.354)		(0.352)		(0.360)
Member in sports/outdoor association		-0.056		-0.064		-0.048
		(0.098)		(0.098)		(0.098)
Member in environmental organization		-0.181		-0.172		-0.195
		(0.141)		(0.142)		(0.142)
Political party		-0.130		-0.101		-0.115
		(0.125)		(0.125)		(0.126)
Workers' union member		-0.178*		-0.173*		-0.175*
		(0.099)		(0.100)		(0.100)
Cultural association		0.068		0.086		0.082
		(0.120)		(0.120)		(0.121)
/cut1	-1.626***	-2.819***	-1.611***	-2.796***	-1.594***	-2.761***
	(0.071)	(0.198)	(0.078)	(0.206)	(0.081)	(0.207)
/cut2	0.315***	-0.691***	0.327***	-0.668***	0.349***	-0.628***
	(0.059)	(0.184)	(0.068)	(0.193)	(0.071)	(0.194)
/cut3	2.256***	1.360***	2.262***	1.384***	2.289***	1.427***
	(0.079)	(0.187)	(0.088)	(0.196)	(0.089)	(0.197)
Obs.	2185	1620	2143	1620	2143	1620
Pseudo R^2	0.002	0.036	0.001	0.036	0.003	0.037

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

Table A3:6 Regression results – Levels of concerns

	(Model 1)	(Model 2)	(Model 3)	(Model 4)	(Model 5)	(Model 6)
Uppsala	-0.281***	-0.386***			-0.228**	-0.357***
	(0.095)	(0.123)			(0.104)	(0.132)
Kalmar	-0.171	-0.181			-0.016	-0.103
	(0.135)	(0.170)			(0.148)	(0.181)
Halland	-0.035	-0.008			0.101	0.150
	(0.105)	(0.134)			(0.124)	(0.155)
Sweden						
<20 km			-0.246	-0.520*	-0.313	-0.624**
			(0.268)	(0.299)	(0.278)	(0.316)
20-50 km			-0.004	-0.094	-0.055	-0.170
			(0.119)	(0.142)	(0.134)	(0.161)
60-100 km			-0.140	-0.105	-0.098	-0.037
			(0.091)	(0.112)	(0.104)	(0.124)
Don't know			0.531***	0.314	0.559***	0.354*

			(0.150)	(0.193)	(0.151)	(0.194)
>100 km						
Female		0.948***		0.953***		0.954***
		(0.096)		(0.096)		(0.096)
≤ 40 years						
40-59 years		-0.083		-0.045		-0.042
		(0.131)		(0.135)		(0.135)
≥ 60 years		-0.176		-0.075		-0.099
		(0.135)		(0.141)		(0.140)
≥ 1 child in household		0.281**		0.286**		0.281**
		(0.127)		(0.127)		(0.127)
≤ 37 000 SEK						
37 – 74 999 SEK		0.096		0.116		0.111
		(0.108)		(0.108)		(0.108)
≥ 75 000 SEK		-0.076		-0.032		-0.048
		(0.141)		(0.141)		(0.142)
Upper secondary edu.						
Post-secondary edu.		0.239*		0.265**		0.250*
		(0.128)		(0.128)		(0.128)
University degree		0.191		0.132		0.202
		(0.126)		(0.121)		(0.126)
Governmental trust (1)						
Governmental trust (2)		0.469***		0.491***		0.492***
		(0.114)		(0.114)		(0.114)
Governmental trust (3)		0.824***		0.849***		0.834***
		(0.157)		(0.157)		(0.158)
Governmental trust (4)		1.603***		1.630***		1.623***
		(0.228)		(0.227)		(0.230)
Governmental trust (5)		1.491***		1.528***		1.489***
		(0.321)		(0.326)		(0.325)
Member in sports/outdoor association		-0.068		-0.038		-0.057
		(0.098)		(0.098)		(0.098)
Member in environmental organization		0.160		0.125		0.155
		(0.140)		(0.140)		(0.140)
Political party		0.231*		0.208*		0.228*
		(0.122)		(0.121)		(0.123)
Workers' union member		-0.018		-0.021		-0.013
		(0.098)		(0.098)		(0.098)
Cultural association		-0.058		-0.059		-0.055
		(0.112)		(0.114)		(0.113)
/cut1	-2.850***	-1.998***	-2.793***	-1.854***	-2.829***	-1.908***
	(0.100)	(0.206)	(0.107)	(0.211)	(0.109)	(0.212)
/cut2	-1.132***	-0.105	-1.045***	0.042	-1.078***	-0.008
	(0.065)	(0.187)	(0.075)	(0.194)	(0.078)	(0.195)
/cut3	-0.416***	0.667***	-0.326***	0.815***	-0.357***	0.768***
	(0.060)	(0.188)	(0.072)	(0.196)	(0.074)	(0.197)
/cut4	1.285***	2.561***	1.359***	2.703***	1.332***	2.669***
	(0.066)	(0.196)	(0.079)	(0.204)	(0.080)	(0.205)
Obs.	2198	1624	2148	1624	2148	1624

Pseudo R^2	0.001	0.043	0.004	0.043	0.005	0.045

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

A3.3. Generalized ordered logit

Table A3:7 Regression result from the generalized ordered logit analysis

		Model 1	Model 2	Model 5	Model 6	Model 7
Uppsala	Not at all likely vs. Not very likely,	0.346**	0.698***	0.329*	0.677***	0.240
	Somewhat likely or Very likely	(0.168)	(0.211)	(0.179)	(0.224)	(0.188)
	Not at all likely or Not very likely vs.	0.107	0.151	0.078	0.129	- 0.050
	Somewhat likely or Very likely	(0.114)	(0.144)	(0.124)	(0.156)	(0.148)
	Not at all likely, Not very likely or	0.568***	0.566**	0.462**	0.598**	0.414*
	Somewhat likely vs. Very likely	(0.184)	(0.234)	(0.211)	(0.265)	(0.226)
Kalmar	Not at all likely vs. Not very likely,	- 0.08	0.248	- 0.123	0.173	- 0.141
	Somewhat likely or Very likely	(0.215)	(0.272)	(0.232)	(0.289)	(0.247)
	Not at all likely or Not very likely vs.	0.120	0.071	0.071	0.024	0.109
	Somewhat likely or Very likely	(0.162)	(0.199)	(0.173)	(0.212)	(0.201)
	Not at all likely, Not very likely or	0.569***	0.625**	0.491*	0.642*	0.713**
	Somewhat likely vs. Very likely	(0.184)	(0.299)	(0.267)	(0.329)	(0.267)
Halland	Not at all likely vs. Not very likely,	- 0.221	0.086	- 0.338*	- 0.087	- 0.267
	Somewhat likely or Very likely	(0.156)	(0.209)	(0.191)	(0.252)	(0.197)
	Not at all likely or Not very likely vs.	- 0.112	0.029	- 0.244*	- 0.124	- 0.237
	Somewhat likely or Very likely	(0.161)	(0.123)	(0.147)	(0.181)	(0.171)
	Not at all likely, Not very likely or	0.157	0.184	- 0.032	0.211	0.085
	Somewhat likely vs. Very likely	(0.212)	(0.255)	(0.261)	(0.309)	(0.283)
< 20 km	Not at all likely vs. Not very likely,			0.413	0.311	0.331
	Somewhat likely or Very likely			(0.397)	(0.481)	(0.402)
	Not at all likely or Not very likely vs.			0.656**	0.603*	0.577*
	Somewhat likely or Very likely			(0.272)	(0.329)	(0.313)
	Not at all likely, Not very likely or			0.665	- 0.128	0.305
	Somewhat likely vs. Very likely			(0.407)	(0.531)	(0.449)
20 - 50 km	Not at all likely vs. Not very likely,			0.194	0.365	0.136
	Somewhat likely or Very likely			(0.211)	(0.263)	(0.225)
	Not at all likely or Not very likely vs.			0.134	0.207	0.171
	Somewhat likely or Very likely			(0.156)	0.186	(0.184)
	Not at all likely, Not very likely or			0.233	- 0.039	0.248
	Somewhat likely vs. Very likely			(0.268)	(0.317)	(0.283)
60 - 100 km	Not at all likely vs. Not very likely,			0.032	0.034	- 0.051
	Somewhat likely or Very likely			(0.157)	(0.185)	(0.165)
	Not at all likely or Not very likely vs.			0.051	0.013	0.025
	Somewhat likely or Very likely			(0.116)	(0.138)	(0.137)
	Not at all likely, Not very likely or			0.232	- 0.085	0.162
	Somewhat likely vs. Very likely			(0.204)	(0.251	(0.217)
Do knot kn	Not at all likely vs. Not very likely,					
	Somewhat likely or Very likely					
	Not at all likely or Not very likely vs.					
	Somewhat likely or Very likely					
	Not at all likely, Not very likely or					
	Somewhat likely vs. Very likely					
Controls		-	Y	-	Y	-

p-value=0,01*** p-value = 0,05** p-value=0,1*

A3.4. Level of concern's effect on the likeliness to return

Table A3:8 Levels of concern on the likeliness to return

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Uppsala	0.110	0.151			0.109	0.139
	(0.100)	(0.128)			(0.109)	(0.139)
Kalmar	0.150	0.129			0.156	0.125
	(0.162)	(0.195)			(0.177)	(0.206)
Halland	-0.120	0.015			-0.175	-0.034
	(0.110)	(0.140)			(0.135)	(0.168)
< 20 km			0.297	0.078	0.416*	0.107
			(0.229)	(0.258)	(0.251)	(0.281)
20-50 km			0.086	0.182	0.160	0.192
			(0.128)	(0.152)	(0.149)	(0.175)
60-100			0.046	0.079	0.026	0.042
			(0.097)	(0.116)	(0.109)	(0.128)
Do not know			0.386**	0.548***	0.375**	0.536***
			(0.155)	(0.199)	(0.156)	(0.201)
Anxiety for radioactive substances in residence at harmless rates	-1.143***	-1.128***	-1.162***	-1.139***	-1.160***	-1.136***
	(0.047)	(0.057)	(0.047)	(0.058)	(0.047)	(0.058)
Controls	-	Y	-	Y	-	Y

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

A3.5. Robustness analysis

The weights in the robustness analysis has been adjusted in proportion to the national population level of education and calculated by dividing the share of the population by the share of the sample. The numbers where presented in 5.1.1., Descriptive statistics under section 5, Data description.

Table A3:9 Weights used in the weighted robustness test

	% in sample	% population	Weight
Upper secondary edu.	25,38	29	1,1426
Post-secondary edu.	26,83	43	1,6027
University degree	47,78	28	0,5860

Table A3:10 Robustness test on the likeliness to return

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Uppsala	0.220**	0.260*			0.185	0.261*
	(0.106)	(0.135)			(0.113)	(0.143)
Kalmar	0.169	0.163			0.122	0.160
	(0.168)	(0.205)			(0.180)	(0.218)
Halland	-0.114	-0.005			-0.233	-0.095
	(0.120)	(0.153)			(0.145)	(0.178)
< 20 km			0.582**	0.479*	0.731***	0.541*
			(0.265)	(0.285)	(0.282)	(0.306)
20-50 km			-0.010	0.069	0.087	0.096
			(0.132)	(0.157)	(0.152)	(0.176)
60-100			0.079	0.016	0.062	-0.039
			(0.101)	(0.125)	(0.113)	(0.135)
Do not know			-0.005	0.180	-0.025	0.159
			(0.155)	(0.193)	(0.158)	(0.196)
Controls	-	Y	-	Y	-	Y

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

Table A3:11 Robustness test on the level of concern

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Uppsala	-0.267**	-0.385***			-0.176	-0.347**
	(0.109)	(0.134)			(0.116)	(0.142)
Kalmar	-0.163	-0.165			-0.001	-0.074
	(0.138)	(0.182)			(0.150)	(0.195)
Halland	-0.015	0.008			0.164	0.213
	(0.113)	(0.145)			(0.130)	(0.163)
< 20 km			-0.504*	-0.819***	-0.597**	-0.950***
			(0.287)	(0.290)	(0.298)	(0.309)
20-50 km			-0.045	-0.105	-0.122	-0.198
			(0.129)	(0.157)	(0.143)	(0.172)
60-100			-0.190*	-0.088	-0.181	-0.043
			(0.098)	(0.119)	(0.111)	(0.133)
Do not know			0.485***	0.326	0.504***	0.358*
			(0.167)	(0.207)	(0.167)	(0.209)
Controls	-	Y	-	Y	-	Y

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

A3.6. Marginal effects

Due to the extension of the of the marginal effects (which corresponds up to 250 rows), the marginal effect presented in section 7.2., Regression analysis, are to be found below. The full version of the marginal effects is available per request.

Table A3:12 Marginal effects of the likeliness to return

Model 2		Model 4		Model 6 (part 1)		Model 6 (part 2)	
Uppsala		**< 20 km**		**Uppsala**		**Gov. trust (2)**	
1._predict	-0.0334**	1._predict	-0.0493	1._predict	-0.0314*	1._predict	0.0453***
	(-2.19)		(-1.43)		(-1.91)		(4.07)
2._predict	-0.0286**	2._predict	-0.0423	2._predict	-0.0268*	2._predict	0.0616***
	(-2.25)		(-1.43)		(-1.94)		(3.77)
3._predict	0.0387**	3._predict	0.0574	3._predict	0.0363*	3._predict	-0.0612***
	(2.25)		(1.43)		(1.94)		(-4.08)
4._predict	0.0232**	4._predict	0.0343	4._predict	0.0218*	4._predict	-0.0457***
	(2.18)		(1.43)		(1.89)		(-3.63)
Post-sec. edu.		**Post-sec. edu.**		**Post-sec. edu.**		**Gov. trust (3)**	
1._predict	0.0262*	1._predict	0.0302*	1._predict	0.0282*	1._predict	0.116***
	(1.72)		(1.94)		(1.83)		(5.26)
2._predict	0.0265*	2._predict	0.0291*	2._predict	0.0281*	2._predict	0.105***
	(1.68)		(1.89)		(1.79)		(6.46)
3._predict	-0.0317*	3._predict	-0.0363*	3._predict	-0.0340*	3._predict	-0.140***
	(-1.71)		(-1.93)		(-1.82)		(-5.98)
4._predict	-0.0210*	4._predict	-0.0230*	4._predict	-0.0223*	4._predict	-0.0815***
	(-1.69)		(-1.90)		(-1.80)		(-5.98)
Uni. degree		**Uni. degree**		**Uni. degree**		**Gov. trust (4)**	
1._predict	0.0362**	1._predict	0.0296**	1._predict	0.0352**	1._predict	0.212***
	(2.41)		(2.06)		(2.35)		(4.35)
2._predict	0.0344**	2._predict	0.0286*	2._predict	0.0336**	2._predict	0.108***
	(2.25)		(1.93)		(2.19)		(6.18)
3._predict	-0.0432**	3._predict	-0.0356**	3._predict	-0.0420**	3._predict	-0.216***
	(-2.38)		(-2.03)		(-2.32)		(-6.38)
4._predict	-0.0274**	4._predict	-0.0227*	4._predict	-0.0268**	4._predict	-0.105***
	(-2.26)		(-1.95)		(-2.20)		(-7.01)
						Gov. trust (5)	
						1._predict	0.323***
							(4.04)
						2._predict	0.0713*
							(1.83)
						3._predict	-0.275***
							(-7.09)
						4._predict	-0.119***
							(-8.05)

Standard errors are in parenthesis

**** p<0.01, ** p<0.05, * p<0.1*

Table A3:13 Marginal effects of the level of concern

Model 2		Model 4	
Uppsala		**< 20 km**	
1._predict	0.0203***	1._predict	0.0273*
	(3.01)		(1.71)
2._predict	0.0499***	2._predict	0.0675*
	(3.18)		(1.74)
3._predict	0.0157***	3._predict	0.0210*
	(3.06)		(1.73)
4._predict	-0.0298***	4._predict	-0.0404*
	(-3.14)		(-1.73)
5._predict	-0.0560***	5._predict	-0.0753 *
	(-3.13)		(-1.74)

Standard errors are in parenthesis
*** *p<0.01,* ** *p<0.05,* * *p<0.1*